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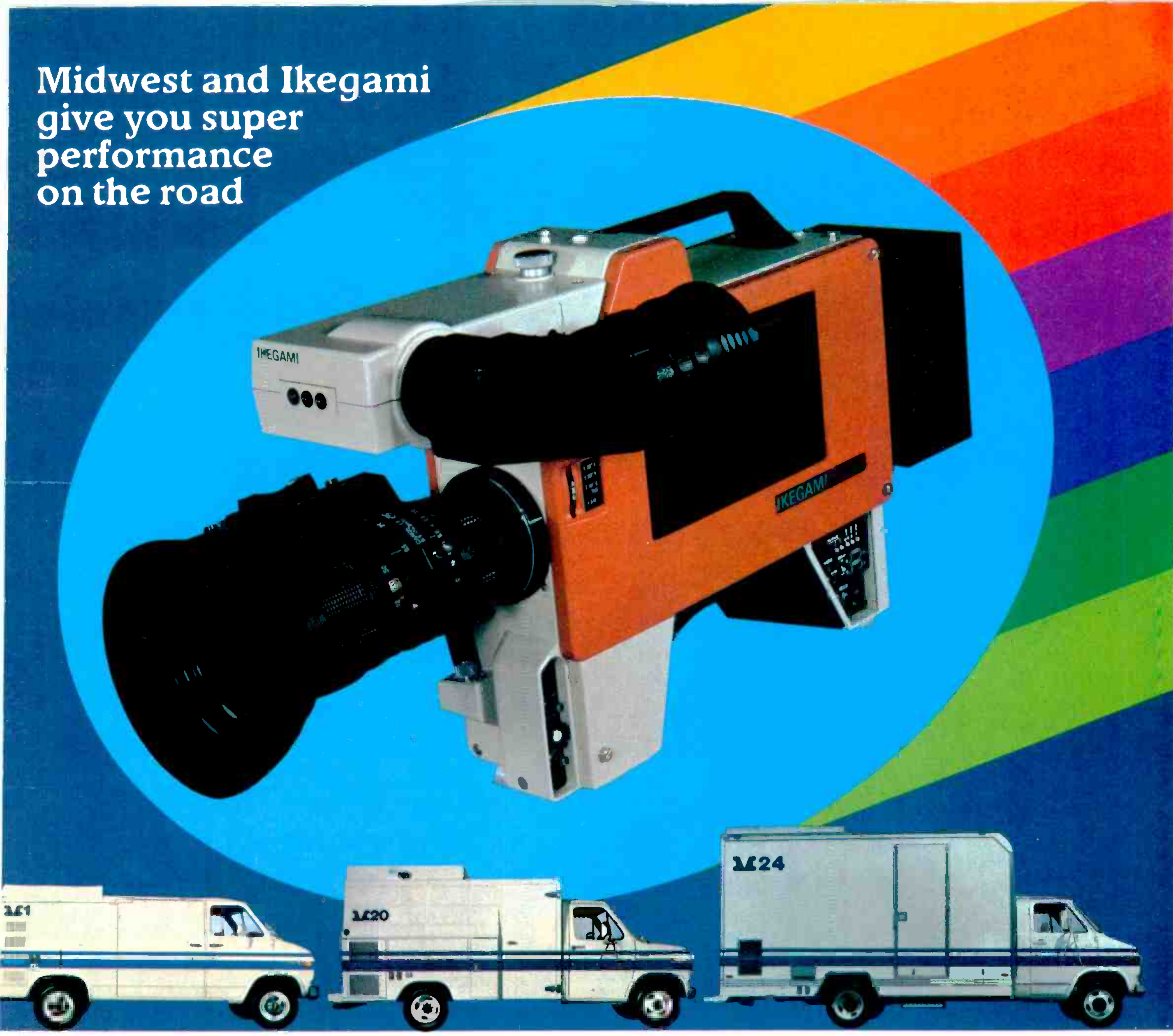

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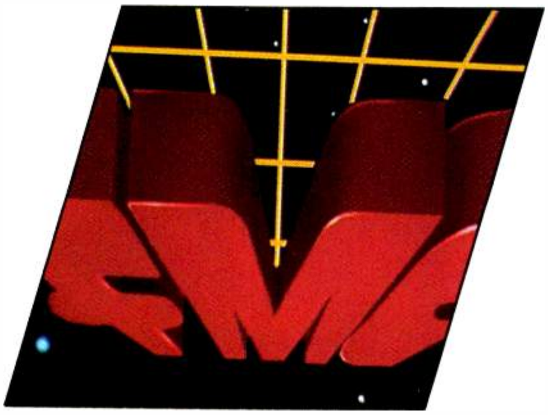

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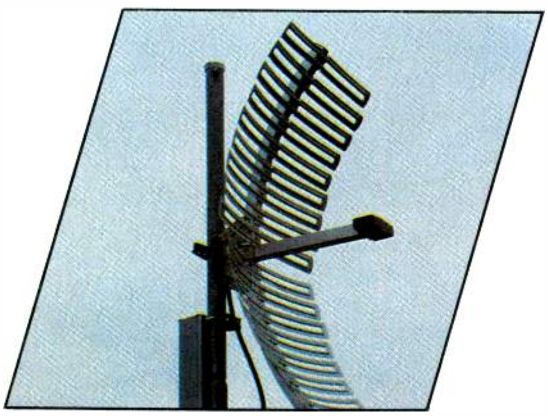

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ON THE COVER
The development of power vacuum tubes is advancing as fast as solid-state technology, although accompanied by less fanfare. Power tubes today are designed with an eye toward high-efficiency operation and high gain/bandwidth properties. Shown on our cover this month is a Q-switched laser machine in the process of cutting a pyrolytic graphite cup into a grid structure for a new type of power tube. (Photo courtesy of Varian EIMAC.)


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PD audio becomes a reality

The recent AES convention in New York provided the setting for the introduction of *Professional Digital* (PD) audio recording equipment. Announced jointly by AEG Aktiengesellschaft, Mitsubishi Electric and Otari Electric, the PD recording format follows the method used by Mitsubishi and Digital Entertainment Corporation X-series recorders.

PD-compatible tape machines will include 32-channel (1-inch), 16-channel (½-inch) and 2-channel (¼-inch) models. Full deck control of all three brands will be accomplished through compatible digital ports. Electronic editing systems will also allow full interchange. Error correction coding of the recorded digital signals protects against missing data because of possible signal dropout.

HDTV awaits final approval

The long process of selecting a single worldwide standard for high definition television neared its conclusion at CCIR meetings in Geneva, Switzerland. In the last round of technical discussions, delegates from more than 50 countries and broadcast-related organizations adopted a proposal for HDTV for studio production and international program exchange. The final approval during the 16th CCIR Plenary Assembly in May 1986 may be based more upon national social, ideological and economic factors than on technical parameters.

Industry leaders at the 1985 Montreux TV Symposium encouraged decision-making toward the production and interchange standard. It was feared that failure to do so would result in a variety of de facto HDTV systems. Subsequently, the technical specifications proposed by Japanese and North American interests found preliminary approval in September and overall acceptance on Nov. 1.

The recommendations, entered by the Advanced Television Systems Committee (ATSC), call for 1125-line images at a 60Hz field rate, using 2:1 interlace. An aspect ratio of 16:9 approximates the wide-screen presentation of motion picture films, which are expected to play a significant role in HDTV programming. The international sampling rate of 4:2:2 will produce 1,920 luminance samples per active line and 960 samples for color difference information. The 16:9 aspect figure will also allow sampling at a 3X subcarrier frequency for various display options.

Concern regarding the implementation of a 60Hz field rate system remains among countries where 50Hz PAL and SECAM standards are in use. However, increasing agreement on the 1125/60 proposal was noted in a response from the Soviet Union, which emphasized a desire to achieve a single standard.

NRSC studies AM

The National Radio Systems Committee (NRSC) has been reactivated to study proposals for standardized AM transmission pre-emphasis and AM receiver de-emphasis curves. The committee will attempt to adopt and then propose to the industry a set of standardized audio curves for both broadcasters and receiver manufacturers. The NRSC is a joint committee of the NAB and the Electronic Industries Association (EIA).

The decision to reactivate the NRSC comes in response to efforts by the NAB's AM Improvement Subcommittee to gain the cooperation of receiver

Continued on page 111

BROADCAST ENGINEERING

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INTERTEC PUBLISHING CORPORATION

Working together

Teamwork. Two groups working together for a common purpose. That definition sums up the relationship of Society of Broadcast Engineers (SBE) and **Broadcast Engineering (BE)** magazine. At the September 1985 meeting of the SBE Board of Directors, the society voted to recognize **BE** as the pre-eminent monthly technical publication serving the broadcast industry.

The joining of forces represents not so much a milestone, but an affirmation that SBE and **BE** have a common goal for serving the audience they share. This goal includes the instruction of radio and TV engineers and the advancement of broadcast engineering as a profession.

In our industry, it isn't often that two organizations, so different in structure, yet so common in goals, create a mutually beneficial relationship. The ties that join SBE and **BE** have always been strong. However, we have now renewed those ties in an effort to address some of the new needs of our industry.

The SBE is more than 20 years old. And, over that period of time, the organization has grown and prospered. With more than 5,000 members, the SBE still represents only a small portion of the total number of broadcast engineers in our industry. To be truly effective, the society needs to grow.

BE, on the other hand, reaches more than 35,000 engineers, managers and industry leaders every month. Although most of our readers are not SBE members, they probably should be. This is where **BE** will help the society.

We will provide you with SBE news updates and events each month in our department section of the magazine. We will print SBE membership application blanks with our regular issues. In short, we will make more people aware of the benefits inherent in joining SBE. And there are other benefits to our relationship with SBE.

First, the SBE will combine the excellent exhibits and attendance of their Central States convention with the **Broadcast Engineering** technical conference this October in St. Louis, MO. In the past, this technical conference has been headed by John Battison as a separate event at Ohio State University. This year, however, Battison will bring his high caliber technical sessions to the SBE convention. The combination of these two proven success stories should make the 1986 national **BE**/SBE convention a spectacular event.

In December 1961, Battison, then editor of **BE**, wrote an editorial suggesting that the time had come for an organization to devote its energies to the needs and interests of the broadcast engineer. The response to the editorial was so positive that the SBE was formed and held its first national meeting in April 1964.

Now, more than 20 years later, the needs are even more critical to our industry. It seems that almost every day, there are new encroachments upon our business. As we have seen with technical deregulation, someone needs to speak out for the engineers' position.

We all know that technical decisions need to be made by technical people. We hope that through the leadership of the SBE, **Broadcast Engineering** can help inform the industry of the technical needs and the appropriate changes that need to be made in broadcasting. When technical decisions are made by technical experts, the whole system benefits. With SBE on our team, it will be easier for engineers to let the industry know what decisions need to be made for the best interests of our business.

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FM upgrade procedures

By Harry C. Martin

The FCC has proposed changes in its rules to permit FM stations to upgrade their facilities to a higher class more easily. Under current procedures, FM licensees may request the assignment of a higher-class channel and simultaneously request a license modification, but other interested parties are permitted to apply for the upgraded facility. The only way to avoid a comparative hearing is to demonstrate that an alternate channel of the same or a higher class is available for use in the community. Under the new rule, the comparative hearing requirement would be eliminated in instances where upgrades can be accomplished through the use of the proponent's existing channel or an adjacent channel. In such situations, the availability of other frequencies would not be a factor.

In proposing this rule change, the commission noted that under existing policies and procedures, an FM station seeking to upgrade to an adjacent channel may elect to withdraw its proposal rather than face a comparative hearing and lose its existing facility. In practice, licensees faced with competition universally withdraw their proposals. In this way, current upgrade procedures waste commission resources and hamper improvements in service. The rules now spawn the filing of expressions of interest by competitors whose sole purpose is to force the proponent to withdraw its upgrade proposal.

The commission plans to delay action on pending rulemaking petitions that could be affected by favorable action on its proposal.

Illegal video transmitters

The commission has issued a public notice pointing out that manufacturing, marketing or use of video transmitters for non-licensed operation is a criminal offense, punishable by a $10,000 fine and one year in jail for the first offense. The commission has noted an increase in the number of manufacturers and equipment suppliers who are marketing transmitters designed to connect to videocassette recorder or camera and transmit the signal over the air to a nearby TV receiver.

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

Two petitions for rulemaking requesting this form of operation were rejected by the commission because of concern about interference to licensed TV stations. The commission pointed out that it has yet to receive any information supporting claims that this type of interference would not occur. As a result, there is no expectation that the rules will be amended to permit video transmission on TV frequencies.

Broadcasters who are concerned about the use of illegal video transmitters in their areas should contact John Reed at the FCC in Washington: 202-653-8247.

Call sign assignments

In another public notice, the commission has clarified its procedures with respect to requests for using a call sign that has been relinquished by another station.

Under Section 73.3550 of the rules, call signs are awarded on a first-come, first-served basis. When requests to change call signs are pending, the relinquished call sign is not available to others until the effective date of the change. Effective dates for call sign changes are specified in public notices, released by the FCC once a week. Before the effective date, applications for relinquished call signs are not accepted. Also, agreements between licensees as to call sign changes will not determine the award of any call sign to be relinquished.

Other rules governing call sign assignments are:

- Requests for new or modified call sign assignments are made by a letter to the FCC. There no longer is any requirement for applicants to notify other stations in their service areas.
- In situations where more than one request for the same call sign is received on the same day, the assignment is made to the station having the longest continuous record of broadcast operations under substantially unchanged ownership and control.
- Stations in different broadcast services (AM, FM or TV) that are under common control may request that their call signs be conformed by the assignment of the same basic call sign, but with a suffix for FM and TV calls. More than 50% common ownership constitutes common control for purposes of the rule.
- Call signs may be applied for by an applicant for transfer or assignment of any outstanding construction permit or license at the time the assignment or transfer application is filed, or at any time thereafter. However, no call sign change will be made effective until the sale application is approved by the FCC and the transaction is consummated.

FOB permitted to assess $10,000 fines

The commission's Field Operations Bureau now is authorized to issue monetary forfeiture notices for up to $10,000 against broadcast licensees. The previous limit was $2,000. Until September, forfeiture proceedings for more than $2,000 were handled by the Mass Media Bureau in Washington.

The commission changed its forfeiture authorizations in this respect because FOB inspections frequently uncover rule violations requiring fines of more than $2,000. The goal of instituting these procedures is to strengthen the FOB's hand, and speed resolution of cases involving violations.

Processing time for FCC applications

The Mass Media Bureau reports the following average processing times for uncontested broadcast applications:

Service	Major Change	Minor Change
AM	4 Months	2 Months
FM	6 Months	3 Months
TV	3 to 5 Months	2 to 4 Weeks

Processing time for authorization for auxiliary facilities now averages 10 weeks. However, Section 74.24 of the FCC's rules (short-term operation) permits a broadcast licensee to operate an auxiliary facility for 30 days per year without an authorization, if airspace and station identification procedures specified in the rule are followed. Such short-term operations are permitted only on a secondary, non-interference basis.

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Strictly TV

Picture the future

By Carl Bentz, TV technical editor

Video monitors. in a TV station are critical to engineers and technicians. Vector and waveform displays show parameters within the video signal, but a final check of image quality requires a picture monitor. The unit demands a certain amount of space depending upon size and mounting. For proper visibility to those concerned, its placement is also important.

The TV receiver in the home is designed to meet similar needs. Some manufacturers have built receivers to fit into corners, and some viewers have built table models or portables into walls, providing doors to hide the occasionally unused television. Component systems with separate display and tuner units such as triangular cabinets, allow interesting built-in installations, but have not found general consumer preference. The problem is the bulky display section. Because of the high voltage power supply and the CRT with its treacherous neck, the television never seems to fit conveniently or comfortably.

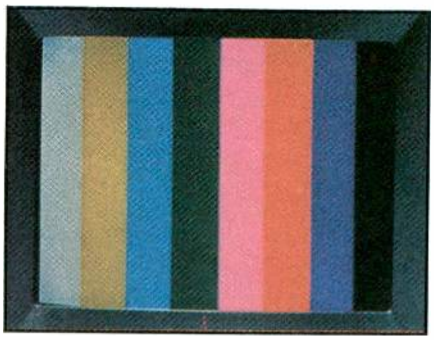
The TV screen that many have wanted for some time is a large flat display, suitable for framing on the wall. Until recently, these flat screens have been deemed relatively impractical. Their price hasn't matched their size or picture quality. Also, an unsightly bundle of wire has had to be disguised or fished through the wall.

New display systems

A CRT requires only a few wires between the electronics and the tube elements. Flat screens, however, are addressed as a series of vertical columns and horizontal rows. When column 15 and row 25 are both energized, one pixel lights up. Before microprocessors, individual wires connected to each row and each column. For a tri-color display, the cabling increased three-fold.

Digital circuitry results in a less cumbersome arrangement. For example, cabling for the large screen display used during the 1984 Olympics (measuring 36' x48') was simplified considerably. Groups of eight rows were each controlled through data receivers. Data transmitted to the receivers included address information to direct *on* or *off* conditions to incandescent lamps. A total of 89,760 lamps displayed 29,920 tri-color pixels. More than a megabyte of memory was needed to drive the system, and four power distribution boxes, each rated 100V and 4300A, operated the large display.

In some instances, people will watch



flat pocket-sized TV screens, while others will use the wrist watch as a double for a TV display. An engineer may simply flip up the flat screen of a take-along computer to continue working on a design project while commuting between cities.

These smaller screens are the result of twisted nematic liquid crystal displays (LCDs). LCDs operate by electrically forcing a crystal to pass or block the path of light coming from behind the controlling layer. A 2-dimensional matrix display has wires connected to an X-Y grid to control the individual pixels. Most LCD systems are monochrome or bi-chrome.

Tri-color LCD displays appeared, however, at consumer electronic shows this year. Using a new approach, thin-

Courtesy of Tektronix

For an oscilloscope display, the CRT produces a yellow output. On the faceplate, two polarizers separate red and green components from the yellow, while an LCD shutter controls the amount of each component to reach the viewer.

film polysilicon transistors, deposited at each display pixel location, perform the switching drive needed by the LCD to control light passage. Today's pixel matrices, however, do not begin to create an on-the-wall picture-frame-sized image.

The liquid crystal shutter has found a niche, at least, in research measurement equipment. Two-color oscilloscope displays are particularly useful in showing relationships between two signals. The shutter covers the faceplate of a monochrome CRT. Through the control mechanism, light from the tube passes through color filters to produce multicolor presentations. Positioning the switching drivers on the screen itself avoids delay time that would result from control cabling.

Multicolor instrumentation manufacturers have tried other non-flat methods, including the standard P22 phosphor CRT. More interesting, however, are CRT displays with differing potentials to achieve different colors. In other words, an electron accelerated by one potential creates one color while another acceleration causes a second color. Mixing electron potential levels then produces a third color. Keeping the accelerating potentials straight becomes difficult for consumer-oriented displays.

Another approach

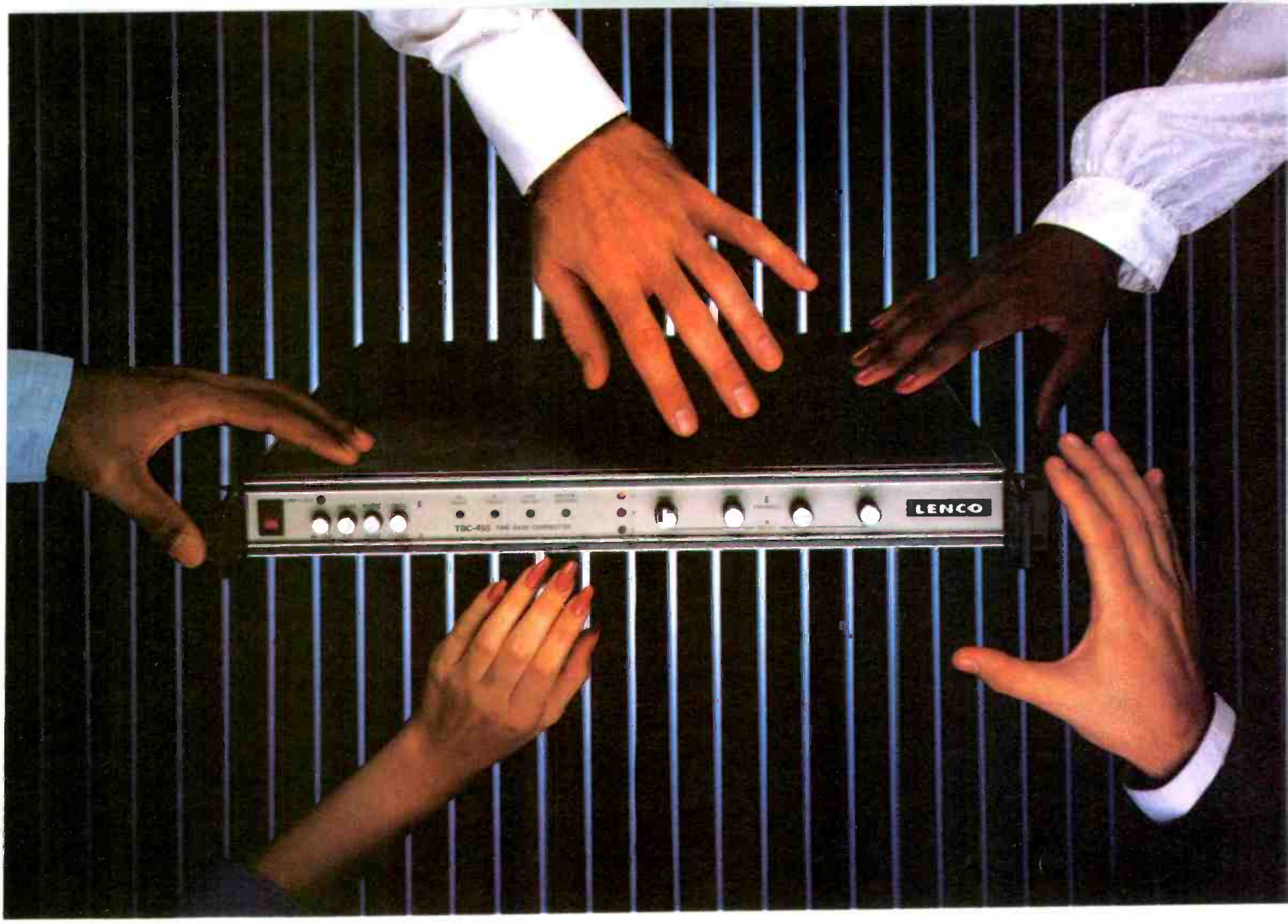
Electroluminescence (EL) also has a possible future in the search for a flat multicolor display. When a potential of about 190V exists between the two electrodes of the display, light is emitted from the panel. Sulfide phosphors, sandwiched between the electrodes (one of them transparent), glow in a characteristic color when excited by an electrical field. Stacking several luminescent layers, one for each primary color, produces additional hues for a full color image. The format uses the X-Y structure to control the spot on the display where light appears.

EL displays of the past have suffered from limited pixel capabilities. Although low light output levels made them suitable for a back-light source in control panels, they found limited use in high ambient light environments. Thin film technology, however, has increased EL pixel counts and light output dramatically. Recent prototypes have shown up to a 1,088 x 256-pixel matrix with a reduced drive potential of approximately 100V.

A new CRT?

Picture tomorrow's TV viewing area. The lights come on full, controlled by a presence sensor. On the wall is a 3' x 4' (3' x 5' or wider for those with HDTV) framed image of your favorite scene from the mountains, a Rembrandt or a still-life picture. Upon your request for, "TV please," the lights dim and the image in the frame fades. With another voice command, the display source becomes the television, computer, VCR or videodisc player.

Such a scenario may sound a bit far-fetched, but recent flat-screen innovations make that future seem not so far away.



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Calculating skywave propagation

By John Battison

Last month's column discussed skywave propagation. Although radio transmission characteristics are generally well understood, and the FCC rules specify methods for calculating coverage and interference areas, there is always a plus or minus factor in the results.

Chances are, you have come across a situation in which a station's predicted contour didn't fall where it was supposed to. The resulting contour was either too far out or too close. If the calculations were performed correctly and the rules were properly applied, why didn't the result match the calculations? One cause might have been higher or lower ground conductivity. Another might have been that the antenna's vertical radiation characteristics were not properly applied.

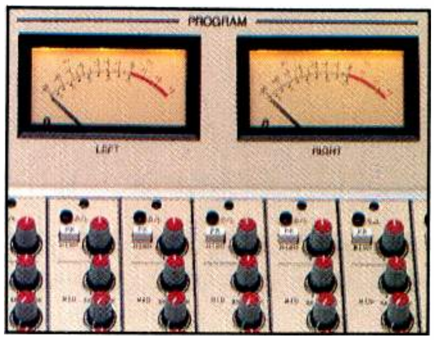
Calculations

To accurately calculate skywave propagation, you must follow a particular set of guidelines. These guidelines are specified in the FCC's rules. Figure 6A of section 73.190 depicts the departure angle vs. the transmission range of an interfering signal.

Curves 2 and 3 of that figure allow for signal strength variations that occur because of scattering and changes in the height of the ionosphere. These curves are used to compute the 10% interfering signal strengths. The two values are read from the chart and applied to the vertical antenna pattern. The curve that gives a higher value of radiation at the significant angle is the one used for calculation purposes.

The higher-value curve is used to ensure conservative values in the computation of the 10% interfering signal. In many cases, therefore, we find that the distant signal strength could have been increased. The result is sometimes the creation of large areas where there is no reception. On the other hand, interference (or at least the reception of the distant signal) sometimes occurs in these dead areas because of ionospheric scatter.

When calculating the desired service contour (the 50% curve), use curve 1 of section 73.190, Figure 6A. This curve is approximately midway between the other two curves. Curve 1 is considered to represent the desired signal strength



at least 50% of the time.

An example of the nighttime limit calculations for a regional station are shown in Figure 1. The values *theta-min* and *theta-max* are obtained from the curves in section 73.190.

T-min-vert-rad and *T-max-vert-rad* represent the minimum and maximum vertical radiation values from the station's antenna. *Max-vert-rad* is the same value as T-max-vert-rad because it is the maximum radiation value anticipated at the pertinent angle. It is this value that is used in the interference calculations.

As we discussed last month, received field strength also depends upon latitude. Figure 2 from section 73.190 provides seven field-strength curves based on midpoint latitudes from 35° to 50° north. To calculate the midpoint latitude, simply find the average of the latitudes of the transmitting and receiving points. Then, using this value, locate the appropriate skywave field strength from the FCC curves.

An example

Using an actual case as an example, we can walk through the calculation process. We are concerned about interference from station WCBF, located 743 miles (1,196km) from our chosen site. Using Figure 6A of section 73.190, find the corresponding theta values from curves 2 and 3 to be 4° and 8°, respectively.

The midpoint latitude is 33.361° north. Using Figure 2 from section 73.190, you should find that the skywave signal strength equals 67.739μV/m. Be sure you use the correct chart.

FROM STATION (CALL)	WCBF
DISTANCE (MILES)	743.131
TRUE BEARING (DEGREES)	357.068
MIDPOINT LATITUDE (DEGREES)	33.361
THETA-MIN (DEGREES)	4.474
THETA-MAX (DEGREES)	8.300
HORIZONTAL RADIATION (MV/M)	38.723
T-MIN-VERT-RAD (MV/M)	41.148
T-MAX-VERT-RAD (MV/M)	46.859
MAX-VERT-RAD (MV/M)	46.859
SKYWAVE FIELD (μV/M)	67.739
NIGHT LIMIT (MV/M)	.635

Figure 1. *The pertinent data needed for interference calculations.*

Now let's look at the antenna. The antenna we are using has a horizontal radiation of 38.723μV/m. This value is less than either the T-min or T-max values because we are using a directional antenna and the radiation at 4° and 8° is higher than it is on the ground.

The commission requires that applications for a directional antenna include either a series of conicals or individual vertical radiation patterns for each azimuth required. (Conicals are antenna patterns plotted at 5° increments from 0° through 60° of vertical radiation above the ground on all azimuths.) The information is required by the FCC, but instead of calculating each azimuth and then entering the data on every vertical section, you may use a computer printout.

The last step is to compute the interfering signal at the distant station from WCBF. Divide the maximum vertical radiation by 100 to convert the value to numbers based on 100mV/m. Multiply this number by the skywave field, then divide by 1,000 to convert it to millivolts per meter. Finally, multiply by 20 to obtain the nighttime limit. The last step is necessary to generate the protection ratio of 20:1.

Example:

$$\frac{\text{T-max-vert-rad}}{100} = \frac{46.859}{100} = 0.46859 = Y$$

$$\frac{\text{Quantity Y x skywave field}}{1{,}000} =$$

$$\frac{0.4686 \times 67.739}{1{,}000} = 0.03174\text{mV/m} = Z$$

Quantity Z x 20 = 0.03174 x 20 = 0.635mV/m nighttime limit from WCBF

If you are trying to determine the nighttime interference limit to your station, you have to go through this calculation for every station on your channel. Once you have found the nighttime limit for each co-channel station, you can then determine the total interference to your station via the rss (root-sum-square) method.

Next month's "re:Radio" will be devoted to winter tower problems and how you can avoid them.

Battison is BE's consultant on antennas and radiation.

Receiving system maintenance

By Elmer Smalling III

Last month we outlined maintenance and adjustment procedures for out-of-doors earth station equipment. This month, we will follow the RF signal from the low noise amplifier (LNA) to the downlink receiver and associated equipment.

Cable care

Coaxial cable or waveguide is used to connect the outdoor components to the indoor receiving system. If coax material is used, it may be dual purpose, carrying power to the LNA along with the satellite signals to the receiver. The power may also be carried through wiring that is strapped to the waveguide or cable.

Check the cable for moisture damage. If the installation is close to a tower, a protective bridge should cover the cable to prevent damage from falling ice.

You can prevent moisture damage by keeping positive pressure inside the cable. Either an air dryer (dessicator) and pump or bottled gas may be used. For pump systems, check for dirty filters and loose air connections. Lubricate the pump as indicated in the instruction manual.

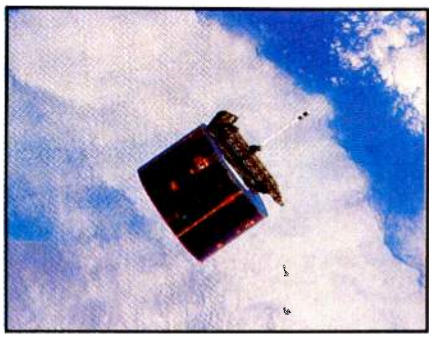
For pump or bottled gas systems, a gauge should show the pressure applied to the line through a system of regulator valves. Too much pressure may damage the window at the LNA signal input port. Too little pressure allows moisture ingress. Make certain the regulator is properly set.

Always keep an extra bottle of gas available. During the winter it is advisable to have several bottles on hand, particularly if access to the site is difficult.

Receivers

New solid-state satellite video receivers require little maintenance, if they operate in a proper environment (temperature between 68°F and 78°F, relative humidity between 20% and 30% and well-filtered air. The receivers should be checked at least once a year for the parameters shown in Table I.

If your system does not meet these specifications, you may have receiver or antenna problems. In a system with multiple receivers testing below the performance limits, the antenna/LNA is most likely at fault. If only one receiver



measures *low*, that receiver should be checked. Ship a copy of your test results with the receiver if it is sent back to the manufacturer or dealer for repair.

LNA power supply

If your LNA uses a power supply that is separate from the receiver, the supply should be checked regularly for correct operating voltages. Because there are many types of LNAs, follow the manufacturer's data sheet for the correct voltages. Make certain that all connectors are securely fastened and free of corrosion and moisture.

Backup power

Many stations have gas or diesel generators with instrumentation to sense ac power system failure. Fuel capacities should provide backup power for up to 48 hours. When your TVRO system supplies vital programming, such as network feeds, sports remotes or satellite news gathering services, it is advisable to have a backup power system.

Video S/N ratio	*52dB*
Differential gain (10-90APL)	*±2%*
Differential phase (10-90APL)	*±1°*
Low-frequency distortion	*2 IRE*
Video response (10kHz-8MHz)	*±2dB*
Audio hum	*−55dB*
Audio response (30Hz-15kHz)	*±0.5dB*

Table 1. *Receiver measurements.*

On emergency or standby power equipment, check the fuel supply, lubricants and coolant levels on a monthly basis. If known outages have occurred, more frequent checking is necessary.

Yearly tests of the generator system should be made using a dummy load, such as a number of studio lights in parallel equal to the TVRO current drain. Frequency stability can be checked with a frequency counter.

The best method for testing the emergency power system is to force a fault condition. By removing the ac power, you can assure that all sensing devices are working as you check the generator system. Plan a thorough check of the system monthly. Make such tests when programming through the TVRO is not critical and when other engineers are available to assist.

For some downlink electronics, backup batteries are used to run the system during ac outages. An uninterruptible power supply (UPS) includes a battery charger and inverter to develop alternating current from a storage battery. Check the battery condition regularly.

Environmental control

The receiver may be located in the studio facility or in a separate equipment shelter at the downlink antenna site. If a small building at the antenna is used, environmental control of some form is desirable. Regular checks of air-conditioning and heating units assures continued proper operation.

General considerations

A properly maintained satellite downlink can be highly reliable. Because the most critical components are outdoors and subjected to weather elements, lightning and possible vandalism, a physical inspection should be made at least once every six months. However, more frequent visits are suggested.

You should never allow ice and snow to accumulate on the antenna surface. They will impair the received signal and jeopardize the dish support structure. For the winter months, purchase or construct a rubber-bladed snow rake to clean out the dish surface, if your site is in a snow region.

Always keep a log of all satellite system tests for future comparison and reliability graphing. If a check of the antenna and receiver equipment shows the signal to be substandard, you may be able to track it to terrestrial interference (TI) caused by microwave communication links.

TI symptoms range from a decreased S/N ratio with increased video noise to bands across the picture. If you have a C-band agile receiver connected to your antenna, you may be able to determine if TI is the problem by scanning with the receiver. You may also hire a service company to check the site for levels and locations of TI sources. In most cases, filtering will eliminate newly developed TI problems.

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

Thyristor servo systems

By Jerry Whitaker, editor

Last month, we examined the characteristics of thyristors (SCRs) and the primary device ratings of interest to the maintenance engineer. This month, we look at how thyristors are used for ac power control in broadcast transmitters.

Figure 1 shows a basic single-phase ac control circuit, which uses discrete thyristors. The rms load current (I_{rms}) at any particular phase delay angle (α) is given in terms of the normal full-load rms current at a phase delay of zero (I_{rms-0}):

$$I_{rms} = I_{rms-0}\left[1-\left(\frac{\alpha}{\pi}\right)+(2\pi)^{-1}\sin 2\alpha\right]^{1/2}$$

The load rms voltage at any particular phase delay angle bears the same relationship to the full-load rms voltage at zero phase delay as the previous equation illustrates for load current. An analysis of the mathematics shows that although the theoretical delay range for complete control of a resistive load is 0° to 180°, a practical span of 20° to 160° gives a power control range of approximately 99% to 1% of maximum output to the load.

The circuit shown in Figure 1 requires a source of gate trigger pulses that must

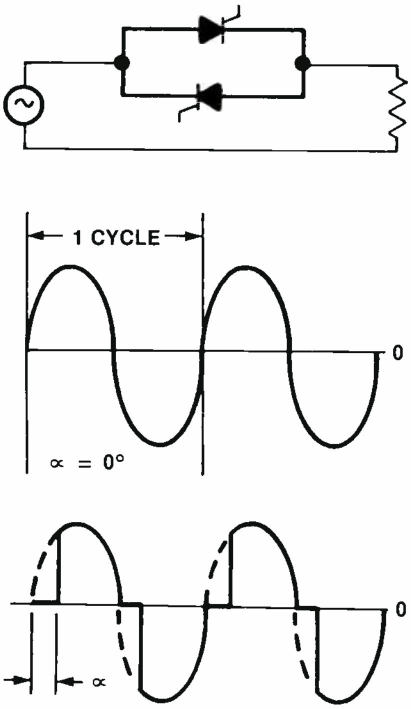
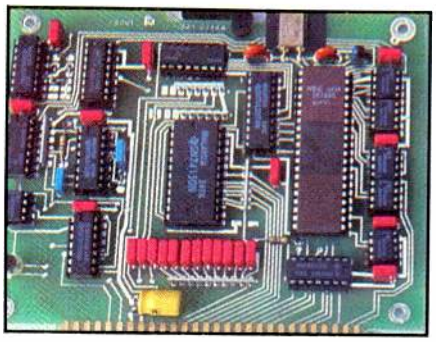


__Figure 1.__ The inverse-parallel thyristor ac power control method (above) and the load voltage and current waveforms for full and reduced thyristor control angles (below). These waveforms are for a purely resistive load.



be isolated from each other by at least the peak value of the applied ac voltage. The two gate pulse trains must also be phased 180° with respect to each other. Also, the gate pulse trains must shift together with respect to the ac supply voltage phase when power throughput is adjusted.

Some power control systems use two identical, but isolated, gate pulse trains operating at twice the applied supply voltage (120Hz for a 60Hz system). Under such an arrangement, the forward-biased thyristor will fire when the gate pulses are applied to the SCR pair. The reverse-biased thyristor will not fire. Normally, it is considered unsafe to drive a thyristor gate positive while its anode-cathode is reverse-biased. In this case, however, it may be permissible because the thyristor that is fired immediately conducts and removes the reverse voltage from the other device. The gate of the reverse-biased device is then being triggered on a thyristor that essentially has no applied voltage.

Inductive loads

The waveforms shown in Figure 2 illustrate effects of phase control on an inductive load, the load commonly used in broadcast transmitters. When inductive loads are driven at a reduced conduction angle, a sharp transient change of load voltage occurs at the end of each current pulse (or *loop*). The transients generally have no effect on the load, but they can be dangerous to proper operation of the thyristors. When the conducting thyristor turns off, thereby disconnecting the load from the ac line supply, the voltage at the load rapidly drops to zero. This rapid voltage change, in effect, applies a sharply rising positive anode voltage to the thyristor opposing the device that has been conducting. If the thyristor *dv/dt* rating is exceeded, the opposing device will turn on and conduction will take place, independent of any gate drive pulse.

A common protective approach involves the addition of a resistor-capacitor (RC) snubber circuit to control the rate of voltage change seen across the terminals of the thyristor pair.

Whenever a thyristor pair is used to drive an inductive load, such as a power transformer, it is critically important that each device fires at a point in the applied waveform exactly 180° relative to the other. If proper timing is not achieved, the positive and negative current loops will differ in magnitude, causing a resultant dc current to flow through the primary side of the transformer. A common trigger control circuit should, therefore, be used to determine gate timing for thyristor pairs.

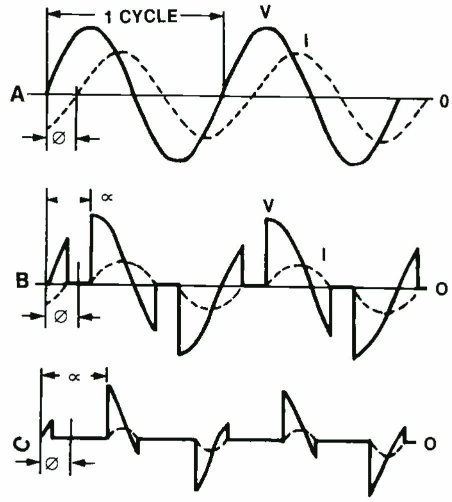


__Figure 2.__ Voltage and current waveforms for inverse-parallel thyristor power control with an inductive load. Waveform A represents full conduction; waveform B represents small angle phase reduction; and waveform C represents large angle phase reduction.

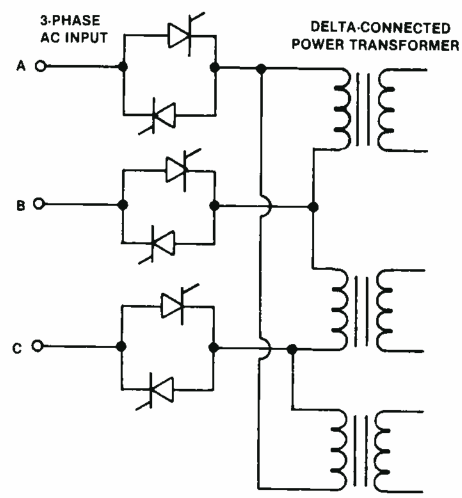
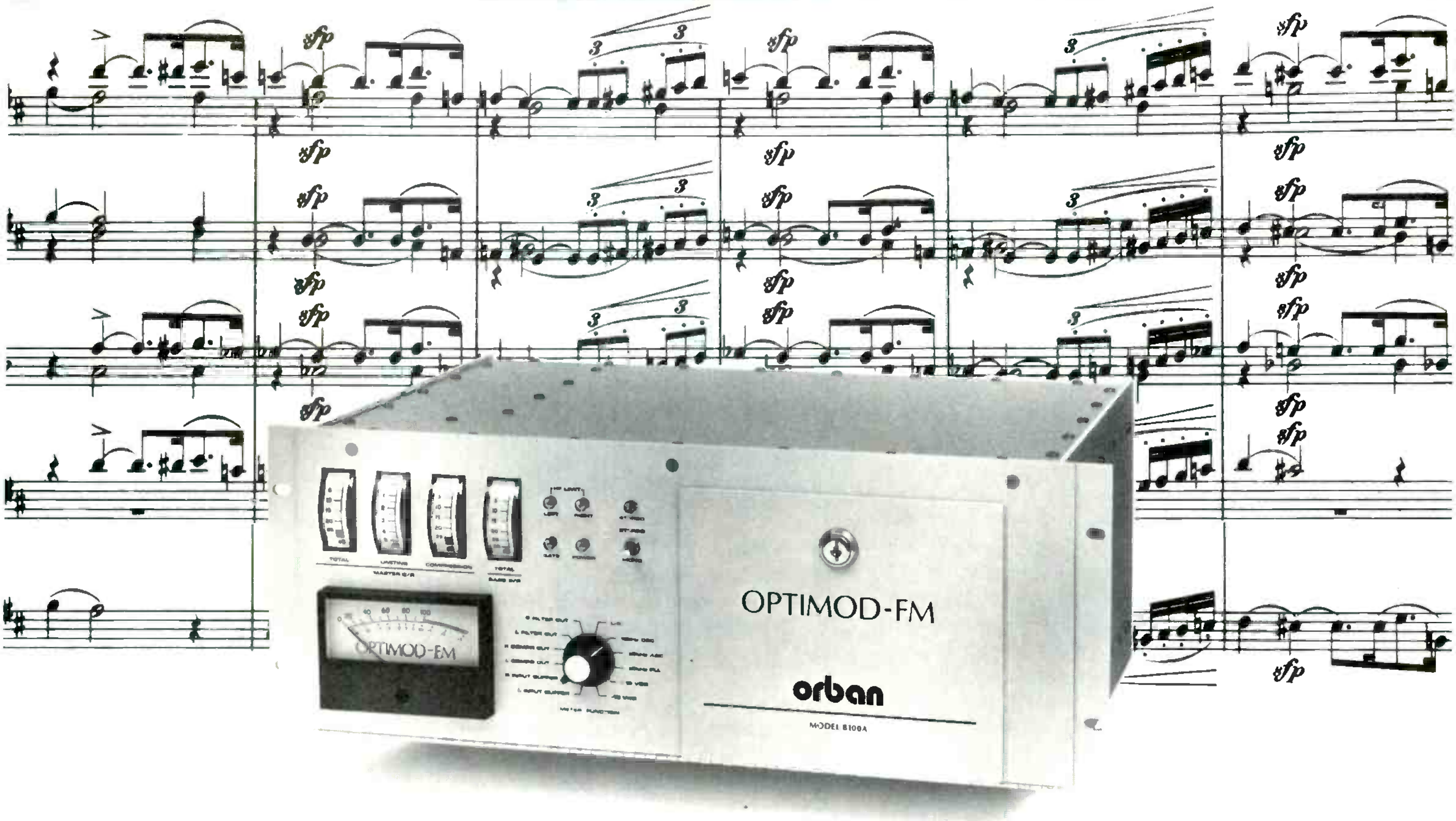


__Figure 3.__ Full-thyristor 3-phase ac control of an inductive delta load.

Editor's note: Background information on thyristor operation from the Howard W. Sams publication, *Reference Data for Radio Engineers, Sixth Edition.*



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Power supply failures

By Jerry Whitaker, editor

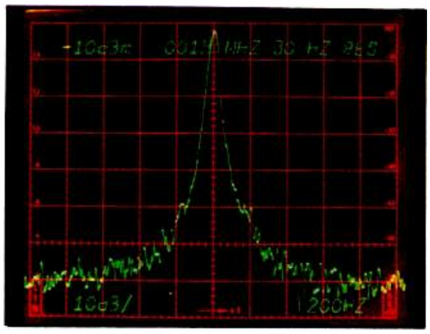
If your transmitter does not want to come up after a failure, don't push your luck by trying to *force* it to work. As outlined in this column last month, the protection systems and devices commonly used in most transmitters guard against *most* types of failures. They are not foolproof, however. Ratings for the primary ac system circuit breakers are based on current requirements at full load, and include a margin of safety to prevent random tripping due to power-line abnormalities. A failure, therefore, resulting in reduced carrier output—or no carrier at all—may leave the system vulnerable to significant fault-induced currents *before* the protective circuit breakers act.

Operation under such fault conditions, even for 20 seconds or less, can cause considerable damage to power-supply components, such as the power transformer, rectifier stack, thyristors or system wiring. Damage can range from additional component failures to a fire in the affected section of the transmitter.

Case in point

Don't think that such a scenario is possible only in theory. I am aware of a case in which such a failure resulted in a fire inside a common 20kW FM transmitter. As far as we were able to determine, the following sequence of events led to the destruction of the unit:

- One or more transient overvoltages hit the transmitter site, causing an arc to occur within the driver stage plate transformer. The arcing continued until particles from the secondary winding broke free from the transformer.
- At this point, the driver output voltage dropped significantly, causing the RF output of the transmitter to decrease to about 25% of normal output. Because the failure occurred between windings of the secondary of the driver plate transformer (and before the driver stage overcurrent sensor), plate voltage remained on. Also, because of the point where the secondary winding short circuit occurred, the transformer primary did not draw sufficient current to initially trip the driver circuit breaker. As a result, ac power continued to flow to the damaged transformer.
- Small pieces of molten metal continued to drop from the driver transformer, landing on the PA plate transformer. These particles dropped into the windings, causing the plate transformer to short and starting a localized fire.



When the smoke finally cleared, we could see that an entire section of the transmitter had been damaged. Besides the two ruined transformers, protection relays were melted away, rectifier stacks were fried and most of the wiring harness was destroyed. The transmitter was determined to be damaged beyond repair.

The disaster recounted here was apparently caused by transient activity that had been occurring over a period of some time. It points out the need to provide positive protection against transient overvoltages at every point in the broadcast facility.

Transients damage not only semiconductor devices, but wire insulation as well. The breakdown of an insulating material, such as that used with electrical wiring (hookup wire or the types of wire used for the windings of a transformer), usually results in localized carbonization. This may be catastrophic, resulting in immediate failure of the component (or system), or in decreased dielectric strength of the material at the arc-over point. The occurrence of additional transients often causes breakthrough at the weakened point in the insulating material, eventually resulting in catastrophic failure.

Single phasing

Any transmitter using a 3-phase ac power supply is subject to the problem of *single phasing,* the loss of one of the three wires from the primary ac power distribution source. Single phasing is usually a utility company problem, caused by a downed line or a blown pole-mounted fuse.

The loss of one leg of a 3-phase line results in a particularly dangerous situation for 3-phase motors, which will overheat and sometimes fail. Figure 1 shows a simple protection scheme that has been used to protect transmission equipment from damage caused by single phasing. Although at first glance the system looks as if it would easily handle the job, operational problems can result.

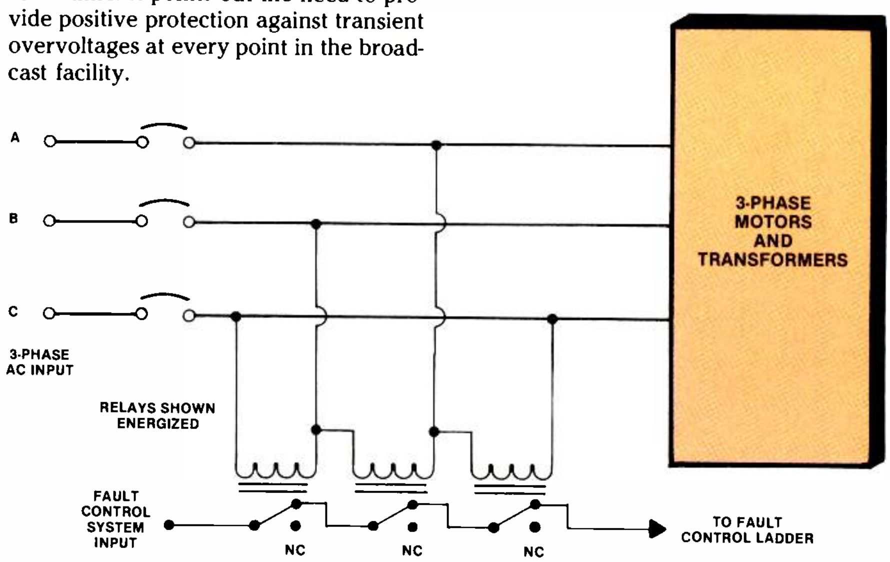


Figure 1. *Using relays for phase loss protection.*

The loss of one leg of a 3-phase line rarely results in zero (or near-zero) voltages in the legs associated with the problem line. Instead, a combination of leakage currents caused by *regeneration* of the missing legs in inductive loads and the system load distribution, usually results in a voltage of some sort on the fault legs of the 3-phase line.

Because of these effects, the relays associated with the down legs will not always drop out. The Figure 1 circuit is sometimes refined by adding dropping resistors in series with each relay coil. Although this is an improved arrangement, it, like other protection systems, is not foolproof.

In next month's column, we'll look at ways around this problem.

320.

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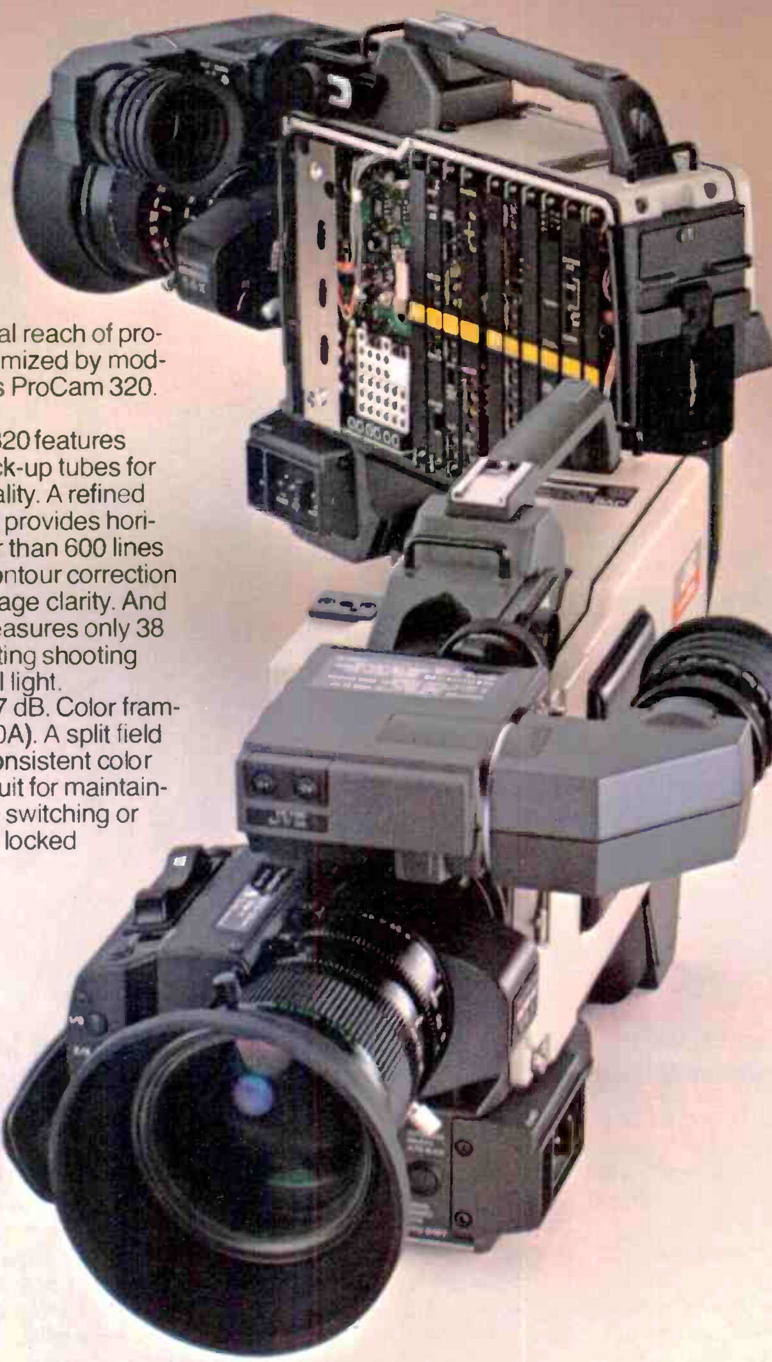

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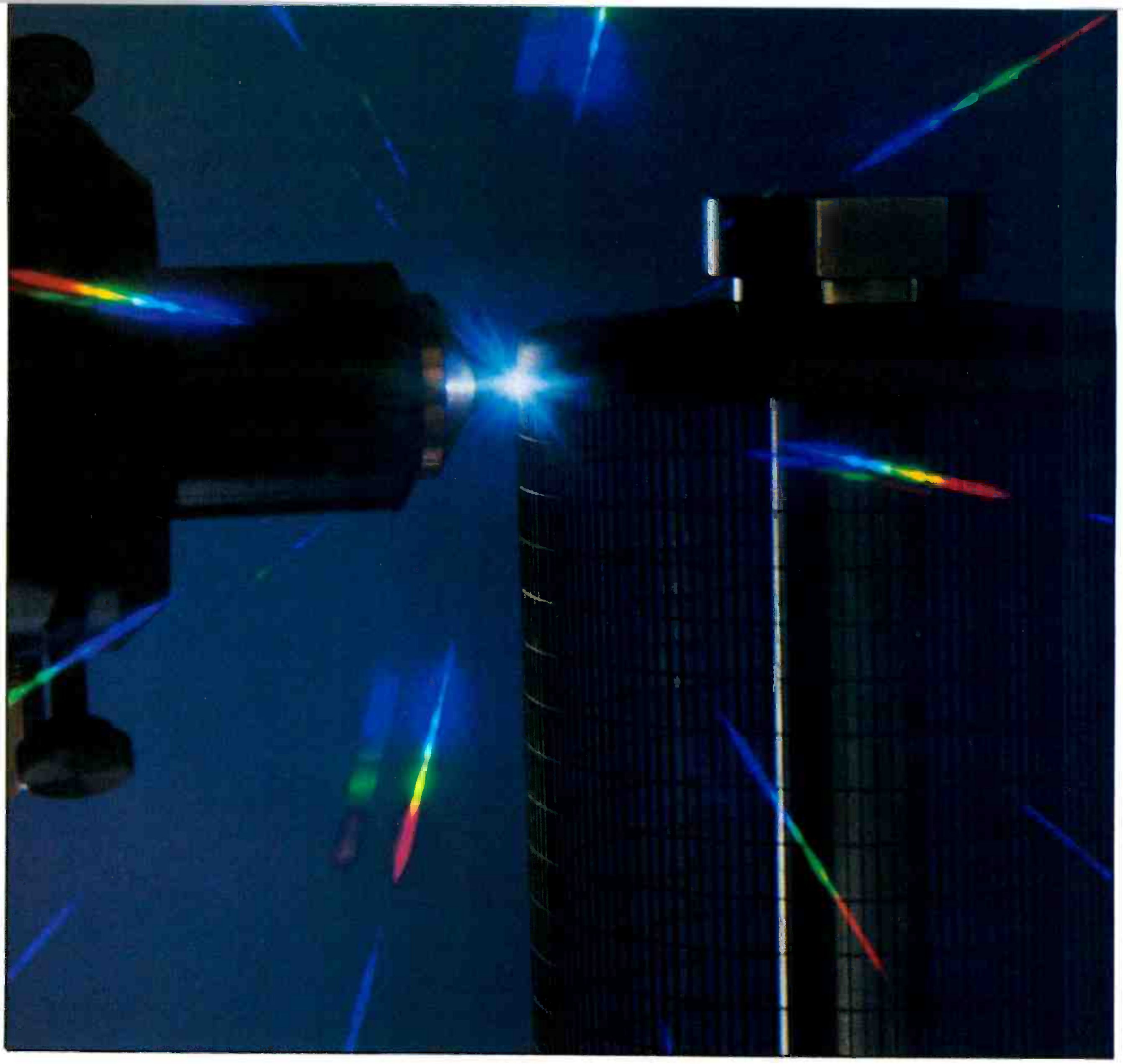


High-tech tubes

By Jerry Whitaker, editor, and William I. Orr

The broadcast industry's need for power tubes capable of higher output and greater reliability is being met with new processes and materials.

The phrase, "high technology," is perhaps one of the more overused descriptions in our technical vocabulary. It is a phrase generally reserved for discussion of integrated circuits, fiber optics, satellite systems and the like. Few people would associate high technology with vacuum tubes. The notion that vacuum-tube construction is more *art* than *science* may have been true 10 or 20 years ago, but today it's a different story.

Orr is an application engineer at Varian EIMAC, San Carlos, CA.

The demand on the part of the broadcast industry for tubes capable of higher operating power and frequency, and the economic necessity for tubes that provide greater efficiency and reliability, have moved power-tube manufacturers into the high-tech arena. Advancements in tube design and construction have given us new broadcast transmitters that allow our industry to grow and prosper. Think about it. What *single unit* in the entire transmission chain of a radio or TV facility symbolizes what we do? The transmitter, of course. And what *single component* of any high-power radio or TV transmitter symbolizes the transmitter itself? The PA tube.

How many power tubes have you

replaced in your career as a broadcast engineer? Ten? Twenty? More? Anyone who has ever worked on a transmitter quickly gains a healthy respect for the power tubes used inside. We know the principles upon which the tube works. We know that electrons are emitted from the heated cathode, are controlled (modulated) by the control grid, are further controlled by the screen grid, then received by the anode. We know how the tube *works*, but how is it *made*?

Have you ever been tempted to break open a power tube to see what's inside? Well, read on. We have a guided tour planned for you.

Tube types

If you bring up the subject of vacuum tubes to someone who has never worked on a broadcast transmitter, you will usually get a blank stare and a question something like, "Do they make those anymore?" Receiving tubes have more or less disappeared from the stage because of the development of transistors and integrated circuits. Some broadcast engineers still lament the passing of the receiving tube. Life seemed so much simpler in those days. There weren't many pieces of equipment that couldn't be fixed with a boxful of 12AX7, 6V6 or 6AU6 tubes. And let us not forget the 5U4. Whether those were really the *good old days* is open to a good deal of debate, but the facts are that times have changed. They have changed in response to customer demands.

Users today are generally asking for systems that incorporate solid-state components in low- and medium-power stages and vacuum-tube components in high-power stages of broadcast equipment. Each technology has its place, and each has its strengths and weaknesses. Take a high-power FM transmitter, for example. New tube designs, coupled with new PA cavity systems, allow a 30kW—or even 50kW—transmitter to be constructed with only one tube in the entire system. Solid-state RF amplifiers raise the exciter signal to a level of 300W to 700W and the PA tube, in a single stage, boosts the power level to the rated output. What semiconductor device can do that in a single step?

Tube design

Tube development is advancing just as fast as developments in solid-state technology, although accompanied by less fanfare. Power tubes today are designed with an eye toward high operating efficiency and high gain/bandwidth properties. Above all, a tube must be reliable and provide a long operating life. The design of a new power tube is generally a lengthy process that involves computer-aided calculations and modeling. The design engineers must examine a laundry list of items, including:

• *Electro-optics*—How the internal elements line up to achieve the desired performance. A careful analysis must be made of what happens to the electrons in their paths from the cathode to the anode, including the typical power gain of the tube.
• *Cooling*—How the tube will dissipate the heat generated during normal operation. A high-performance tube is of little value if it will not provide longevity in typical applications. Design questions include whether the tube will be air-cooled or water-cooled, the number of fins the device will have, and the thickness and spacing of the fins.
• *Operational parameters*—What the typical interelectrode capacitances will be, and the manufacturing tolerances that can be expected. This analysis includes: spacing variations between elements within the tube, the types of materials used in construction, the long-term stability of the internal elements and the effects of thermal cycling.

Cost considerations must also be taken into account. The availability of materials is important, as is the amount of labor required to build the device.

An example

To illustrate the development process, consider a case in point: the 4CX40,000G power tube. A need is identified for a high-gain, air-cooled power tetrode capable of producing up to 60kW at 100MHz for the forthcoming generation of VHF FM and TV transmitters. In order to meet the performance requirements of TV service, it must provide wideband performance It also must operate efficiently to yield an attractive overall cost/performance ratio.

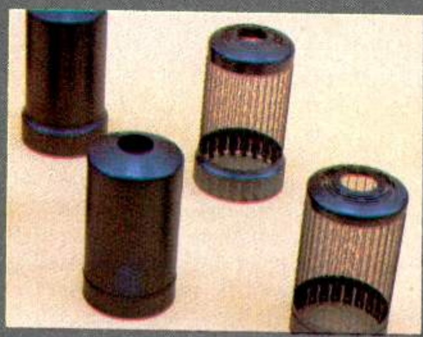
The operating parameters established for the example tube are as follows:
• Generic product name: 4CX40,000G

A tube engineer designs the coaxial base assembly for a new 40kW ceramic/metal tetrode using CAD/CAM procedures. A computer-generated tape will later be used to control milling operations for device production.

A 4-axis milling machine uses tape from the CAD system for automatic precision milling of odd shapes for contouring fittings, radial threaded bolt holes and other complex configurations. The operator is shown preparing jigs and fixtures for a 4CX40,000G.

A pyrolytic graphite production station, where natural gas is converted by chemical-vapor deposition into a graphite cup that will later be cut by a laser to produce grid structures for power tubes. Operators are shown preparing one of the two furnaces for use.

All photos in this article courtesy of Varian EIMAC



Before and after. At left are two pyrolytic cups about 30 mils (3/100 inches) thick after processing in the pyrolytic graphite production station. The cups are ready for precision laser cutting to an accuracy of 0.3 mils (3/10,000 inches). At right are two finished grid structures.

An optical comparator projector displays the image of a finished pyrolytic grid enlarged 100 times. The inspector checks for alignment, bar width and TIR (total indicated runout, a comparison of the product element to a true circle).

A tube technician mounts the control grid of a 4CX40,000G onto its base structure. The tube assembly is held on a spinning mandrel for quick visual alignment. The tube's screen grid is shown in the foreground.

- Power output: 60kW at 100MHz
- Usable upper limit frequency: 250MHz
- Power gain: 18dB or greater
- Cooling provided by forced air through external anode fins
- Internal elements (control grid and screen grid) to use new pyrolytic graphite grids.

Basic engineering considerations and experience determine that the device will be about 12 inches high and 10 inches in diameter, with a coaxial base and a finned, air-cooled anode. In order to achieve the high level of emission required, a thoriated-tungsten mesh filament is proposed. Because of the high operating frequency, the tube must be physically short; therefore, the filament must be short and heavy. This indicates a low voltage, high current emitter.

Inputs from transmitter manufacturers and design engineers come together to determine the electrical characteristics of the tube. The electron geometry is studied in a computer program and the necessary changes made in the proposed tube structure to achieve the designed performance. CAD/CAM procedures are used when applicable.

After the computer design is completed, a prototype tube is constructed. The basic ingredients of a power tube may include carbon, copper, alumina, ceramic, iron, nickel, cobalt, molybdenum, chromium, tungsten, tantalum, thorium, zirconium and platinum. Alloys such as copper-silver, copper-nickel and copper-nickel-gold are used in various brazing processes. The tube will be a veritable chemical laboratory in miniature with both chemical and physical vapor deposition continuing throughout its life.

The grid and screen elements are laser-cut from solid pyrolytic graphite cups, ensuring close tolerance where errors of a few thousandths of an inch can ruin the tube's performance. Pyrolytic graphite grids are preferable because they reduce primary and secondary grid emissions and therefore, provide improved operating efficiency.

The prototype

The prototype tube is assembled in three basic parts: the base structure, which includes the socket terminations; the element support, which includes the filament, grid and screen assemblies; and the anode, which includes the ceramic outer insulator and the air-cooling assembly.

When the tube is complete, it is given a static test to determine the operating characteristics. The tube is run in a curve plotter to establish a set of constant current curves from which the optimum operating parameters of the device are established. Based on these results, the original computer program can be analyzed for any necessary changes in element spacing, element diameter and other design parameters.

The 4CX40,000G tube passes quickly now from the experimental prototype to preproduction stage. Sample tubes may be sent out to customers for incorporation into new equipment designs and for field testing. At the same time, specialized test equipment for the tube is built.

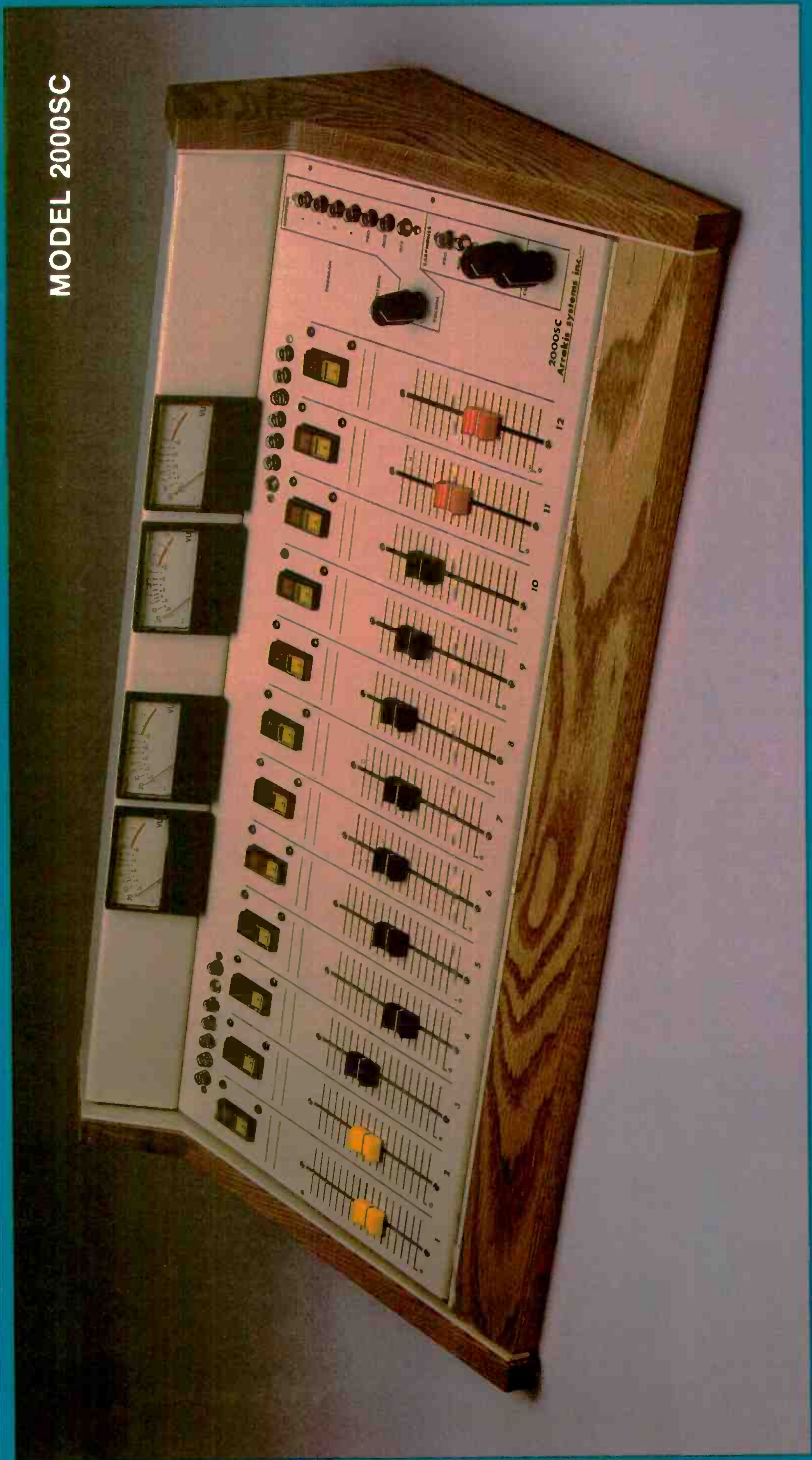
When the first power tubes are completed, the development remains far from finished. The tube must be tested in the same way the customer will use it. Simultaneous with tube design, a cavity design is undertaken. Test data is run on the tube/cavity combination up to the full rated power output, and higher. At a maximum power level, the final 4CX40,000G operating specifications are established after complete temperature and dissipation runs have been evaluated and confirmed over a period of time.

Tube production

After a tube has been placed into production, it follows a regular assembly process. And although each tube type is unique, requiring some degree of specialization at various stages in the construction process, some generalizations can be made with respect to building power vacuum tubes. The general production process involves the following steps:

- *Machining of major parts*

On the outside, a tube looks like one big unit, but it is really a group of smaller parts that must be machined and assembled to tight specifications. The first factor that separates tube types is the method of cooling used: air, water or vapor. Air-cooled tubes are common at power levels below 50kW. A water-cooling system is much more effective than air-cooling, by as much as a factor of two, in transferring heat from the device. Air-cooling at the 100kW level is virtually impossible because it is difficult to physically move enough air through



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the device (if the device is of a reasonable size) to keep the tube sufficiently cool. Vapor-cooling provides an even more efficient method of cooling a PA tube than water-cooling. Naturally, the complexity of the external blowers, fans, ducts, plumbing, heat exchangers and other hardware must be taken into consideration in the selection of a particular method of power-tube cooling.

• *Subassembly fabrication and brazing*

The anode and cooling fins begin as flat sheets of copper. They are stamped by the tube manufacturer into the necessary sizes and shapes. Depending on the power level, it may take several stamping operations to form the anode assembly. Once all the parts have been machined, the anode and cooling fins are stacked in their proper positions, clamped and brazed into one piece in a brazing furnace.

While the metal components of the tube are being formed, the ceramic structures are beginning to take shape. The ceramic elements used in a vacuum tube are built in sections. Each element builds upon the previous one to form the base of the tube. The ceramic-to-metal seals are created using a special material that is *painted* onto the ceramic and then heated in a brazing oven. When the part comes out of the high-temperature oven, the painted area provides a metallic structure that is molecularly bonded to the ceramic and may be brazed onto.

This process requires temperature sequences that dictate completion of the highest-temperature stages first. As the assembly takes form, lower oven temperatures are used so that completed bonds will not be damaged.

• *Grid fabrication*

The control and screen grids of a power tube may be constructed of a wire structure welded at all crosspoints or of a laser-cut pyrolytic cup. Wire grids are prepared by operators that wind the assemblies using special *mandrels* (forms) that include the required outline of the finished grid. The operators spot weld the wires at all intersecting points.

Pyrolytic grids are a high-performance alternative to wire grid assemblies. Pyrolytic grids are ideal vacuum-tube elements because they don't expand like metal. Their coefficient of expansion is small, preventing movement of the grids inside the tube at elevated temperatures. This preserves the desired electrical characteristics of the tube. Because of tighter tolerances, pyrolytic grids can be spaced more closely than conventional wire grids. Another benefit is that the pyrolytic grid is a single structure, having no weld points.

• *Heater/cathode assembly*

The thoriated-tungsten filament (or cathode) commonly used in broadcast power tubes is created in a high-temperature atmosphere that forms a deep layer of ditungsten carbide on the surface of the elements. This is a critical stage because, if the carbide layer is too deep, the filament will become too brittle to withstand shipping and normal handling. The end of a tube's useful life (for this type of filament) occurs when most of the carbon has evaporated or has combined with residual gas, depleting the carbide surface layer.

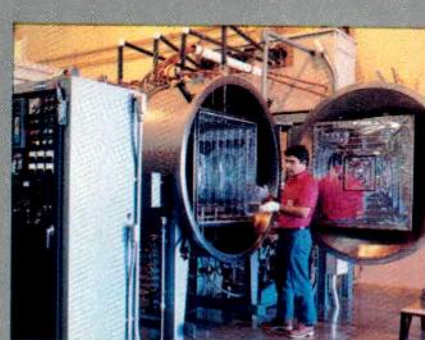
Theoretically, a 3% increase in filament voltage will result in a 20° Kelvin increase in cathode temperature, a 20% increase in peak emission, and a 50% decrease in tube life because of carbon loss. This cycle works in reverse, too. For a small decrease in temperature and peak emission, the life of the carbide layer—and hence, the tube—can be increased by a substantial amount.

The actual construction of the filament assembly can have an effect on the performance of the tube and the performance of the transmission system as a whole. Filaments built in a basket-weave mesh arrangement offer lower distortion in critical high-level AM modulation circuits. The mesh filament is also more rugged and resistant to physical shock than simpler geometrics.

• *Mounting of grids and filaments*

The tube is built in essentially two parts: the base, which includes the filament and supporting stem, control grid and screen grid; and the anode, which includes the heat-dissipating fins made in various machining steps. Mounting of the grids and filament onto the base of the tube is a delicate procedure. The control and screen grids are usually spaced closely, requiring that each assembly be held to tight tolerances. With small tubes, element alignment becomes even more critical because all of the components are scaled down in size. This requires tighter tolerances to be main-

An operator prepares carbon jigs that hold tube filament stems. The jigs will go into a brazing furnace that operates with a hydrogen atmosphere at about 900°C. Anode assemblies for various tubes can be seen in the background.



An ultraclean, ultrahigh vacuum furnace is used for vacuum firing of wire-wound grids to remove residual gas and for vacuum scrubbing of the stem and support structure of the 4CX40,000G. The operator is shown inspecting a wire-wound grid assembly.

Hydraulic presses are used to stamp out anode assemblies for various tubes. This 125-ton press is shown producing stainless steel water jackets for megawatt tubes. In the foreground is a stack of copper anodes already stamped for the 4CX40,000G.

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A tube technician prepares a 4CX40,000G anode assembly for the brazing operation. Individual cooling fins are stacked around a copper anode core and ringed by an outer anode band. The next step in the process is the brazing furnace.

An assembled 4CX40,000G, mounted anode down on a tubulation stand, is prepared for the vacuum bake-out stage. An electric bake-out oven (above the tube and behind the wire mesh screen) is lowered over the device to heat it as the vacuum pump operates.

A curve-plotter is used to establish the electrical characteristics of production tubes for quality control. Filament voltage and grid bias are applied and, after warmup, screen and plate voltage are switched on.

tained for each element.

The base subassemblies are welded using a tungsten-inert gas (TIG) process in an oxygen-free atmosphere (a process sometimes referred to as *Heliarc* welding) to produce a finished base unit. During this process, quality control inspectors ensure that the assembly is correctly aligned and that dimensions fall within accepted tolerance levels.

• *Final assembly and evacuation*

The base assembly is matched with the anode and the completed tube is brazed into a single unit. The tube then goes through a *bake-out* procedure. Baking stations, either fixed-position or automatic rotary systems, are used to evacuate the tube and bake out any oxygen from the copper parts of the assembly. Although oxygen-free copper is used in tube construction, some residual oxygen exists in the metal and must be driven out for long component life. Gauges are used to measure the vacuum inside the tube. A typical vacuum reading of 10^{-8} Torr is specified for most power tubes (formerly expressed as 10^{-8}mm of mercury). For comparison, this is the degree of vacuum in outer space about 200 miles above the earth.

After a specified amount of tube bake-out using external heaters, the tube's internal heater is activated to complete the process. On some of the larger power tubes, you can actually see the filament glowing through the ceramic during the end of the bake-out process.

• *Testing, aging and cleaning*

Most tubes are burned in for a period of several hours, during which time a test signal is applied to the device. The signal may simply be a steady-state dc voltage on the grid or an RF signal to check various tube parameters. Test assemblies are set up so that an operator can check a number of tubes at one time. Not all tubes receive the same tests. The selection of test parameters depends on the intended applications.

After the tube has gone through all of the foregoing steps, it looks rather dirty. It is cleaned (sandblasted) to remove any dirt or discoloration, and is then plated with silver or nickel to improve electrical conductivity and to prevent oxidation.

The final testing stage reveals any problems that may have developed during the manufacturing process. The number of tubes that flunk one of the tests along the way depends upon the complexity of the tube, but the rejection rate is generally quite small. The most frequent cause of tube failure is leakage. Pinhole air leaks in the materials or bonds degrade the internal vacuum and cause the tube to be rejected.

The second-ranking reason for tube failure is low emission or some other form of unacceptable electrical performance. Cosmetic failures, such as bent cooling fins, account for most of the remaining rejections observed.

The typical yield on a newly designed tube is 80%-90%. On an established tube, the yield is 90%-95%.

Tube manufacturing involves a great deal of chemical engineering. Operation of the tube, in fact, actually involves a slow chemical process. The filament is continually changing during the operating life of the tube. When the process is finished, you've lost all emissions from the device.

Tube sockets

Any one type of tube may have several possible socket configurations, depending upon the frequency of operation. If the tube terminals are large, cylindrical surfaces, the contacting portions of the socket consist of either spring collects or an assembly of spring finger-stock. Usually, these multiple-contacting surfaces are made of beryllium copper to preserve spring tension at the high temperatures present at the tube terminals. The fingers are silver-plated to reduce RF resistance.

If the connecting fingers of a power-tube socket fail to provide the designed contact with the tube element rings, a concentration of RF currents will result. Depending upon the extent of this concentration, damage may result to the socket. Once a connecting finger loses its spring action, the heating effect is aggravated and tube damage is possible.

A new series of tubes are available that have no sockets at all. Intended for cathode-driven service, the grid assembly is formed into a flange that is bolted to the chassis. The filament leads are connected via studs on the bottom of the tube. Such a configuration completely eliminates the tube socket.

The future

Despite the inroads made by solid-state technology, the power vacuum tube oc-


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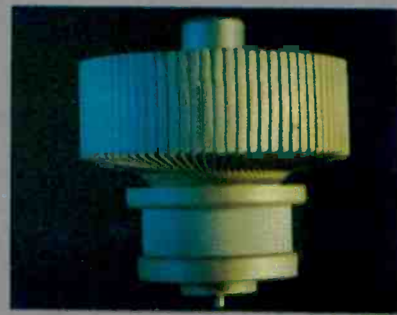
The finished product. As a final production step, the tube is cleaned, silver plated and labeled. This device, a 4CX40,000G, will produce 50kW of power at 100MHz.



The other end of the power spectrum. This tube, an 8938, provides more than 1.5kW at 400MHz. The device is designed for cathode-driven service.

The design of a companion cavity is a key part of power-tube development for FM and TV applications. Shown is the interior of a cavity used with the 4CX40,000G tube. A movable anode plate resonates the cavity at the chosen operating frequency.

A prototype cavity is tested for operation at 65kW output at 50MHz. Measurements are taken to determine the RF operating characteristics of the design, and the performance of the cavity coupling and tuning controls.

cupies, and will continue to occupy, an important role in the generation of high-power RF in the HF and VHF regions. No other devices can do the job as well. Certainly, solid-state components cannot, especially if cost, size and weight are considerations.

As far as we know, there are no technological breakthroughs on the horizon that will bring about the development of extremely high-power semiconductor devices. Don't expect to find a 2N4CX40,000G super MOSFET transistor at your local supply house anytime soon!

Today's modern power tube is unlike the power tubes in use a decade ago. And with the trend in the broadcast industry toward operation at higher power levels and higher frequencies, the vacuum tube is certain to remain on the scene for a long time to come.

Bibliography: "The Care and Feeding of Power Grid Tubes," by the laboratory staff of Varian EIMAC, San Carlos, CA.

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Making stereo TV work

Edited by Jerry Whitaker, editor

Before stereo television can be transmitted, it must be produced and distributed. And that's not as easy as you might think.

Courtesy of Centro

The production of stereo audio for television is a whole different ball game for the networks and program producers. And this fact should be of more than passing interest to individual stations, because most of what we put on the air comes from these two groups. Shown is one of the audio post-production suites at Paramount Studios.

Few people would disagree that the conversion of TV stations to stereo operation is occurring at an impressive rate. The NAB estimates that more than 110 stations are now capable of broadcasting stereo and/or separate audio program (SAP) signals. Given current and projected growth rates, this number could reach the 200 mark by the end of 1986. Statistics show that of the stereo stations currently on the air, most are located in the top 100 markets, covering more than 50% of America's TV households with a multichannel sound (MTS) signal. How many of those households include a receiver capable of reproducing a stereo TV signal, however, remains unknown.

Regardless of the actual numbers of stereo sets sold, there is unquestionably a good deal of interest in MTS on the part of consumers and, of course, broadcasters. Clearly, stereo television received a significant push earlier this year when NBC began distribution via satellite of stereo programming to its affiliates. The Public Broadcasting Service (PBS), with a long history of innovative program distribution, is moving forward with plans for regular stereo programming. Both ABC and CBS have experimented with stereo; however, only ABC has announced plans for implementation of multichannel service.

The problem at hand—from the networks' point of view—is twofold: How will stereo programs be produced, and how will they be distributed?

Editor's note: This article is based on a special SMPTE seminar on implementing stereo television. (See the sidebar, "SMPTE/USC Stereo Conference," page 38.) Major contributors to the text were Tom Holman (Lucasfilm), who discussed the production aspects of stereo, and Don McCroskey (ABC, Los Angeles), who discussed transmitting stereo programming. Additional information was obtained from the NAB report, "Stereo Television: An Interim Report," by Robert Yadon, September 1985.

Making stereo

To most broadcast engineers, the world of motion picture production seems foreign. We're not quite sure what those people do, or how they do it. This

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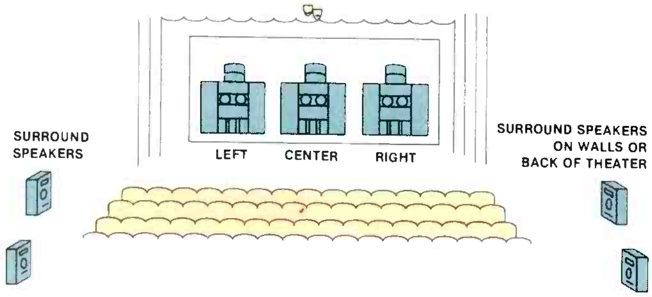

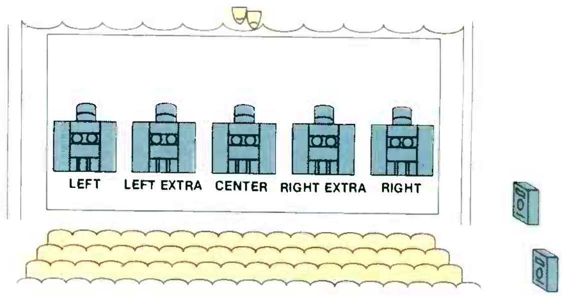

Figure 1. *Above, loudspeaker placement for stereo using 35mm film.*

Figure 2. *Above right, loudspeaker placement for stereo using 70mm film.*

lack of knowledge about the film industry and the production of serial TV programs can lead to an underestimation of the work required to produce stereo audio for TV use.

Typically, 35mm film releases carry four discrete channels, assigned to *screen left, screen center, screen right* and *surround* (Figure 1). The surround channel is connected to small speakers located around the side and back walls of the theater. There must be enough of them so that the track will truly seem nondirectional to the theater patron.

70mm film releases typically carry six discrete channels, assigned to screen left, *left extra,* center, *right extra,* right and surround (Figure 2). Unfortunately, generating a stereo running master from a 35mm or 70mm theatrical release involves much more than simply pulling off the left and right signals.

The most desirable solution to this problem is to go back to the premix stage where the mixes represent left, center and right signals for sound effects, music and dialogue. Although there is usually no dialogue pan, the left, center and right signals are needed for reverb returns. The proper audio mix for a TV stereo master is almost always different than the proper mix for a theatrical release because of the reduced screen size, lack of a center channel and unpredictable placement of the TV receiver speakers.

Generally speaking, the music should be kept as wide as possible, and perhaps the ambience should also be made as wide as possible. However, specific events on the screen should be kept narrow. Sound effects that are wider than the image of the TV screen are annoying and confusing to the viewer.

The second most desirable method of generating TV stereo from a movie release is to use the *stereo variable area* left track and right track master as is, and put it out as stereo. This may not be a bad solution in many cases. And it is by far the most practical solution if the producer can't afford the dubbing stage time to make a TV running master.

Building a TV running master after the theatrical release master has been completed might require a few extra days of work on a big picture, once all of the other materials are prepared. This does, however, add a significant amount of expense to the producer's budget.

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Continued from page 32

The third most desirable approach to TV stereo is to make a TV running master from a left, center and right master by splitting the center channel into left and right. Although it is less than optimum, this approach can produce a stereo program of reasonable quality.

The fourth most desirable method of generating stereo is to use a stereo synthesizer and *invent* stereo. There is, however, an aesthetic price for simulated stereo. It must be done artistically and judiciously to come out right.

Dynamic range

Another problem in this effort involves the decrease in dynamic range that is experienced as we move from film—especially magnetic film—to videotape and video distribution.

A comparison of 3-track magnetic film and 1-inch videotape recorded on a layback machine shows that, at high frequencies, performance of the two systems is relatively close. At lower frequencies, however (especially 200Hz), there is an 8.5dB performance difference between videotape and magnetic film. At the other end of dynamic range we also run into trouble. Videotape is typically about 8dB worse in midband noise (2kHz-3kHz) than film. Some form of dynamic range control, therefore, is necessary.

To accomplish the conversion from motion picture stereo to TV stereo, the most desirable solution is, again, also the most expensive solution: go back to the master tracks and remix the program for the dynamic range of television. Alternatives are, of course, available, including manual or automatic gain-riding to reduce the program dynamic range. Manual gain-riding is generally preferred to automatic compressors or limiters because of the artistic input that human involvement in the process can provide.

These considerations present the program producer with a new set of problems, but they are problems that can be solved. Any studio that can release a major motion picture on ½-inch videotape for use by consumers in stereo can certainly release the same film on 1-inch tape for the networks and independent stations.

Distributing stereo

Despite all of the talk about stereo, it is still the *monophonic* signal that currently pays the bills of any station. It is just as important to maintain good monophonic compatibility as it is to produce effective and natural stereo programming.

There is currently a great debate raging in some circles as to whether discrete left and right channels or matrixed sum and difference signals should be used for in-house distribution and interchange of tapes. The matrix argument goes like this:

Matrixed L+R can be monitored directly for monophonic compatibility, reflecting what the end-user will hear. In a discrete system, left and right signals must be properly matrixed (in a 1:1 ratio) at each monitoring position to achieve the same capability. If the polarity of the matrixed sum or difference signal is accidentally inverted, the monophonic listener will hear no change. The stereo listener will hear the left and right channels reversed. Although this is regrettable, it isn't a complete disaster. In a discrete system, however, if the polarity of either the left or right channel is inverted, the monophonic listener (when mono program material is being broadcast) will hear L–R (nothing).

These are powerful arguments for transmitting matrixed signals. However, other factors must also be considered, such as the multiple transmission paths through which normal TV programming passes. The signal path can only be described as torturous:

From the studio, the feed travels through a routing switcher to recording, editing, assembly and recording. After duplication, the feed goes to playback, a routing switcher, through a break studio, to another routing switcher and then to the network satellite or telco link to New York.

Now things get interesting. From the telco terminal or satellite receiver, the program feed goes to recording, then to playback, through a routing switcher to a commercial integration studio, through another routing switcher and to recording. At final playback, the feed goes through a break studio, a routing switcher and back to the West Coast, where the program is rerecorded and, upon playback, sent through another routing switcher, break studio, routing switcher and finally to the West Coast network (either telco or satellite) for transmission to the affiliate stations.

And this is when things go right!

At every link in the chain the opportunity exists for the occurrence of unwanted stereo amplitude differentials. Tests have shown that a level differential of just 1dB in a matrixed system can reduce a typical separation figure of 35dB to about 24dB. (See Figure 3.) Amplitude and phase coherence between channels is less critical in a discrete left-and-right distribution system than in a matrixed system. The discrete system is also easier to monitor in stereo and easier to correct if a problem occurs. Another consideration is that with the discrete left-and-right method of distribution, the station will still have a satisfactory center dialogue signal despite the failure of either channel, because the dialogue remains mixed to the center.

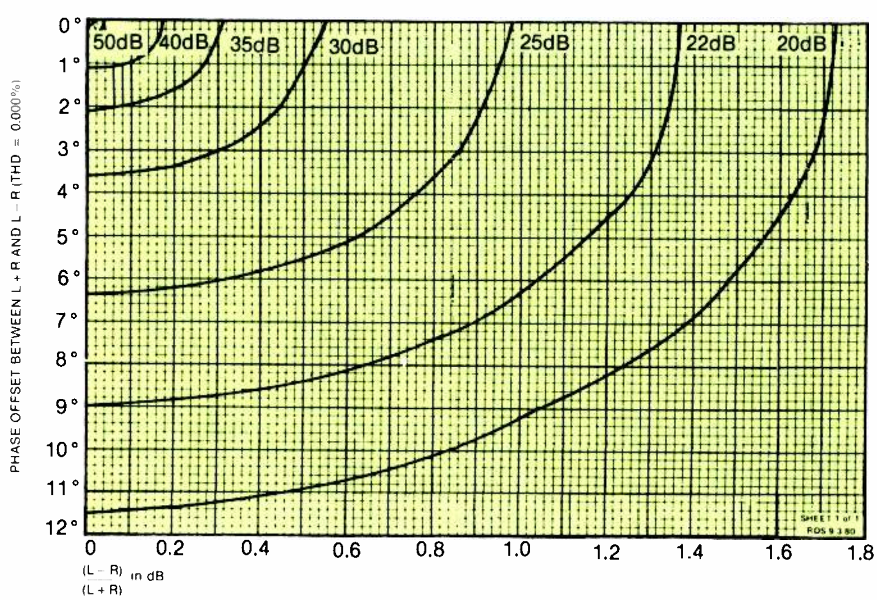

Figure 3. *A graphical representation of the influence that amplitude and phase coherence has on stereo separation in a matrixed system. The curves of constant separation are given for seven levels of stereo separation (20dB to 50dB).*

Preventing problems

It behooves us all to check out our plants, piece by piece, to be sure there isn't some combination of interconnected equipment that is lying in wait to strike at the most inopportune time. Sometimes problems are corrected by reversing things at both ends; this method must be avoided at all costs.

Any new or temporary equipment must be carefully checked for polarity inversion between input and output. Unbalanced equipment will present a particular problem, because inversion cannot be effected without the use of transformers or buffer amplifiers.

Whatever your timetable for implementing stereo television, the time to begin working on the conversion is now. The work you have ahead of you will require long hours and a commitment to quality sound. Audio is more than just narrowband video.

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For more information on Varian's "S" tube call Varian Microwave Tube Division or contact any Electron Device Group sales organization worldwide.

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SMPTE/USC stereo conference

This article is based on information presented at a unique 1-day seminar earlier this year at the University of Southern California in Los Angeles. Sponsored by the Society of Motion Picture and Television Engineers (SMPTE) Hollywood section and the USC School of Cinema and Television, the seminar was titled, "Stereo for Television—A Whole Different Ball Game."

The special gathering brought together some of the top technical people in the motion picture and TV industries. The seminar examined production and post-production considerations for film and tape, stereo perception, dynamic range of various media and the typical viewing environment for television. Seminar participants included:

- *Craig Curtis, NBC, Los Angeles*
- *Don McCroskey, ABC, Los Angeles*
- *Waldon Watson, Universal Studios*
- *Diana Deutsch, University of California, San Diego*
- *Peter Butt, NBC, Los Angeles*
- *Tom Holman, Lucasfilm*
- *Art Schneider, Color Systems Technology*
- *Paul Sehenuk, Universal Studios*
- *John Bonner, Warner/Hollywood Studios*
- *Shawn Murphy, Disney Studios*
- *Rick Chase, Rick Chase Productions*
- *Ron Estes, NBC-TV, Los Angeles*
- *Lou Bardfield, KTLA-TV, Los Angeles*

The seminar covered the many requirements for and problems of implementing TV stereo at the production stage. It also produced some quotes worth remembering.

Notable quotes

- *Don McCroskey:*

"Broadcasting is a 24-hour-a-day business using program material from a tremendous number of sources. This fact separates broadcasting from the recording industry and the film industry."

- *Tom Holman:*

"Stereo TV will definitely raise the cost of motion picture production because movie theater stereo and broadcast stereo are two different things. Stereo TV will likely wind up as a kind of hybrid, somewhere between mono and full, elaborate motion picture stereo. Given the financial restraints of the industry, this situation is the best we can hope for."

- *Paul Sehenuk:*

"Cost is a real concern for getting stereo TV programs onto the screen. We currently spend a day or two dubbing a show for the air, and that is usually all the time we have. If the industry wants to produce optimum stereo, we may have to extend the dubbing period as many as three extra days. That's more than we would have normally spent in the first place!"

- *Shawn Murphy:*

"I think we all agree that synthesizing stereo from monophonic material is not the best thing to do. It is, however, a necessity in our business at this time. If you are going to synthesize stereo, do not exaggerate the stereo effect to the point that it is obvious or disconcerting. In time, the TV industry will become like FM radio, where everything is aired in stereo, and it is unique when material is not 2-channel."

- *Ron Estes:*

"I think the worst that ever happened to TV audio is when the audio-follow-video system was instituted and the audio operator was eliminated. There is no device that can do what the human ear does."

"We're putting out 50 kw of AM Stereo and we've never sounded better."

Morris Blum
President and General Manager,
WANN Radio, Annapolis, Maryland

"As anyone who's been in this business a long time knows—if you don't move ahead, you're left behind.

"We've just upgraded WANN to a 50,000 watt, four-tower directional array. We now reach a potential market of six million people.

"That—along with a new urban contemporary sound—means that WANN is moving ahead, planning for the future . . . and sounding better than ever.

"And Of Course, We're In Stereo"

"AM Stereo is the most phenomenal sound I've heard in 40 years of owning this station.

"We sound absolutely great in stereo—a purer, cleaner high-quality signal. We even sound better in Mono.

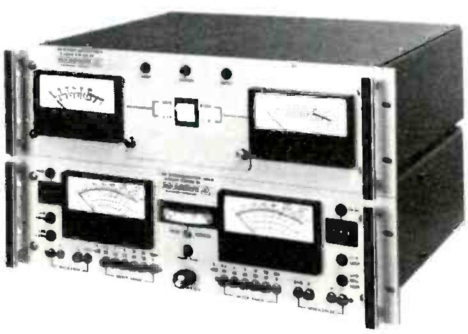
"And you can be sure AM stereo receivers are coming. By next year, over 30% of all new cars will have AM Stereo. And we're ready to capture those listeners *right now.*

"Naturally, I Chose Delta Electronics"

"When I decided to upgrade to AM Stereo, I chose Delta Electronics. Why? Because Delta's been around a long time, providing precision equipment to the broadcast industry long before they came into AM Stereo. They know my business and they know what they're doing. They installed my C-QUAM® stereo system without a hitch.

"And Delta's C-QUAM system is rugged and reliable, built to work the way it should. Literally trouble-free. Plus, it's got the numbers to back it up: over 65 systems operating in the U.S. and worldwide.

"Even better, Delta stands behind it with full technical and service support. Any problems or questions—I just pick up the phone. They're always ready to help.



Delta's C-QUAM Stereo System: ASE-1 Exciter (top) and ASM-1 Modulation Monitor. FCC laboratory tested and type-accepted.

"Next Time You're In Annapolis . . ."

"Stop by and I'll personally give you the deluxe station tour.

"Better yet, turn your dial to 1190 and hear for yourself the new sound of AM Stereo—and hear where your listeners are going to be."

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DELTA ELECTRONICS

State of the industry

By Rhonda L. Wickham, managing editor

How does your budget compare? Are you keeping up with colleagues who have similar budgets?

"It was the best of times, it was the worst of times, it was an age of wisdom, it was an age of foolishness..."

When Charles Dickens wrote these famous lines in "A Tale of Two Cities," he was speaking of another time and place. However, if he lived today as a broadcast engineer, he might use the same words to describe various segments of the broadcast industry.

In many regards, the broadcast industry is experiencing the "best of times." Broadcast engineers are witnessing the growth potential and technological advancements predicted for many years. The technologies once dreamed about are becoming realities in the expansion of satellite networks and distribution capabilities; in the evolution of digital equipment, pushing to higher definition and faster transmission; in the emerging role of the computer and progress of compact discs and laser optic recording. As this list of achievements grows, so does the actualization of these technologies through placement within broadcast stations.

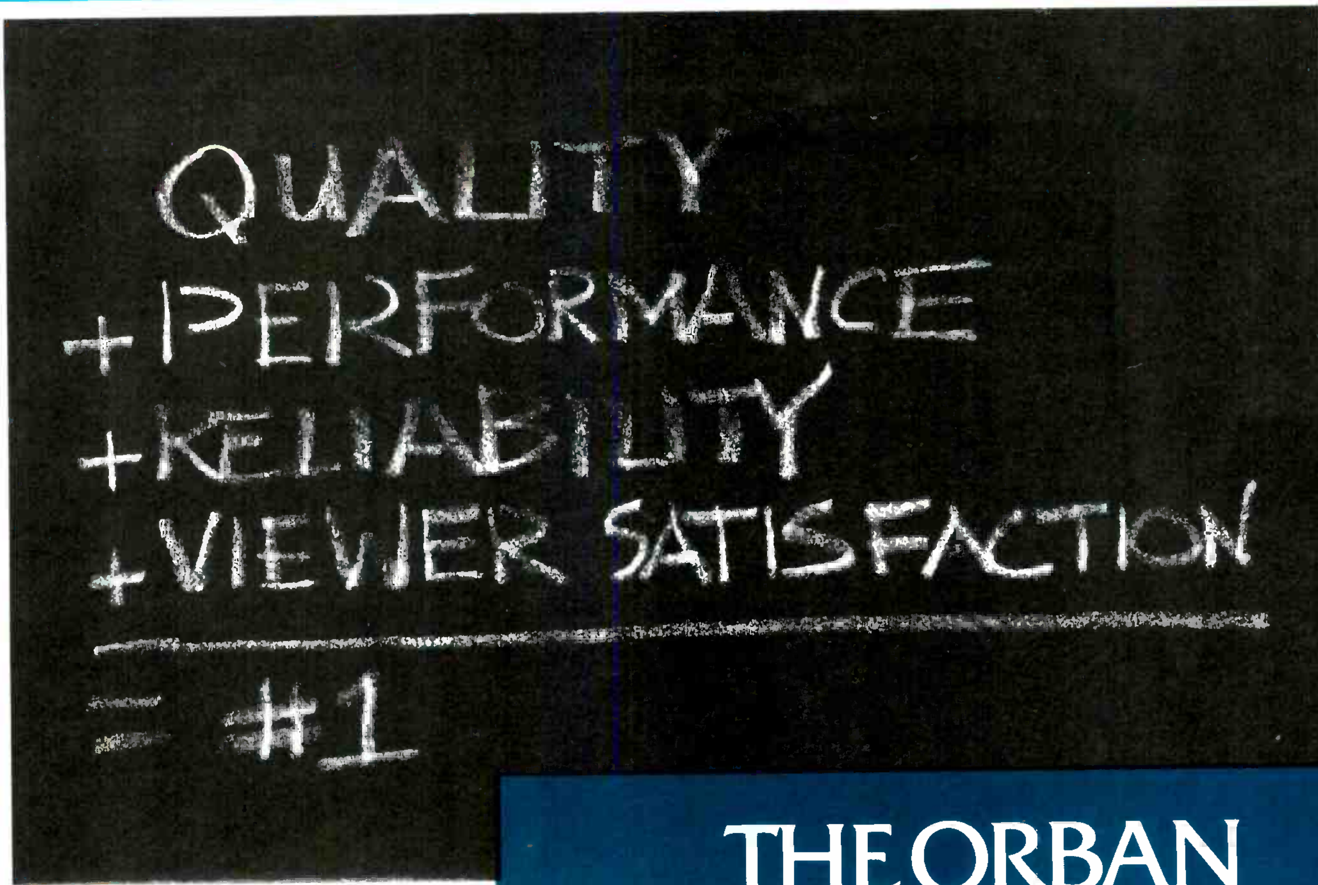
Perhaps pronouncing the sentence of "the worst of times" on our industry today is a little harsh. Although the problems and inadequacies that some are experiencing are not easily or quickly reckoned with, there are solutions. Nevertheless, there are those of us who are concerned about the future of AM stereo, those of us who are being adversely affected by the lack of definitive technical standards, and on a scale closer to home, those of us who are worried about the imposing threat of going off the air because the transmission equipment is not properly maintained.

Although "I wish we had more money to work with" and "If we could replace some of this equipment, we would be more competitive" are common appeals, the underlying current is positive, characterized by a longing to resolve all the concerns and solve all the problems.

Table 1. *The TV and radio percentages for upgrading facilities and planning studio improvements.*

	ALL MARKETS	TELEVISION				RADIO			
	Total %	TV %	Top 50 %	Top 100 %	Below Top 100 %	Radio %	Top 50 %	Top 100 %	Below Top 100 %
Considering Upgrading Facilities	**82.7***	**86.7***	**88.0***	**86.1***	**84.0***	**77.3***	**75.6***	**77.9***	**78.6***
Areas									
Production	50.8	51.8	55.8	52.8	40.0	49.4	56.3	48.5	43.4
Master control	42.2	48.2	49.4	50.9	42.0	33.9	34.1	30.9	35.2
Transmitter	37.7	32.8	30.3	30.6	42.0	44.3	46.7	45.6	41.4
Editing suites	27.2	44.0	53.2	35.2	29.0	4.3	5.9	4.4	2.8
ENG/RENG production	25.8	38.3	42.7	36.1	29.0	8.6	7.4	11.8	8.3
Antenna system	23.2	15.2	15.0	15.7	15.0	34.2	34.1	35.3	33.8
Remote controls	21.9	20.2	22.1	15.7	20.0	24.1	28.1	25.0	20.0
Planning Studio Improvements	**52.6**	**51.6**	**54.7**	**61.1**	**43.0**	**54.0**	**53.3**	**60.3**	**51.7**
Redesigning studios	28.9	28.0	27.7	28.7	28.0	30.2	31.1	33.8	27.6
Expanding studio space	19.2	19.4	21.7	23.1	9.0	19.0	19.3	16.2	20.0
Relocating to new facilities	16.9	15.6	19.1	9.3	13.0	18.7	15.6	23.5	19.3
Base =	823	475	267	108	100	348	135	68	145

*Adds to more than total due to multiple responses



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The Orban TV Stereo Equation: Quality + Performance + Reliability + Viewer Satisfaction = The choice of the majority of stereo TV broadcasters.

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Table 2. New equipment expenditures for TV segment in 1985.

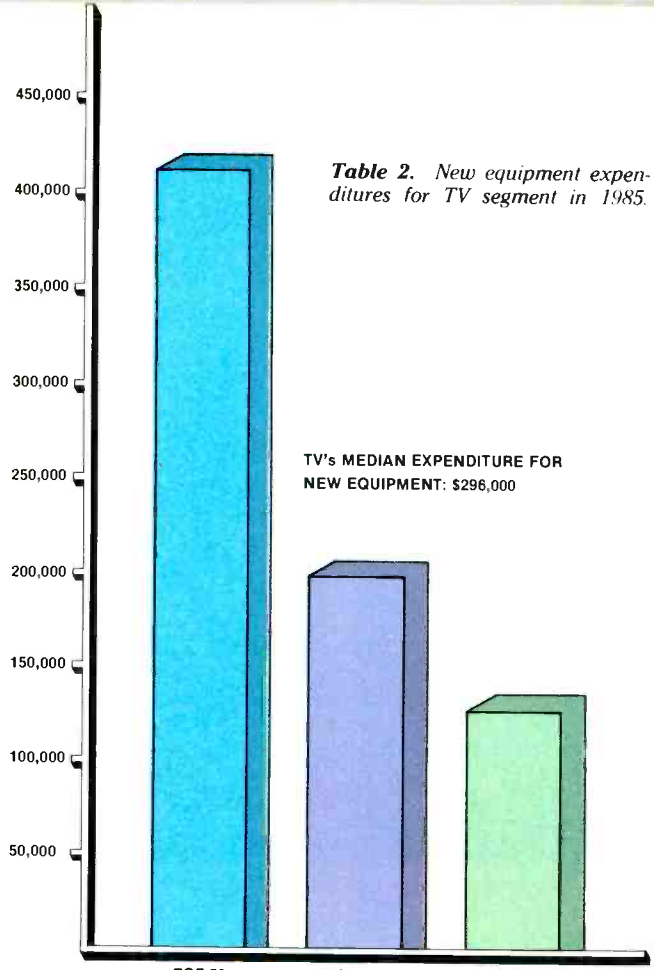
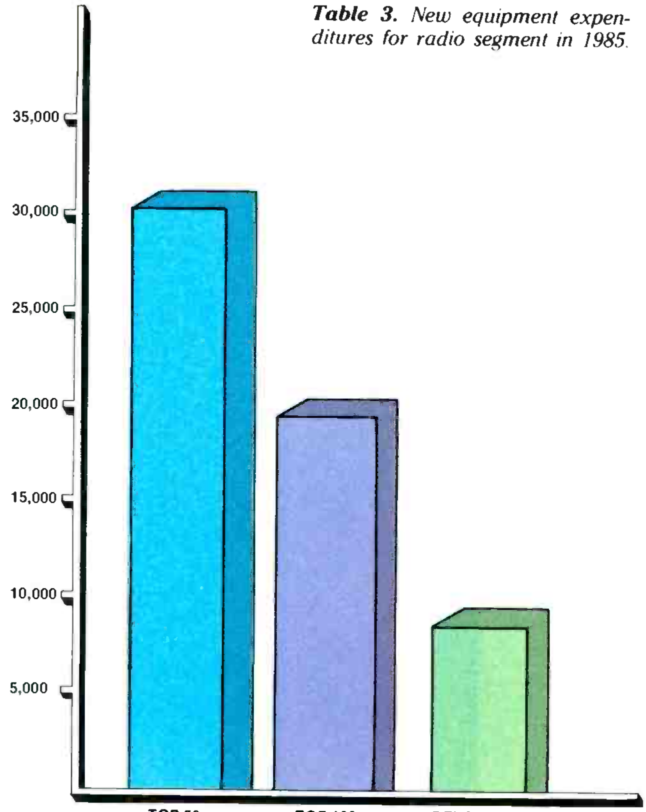


Table 3. New equipment expenditures for radio segment in 1985.



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Color temperature should normally be adjusted at both high and low light levels. Balance of the three primary colors should track at the "grey" levels in between. To facilitate "grey scale tracking," the PM5539 has a wide sensitivity range (1 to 300 NIT's full scale).

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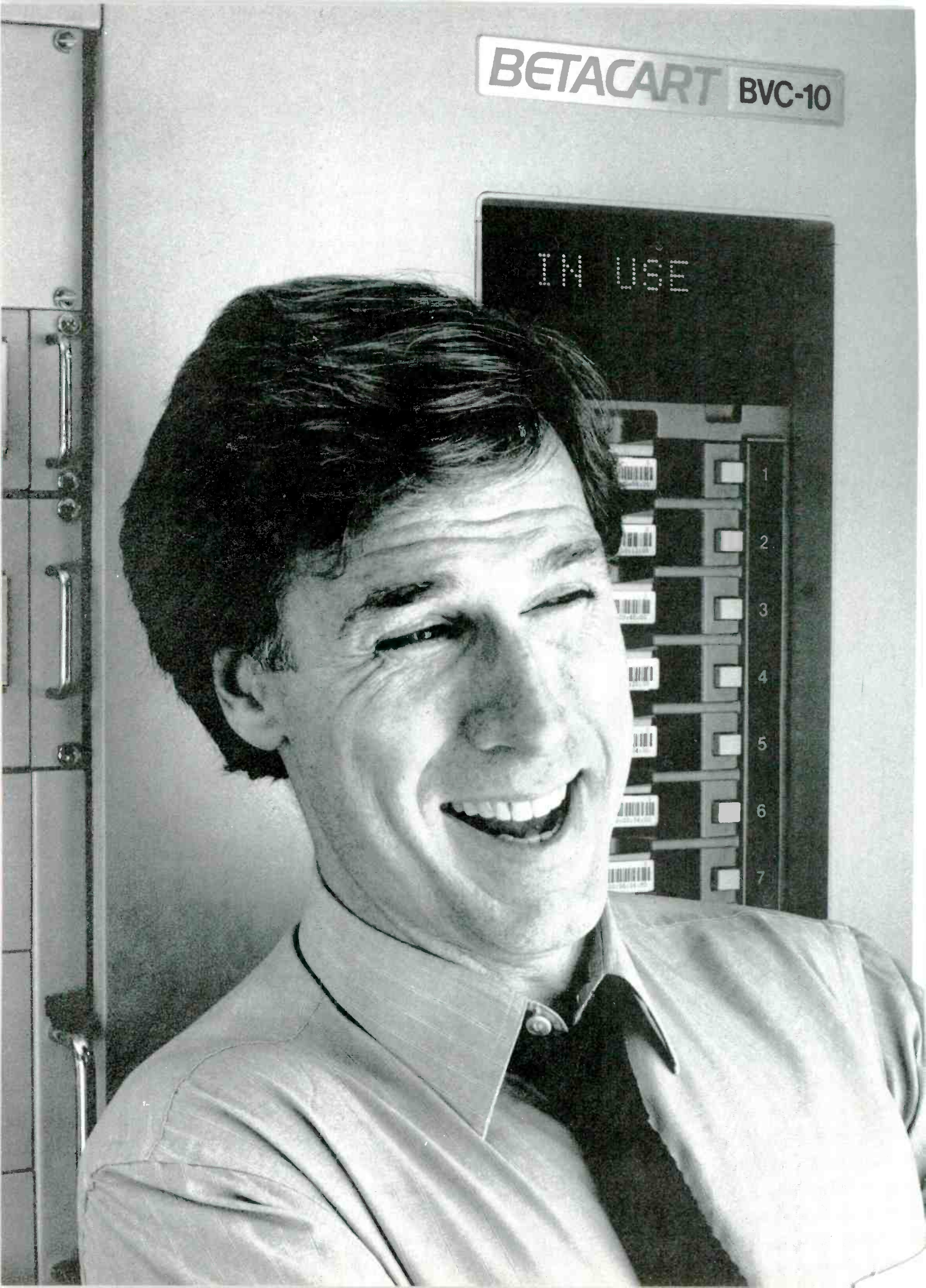
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No matter what the times are, the budget of the station is a given, and the broadcast engineer has to work with the available resources, no matter how limited. Old equipment workhorses continue to plod along. New equipment is meshed cost-effectively with existing equipment and standards. To this end, the broadcast engineer strives to breathe life into the airwaves.

With this in mind, we prepared our annual state of the industry survey to find out in more concrete terms what you, the broadcast engineer, face in your pursuit of the highest-quality signal. What are your budgets? Are you keeping pace with your colleagues who have the same resources to work with?

The results of our survey are broken down for radio and television, and then divided into the *top 50, top 100* and *below top 100* markets. This survey was scientifically conducted by the marketing research department of Intertec Publishing, under the direction of Kate Smith. On Aug. 20, 1985, 1,900 questionnaires were mailed to recipients of **BE** on an "nth name" basis. On Oct. 7, 1985, 823 completed forms had been returned, providing a response rate of 43.7%. The data contained in this report is based on these responses.

Upgrading facilities

In both the radio and TV segments, the majority of respondents indicated that they were considering facility facelifts: 82.7% for television and 77.3% for radio. Most of the plans included production and master control improvements, transmitter modifications and editing suite updates. (See Table 1.)

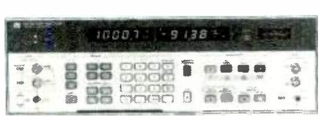
ENG/RENG production, surprisingly, was ranked lower as an area being considered for upgrading. Despite all the product introductions boasting smaller size, lighter weight and improved performance, it seems as though many facilities are taking a wait-and-see attitude toward spending additional money on field production. Their focus remains inside the station or facility and on assembling and transmitting the best possible signal.

Studio improvements

The median age of most TV studios is 14.2 years, with more than half of the top 50 market studios being at least 15 years old. In light of the available budgets of the top 50 market stations, we find these numbers surprising. The radio studios tell a slightly different story. The median age is 9.2 years, with more than half of the studios less than 10 years of age.

What are the lowest-priced audio analyzers doing in a Hewlett-Packard ad?

Hewlett-Packard? That's quality. Performance. Top of the line.



True. But it's also a fact that HP programmable audio analyzers cost less than any others on the market. At $5800* they do more, too. They carry out full frequency range testing. Fast. Tests that used to take hours now take you minutes. Just push a button, and the analyzer measures both distortion and frequency.

The HP 8903B packs a lot of instruments in one low-cost box. Besides the analyzer, there's a source, an ac/dc voltmeter, a frequency counter, signal-to-noise meter and a sweeper.

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	ALL MARKETS	TELEVISION				RADIO			
	Total %	TV %	Top 50 %	Top 100 %	Below Top 100 %	Radio %	Top 50 %	Top 100 %	Below Top 100 %
Budget for Convention/Show Attendance	56.7	68.2	70.8	63.9	66.0	41.1	51.9	42.6	30.3
Shows									
NAB	53.9	66.7	70.8	62.0	61.0	36.5	49.6	33.8	25.5
SMPTE	14.5	24.2	33.7	14.8	9.0	1.1	1.5	1.5	0.7
WOSU	5.6	4.4	2.2	6.5	8.0	7.2	8.1	11.8	4.1
AES	3.6	4.4	7.9	.....	.....	2.6	3.0	4.4	1.4
NRBA	2.9	1.9	2.2	0.9	2.0	4.3	5.9	4.4	2.8
IBC	1.1	1.9	3.4	.....	.....	.....	.....	.....	.....
Montreux	0.7	1.3	2.2	.....	.....	.....	.....	.....	.....
Budgeted for Training Seminars/ Programs in 1985 and 1986	42.0	57.3	62.2	57.4	44.0	21.3	26.7	25.0	14.5
Base =	823	475	267	108	100	348	135	68	145

***Table 4.** Show and seminar budgets.*

Faced with facilities designed and built long before the age of the digital studio, a majority of respondents indicated that they were planning on improving their studios. These improvements include redesign, expansion of existing space and even relocation to new facilities.

TV budgets

To no one's surprise, the pockets in television run deep. The median TV facility new equipment budget was estimated to be approximately $296,000 for 1985. Stations in the top 50 markets indicated that approximately $420,000 was spent on new equipment during the year. The top 100 and below top 100 markets came in with $204,000 and $132,000, respectively. (See Table 2.)

The budgets for 1986 are consistent with those of 1985. Approximately 45% of the respondents indicated that their budgets would be about the same, while 25% expected more money to be allocated for new equipment.

Radio budgets

Not surprisingly, the pockets in radio do not run as deep as they do in television. The average expenditure for new equipment at radio stations in 1985 was approximately $16,400. The breakdown of expenditures by the various market segments is particularly revealing. In the top 50 markets, $30,250 was spent on new equipment; in the top 100 markets, $20,000; and in the below top 100 markets, the median value was just $9,700. (See Table 3.) In many instances, the latter value would only be sufficient for the purchase of one new piece of test equipment or two or three cart machines.

Maintenance

Another surprise came in the area of maintenance. Although some budgets for new equipment seem rather restrictive, the majority of radio and TV facilities profiled indicated that they were content with the maintenance allocations for their stations. There are no median expenditure results to report because the maintenance needs vary dramatically from station to station.

Consulting services

Engineering consulting services are used by a healthy segment of the industry, according to the statistics provided by our questionnaire. In the TV segment, 48.6% of the respondents indicated that they used an outside consulting service. An average of 60% of radio stations used such a service. This difference can be explained by two reasons. First, the number of seminars and hands-on technical sessions available to video and TV personnel usually exceeds those available to radio engineers. In response, some stations rely on an outside consultant to advise them of technical requirements and standards. Second, radio stations—particularly AM stations—traditionally rely on consultants for antenna adjustment and pattern work. The complexity of directional antenna design and maintenance usually requires an engineer with specialized training.

Shows and seminars

The broadcast industry hosts a wide-ranging number of trade shows and conventions throughout the year. These include exhibitions and technical seminars sponsored by NAB, SMPTE, AES, WOSU, NRBA, SBE, IBC and Montreux. These shows provide a forum for broadcast engineers and other station personnel to step out of their day-to-day work and see new equipment, witness new and developing technologies and learn new methodologies to take back to their own stations.

Over the past five years, NAB, SMPTE and AES have experienced marked growth. The show's exhibitors have increased by 10% each year and the number of attendees has increased by at least 20%. This is reflected in the budgets of radio and TV stations. More than 65% of TV stations budgeted for attending the annual NAB convention and exhibition. SMPTE was the second-highest show budgeted for. Other shows for consideration were WOSU and AES.

More than 41% of radio engineers budgeted for attending trade shows. The major convention, as in television, was the NAB. An interesting result of the survey was that WOSU came in ahead of NRBA and AES for consideration for show attendance.

Training seminars and programs also rate for budget consideration, more so in television than in radio. More than 50% of TV stations have seminars slated for attendance in the coming year. Only about 20% of radio personnel are budgeted to attend seminars. This reflects not so much the limited budgets as it does the limited number of seminars and training sessions geared to radio personnel.

In an ideal sense, these may not be the best of times, but in a realistic sense, they are far from the worst of times for broadcast engineers. Facilities and stations are allocating the funds and investing in their equipment and personnel. They are improving studios and upgrading equipment. Although an unlimited budget is often dreamed of, it is the wise placement of limited funds that separates the intelligent from the foolhardy.

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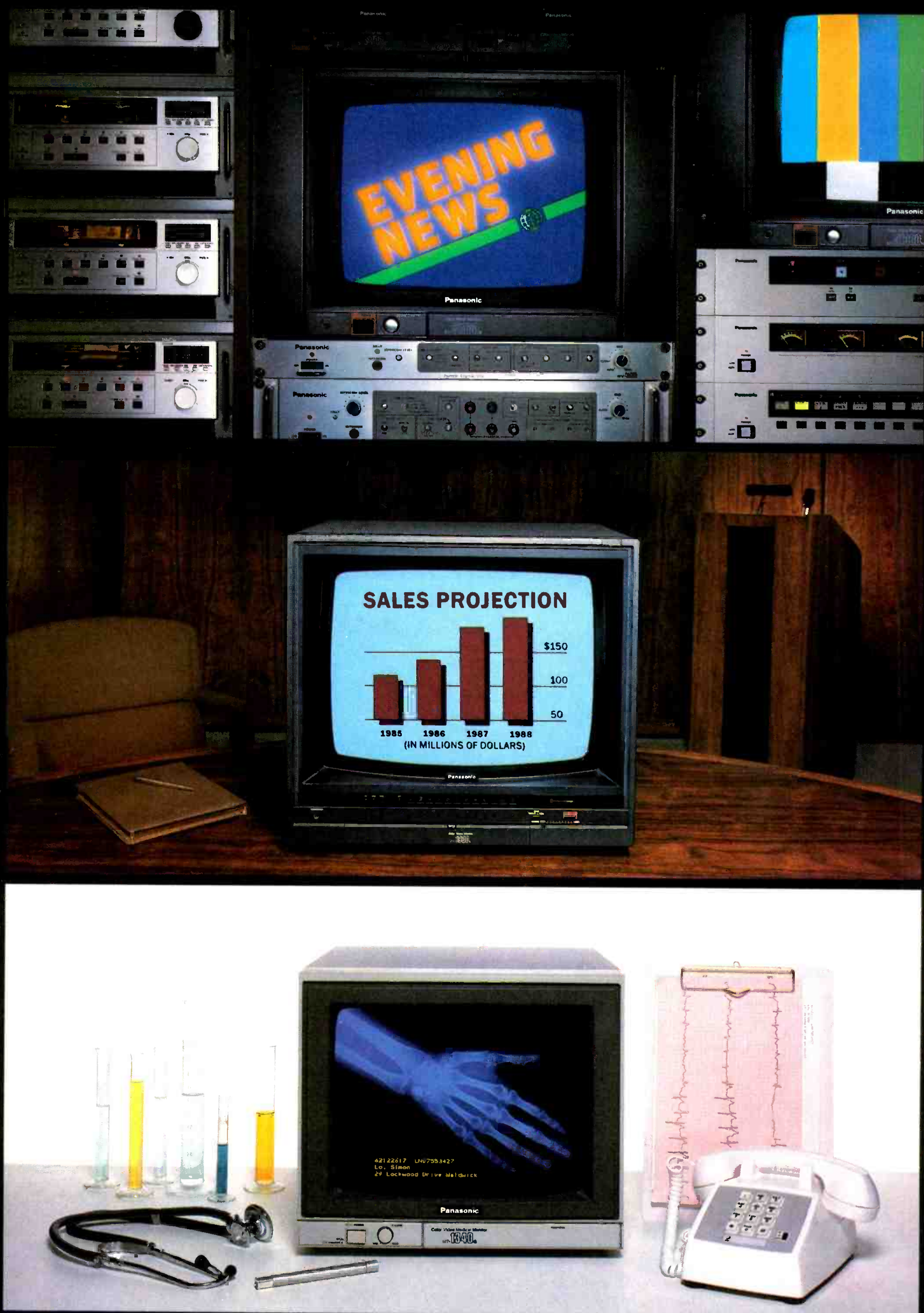
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Perhaps the most versatile of the BT Series are the 7" monitors. There's one that operates on both AC and DC so it's perfect for field use. Another model includes switchable line inputs, external sync terminals and is available as a single unit or in a dual rack.

Our CT monitors also come in a wide variety of configurations. You can choose from our 19" models. One comes with a tuner, and one can be used internationally because it lets you switch between NTSC, PAL and SECAM. The CT Series 13" and 14" monitors include models with a built-in tuner, NTSC composite and RGB inputs for use with computer graphics. And when light weight and portability are important, there's the CT Series 5" monitor receiver.

For medical use, the MT-1340G conforms to the UL-544 standard. Its Data Grade in-line picture tube provides the precise resolution medical applications require. While RGB inputs assure you of critically accurate color reproduction.

By now it should be clear, no matter what your special application, the monitors in the BT, CT and MT Series have the right qualifications. Monitor pictures simulated.

For more information, call your nearest Panasonic regional office. Northeast: (201) 348-7620. Midwest: (312) 981-4826. Southeast: (404) 925-6835. Southwest: (214) 257-0763. West: (714) 895-7200. Northwest: (206) 251-5209.

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New horizons for digital graphics

By Richard Taylor

If any single development has created a revolution in the broadcast industry, it would have to be electronic graphics.

The impact of digital graphics systems on the TV industry has been enormous, and the future holds promise for more and more developments. Above left, Joni Jacobson of Television Associates (Mountain View, CA) mixes a color on a paint system. Above right, an image she produced uses 3-D modeling.

The development of digital video techniques in the studio has brought about dramatic changes in the way TV programs are assembled and edited. But what will tomorrow bring? As we move closer to the all-digital studio, is there potential for another revolutionary concept in the near future?

The digital age

The digital video revolution began in the late 1960s with the development of high-speed analog-to-digital converters. Little did research workers of those early days know what they were starting.

The first digital machines to appear were time base correctors, followed by synchronizers. Both devices were essentially engineers' tools that made it possible to replace much more cumbersome techniques that were being used to ensure signal stability. At that time, it was thought that engineers would be the main beneficiaries from digital video, but the next development—the zoom machine—proved that the real advantages were to be for creative directors.

For the first time, directors and editors could change the size and position of the picture, either from a live feed or a VTR playback. A whole world of effects and transitions exploded from this simple (or not so simple) capability. Initially, pictures tumbled, spun, flipped, zoomed and slid all over the screen. When the novelty wore off, subtler and more creative techniques, such as those we see today, came into use.

Growing up

Digital effects in themselves have changed enormously in the past few years, with video image manipulation systems allowing the creative user to do almost anything. This represents a fascinating change in the forces that motivate equipment design.

At first, the engineering problems that could be solved by digital techniques were clear and the path for the development of machines was definable. The advent of the zoom machine, however, brought the creative operator into the picture and stimulated a dialogue between users and engineers. Discussions centered on what the machine might achieve, what features it should include and how it should behave. The video artist took the initiative and pushed hard for more and more features. The result was

Taylor is managing director of Quantel.

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Because your station's newsteam is probably struggling with a mixer that wasn't intended to handle the daily hassles of news production, there's lot's of compromises, lost opportunities and much aggravation. The result? Everybody suffers.

You're looking at a solution that will instantly change this dismal situation. We call it, simply—Newsmixer.™

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the addition of rotation and perspective effects to the artist's repertoire.

At this point, the design engineers stepped in to try to incorporate more freedom for the system user. They built a prototype and told the user, "Here's even more power than you asked for—try it." Naturally, the video user's appetite was not satiated for long. Taking the reins again, the artist demanded more real time control, and with that provision, achieved a myriad of effects and transitions far beyond the engineer's original conceptions.

Photos courtesy of Quantel

Bob Fisk, Varitel Video (San Francisco), uses an advanced effects system with Floating Viewpoint control to create smooth movement of video.

Digital graphics systems have changed the look of many of the programs we see on television, particularly news shows. For this graphic, the coin was scanned into the system via a TV camera, then artistically cut and pasted for the pie chart effect.

Stylus to pad

The goal of developing creative freedom for the user leads naturally to digital graphics systems based on the *paint system* concept. Prior to electronic art systems, graphic design departments with studios were rather the poor relation, often located away from the mainstream of the complex and sometimes buried in the bowels of the building. In production and facility houses, they barely existed.

The arrival of the all-electronic graphic design studio rocketed the designers to center stage and their influence in pro-

gram production increased accordingly. In production houses, the proliferation of artists and designers was unprecedented.

Productivity increased by a factor of at least five. What was fascinating and encouraging is that the pool of designers was being employed to meet the demand for top-quality graphics, which increased five times in proportion.

The impact of digital TV on graphic designers was to radically change their lives. Apart from this, it produced a fundamental and striking change in the on-air *look*. The sheer quality, quantity and detail of graphics today have increased dramatically, allowing the viewer greater understanding, heightening the visual impact and immediacy and presenting the opportunity to appreciate the creativity behind the images.

Ends or trends

Is the purpose of digital techniques simply to replace existing analog methods, or is it to break new ground? The answer is, of course, both. Synchronizers, still-stores and digital VTRs all replace existing methods, making system designers' jobs much more straightforward. At the same time, image-manipulation effects and graphics

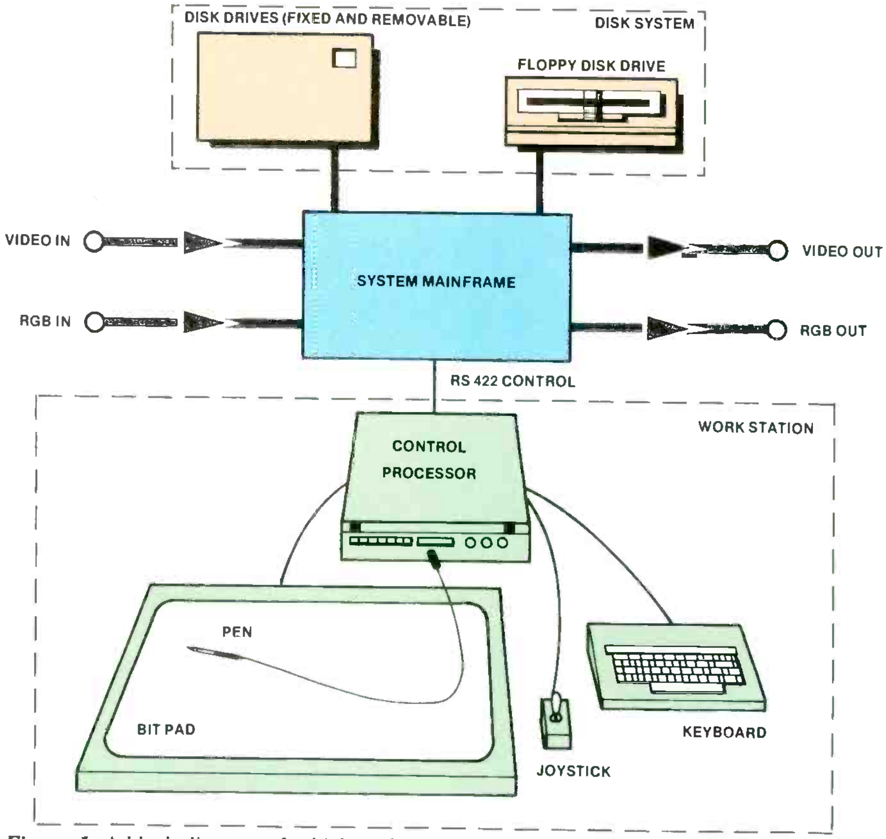

Figure 1. *A block diagram of a high-performance digital paint system.*

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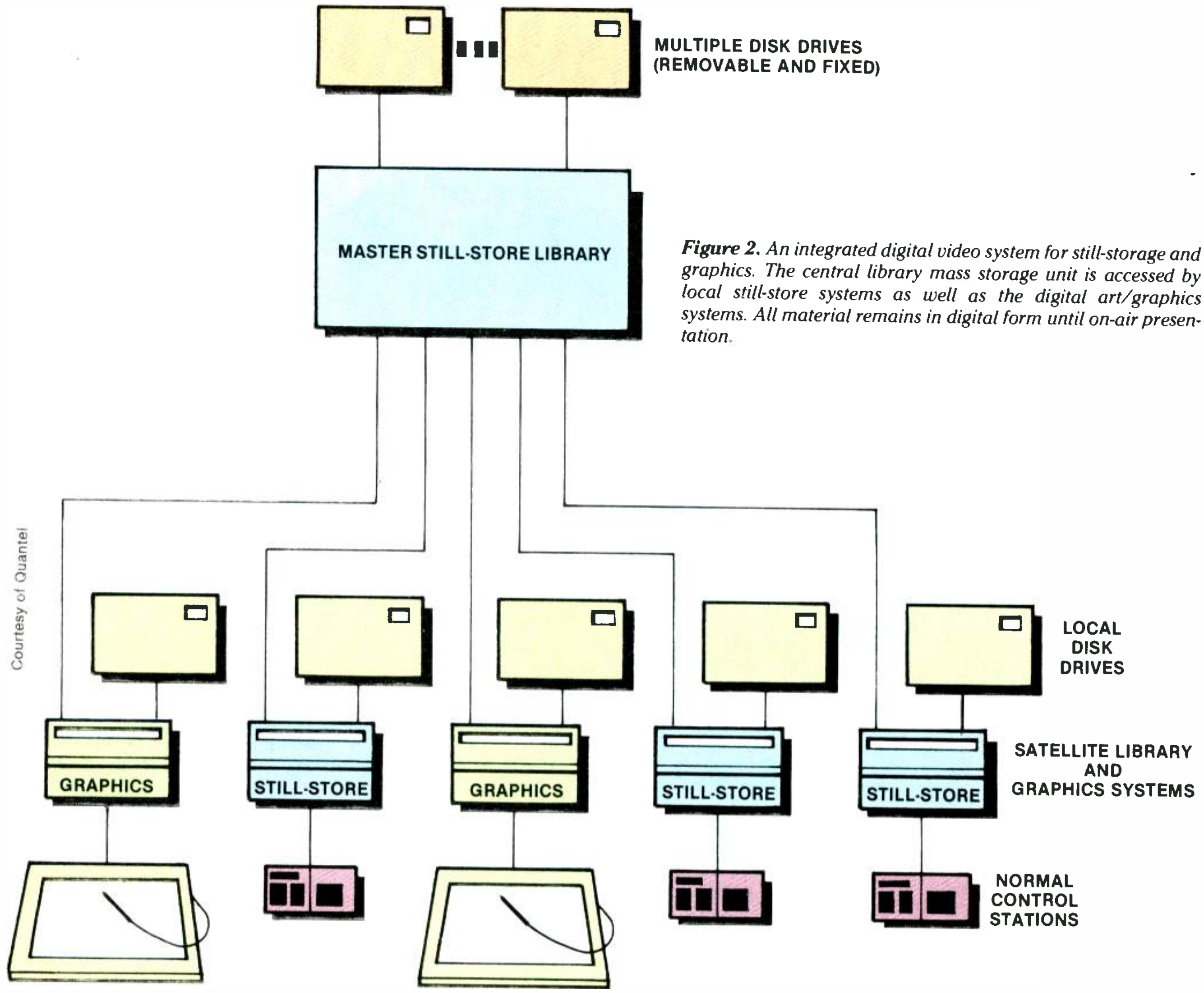

Figure 2. *An integrated digital video system for still-storage and graphics. The central library mass storage unit is accessed by local still-store systems as well as the digital art/graphics systems. All material remains in digital form until on-air presentation.*

devices continue to break new ground.

Undoubtedly, the digital processing of video brings higher quality to the signal chain through any studio. Or, more correctly, it *should* bring higher quality. Incorrect or truncated processing algorithms for interpolation can seriously degrade the picture.

From the engineer's point of view, the design of a graphics system falls roughly into two parts: first, the actual manipulation or handling of the picture and, second, the control mechanism. At first glance it would seem that handling would be the more formidable task. The truth is that, if the user is to be given true creative freedom, the control mechanism is usually more difficult than the video processing.

System designers may be tempted to merely provide more memory to achieve the added resolution for higher-resolution imaging. The speed of calculation, however, is also an essential factor to be considered. Designing a system to include more resolution at acceptable operating speeds may involve an entirely new topology. Fortunately for TV products, the computer industry has forged ahead to develop 32-, 64- and even 128-bit-wide processing circuitry to accommodate advanced video products.

The next step

Now, as the first machines conforming to the agreed digital standard are beginning to appear, it is appropriate to question what the future holds.

The temptation is strong to make all of the elements of the digital studio look the same to the user as traditional analog elements. If we give in to the temptation, however, will we ever realize the power of digital technology to its fullest extent, particularly in the area of control?

Take a switcher, for example. From the knob-per-channel switchers at the birth of television came assignable switchers, mix effects amplifiers, keyers, rotary wipes and, of course, digital effects. Desks have grown in size to the point that special long-armed TDs need to be bred!

The digital switcher could take the form of digital electronics underneath a conventional desk, or it could be radically different. The proposition is that it should be radically different.

The same argument applies to editing. Videotape recorder facilities and the sophistication of computer-assisted editors are amazing technological feats. A digital edit suite could take the form of digital VTRs being controlled by a conventional computer editor, or it could be something radically different. Again, the proposition is that it should be radically different.

A change in the edit suite could be every bit as great as the change brought about by electronic graphic equipment.

Suppose the technical director sits at a table and composes edits and transitions in a manner more akin to movieola-style film animation than to conventional computer editing. The edits are related to the pictures themselves, rather than to time code. The source of the director's images is no longer videotape, but rather, live random-access frame storage.

Perhaps this is a flight of fancy, but perhaps it is not. Precursors of tomorrow's digital studio exist today, from video graphics creation to video and audio processing, recording and editing. Certainly, there also exist the creative minds that will take us beyond today's dreams.

Changing the FCC rules

By Robert D. Greenberg

The FM broadcast band is undergoing a major facelift.

The FCC has recently enacted several rule changes that affect FM broadcasters in a number of ways. One of these changes, Docket 80-90, allocates almost 700 new channels to communities throughout the United States. In a related docket, a procedure for applying for these allocations and other allocations is described. This docket also developed the first-come, first-served approach to license allocation.

Other changes are strictly technical in nature. One of the technical changes resulted from a compromise agreement among broadcasters rather than the FCC. Another technical change requires that stations allocate financial resources to resolving complaints about interference. For the first time, stations are now being held accountable for their station's signal interfering with the reception of other radio and TV signals.

Greenberg is an engineer with the Federal Communications Commission.

FM blanketing

One new regulation that may affect stations is the FCC's rule on FM blanketing interference. Blanketing is defined as interference to the reception of other broadcast stations by an FM broadcast signal of 115dBu or greater signal strength in the area adjacent to the antenna of the transmitting station. The new rule on FM blanketing outlines the station's responsibility for satisfying complaints about blanketing for locations within this defined area. The ruling also encourages broadcasters to carefully consider the potential problems with blanketing when selecting a transmitter location.

The distance to the 115dBu blanketing contour is determined by the following equation:

$$D\ (\text{miles}) = 0.245\sqrt{P}$$
$$D\ (\text{meters}) = 0.349\sqrt{P}$$

Where: P = power in kilowatts

New stations are required to satisfy all complaints of blanketing interference for a period of one year without cost to the complainant. This means that the station assumes full financial responsibility for

Table 1. The chart below lists some of the important technical differences between educational and commercial FM stations.

FM BAND – TWO BROADCAST SERVICES
FM SPECTRUM

88.1MHZ TO 91.9MHZ	92.1MHZ 107.9MHZ
20 CHANNELS	80 CHANNELS
CH. 201 TO CH. 220	CH. 221 .... CH. 300

	EDUCATIONAL	COMMERCIAL
NUMBER OF LICENSEES	1,500 LICENSEES	3,500 LICENSEES
APPLICABLE FCC RULES	SUBPART C	SUBPART B
HOW THE TWO PARTS OF THE FM BAND ARE DIVIDED	RESERVED FOR NCE USERS ONLY	MAY BE USED BY BOTH NCE AND COMMERCIAL STATIONS (NON-RESERVED)
STATION TECHNICAL CRITERIA	USE OF THE NCE BAND IS GOVERNED BY CASE-BY-CASE NON-INTERFERENCE ENGINEERING CRITERIA	SIX CLASSES, A, B1, B, C2, C1, C WITH VARIABLE ERP AND HAAT LIMITS
HOW ALLOCATIONS ARE MADE	ADVANCE RULEMAKING IS NOT REQUIRED	USE OF THE COMMERCIAL BAND IS GOVERNED BY AN FM TABLE OF ALLOTMENTS. CHANGE VIA RULEMAKING PROCEEDING

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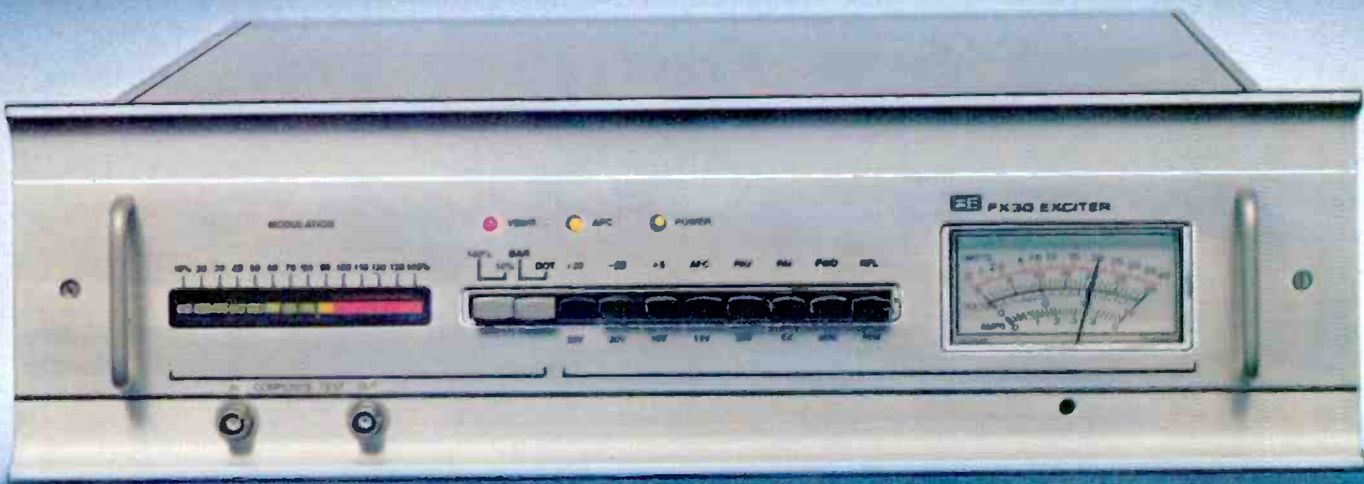

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Queue
A list or line of applicants based on the date received by the FCC. If you lose your place in the queue, you have to go back to the beginning and start over.

Tenderability
This is the point where the commission looks for completeness and consistency. It is the first stage of the review process.

Acceptability
At this point, the commission will look for compliance with the technical rules. Action on some waiver requests takes place here.

Grantability
This is the last stage of the review process. The commission will look for compliance with the legal rules.

Table 2. *There are certain new terms that engineers should be familiar with if they hope to submit successful applications. The terms listed above are now standard with the FCC.*

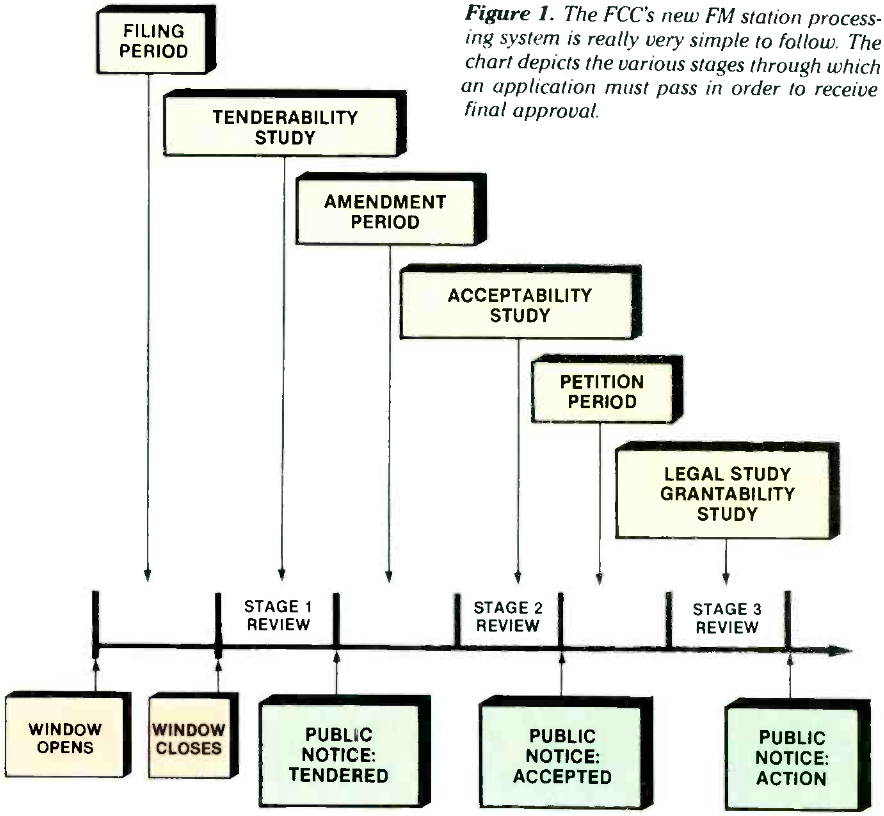

Figure 1. *The FCC's new FM station processing system is really very simple to follow. The chart depicts the various stages through which an application must pass in order to receive final approval.*

rectifying all of these complaints within the 1-year period. This requirement does not include malfunctioning or mistuned receivers, improperly installed antenna systems or the use of high gain antennas. Antenna booster amplifiers and non-RF devices, such as tape recorders and hi-fi amplifiers, are also exempt from this protection.

Persons located outside the blanketing area are not provided with this same protection. However, stations are expected to cooperate with these complainants by providing technical assistance in determining the cause of the problems and providing advice on corrective measures. However, the stations have no obligation to resolve these problems.

In an effort to prevent future FM blanketing problems, the FCC encourages stations to carefully choose their transmitter sites. The FCC suggests that stations balance the need to provide the requisite signal to the city of license while minimizing blanketing interference. You may recall that the old regulations called for the transmitter to be as near to the center of the city as possible. Under these new rules, the transmitter site would ideally be located

Table 3. *Items of an application that can result in rejection during the third-stage review.*

1. The proposal does not provide a signal of 70dBu (3.16mV/m) or better over the entire principal community of license pursuant to 47 C.F.R. Section 73.315(a).
2. The proposed site is short-spaced to authorized facilities, reference coordinates of allotments to Section 73.202, and/or protected pre-filed applications pursuant to 47 C.F.R. Section 73.207.
3. The application does not meet minimum or maximum power and antenna height requirements under 47 C.F.R. Section 73.211.
4. There are inconsistencies between the geographic coordinates shown in Section V-B of Form 301 and the site plotted on the topographic map. It should be noted that the geographic coordinates must be correct to the nearest second.
5. The specified antenna site ground elevation does not agree with the value found on the site map.
6. The values in the Tabulation of Terrain Data shown in item 15 of Section V-B of FCC Form 301, which include the appropriate antenna heights and distances to field strength contours, are not calculated in accordance with 47 C.F.R. Section 73.313. If major discrepancies are found in the heights of antenna radiation center above average elevation of the radials of predicted distances to the 3.16mV/m and 1mV/m contours, the application will be returned as unacceptable for filing.
7. The proposed class, frequency, or community of license does not agree with the appropriate allotment.
8. The applicant does not have a reasonable assurance of antenna site availability.
9. The proposed directional antenna (if any) does not meet the requirements of 47 C.F.R. Section 73.316 and Section 73.213 of the rules.
10. The information incorporated by reference to another application cannot be used because:
    a. The applicant is not a party to the referenced application.
    b. The referenced application is not adequately identified.
    c. The information in the referenced application is not sufficient for the purpose of this application.
11. The applicant does not meet the U.S. citizenship requirements of Section 310 of the Communications Act of 1934.
12. The application is late-filed (i.e., filed after a "filled" window has been closed) or is filed before the applicable window is open.
13. The application is patently in violation of the international agreements contained in 47 C.F.R. Section 73.1650(b).

The above deficiencies are not all inclusive. Applications found to be defective for reasons not listed herein will be returned as not acceptable for filing.

in a sparsely populated area.

NCE-FM rule changes

The FCC has been looking into the problem of channel 6 interference from non-commercial educational (NCE) FM stations with an eye toward several possible solutions. One area for improvement could come from better-designed TV receivers. The commission noted that much of the channel 6 interference was caused by the inability of TV receivers to adequately reject adjacent channel signals. Even though the commission has the statutory authority to set receiver standards, it is reluctant to do so. Currently, the Electronic Industries Association/Consumer Electronics Group (EIA/CEG), with commission participation, is developing voluntary TV receiver standards to address the interference problem. The commission is looking for voluntary, as opposed to regulatory, compliance so that it can begin to relax the FM assignment criteria. As these new receiver designs enter the marketplace, much of the channel 6 interference should be eliminated.

Other technical changes have been proposed to help the channel 6 interference problem. One change would allow the use of vertical polarization powers in excess of that used for horizontal polarization. Other possible remedies include the use of receiver filters and the co-location of NCE-FM and channel 6 transmitters.

All of these proposals have effectively been adopted in the form of a compromise agreement jointly submitted by the Association of Maximum Service Telecasters, the National Association of Broadcasters, Taft Broadcasting Company, McGraw-Hill Broadcasting Company, Storer Broadcasting Company, Corporation for Public Broadcasting, National Public Radio and the National Federation of Community Broadcasters. The primary provisions of this compromise include:

- Power limitations for new NCE-FM stations are based on an equation such that the predicted interference occurs to no more than 3,000 TV-6 viewers.
- Increased NCE-FM power if remedies, such as vertical polarization, careful transmitter site placement or receiver filters, are used. In those situations where filters are the adopted method, the station is required to furnish a maximum of 2,000 units.
- Continued studies will take place on the interference problem. The studies will attempt to better define the extent of channel 6 interference and examine improvements in TV receivers as the ultimate solution.
- All current NCE-FM stations are grandfathered with provisions for future changes in facilities.

Docket 80-90

The most far-reaching FCC rule change centers on Docket 80-90. This docket made four basic changes in the FM allotment structure. Because of these changes, many stations are now required to either upgrade their facilities or be subject to reclassification (down-rating) to another (lower) class of station. The basic changes are as follows:

- Stations with Class A facilities can now operate on the 60 Class B and C channels.
- The number of station classes increases from three to six. The three new classes are B1, C1 and C2.
- Existing Class B and C stations are required to meet or exceed minimum facility requirements or be reclassified to the appropriate class.
- The commission's technical FM rules are converted to the metric system of units.

Let's look at what one of these new rules means for a typical Class C station. If that station has an antenna height above average terrain (HAAT) of 600 feet (or 183 meters) and an ERP of 80,000W, it will be down-rated to Class C1. Stations need to be concerned about this down-rating process because it affects the applicable mileage separation rules. In other words, if your station is down-rated from a C to a C1, you have a smaller protection area than before. The

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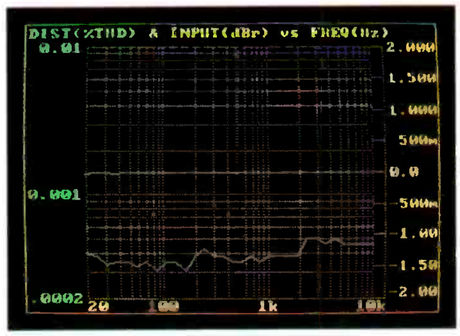

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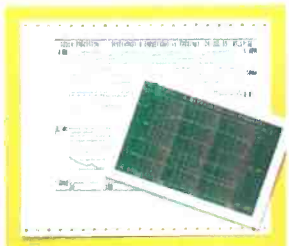

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*25mm format

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1:2.4 at 162mm

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Max. Relative Aperture: 1:1.7 through 91mm
1:2.2 at 112mm

same rules apply to a Class B station down-rated to B1 status.

In a related docket (Docket 84-231), the FCC amended the FM Table of Allotments by adding 689 new allotments to communities throughout the country. This was the FCC's first actual step toward implementing Docket 80-90. The commission released the first 80-90 channel (channel 243) by Public Notice dated Sept. 27, 1985. The window open date was Oct. 15, 1985, and the window close date was Nov. 15, 1985. The commission will periodically release public notices, announcing window open and close dates for the 80-90 channels.

First-come, first-served

In what has recently been viewed as the most controversial action by the commission, Docket Number 84-750 sets up new procedures for the filing of applications for allotments and licenses. The so-called first-come, first-served rule includes the following provisions:

- Procedures for filing applications for the 689 new allotments.
- Procedures for filing applications for the current 152 vacant allotments as well as future individual allotments generated by rulemakings.
- Procedures for modifying existing FM commercial facilities.
- Elimination of the A cut-off list procedures for commercial facilities, replacing it with a window/first-come, first-served processing system.

One important aspect of these new procedures is the up-front screening approach to processing applications. Under this new procedure, site availability certification and strict adherence to the multiple ownership rules will reduce speculative filings that frustrate both the commission and serious applicants.

The new policy allows the commission to summarily return any application not meeting all of the technical criteria on the first review. Some engineers have criticized this approach because it prevents applicants from correcting their applications, even if the FCC finds only a minor error. Once an application has been rejected, it can be refiled, but it will be considered as a new application. In other words, the refiled application will carry a date corresponding to when it reaches the FCC. The applicant's original place in the queue has been lost and cannot be retained. In those cases where licenses are decided on a first-come, first-served basis, you can see why it is crucial to have an error-free application.

1—ENVIRONMENTAL IMPACT
2—U.S. CITIZENSHIP
3—PUBLIC NOTICE
4—CHARACTER ISSUES
5—FINANCIAL ISSUES
6—EEO
7—MULTIPLE OWNERSHIP
8—PETITIONS TO DENY
9—MAIN STUDIO IN CITY OF LICENSE
10—SITE AVAILABILITY
11—FAA REQUIREMENTS
12—INTERNATIONAL REQUIREMENTS
13—WAIVER REQUESTS
14—INTERAGENCY REQUIREMENTS

Table 4. The acceptability study reviews the items shown here. This second-stage review covers the technical aspects of the application.

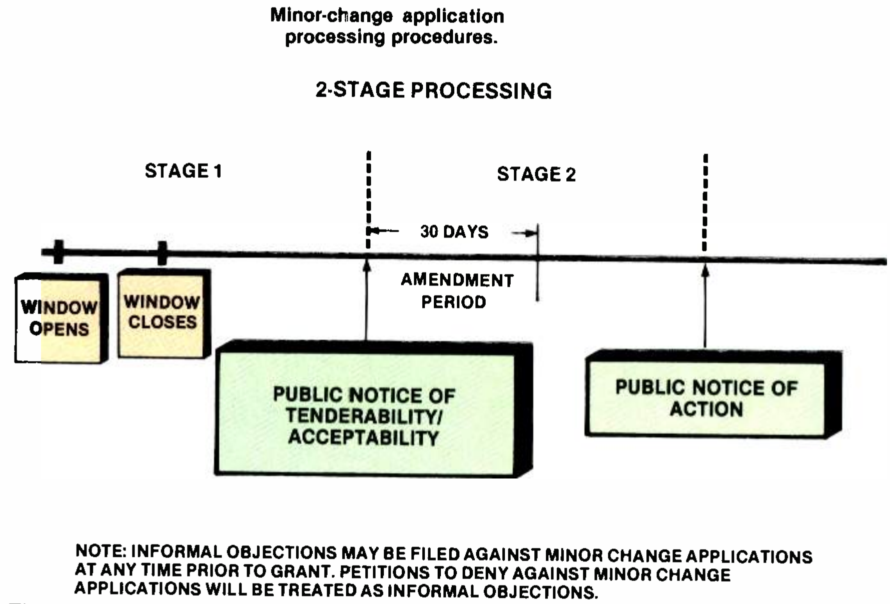


***Figure 2.** Minor change applications need to pass only through the 2-stage processing system.*

In order to understand these new procedures, there are a number of terms that you need to know. Table 2 lists these important terms and their definitions. You must become familiar with them if you want to be successful in filing any applications with the FCC.

3-stage review

Let's now turn to the actual processing procedure for new allocations and major change applications. The new FCC procedure consists of a 3-stage review processing system as shown in Figure 1.

The first stage is the tenderability study. In this stage, the application is examined for completeness and consistency. If the application is found tenderable, a public notice will be issued, triggering a 30-day amendment period. It is important to remember that this amendment period may *not* be used for tenderability purposes. You cannot modify anything in the application just to make it acceptable under the first examination process.

The second stage is the acceptability study. In this stage, the commission looks for compliance with the technical rules. If any requests for waivers have been made, they will be reviewed in this stage. If the application is found acceptable, a public notice will be released, triggering a 30-day petition-to-deny period. Table 3 lists some of the factors that can trigger a rejection at this stage of the review process.

The third stage is the grantability study. At this point, the commission will look for compliance with the legal rules. Table 4 lists some of the factors considered by the commission at this stage of the review process.

If your application clears this hurdle and you are the only applicant, your application will be granted and the public notice will be issued. If you are in a mutually exclusive situation, you will be designated for a comparative hearing, and the commission will issue a public notice announcing that action.

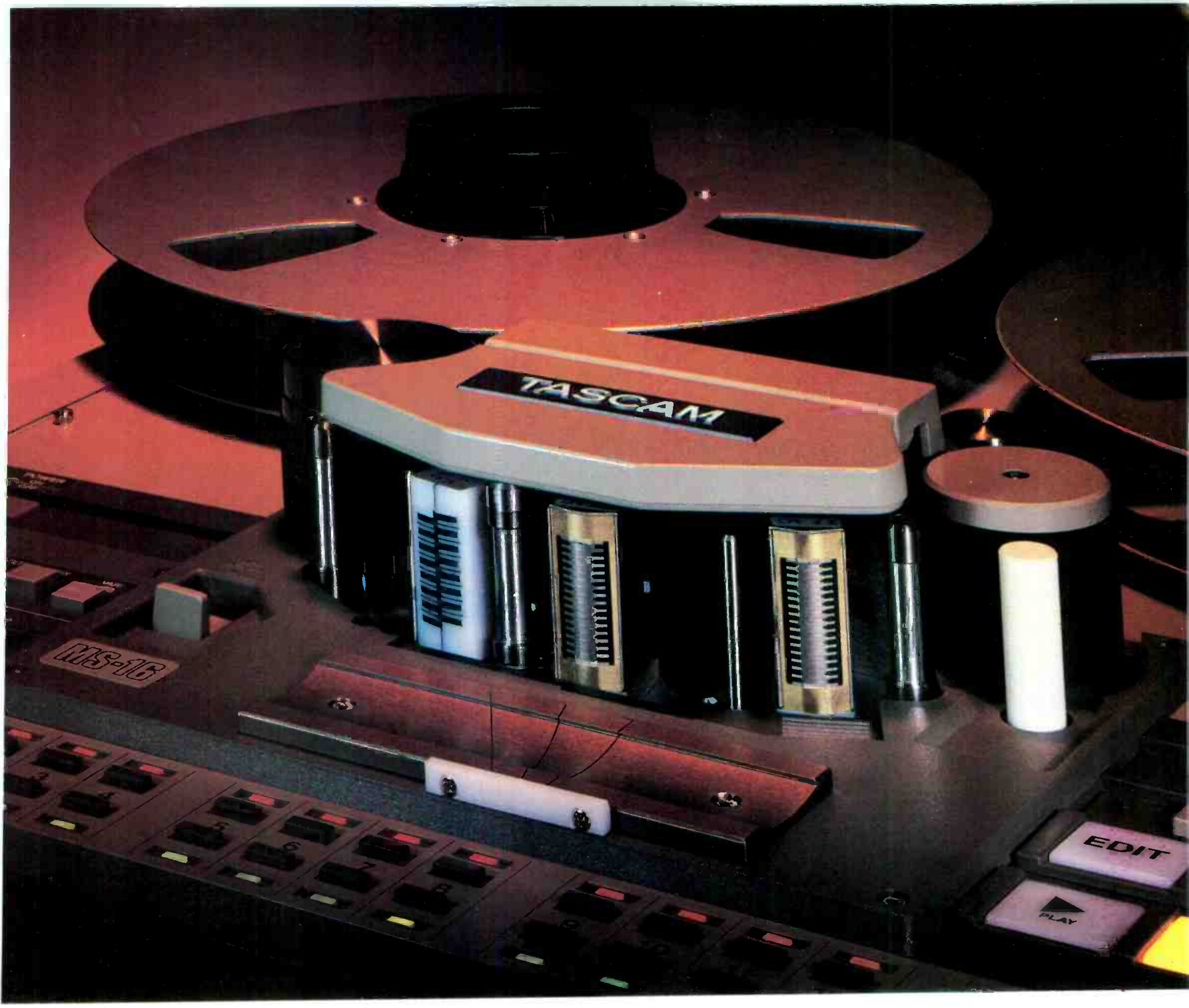
Minor changes

The new process for a minor change application consists of a 2-stage review. (See Figure 2.) The tenderability and acceptability studies will be completed at the same time. Upon completion, one public notice of tenderability/acceptability will be issued. If no amendments are required and no objections filed, the final public notice will be issued at the time your application is approved.

The key to success

The first and most important key to filing a successful application is to begin the work far in advance of the closing window date. Don't put off the work until the last minute. Second, look it over for accuracy and then look it over again. As another check, have someone not directly involved with the project go through the application. Sometimes, a newcomer can spot something that you have overlooked. Finally, file your application early in the window. Remember, in some cases, the difference between being granted the application and losing out is simply the date it was filed with the FCC.

Editor's note: The opinions expressed by the author are not necessarily those of the Federal Communications Commission.



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Circle (42) on Reply Card

The future of ITFS

By Carl Bentz, TV technical editor

Instructional Television Fixed Service, a service that has been slow in coming, may now be about ready to take off.

A number of problems have beset ITFS since it was established by the FCC in 1963. Although some engineers have said the letters are a code for *In The Future Sometime*, ITFS actually stands for Instructional Television Fixed Service. ITFS was originally developed to share the 2.5GHz to 2.69GHz spectrum with the Private Operational Fixed Service (POFS) and was restricted in use to educational organizations for educational purposes. However, this spectrum, which would have allowed for expanded educational TV (ETV) activity, presented technical problems at that time. And because of limited funding for ETV, equipment development was delayed.

It is easy to understand why many broadcast engineers in the '60s thought that ITFS was meant to be sometime in the future. However, eight years after its introduction, the FCC officially allocated 28 of 31 possible channels to ITFS. Three channels were retained for POFS use, but the door was opened for ITFS. By 1971, 127 systems operated 370 on-air channels, and by 1977, 175 licensees served 7.5 million students, ranging from preschool to post-graduate.

In 1982, the FCC was deluged with more than 250 applications, indicating a new interest in the service. Many applications requested rules waivers. A number of technical rule changes and a loss of eight channels to common carrier services resulted. However, the fact that ITFS was victorious over strictly commercial operations on the other 20 channels was heartening.

At receiving sites, equipment is simplified to a small antenna with a mast-mounted LNA/receiver. Power is inserted in the VHF RF cable leading to the viewer's set.

NNS debut

FCC rulemaking produced a number of changes that will be in effect when the PBS National Narrowcast Service (NNS) officially signs on-air in February. In a 15-week demonstration, NNS will augment educational efforts of PBS affiliate UHF and VHF transmissions in 21 cities. The 5-hour, 5-day-a-week schedule will carry college credit courses with continuing education, career training and professional development materials completing the fare.

In all, 375 hours of programming will be relayed to the 21 test markets via the PBS satellite interconnect for transmission to business and college subscribers via ITFS and addressable cable. Five live seminars are planned to feature interactive audio feedback. Subject areas for the programming will include first-line supervision; middle and executive level management; computer literacy and applications; effective communications; sales and marketing and basic skills development.

Initially, PBS, its affiliates and the Annenberg/Corporation for Public Broadcasting project will fund the programming. After the 15-week demonstration, however, NNS will be on its own, supported by subscriber, student enrollment and course license fees.

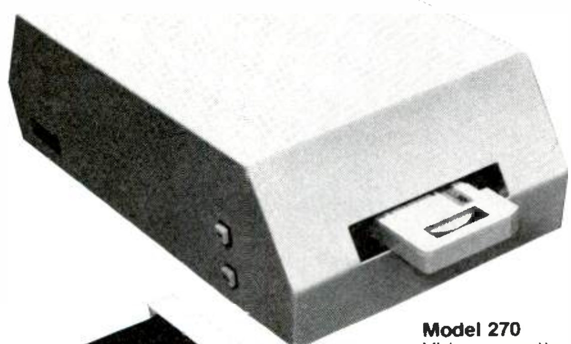
ITFS technicalities

An auxiliary to ETV, ITFS systems are licensed for educational and cultural development programming. The continuing education, in-service training and skills development material may be used by other organizations, such as hospitals, colleges and businesses. Receiving sites must be reported on the station license application.

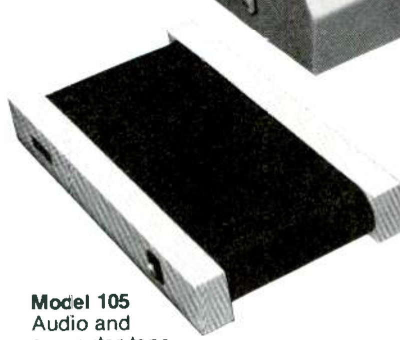
Continued on page 74

Wipe out recorded material

Model 1400
One-inch video tape eraser



Model 270
Video cassette tape eraser



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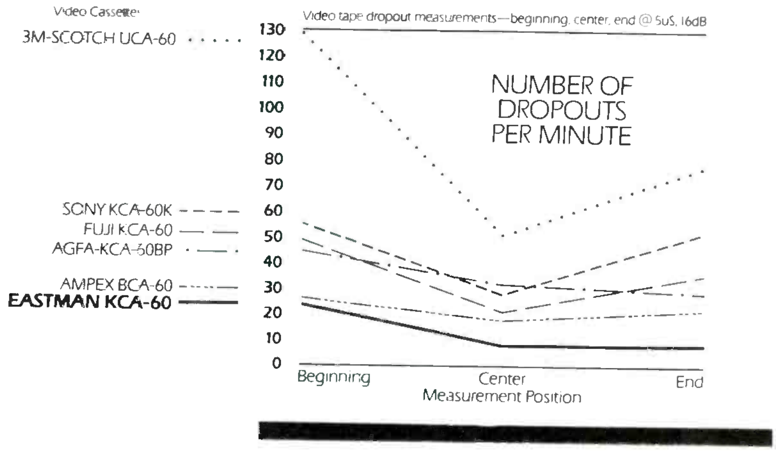
Video Cassette
3M-SCOTCH UCA-60
SONY KCA-60K
FUJI KCA-60
AGFA-KCA-60BP
AMPEX BCA-60
EASTMAN KCA-60
Video tape dropout measurements—beginning, center, end @ 5uS, 16dB
NUMBER OF DROPOUTS PER MINUTE
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Beginning
Center
End
Measurement Position


Scotch
UCA 60
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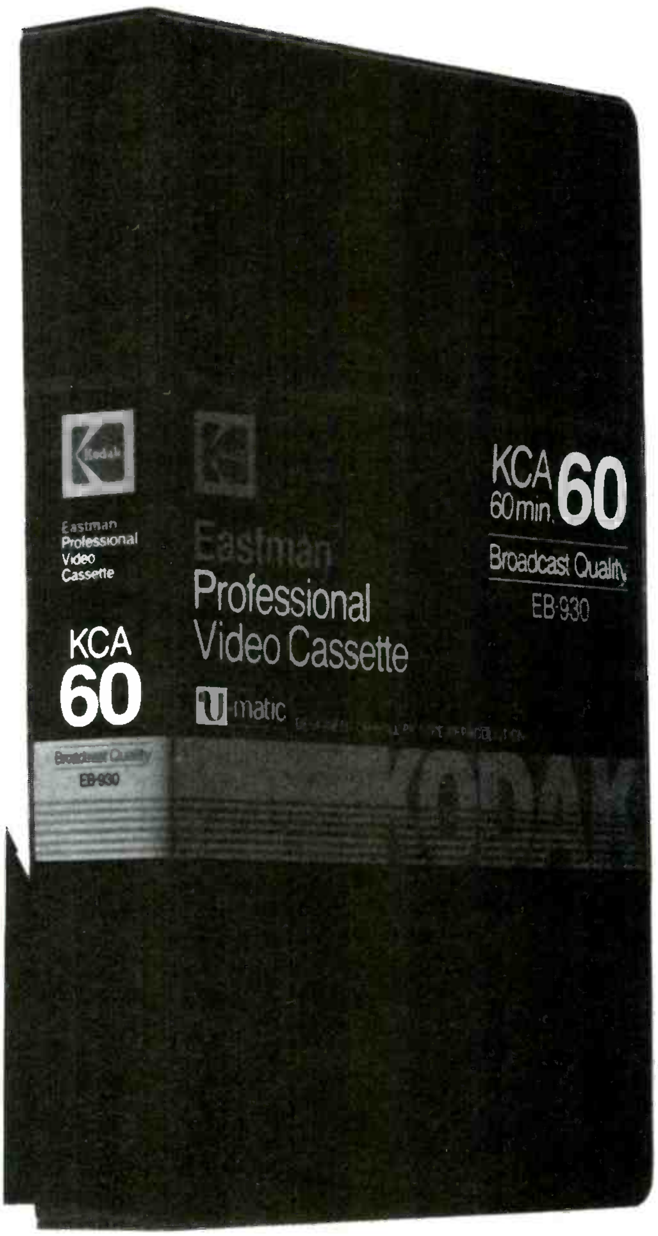

Six leading brands of ¾-inch broadcast-quality video cassettes were recently tested by an independent lab for a major video publication. When it came to dropouts, Eastman professional video cassettes outperformed every other tape tested. For a reprint of the published test results, write to Eastman Kodak Company, Dept A-3061, 343 State Street, Rochester, NY 14650. And for more information about Eastman professional video cassettes, call 1 800 44 KODAK, Ext 861 (1 800 445-6325, Ext 861), or contact your nearest dealer in Eastman professional video products or your Kodak sales and engineering representative.

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Circle (44) on Reply Card

Group & Channel	Video Carrier	Aural Carrier	Response Channel
MDS I	2154.75	2150.25	
MDS II	2160.75	2156.25	
A-1	2501.25	2505.75	2686.0625
B-1	2507.25	2511.75	2686.1875
A-2	2513.25	2517.75	2687.0625
B-2	2519.25	2523.75	2687.1875
A-3	2525.25	2529.75	2688.0625
B-3	2531.25	2535.75	2688.1875
A-4	2537.25	2541.75	2689.0625
B-4	2543.25	2547.75	2689.1875
C-1	2549.25	2553.75	2686.3125
D-1	2555.25	2559.75	2686.4375
C-2	2561.25	2565.75	2687.3125
D-2	2567.25	2571.75	2687.4375
C-3	2573.25	2577.75	2688.3125
D-3	2579.25	2583.75	2688.4375
C-4	2585.25	2589.75	2689.3125
D-4	2591.25	2595.75	2689.4375
E-1	2597.25	2601.75	
F-1	2603.25	2607.75	
E-2	2609.25	2613.75	
F-2	2615.25	2619.75	
E-3	2621.25	2625.75	
F-3	2627.25	2631.75	
E-4	2633.25	2637.75	
F-4	2639.25	2643.75	
G-1	2645.25	2649.75	2686.8125
H-1	2651.25	2655.75	
G-2	2657.25	2661.75	2687.8125
H-2	2663.25	2667.75	
G-3	2669.25	2673.75	2688.8125
H-3	2675.25	2679.75	
G-4	2681.25	2685.75	2689.8125

Group A, B, C, D assigned to ITFS.
Group E, F assigned to MDS.
Group H assigned to POFS.
All frequencies given in MHz.
MDS visual and aural carriers may be inverted upon the operator's decision.

***Table 1.** ITFS/MDS band frequency assignments.*

Continued from page 70

A block of four channels is allocated to a licensee (see Table 1). Each channel in the block is 6MHz wide and essentially forms a standard NTSC signal. Video is amplitude-modulated, while audio is frequency-modulated onto a VHF channel, then mixed upward to the ITFS carrier frequency.

Only FCC type-accepted transmitters, rated at 10W, will be licensed. A single channel at 10W will provide a usable signal at line-of-sight locations between 17 and 20 miles away. In multichannel operation, the distance is reduced by several miles by losses in the channel combiner network. Waivers could permit use of 100W transmitters, if the need for increased power can be proved and if interference is not created for other ITFS operators.

A single wideband antenna transmits the four channels of a group simultaneously. Most often omnidirectional antennas are used, although directional antennas may be more practical, depending upon the receiving site locations. All four channels from a given transmitting antenna have a common polarity, either horizontal or vertical.

Temporary and repeater installations may be operated under the license. A temporary transmitter site allows pickup of programming to expand the service with live seminars from remote locations. Repeaters may be needed to get signals from more distant temporary sites to the main transmitter.

Technically, 2-way video links exist. Practically, however, interactivity will use 2-way audio response facilities. Specific frequency allocations for audio response fall between 2.686025GHz and 2.6898125GHz. Each 125kHz-wide channel is assigned to an ITFS channel and may carry AM or FM intelligence. If AM, modulation must not exceed 100%; if FM, deviation must not exceed ±25kHz. Using standard telephone lines for audio interactivity, however, may prove more feasible.

Signals at receiving sites must present

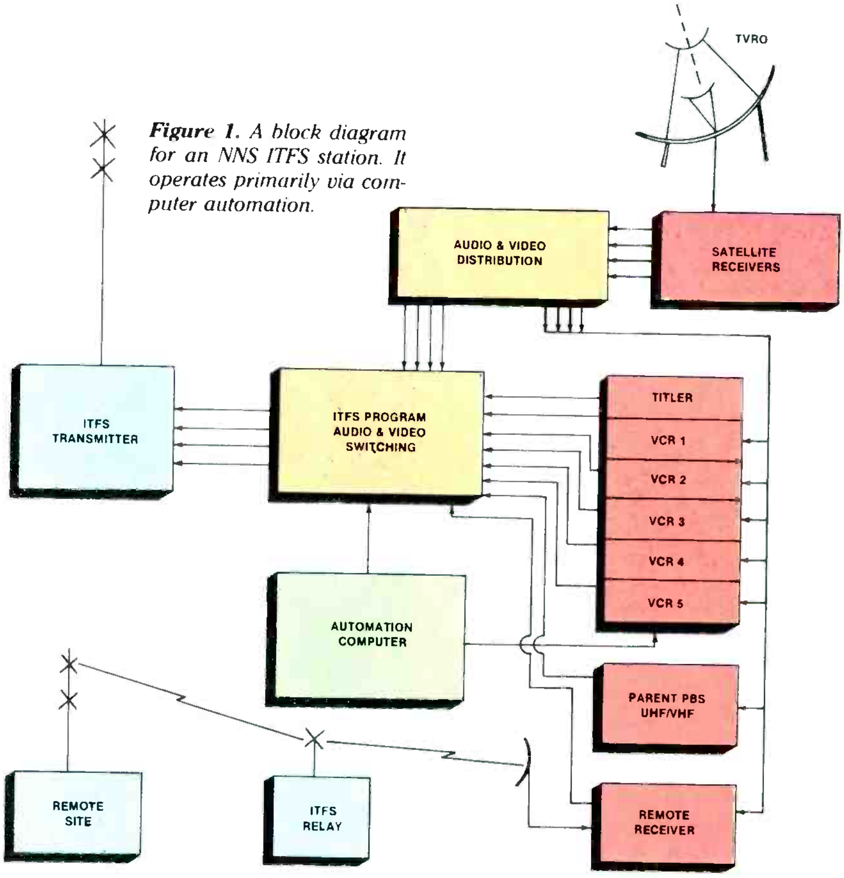


Figure 1. *A block diagram for an NNS ITFS station. It operates primarily via computer automation.*

a S/N ratio of 43dB or greater, based on a maximum parabolic dish size of six feet, but smaller antennas would be preferred. This ratio falls 3dB short of the 46dB *excellent* picture quality determined by the Television Allocations Study Organization (TASO) and means you might detect slight snow.

The ITFS system design must take into account all microwave experiences caused by atmospheric effects of precipitation and temperature inversion and line-of-sight path requirements. In other words, the path from transmitter to receiving sites must be designed and must consider Fresnel zones, possible radio-opaque obstructions and reflecting surfaces (buildings, towers and bodies of water).

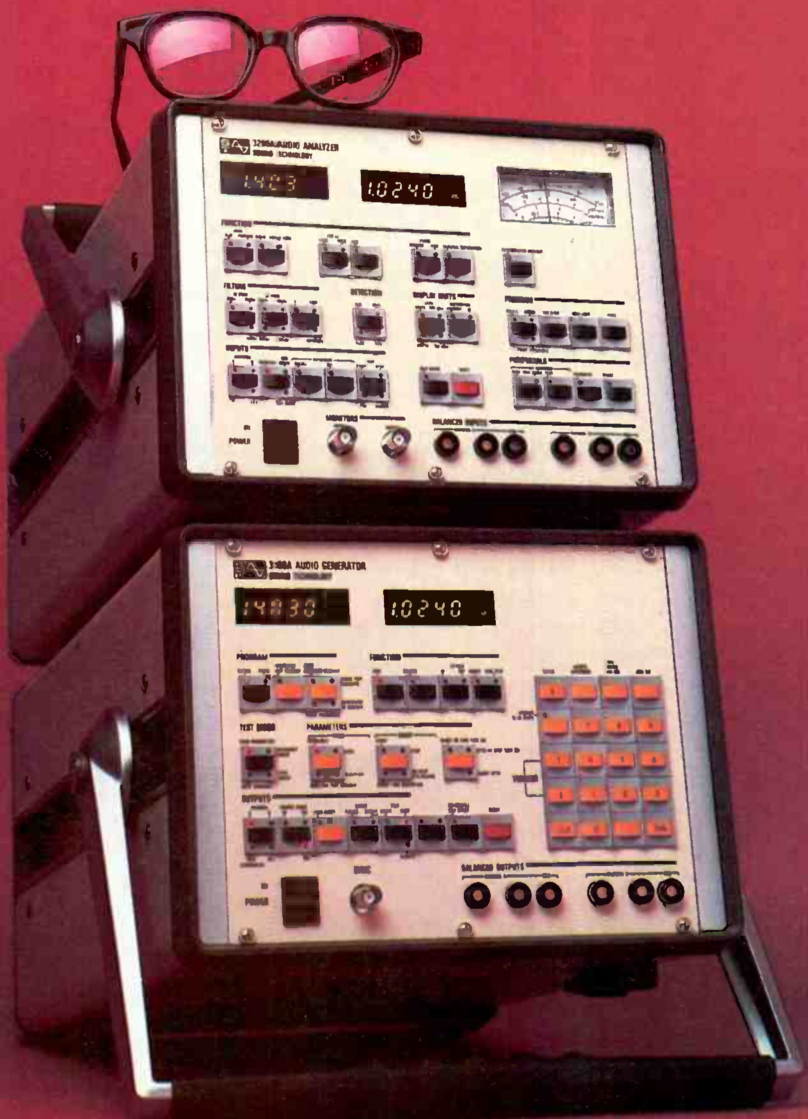
Visual and aural carrier frequencies must be checked at least once each month. The visual carrier tolerance is within ±60kHz. The aural carrrier must remain within ±1kHz of 4.5MHz above the visual carrier. The visual carrier may not increase to more than 110%, while aural power must stay between 10% and 70% of visual power.

Technical relief

The transmitted signal must meet NTSC requirements, but the originating equipment need not meet the stringent requirements of the standard broadcast studio. Video and audio signals must meet quality levels, agreed upon by both the transmitting and receiving parties. Strict adherence to RS-170 is not required, which reduces equipment costs for the transmitting party.

For example, if current ½- and ¾-inch VCR equipment provides acceptable im-

Faster than a speedy floppy disk, More powerful than a personal computer, and able to leap long distance remotes with a single button, it's . . .



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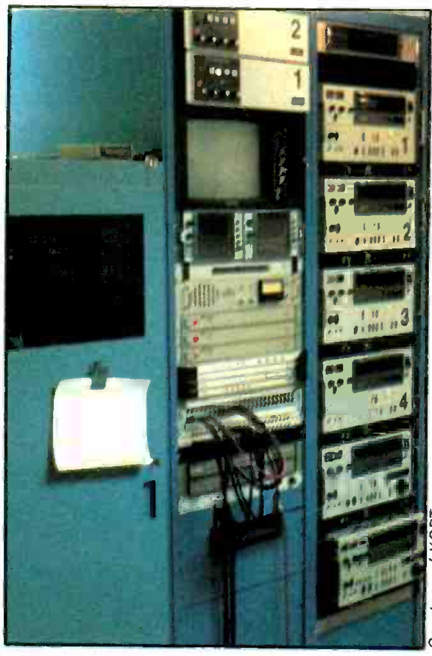

Courtesy of KCPT

Seven automatically operated VCRs are included in the KCPT-TV 19 (Kansas City, MO) system. The six VCRs at the right are for longer program segments and recording. At the left, there is another unit designated for short program items.

age stability, then time base correction is not an origination requirement. Most will prefer to use TBCs, however, as taping of NNS material for repeat and delayed presentation is planned.

If all programming came directly from the NNS satellite feed, correction would not be necessary. Some stations will use frame synchronizers for local title keying and IDs. Split-screen presentations of remote and studio images will require synchronization.

Non-standard video signals, contained with the 6MHz bandwidth, are not precluded by the rules. Waivers have allowed transmissions of SECAM-60 for special purposes. Actual video signal quality is the responsibility of receiving and sending parties.

Subcarrier rulings for ITFS carriers closely follow current broadcast regulations. Data and voice information are allowed.

Waivers to the regulations can allow ITFS signal delivery to CATV systems for carriage on cable channels that are not available to the general cable viewer. A determination of the cost of cable reception must include subscriber access to the special service channel (similar to pay services).

Although educational programming might be desirable, direct transmission into homes defeats the closed circuit nature of ITFS. The cost of direct reception at home from an ITFS transmitter will generally involve an expense averaging $3,500.

Possible problems

Engineers accustomed to UHF and VHF signals will find the 2.5GHz to 2.686GHz spectrum to be both similar and different. First, because the spectrum is termed microwave, ITFS transmissions are almost exclusively line-of-sight. Passive reflectors can be used in reaching otherwise impossible sites.

Control for the ITFS equipment includes an automation computer with CRT, keyboard, disk drives and printer. Additional equipment includes monitoring and titling units.

Some frequency-sharing with TV ENG systems may occur. The directional nature of both ENG microwave and ITFS receiving antennas will technically avoid

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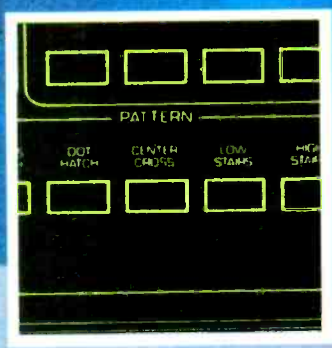

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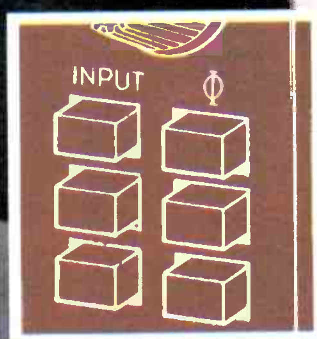

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interference to ITFS. Practically, however, a possibility exists for occasional inter-service signal interference.

Spurious emissions at more than 3MHz outside the upper and lower edge of each 6MHz channel must be attenuated more than 30dB below the visual carrier of the assigned channel for transmitters rated at 10W or less. Out-of-band attenuation for transmitters rated greater than 10W must be more than 40dB.

If an area has only one ITFS operation (for example, channel group A), receivers separate the four channels easily. If there is additional activity on group B channels that interleave with the A group system, adjacent channel interference is highly probable.

Several steps can be taken to reduce interference. First, common sync should be used with video on all channels of a group. Second, if possible, the transmitting antennas for both groups should be co-located. Polarity differences between the antennas significantly reduce reception by group B receivers of group A signals. Also, co-location of antennas simplifies the problems of signal overloading, if a group A receiver were closer to the group B transmitter.

The limited coverage of ITFS signals suggests that channel groups may be assigned to other users at relatively short distances. If such an assignment is proposed, directional transmissions can avoid excessive co-channel interference for receiving sites of the initial facility. The ratio of received carrier level from the desired to undesired transmitter must be 42dB or greater.

NNS downlink TVRO is situated on the TV station studio roof and is less prone to vandalism. An ice-bridge protects the feedline from falling ice off a nearby transmission tower.

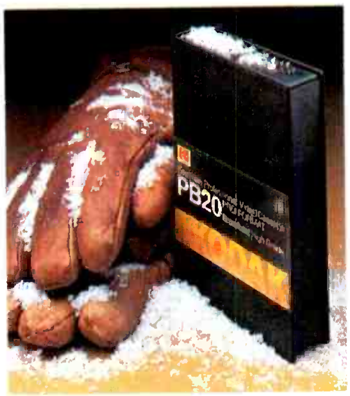
Beyond education

If the PBS NNS demonstration is successful, coverage expansion is planned. Additional ITFS facilities will be installed at PBS affiliates according to the demand. Many school districts currently use the band and usage is expected to continue. The current rules allow licenses to non-profit educational organizations only.

Do commercial ventures threaten to take frequencies away from the service? It has already happened, once in 1971 and again in 1983, when first block H was assigned to OFS, then blocks E and F (see Table I) were re-allocated to common carrier services. MDS (Multipoint Distribution Service) and MMDS (Multichannel MDS) have caused heated debates at the FCC. MDS/MMDS operators propose taking additional groups of ITFS frequencies for more efficient spectrum use for entertainment transmissions by subscription.

MDS service now has two channels, 2.15GHz-2.156GHz and 2.156GHz-2.162GHz, and the 4-channel blocks E and F for pay-TV services. MDS signals are non-standard NTSC in that the aural and visual carriers may be inverted. The format choice is left to the operator, providing some degree of signal security for commercial users. Otherwise, most of the rules for ITFS closely follow those of the MDS transmissions.

Deregulation or reregulation by the FCC has proved that few rules in parts 73, 74 and 76 of the broadcasting regulations are cast in concrete. If the NNS programming does not catch on and if the continuing growth of other educational activity in the 2.6GHz spectrum falters, that radio space could be reallocated to other operations.



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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.

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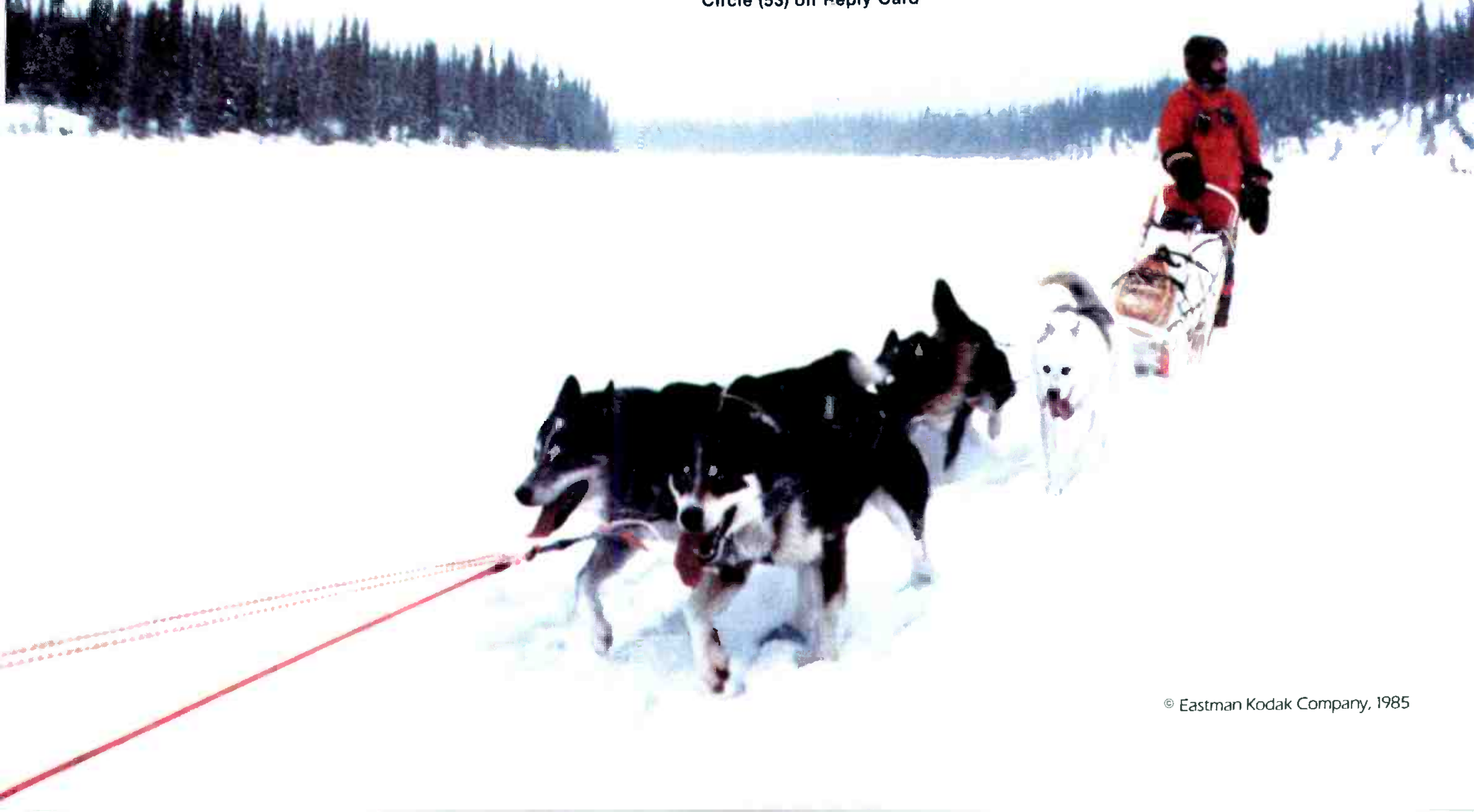

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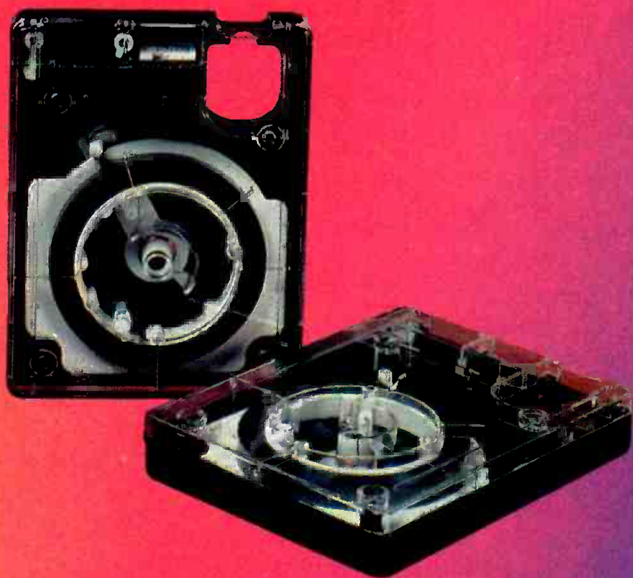

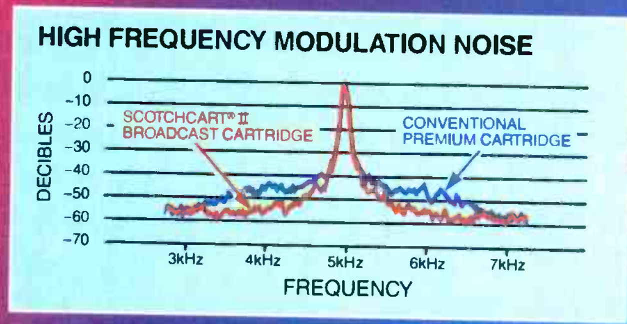

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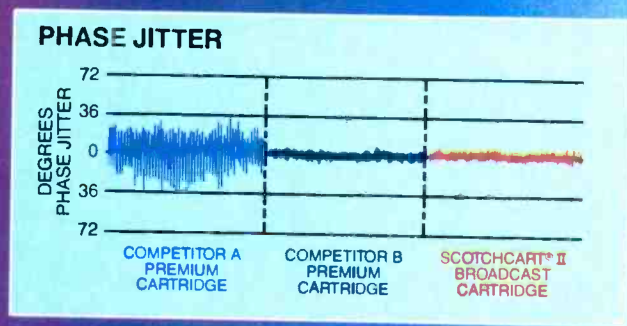
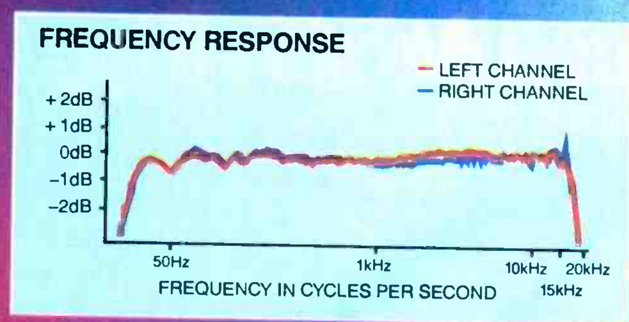


Some competitive cartridges sound muddy on the air because of excessive phase jitter. ScotchCart® II broadcast cartridges sound crisp and clean.



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.

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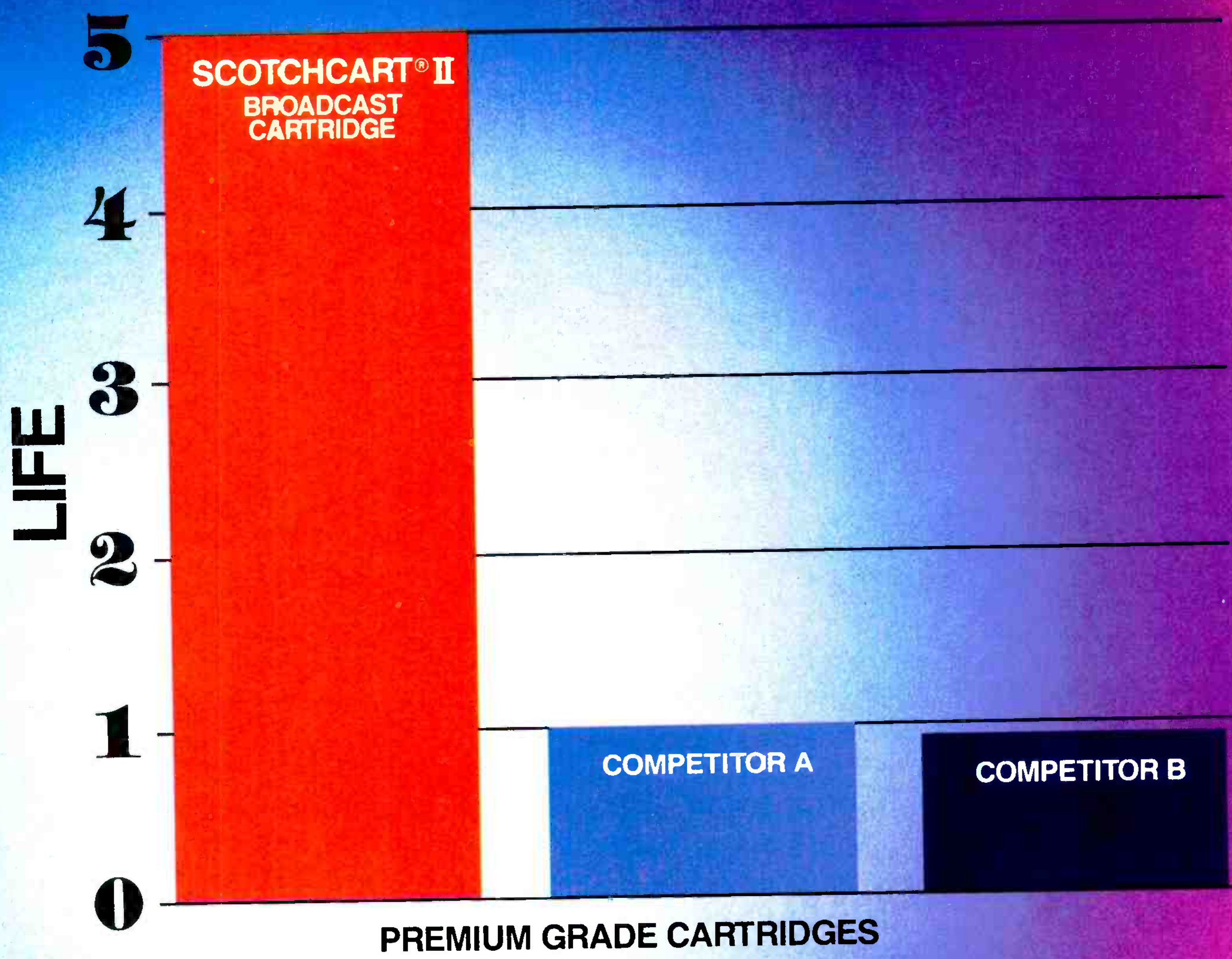

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Tascam model 42

By Brad Dick, radio technical editor

From all external appearances, the Tascam model 42 stereo tape recorder is not much different from many other recorders on the market. However, don't let appearances deceive you, for behind this common appearing exterior lies a dynamite tape recorder.

The model 42 provides all of the standard features one would expect in a medium-priced stereo tape recorder. The recorder handles 10½-inch reels and has large VU meters with peak reading LEDs. The motion controls are conveniently placed and operate smoothly.

The rear and front panel

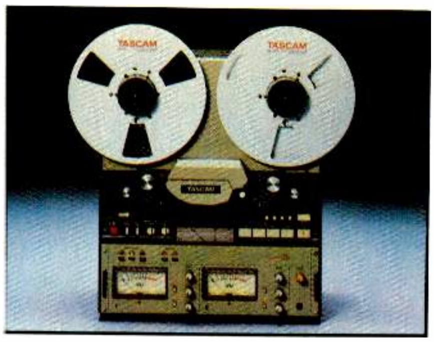
The rear panel inputs and outputs terminate in both XLR and RCA pin jacks. The XLR inputs and outputs are active balanced and the pin jacks are unbalanced. A microphone input switch provides 20dB of attenuation for those occasions when the level is too hot for microphone inputs and too low for line inputs.

Special jacks allow you to connect both dbx and time code equipment. One rear panel jack provides the necessary voltages to automatically control a DX-2D dbx noise reduction system. The time code connector is wired to directly interface with most time code synchronizers and controllers. The connector provides the necessary feedback signals from the capstan motor tach, logic and tally lines.

The rear panel also provides a remote control connector. The unit does not allow the recorder's special features (RTZ, STC) to be used with the remote control. However, the new 42B recorder allows the full use of the recorder's search and cue features and several other options through an optional AQ65 remote control/auto locator.

A 3-position switch provides two fixed tape speeds and one variable or external speed. The variable speed function provides a ±12% variance from standard. One unique aspect of the speed control is that it works in both play and record modes.

The input level controls use concentric attenuators, one for the microphone inputs, and another for the line level inputs. For studio applications, this configuration may be adequate. However, for field recording, it would have been preferable to allow selection of either line or microphone levels for each input. The way the recorder is configured prohibits the use of more than two microphones or two line inputs at once.



The 42B, a new version of the model reviewed.

You can use two of each. But, what about those times when you need four microphones or four line inputs? A simple rear panel switch could, in essence, double the usefulness of the inputs.

The recorder provided a couple of surprises shortly after it arrived. Just after the machine was delivered, my recording engineer spied the machine in the lobby. Wanting to be the first person to try out the recorder, she attempted to take it back to the recording studio. She failed.

This recorder weighs in at 71 pounds. In the case of my engineer, the recorder represented about 75% of her own weight. Just because a recorder has handles, doesn't mean it's qualified for field use. If you really want to use the 42 in the field, you had better hire a hefty person to carry it.

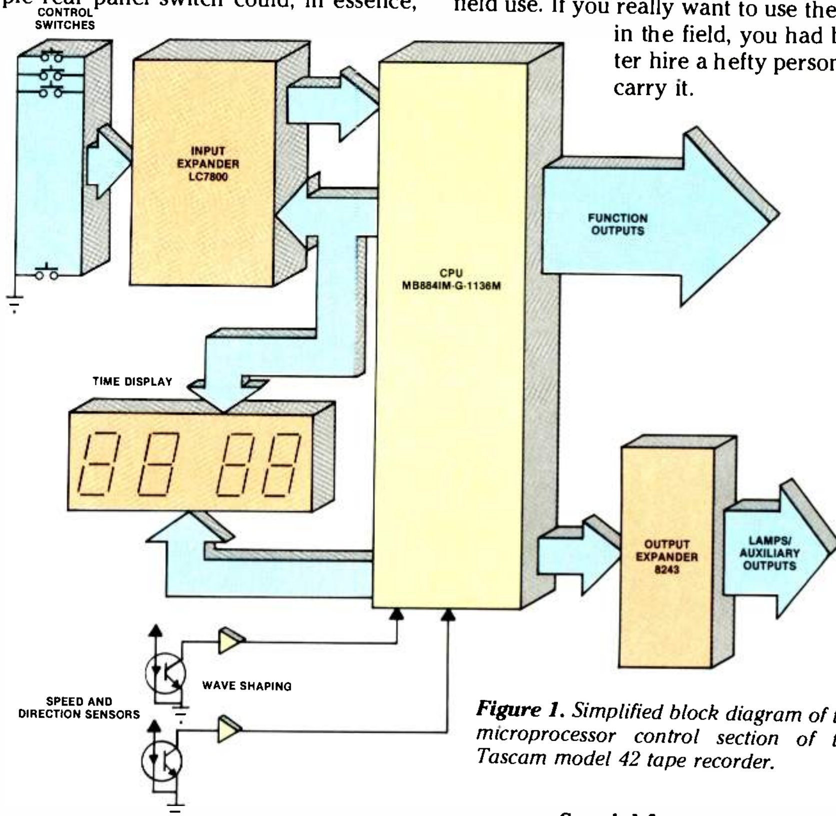


Figure 1. *Simplified block diagram of the microprocessor control section of the Tascam model 42 tape recorder.*

Special features

The machine provides excellent tape handling. Everything in the recorder is controlled by a microprocessor. The microprocessor allows the user complete freedom to press any number of buttons in any sequence and know that the recorder will not damage the tape. Figure 1 is a simplified block diagram of the recorder's control logic. The logic system is so sophisticated that it even provides intermittent pulsing voltages at the beginning of solenoid activation cycles. The pulses assure stable operation of the solenoids. The reel motors are also carefully controlled providing quick and efficient tape movement.

In the fast wind modes, the tape is shuttled at a speed of 240ips. Although this speed is fast enough for normal use, it

Performance at a glance

Frequency response
±2dB, 30kHz to 22kHz at 0VU, 15 ips*
±2dB, 30kHz to 16kHz at 0VU, 7½ips*

THD
0.8% at 0VU, 1kHz, 150nWb/m

Signal-to-noise ratio
70dB, A weighted (NAB), 15ips

Crosstalk
Greater than 55dB down at 1kHz, 0VU

Wow and flutter
+0.05% rms, NAB weighted, 15ips
+0.06% rms, NAB weighted, 7½ ips

Recording amplifier headroom
28dB above 0VU at 1kHZ

*These values represent the manufacturer's guaranteed specifications. The measured performance was actually much better. See the text for details.

Dick was director of engineering at KANU/KFKU, Lawrence, KS when he prepared this report.

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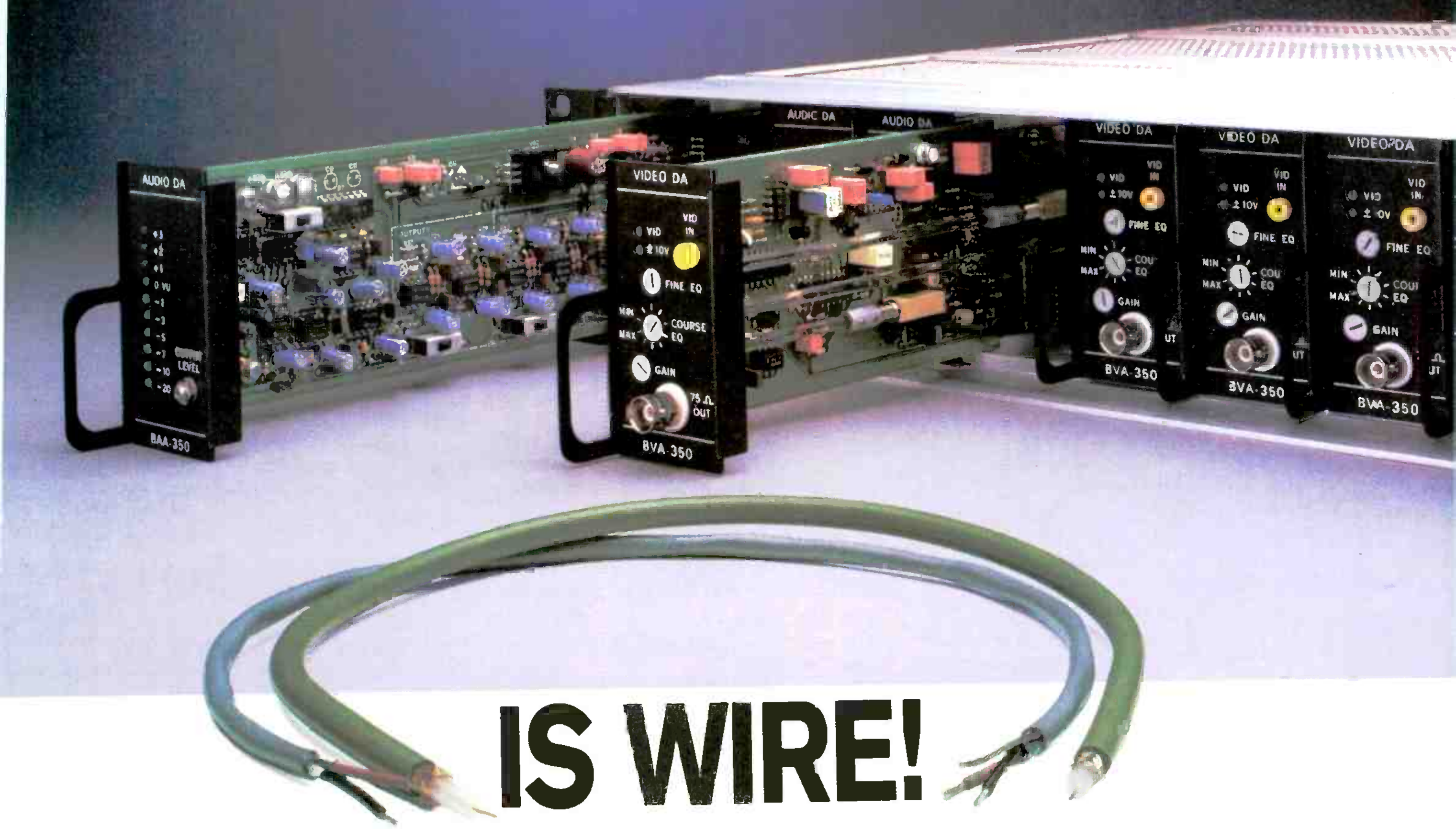

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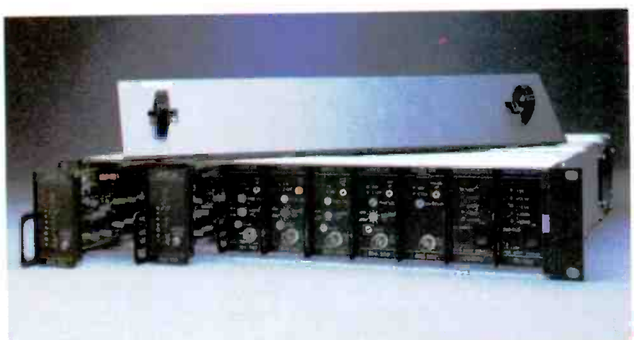

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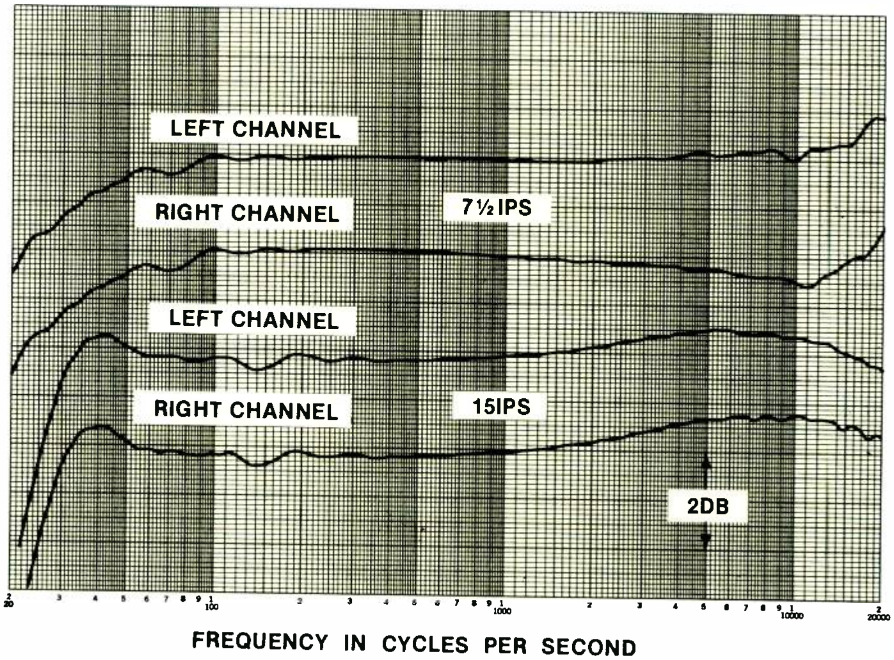

Figure 2. *Record-play frequency response plots. The upper two traces represent 7½ips and the lower two traces were run at 15ips.*

sometimes results in a rough tape pack. By pressing the appropriate fast motion control a second time, the tape speed is slowed to 80ips. The slower, although still quite fast, speed provides a uniform tape pack, reducing edge damage and print-through.

The Return to Zero (RTZ) button allows you to return to the 00:00 point on the tape. If you press the RTZ button while in the play or fast wind modes, the recorder will quickly locate the zero time point on the tape. The RTZ function works from the positive and negative time domains.

The recorder offers an additional cueing feature, Search to Cue (STC). Pressing the cue button stores the current reading of the digital tape timer in the microprocessor memory. Later, when the STC button is pressed, the machine will quickly search and locate the previously stored timing point. This feature gives the machine two cueing points, RTZ and STC. If the play button is pressed after either the STC or RTZ controls have been activated, the recorder will enter the play mode upon arriving at the correct timing point. The accuracy for both modes is within one second.

The STC and RTZ features are used in conjunction with the digital tape timer. The timer's LED display indicates both positive and negative time domains for times up to 99:59. All negative times are prefaced by a minus sign on the display.

Measured performance

Unfortunately, the unit we received somehow missed the final alignment check and did not meet the factory specifications. Even so, it took only a few minutes of alignment for the real audio capabilities of the recorder to show up.

Figure 2 shows the record-play frequency response for both channels at 7½ and 15ips. The plot, however, does not tell the complete story. As the input frequency was increased, the recorder's output level did not reach the −3dB point until the frequency was 28.8kHz. Never have I seen a recorder in this price range come even close to this type of audio performance at 7½ips.

Another interesting point about the model 42 is that the sync circuits are equally as good. In fact, the alignment procedure for the sync reproduce amplifier is identical to that used for the reproduce amplifier.

Operational concerns

After the machine passed the standard measurement tests, it was installed in a news production studio in order to get some feedback from the operators. Problems quickly developed. Within two days of installation, the news staff complained about excessive wow and flutter. Checks showed that the machine had indeed developed a case of poor speed control.

A call to the California service center brought us a new motor. With full confidence that it would solve the problem, it was installed. It didn't help. The machine still would not run properly. At this point serious troubleshooting began.

Because the motor was not the cause of the problem, the capstan motor drive circuitry was the next likely culprit. After a fair amount of head scratching, Bob Pearson, chief engineer, discovered three ICs on the circuit board that are not mentioned in the manual. A quick check of these parts with a scope showed that one of the chips associated with the motor drive circuitry had a steady state output. Because the other half of the chip had a changing output, he surmised that the IC might be defective and replaced it. Replacing the IC cured the problem.

It took a while to discover the cause of the problem because the recorder's manual never discussed these three ICs. After talking with a factory representative, I was told that the current version of the recorder, the 42B, is supplied with a corrected manual. With this change, troubleshooting the machine should be easy.

The motor speed problem provided the opportunity to check the machine's serviceability. The rear panel is held in place with six screws. Once they are removed, the panel hinges down, revealing the cable connectors to the circuit boards and test points. The capstan servo adjustments, located on the capstan circuit card, are easily accessible from the rear. The tape tension adjustments can be accessed by removing the front panel splicing block. All of the audio adjustments are available through the bottom of the recorder. Once you have located the necessary adjustment points, this recorder is easy to service. Extender cables and cards should not be required for most of the problems you might encounter.

Overall impressions

The Tascam model 42 is an excellent tape recorder. The audio performance will be difficult to match with any machine in its price range. The recorder really shines in the area of tape handling. The recorder could not be fooled, no matter how I punched the buttons. The microprocessor-controlled recorder always performed smoothly, never spilling so much as an inch of tape.

The technical manual for the recorder is excellent, even considering the one error I discovered. One section of the manual is devoted to the use of the recorder with optional equipment such as dbx and Dolby noise reduction systems and time synchronizers.

The manual also contains good, useful information on the practical application of recording technology. The manual explains terms such as VU, dB and headroom. It discusses impedance and how it relates to interfacing equipment. Although experienced engineers may not need this kind of information, it certainly is helpful to the new user.

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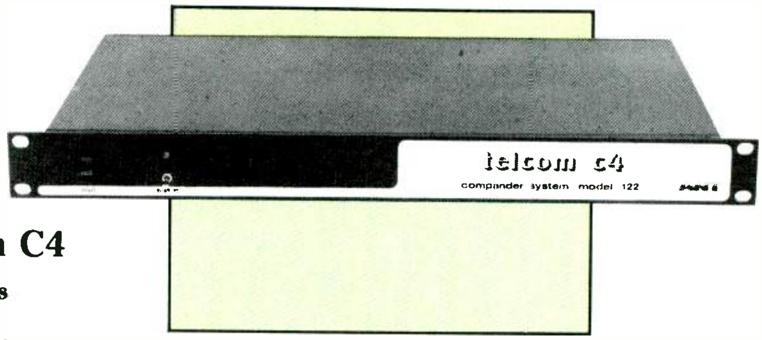

ANT telcom C4

By Ben Weiss

In recent years, there has been a growing trend for broadcasters and recording companies to use companding systems in an effort to improve their signal quality. This need for improvement has been, in part, brought about by the higher quality available from other forms of source material, such as digital disks and digital tape recorders.

The telcom C4 compandor, from ANT Telecommunications, was developed to address this need. The compandor was first used in Germany for that country's broadcast and recording studios. It was so effective that the compandor became standard equipment for all German broadcast companies in 1980 and is now used throughout the world.

Companding—the process

Companding is a process that effectively reduces the influence of noise on signals that must be transmitted or recorded. The transmission system can be anything from a telephone line to an STL system or a tape recorder. The compandor relies on the capability of processing the originating signal in such a way that the interference or noise that is added in the transmission process can be effectively removed at the system's receiving end. In order for the companding process to be effective when used in a variety of systems, it must meet the following criteria:

Weiss is director of engineering at KLSI-FM, Kansas City, MO.

- Noise and distortion should be limited by the recording or transmission medium, not the electronics of the companding process.
- The process should not increase the probability of overload.
- The system should be easy to use, stable, trouble-free and inexpensive.
- The process should not be sensitive to amplitude and phase errors in the medium.
- The system should not increase any channel imbalances that may exist in the system.
- Any overshoot occurring during compression should not exceed the system's limits.
- The process should be inaudible and distortion-free.

If we assume that all of the above criteria can be met, how is it accomplished?

Performance at a glance

Frequency response
10Hz to 30kHz, +0, −3dB

Noise (encode and decode)
97dB IECA-rms

Dynamic range
≥ 115dB

Possible noise voltage reduction
(encode + decode) ≥ 28dB

Headroom above crosspoint
18dB, 15Hz to 20kHz

Impedance
Input
> 8kΩ, balanced floating
> 20kΩ, 1V unbalanced

Output
600Ω, balanced floating
5kΩ, 1V unbalanced

Principles of operation

A compandor consists of a dynamic compressor and a dynamic expander. The compressor is located before the transmission or recording medium and the expander is located after the receiver, as shown in Figure 1. The two components are complementary to each other. The processing exerted on the signal to be transmitted, called transfer function X, must later be reversed by the reciprocal function, 1/X.

On the whole, a signal that passes through both components remains unchanged. However, a signal that passes through only one of the processes is modified. For example, the noise signal, which superimposes itself on the useful signal in the transmission system, only passes through the expander. Its intensity is reduced by the fact that the expander is capable of attenuating the level of weak signals; in this case, noise. (See Figure 2.)

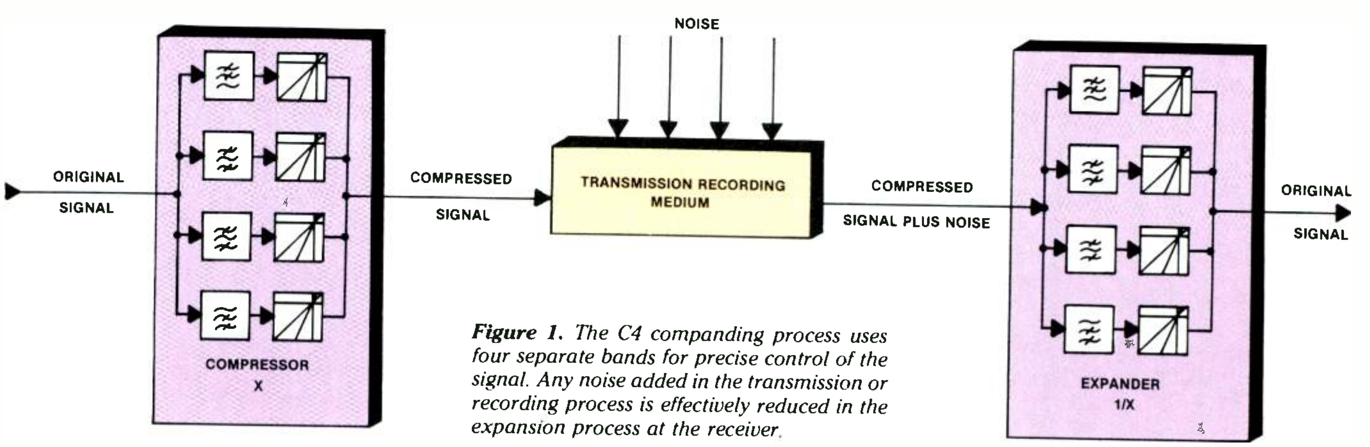

Figure 1. *The C4 companding process uses four separate bands for precise control of the signal. Any noise added in the transmission or recording process is effectively reduced in the expansion process at the receiver.*

Potential errors

Although this encode-decode process appears to be simple, there are several areas where problems can occur. For instance, if the transmission or recording system does not have a linear transfer function of one, then the process will not operate properly. A tape recorder with a frequency response error of ±1dB will affect the compressed-expanded audio in such a way that the net frequency response error can be as much as ±2dB (assuming a 2:1 compression ratio). To resolve this problem, the compression ratio must be kept as low as possible, but high enough to still provide satisfactory results. The C4 Compandor uses a compression ratio of 1.15:1, lower than other designs.

High level signals can also produce errors such as that described previously. When a tape recorder receives a signal sufficient to force the tape into saturation, the tape no longer operates in a linear fashion. In this case, the reproduced audio will no longer correspond to the original audio because of the nonlinear transfer function occurring on the tape.

Another potential problem for companding systems centers on how the compression-expansion is controlled. If the control voltages for the voltage-controlled amplifiers (VCAs) are developed by peak value rectifiers, then the results may be influenced by phase shifts in the transmission or recording system. On the other hand, rms value rectification is difficult to design and provides no protection against overshooting and distortion.

Finally, the attack and release times of the compandor are critical to the reproduced audio quality. Development of the correct attack and release times requires complex circuits. Fortunately, modern LSI chips allow the proper design of these circuits.

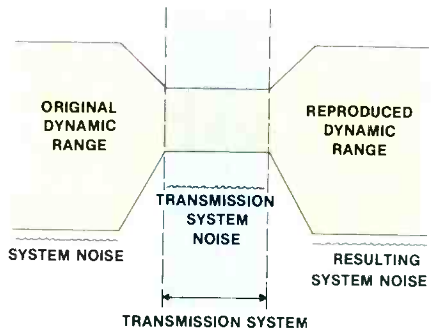

Figure 2. The process of companding relies on the capability of a circuit to compress the signal into a narrow dynamic range before transmission. As the signal passes through the transmission system, noise is added. The expander at the receiver then reduces the noise back down to a low level as the original signal dynamics are reproduced.

Compandor design

The telcom C4 relies on a combination of several concepts to solve compandor design problems. One of the solutions relies on the use of four bands of audio instead of a single audio band for processing. The unit divides the incoming audio into four separate sub-bands with center-frequencies of 55Hz, 550Hz, 2.5kHz and 15kHz. The advantage of using four sub-bands instead of a single band of audio is each can be processed independently. For example, each band has its own compandor and expander. Each compandor and expander, in turn, has its own detection circuits to drive the VCA. By using peak detectors, the probability of phase response errors is greatly reduced. Separate audio processing allows each circuit to be optimized for the characteristics of that particular band of frequencies.

The telcom C4 is unique in that it is level independent. In other words, any level changes in the transmission or recording system will not cause coloration or distortion of the audio. If you record at one level and, later, play the tape back at a different level, the unit

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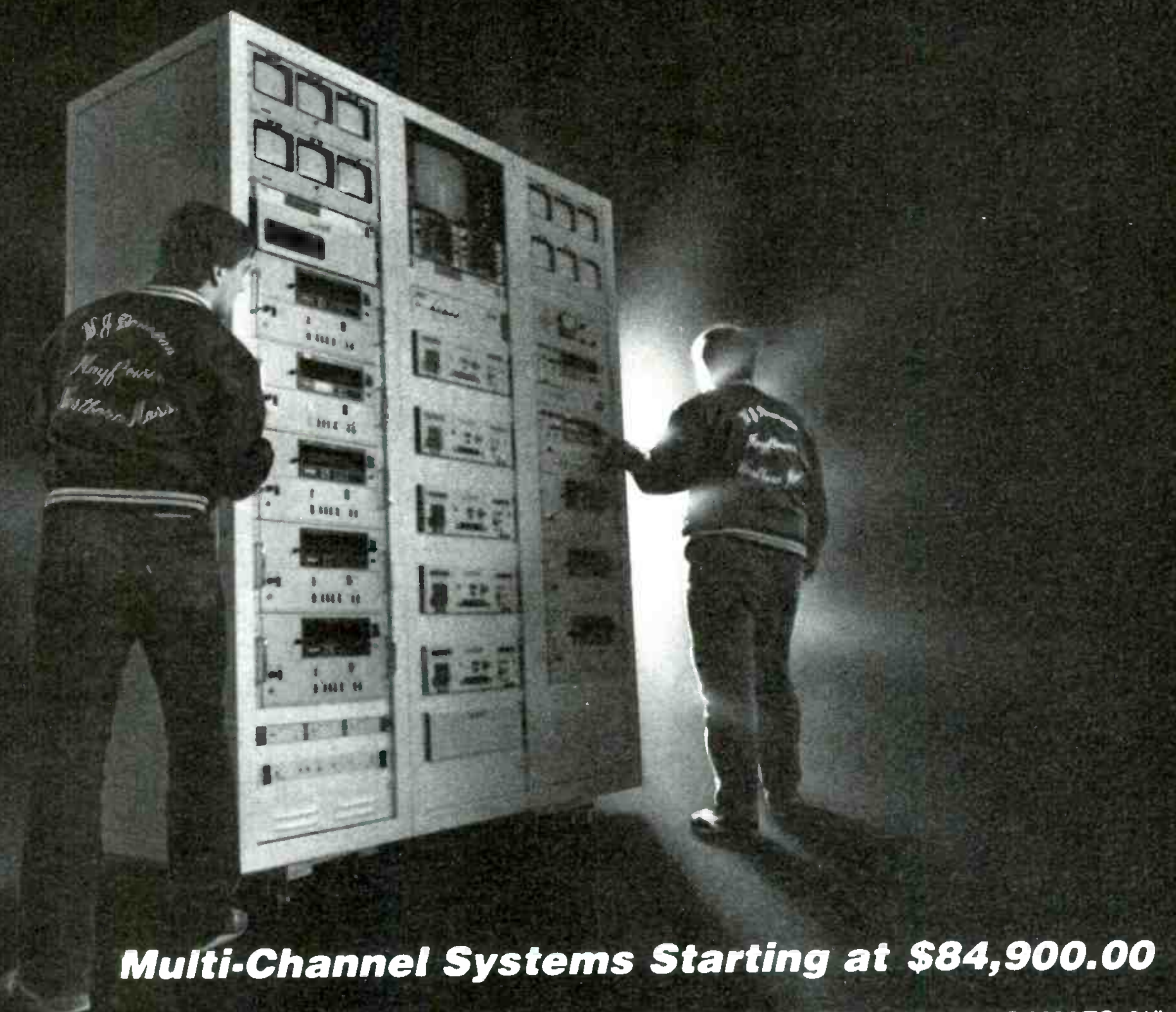

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continues to provide the desired noise reduction.

Finally, the use of separate audio band processing allows the attack and decay times of the VCAs to be carefully matched to the audio. This design reduces noise tails and tape modulation noise, which can be a problem for some compandors.

Construction

The unit is supplied in a 1¾-inch-high rack-mount assembly. The compandor has only two switches: power and processing on and off. The rear panel provides the audio input and output connections and a remote control input. The companding system can be controlled by the application of 5Vdc to 30Vdc to the remote control plug. A 24Vdc source is provided on the plug, so all you need is a set of normally open contacts.

The compandor provides an identification tone for initial alignment and can be easily configured to operate at any standard input level by adjusting an internal control. To align the compandor to your system, you activate the identification tone by using connection points on the remote plug. The output level is normally set to +6dBm. Next, the system input level is applied to the compandor and the level control is adjusted until the output again reaches +6dBm. The process is easy and only needs to be done when the input levels differ significantly from the normal configuration.

Performance

The unit was first installed on an old tape recorder. The recorder's electronics were known to be noisy, so I thought this would be a perfect test. When the unit was first connected, I thought it was defective because there was no sound coming from the C4. A quick check indicated that the unit was properly connected, so I applied some audio to the recorder and began recording music from a compact disc. Listening to the output of the compandor, after the signal had been recorded, was exciting. The noise, which had been so much of a problem for the recorder, was no longer present. The sound from the compandor was crisp and clean. There was no evidence of breathing, distortion or coloring of the signal. A noise measurement showed that the compandor provided a 24dB improvement in the performance of the recorder.

At KLSI, the main use for a companding system is in remote broadcast situations. With the current cost of $351 per month for a remote loop, it is not too difficult to justify the purchase of RPU and production equipment. The unit could provide excellent audio quality for remote broadcasts when it is coupled with an RPU system.

If I have any concerns, it's about the manual. The unit comes supplied with a 9-page manual with no circuit diagrams or troubleshooting information. The technical description is sketchy and you are left to assume that the unit is operating properly. Also, there are no user tests listed that might be of help if you have a problem. I understand that the unit is complex and maybe most users can't service it. However, for peace of mind, it would be helpful if the user at least knew technically how it was supposed to work and could run a test to prove it.

However, the unit is a quality piece of equipment, despite the drawbacks of the manual. It is well constructed and should last for a long time. I wish I could equip all of my recorders and remote lines with one of these devices.

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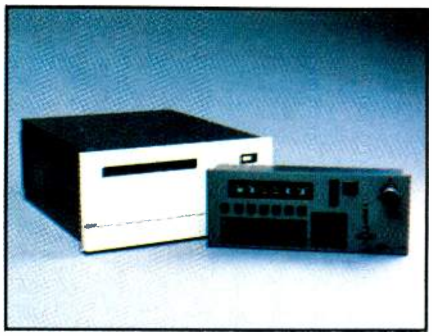
Abekas A52 Digital Effects System

By Leroy Shafer



The Abekas A52 is a digital, keyframe-based video effects machine, designed for efficient on-the-air operation and post-production use. The standard compact system includes the control panel and rack-mount chassis.

An optional combiner allows up to four control panels and two output channels. With a remote assignment panel, the system may be configured as either one dual-channel or two independent single-channel systems. Coupled with the optional digital effects combiner, the A52 provides a flexible multichannel system.

The dual-channel configuration can be operated from any one of the four control panels. When it is used as two single-channel systems, one control panel is assigned to each output channel. True dual-channel operation is achieved by allowing each output to be programmed independently to the fullest extent along a common time-line. (See Figure 1.)

Maintaining control

The control panels are connected to the main chassis by 9-conductor cables. Without remote powering of the control panels, a maximum cable length of 2,000 feet is possible. Communications between control panels and the processor proceed at 38.4kbaud using RS422 protocol. External control via RS232 and RS422 serial ports may be used with all control functions emulated by a computer.

Performance at a glance

- *Transparent picture quality with digital processing.*
- *36 on-line effects with 12 preprogrammed effects and 18 user-programmed effects.*
- *Additional effects included: mosaics, solarization, iterative freeze, splits and 4-, 9- and 16-picture multi-freeze.*
- *Off-line storage of up to 16 keyframe multichannel effects with DataKey*
- *External control via RS232 and RS422 serial ports.*
- *Dual-channel operation with up to four remote control panels.*
- *Inputs: composite analog, composite digital, reference (gen-lock).*
- *Outputs:*
  - *2 composite analog video RS170A;*
  - *2 composite analog key RS170A;*
  - *1 composite digital video;*
  - *Optional RGB and sync.*

A switcher and editor can interface through four contact closure inputs. These contacts trigger the A52 to run an effect forward and reverse, pause an effect already in progress or freeze the incoming video. Contact closure outputs can trigger an external device, such as a video switcher, for simple A/B switching. Digital input and output ports make it possible to interface the A52 with still-store system.

Signal connections

The unit has two processing inputs, one analog and one digital. It also provides a looping analog reference (gen-lock) input for user convenience and interfacing.

The system provides three types of outputs: composite analog video, composite analog key video and composite digital video. There are two outputs for each analog signal and one for the digital signal. Optional RGB and sync outputs are available.

Operating features

The unit's ease of operation stems from a unique control panel design. The panel includes a high-resolution graphics display, professional 3-axis joystick, numeric keypad, optically encoded fader bar, dedicated keys and a DataKey slot.

The heart of the control panel is the graphics display and associated multilevel softkeys. Softkeys are defined by information clearly displayed on the panel above the keys.

The joystick is used to specify parameters during programming. For example, after activating the softkey for border, the joystick selects the hue,

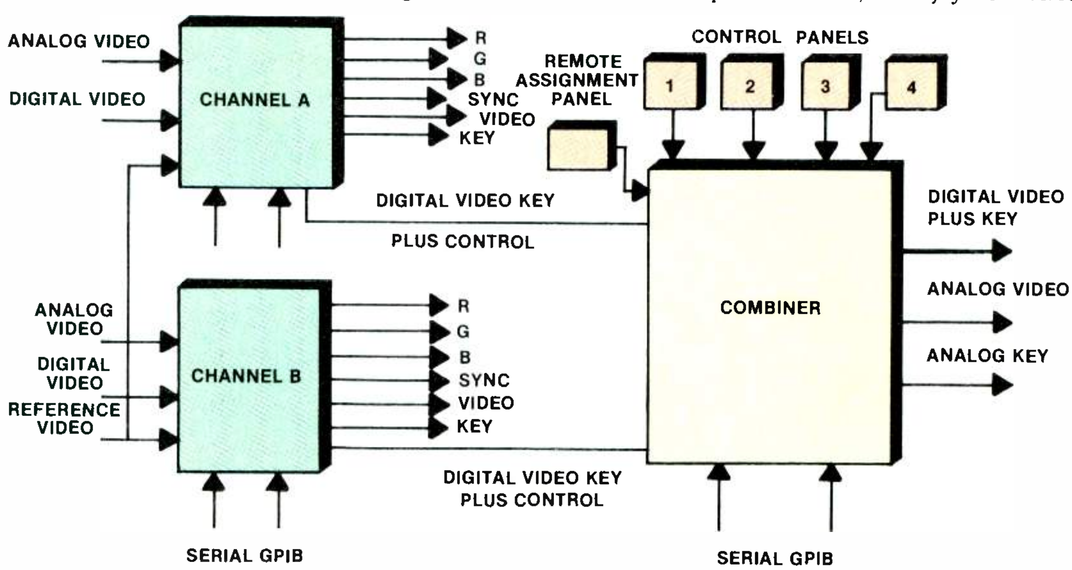


Figure 1. The Abekas A52 can be configured in many ways. Up to four control panels and two separate outputs can be obtained from the special effects system.

Shafer is assistant general manager for the Houston Livestock Show and Rodeo, which operates its own state-of-the-art video production center.

saturation and luminance of the border. After pressing the XYZ softkey, the joystick allows exact XY axis positioning as well as reduction or enlargement in size of the processed video.

There are softkey/joystick combinations that control background color, compression axis, crop and aspect. The aspect parameter controls flips and tumbles.

The operator may enter precise effects parameters with the numeric keypad. The keypad allows duplication of the size, position, border, background, time durations and other parameters of a previous effect. A complete record of a complex effect can be recorded and recalled at a later date in much the same way that an edit decision list can be recorded for an editor. The keypad also allows editing and transferring of effects to and from a work-space memory.

The fader bar runs effects manually forward or reverse. End-to-end fader travel runs a complete effect. The bar position directly corresponds to a given point on the time-line of the effect, thus enabling precise control when manually rehearsing any part of an effect. Also, the fader bar sets manually encoding border widths and mosaics.

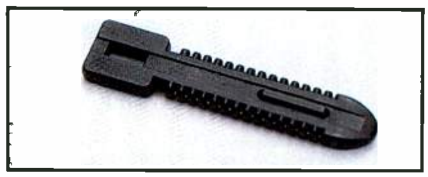
Special effects

The system's effects are defined by keyframes. Each keyframe is a set of parameters, such as size, position, aspect, border, crop and background, at a particular point in the effect. Keyframes are created by specifying parameters with the joystick or keypad.

As parameters are varied, the output monitor instantaneously responds to all changes, providing visual feedback. Also, the exact parameters for each effect are shown on the graphics display.

For live use, the system has 36 on-line effects accessed through an effects menu. The menu appears at power up or when the effect key is pressed. There are six groups of six effects, and each initially appears above each softkey. Pushing a softkey selects an expanded menu of a group by displaying one effect above each key. The softkey can then directly select one effect.

Twelve of the 36 are frequently used effects and are factory pre-programmed and presented pictorially on the graphic display. These effects include flips, tumbles and various compressions and slides. These 12 effects are assigned softkey selection numbers 13 through 24. They are 2-keyframe effects that can be brought into work-space memory, edited or modified and returned to effects storage. After modification, original programming is restored by using a softkey reset.



Off-line storage is provided with a DataKey. The small reusable memory device is fast, economical and fits right in the control panel. It can store one 16-keyframe multichannel effect.

Effects selections one through six each contain up to 16 keyframes and are stored in volatile random-access memory. Selections 7 through 11 each contain up to six keyframe effects in a non-volatile memory. Number 12 contains up to 16 keyframes in volatile memory, which is normally used with the DataKey off-line storage device. Effects 25 through 36 are non-volatile 2-keyframe choices that are user programmed.

The system offers mosaic and solarization; iterative freeze (strobe effect); 4-, 9- and 16-picture multifreeze; and various picture splits. These are always immediately available to the operator through hardkey and softkey combinations.

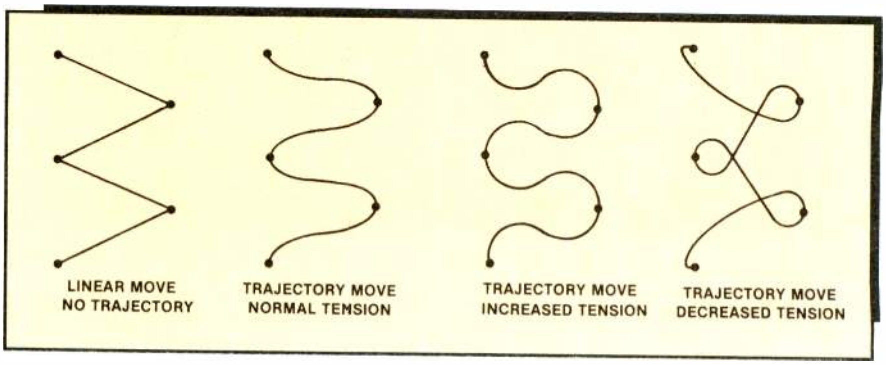


Figure 2. *In addition to linear motion, any effects can be programmed with trajectory for a curved path between keyframes. The path of a given trajectory can be altered with tension.*

Our staff has determined that up to 49 different parameters can be stored for a single keyframe. The transition between 49 parameter keyframes can produce unbelievably complex 2-keyframe results.

In operation, the system seeks differences in parameters from one keyframe to the next and smoothly interpolates between them. The interpolation can be either linear or trajectory (for curved paths). As many as 16 keyframes can define a trajectory. Any trajectory path can be modeled with tension (Figure 2).

Off-line storage

Off-line instruction storage is accomplished by the use of a DataKey EAPROM. The device is an erasable memory unit that fits into a key slot on the control panel. The device is about the size and shape of a car key and stores up to two 16-keyframe effects for a single-channel operation or one 16-keyframe multichannel effect.

Additional optional features

Recent software updates incorporate a hold feature, allowing the effect to jump from one keyframe to another with the background off (random freeze). The operator may compose layer after layer of background, stripes, pictures or even drop-shadows for creating graphics. All layers are generated digitally within the system, which prevents generation loss.

The unit may be used to create complex shapes with still video images. We knew that the system did not have perspective and rotation options, but we were amazed to learn that a variety of shapes could be created by using still pictures.

Other features include: variable compression axis, full manipulation of cropped pictures, variable aspect ratios, variable durations for each keyframe or each effect, programmable break or pause, soft-edge key signals and A/B video switching.

Picture quality

Although my previous comments have centered on the operation and programmability of this machine, you should know that the picture quality is excellent. The system's transparency is the result of digital signal processing. The incoming composite signal is immediately digitized to eliminate the analog decoding problems, such as drift and complex adjustments.

Digitally encoding into 4:2:2 components precedes all other processing. The result completely eliminates the stepping usually associated with moving a picture slowly across the screen. Equally important, the key output moves as smoothly as the picture.

Evaluation and opinions

I have been impressed with the system from the beginning. It worked right out of the box and was easily wired into the system. It has met all my requirements admirably.

Adjustments are well defined in the operator's manual. Phasing and timing of the machine into the system was a snap and the stability of the ouput signal has been excellent. System phasing and timing are checked before each major editing session, but I have found no drift on the output signals.

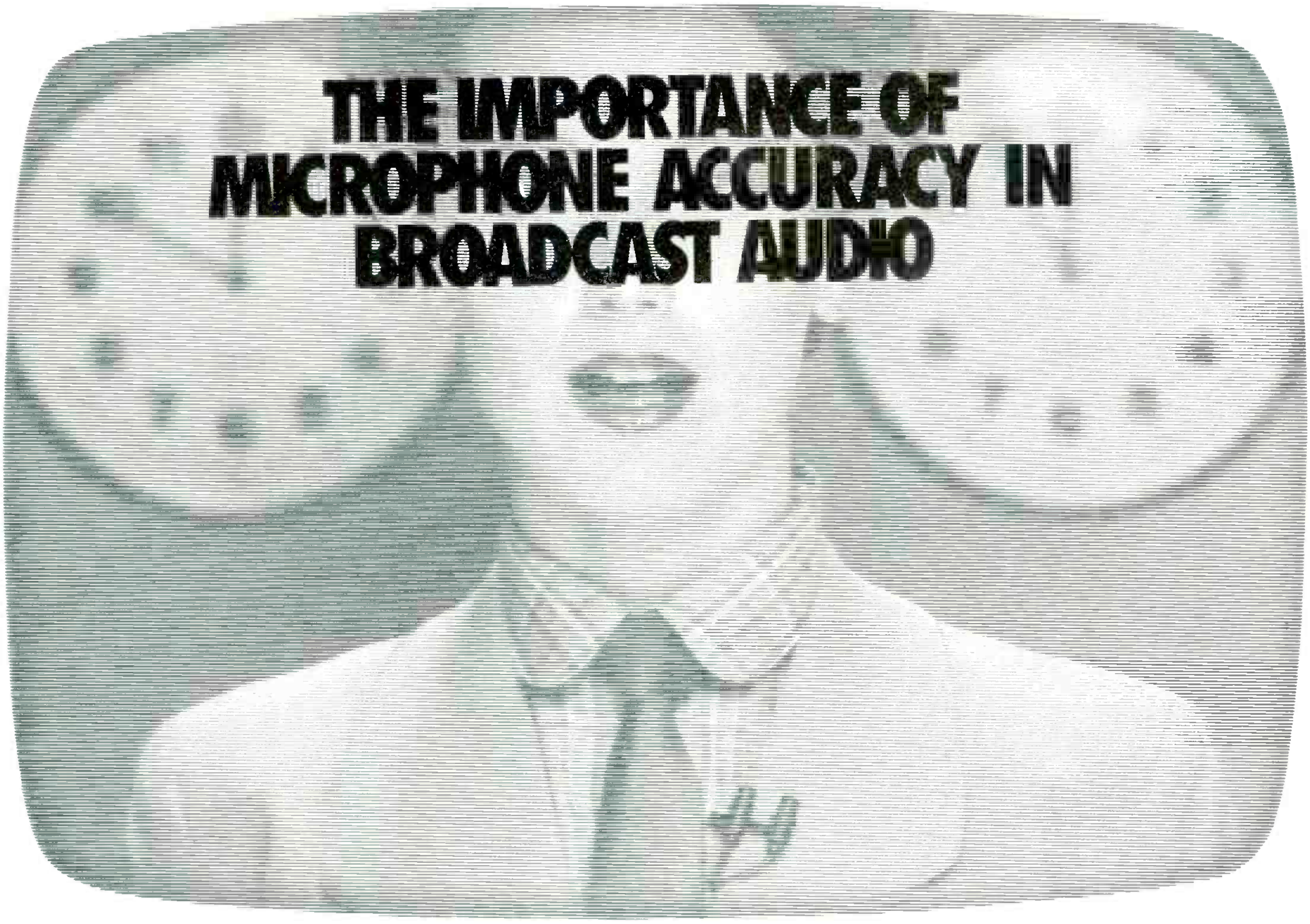
There have really not been any complaints. However, I would like to see the analog adjustment pots, which are currently mounted on top of printed circuit boards, moved to the edge of the boards. For example, the video output level and black output adjustments require the use of an extender card.

Of course, if I were to make a wish list, I would suggest perspective and rotation as desirable options. However, overall, our directors, editors, technicians and management have said that the system is one of the most effective live and post-production effects units available for the price.

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

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

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



A distinctive voice remains as important to a successful broadcast announcer as a recognizable visual presence. *Microphones are the critical first step in the broadcast audio chain. Acting as a highly accurate sound "lens," they must be sensitive enough to faithfully transmit* all *of the subtle personal nuances and inflections that distinguish one announcer's voice from another.*

Today's sophisticated broadcast productions demand more from microphones. Differences in relative mic performance are more readily apparent, and an inferior microphone stands out like the proverbial sore thumb.

In the most basic sense, any microphone need only capture the sound source exactly and convert it to electrical energy — no more, no less. *Obviously, microphones necessarily have different characteristics based on differing transduction technologies and designs. But at Beyer, we believe that the superiority of a microphone is in large part based on how accurately it transduces the source material — with no excuses based on size or applications.*

In broadcast, Beyer's concept of "accuracy" means the difference between a microphone that can focus in on a specific voice and produce a totally realistic, professionally acceptable performance, and a mic that simulates *a performance by only capturing the bare outline or "silhouette" of an announcer's voice. We've dedicated the most complex and sophisticated technology in existence to reinforce the truth of this basic premise.*

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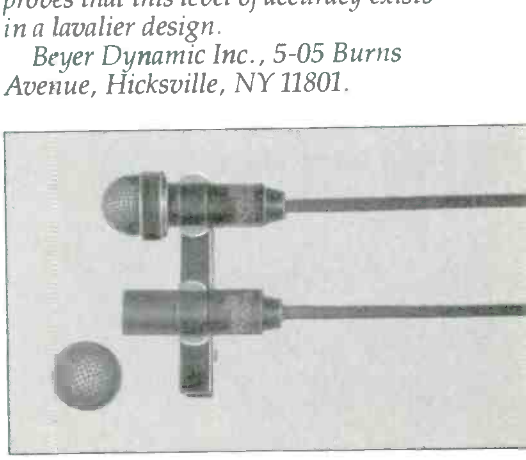
The MCE5 is available in various terminations for the widest range of broadcast applications including wireless. Underscoring our longterm commitment to the broadcast industry, the MCE5 is one of a family of reliable Beyer broadcast products designed for ENG, EFP and Film/Radio/Video studio production. It has been widely adopted by discerning broadcast engineers in the U.S. and Europe.

For those engineers who feel that announcers' voices should be as recognizable as their faces, the Beyer MCE5 proves that this level of accuracy exists in a lavalier design.

Beyer Dynamic Inc., 5-05 Burns Avenue, Hicksville, NY 11801.



Circle (65) on Reply Card

ACCURACY IN AUDIO **beyerbroadcast**

Computer-assisted music rotation

By Michael Hendrickson

In last month's column, we described the use of a computer to provide a live-assist automation system for a radio station. This month, we will discuss the hardware that is required to interface the computer to broadcast equipment.

You will need four basic items to make the system operate: the computer, audio switcher, control panel and the computer interface. The required hardware is easy to build and not expensive. Although this system was developed for my particular computer, the technology is applicable to most other computers. Armed with a technical manual for your computer, you should be able to modify these plans to make them work with your system.

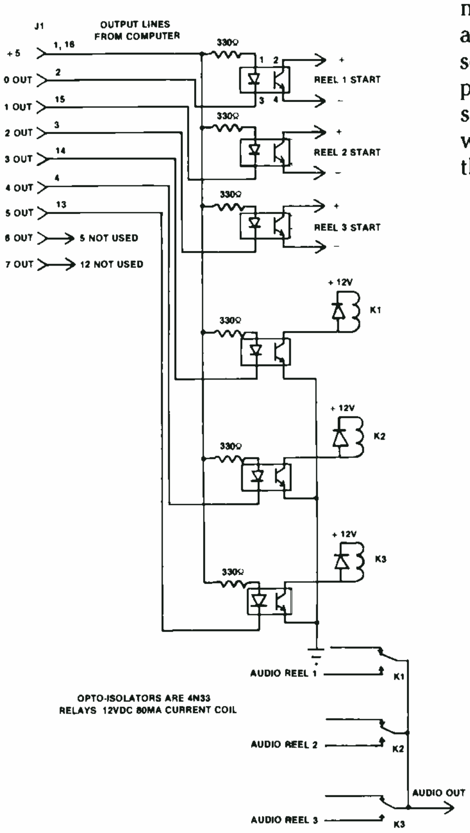


Figure 1. Six opto-isolators are required to buffer the output bus from the computer and drive the tape recorders and audio relays.

Feedback

The key to successful system implementation is to get the computer to follow a sequence of instructions and then make decisions based on information from the outside world. You need to consider several requirements when providing information to the computer.

Because the computer uses an 8-bit microprocessor, the input and output lines are grouped in multiples of eight and are usually available on the rear panel of the computer. The TTL level signals on these lines should be buffered before they are tied to any equipment. We can, however, use these TTL level signals to drive other devices through those buffers, thereby allowing the computer to *talk* and *listen* to the outside world.

During the execution of the program, the computer *reads* the input data lines and stores a number in a specific memory location. The stored number is always between 0 and 255 and represents the unique combination of signals present on the data bus at that time. The stored number tells the computer exactly what is happening with the equipment that it is connected to.

Control

The output lines from the computer are used to control the tape machines and audio switcher. Basically, the output lines operate in the exact reverse to the input lines. To activate any equipment, a unique number must be applied to the output data bus. If, for example, we apply a decimal 4 to the output data bus, tape recorder three will be started. The decimal number 32 could be used to turn on the audio for that recorder. The number 36 could be used to both start the recorder and turn on the audio.

The computer program contains subroutines with all of the necessary control functions we want to activate. A main program calls up these subroutines, which contain the list of numbers. As the list of numbers is applied to the output data bus, different control functions are activated.

Once an output line is changed, either from low to high or from high to low, the state remains constant until it is again addressed by the computer. The inputs can change at any time, but the computer will not recognize that change until the program tells the microprocessor to look again at the input data bus. Although this

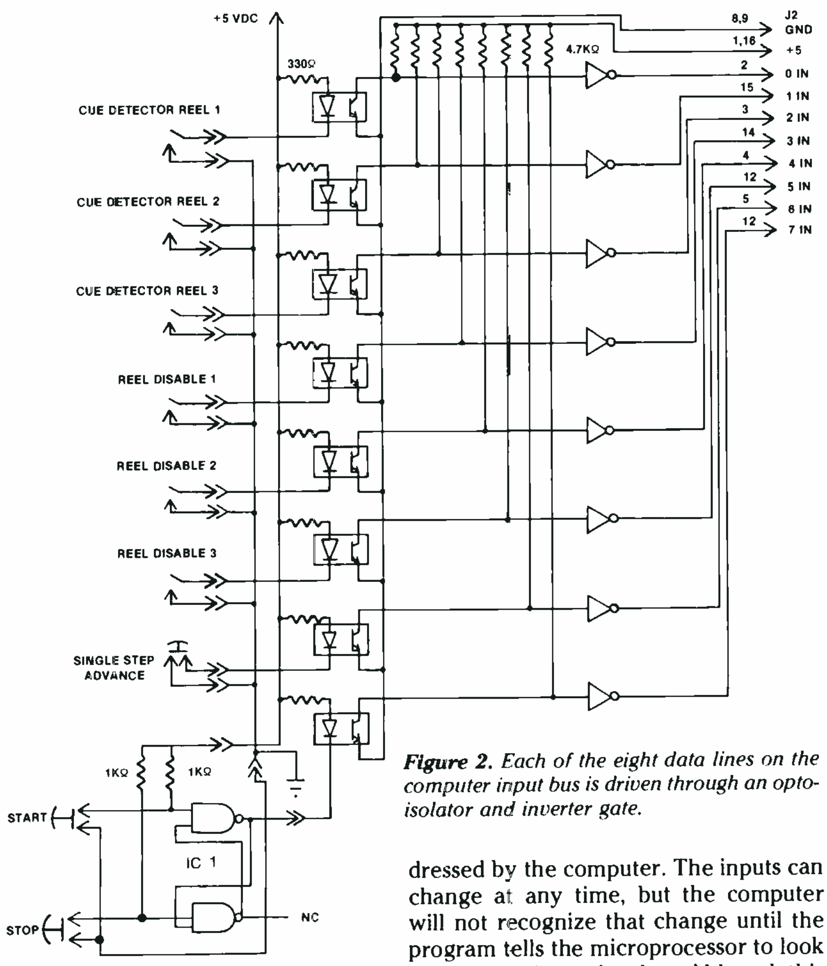


Figure 2. Each of the eight data lines on the computer input bus is driven through an opto-isolator and inverter gate.

Hendrickson is chief engineer for Hedberg Broadcasting, Blue Earth, MN.

may seem like a problem, the computer operates so rapidly that the lines are examined many times each second.

Protection circuits

The signals present on the input and output data buses cannot be directly connected to our equipment. Because of the voltages, we need to use opto-isolators to provide level and power conversion from the computer to the other equipment. Opto-isolators allow us to use the low-level TTL voltages to control the much higher voltages encountered in tape machines. Opto-isolators also protect the computer from high-feedback voltages that might be sent back to the input data bus.

The opto-isolator is composed of an LED, which is optically coupled to a phototransistor. When the LED turns on, the resulting light causes the phototransistor to conduct. The two devices are packaged together but are electrically isolated from each other. The opto-isolator serves the same purpose as a relay but has the additional advantage of bounce-free, high-speed operation. In this application, all we're concerned about is the isolation provided by the opto-isolator.

Control panel

The control panel uses three momentary contact push-buttons and three toggle switches to communicate with the computer. These push-buttons allow the operator to start or stop the computer and single-step the music rotation. The stop and start buttons are used to set or reset a flip-flop, IC1. This flip-flop provides the debounced, steady-state output required by the computer. The single-step push-button is connected to the computer through an opto-isolator, as are the cue tone detectors and reel disable switches. The disable switches tell the computer to bypass a particular machine. If the rotation calls for a machine and the disable switch has been activated, the program simply goes to the next machine.

Each tape deck is equipped with a 25Hz cue tone detector that tells the computer when the music selection has ended. The cue tone begins just before the music selection ends and continues to just before the next selection begins. As the tone begins, the tone detector closes a relay contact. This contact remains closed until the cue tone ends. At the beginning of the tone, the computer starts the next tape deck. When the cue tone ends, the cue detector stops the machine that it is associated with.

The audio switch provides simple relay control of the audio signals. When the computer starts a tape deck, it also activates the appropriate relay to pass that deck's audio. Although other circuits could have been used to control the audio, 4PDT relays are inexpensive, easy to use and reliable.

The BASIC software will probably come with the computer. Your most difficult task may be in translating my program to the BASIC used by your computer. In addition to the BASIC software, you will need a compiler. Programs written in BASIC will not execute the commands fast enough to allow the hardware to operate properly. The compiler will convert the BASIC commands into a format that the computer can execute much faster.

Advantages

One of the advantages of using a computer to automate the music rotation is the low cost. Given the prices of today's computers, you should be able to assemble the computer, disk drive and monitor for less than $1,000. If you purchase all new hardware to build the interface and control panel, the additional cost will be about $200.

Don't let computer technology scare you away. This simple, yet useful, program and hardware may be just the project to help you overcome any hesitancy to enter into the world of computer-controlled equipment.

Editors note: A copy of the program listing for this system is available from the Society of Broadcast Engineers, 7002 Graham Road, Suite 118, Indianapolis, IN 46220.

If you have ideas that might be of use to other engineers, send them in for consideration for publication in this column. Address your ideas to Technical Editor, **Broadcast Engineering**, P.O. Box 12901, Overland Park, KS 66212.

AM receiver demo highlights show

By Brad Dick, radio technical editor

The Radio '85 convention in Dallas was both more and less than expected. The show, the second hosted jointly by the NRBA and the NAB, attracted some 5,000 broadcasters and exhibitors. It included 111 exhibits covering more than 19,000 square feet of floor space in the Dallas Convention Center.

Although the attendance may have been encouraging to the sponsors, the show's value to the engineer was limited. The seminars and speakers were top-notch, but they alone wouldn't justify one's attendance at the convention.

Receiver demonstration

One of the high points of the convention, from a technical aspect, was the NAB's demonstration of AM receivers. A listener could select the output from any of seven AM receivers to check audio quality. Unfortunately, many people may have missed the demonstration because of its location in the NAB publications booth, away from most of the other exhibits.

The audio source for the demonstration was a CD player connected to an RF

generator. The equipment simulated a closed circuit low-power AM broadcast station. The lack of an AM stereo generator confused some of the attendees. Some people felt that the test was invalid because it was conducted in monaural instead of stereo. Unfortunately, this point of view is common within the industry. Many broadcasters still don't understand the improvements that the new stereo receivers bring to monaural AM sound.

Improved fidelity

The key point of the demonstration was that the new stereo radios make all AM, even monaural AM, sound better. The demonstration was conducted as a part of the NAB's continuing effort to increase the visibility of and interest in AM improvements.

The demonstration setup, illustrated in Figure 1, provided a unique high-quality test comparison of the various receivers. Four of the receivers were stereo, but because the transmission was not stereo, all were operating in monaural.

As listeners switched among the various receivers, the differences in audio quality became apparent. The three monaural receivers exhibited a lack of high-frequency response, indicating a tendency to follow the CCIR 3.1kHz rolloff curve.

According to industry officials, almost any station would sound better on the new generation of stereo receivers. However, if the listener is ever to be convinced, the broadcaster must first be educated. Station managers, program directors and chief engineers should all have AM stereo receivers in their cars, homes and offices. Once broadcasters have heard how good AM can sound, they can begin to promote it.

The exhibit is only one part of the NAB's efforts to increase industry awareness of AM radio's potential. Other efforts include educating broadcasters, dealers and consumers on AM's capability to produce high-fidelity audio; generating even more interest in AM stereo; developing improved antenna technology; and promoting FCC rules that limit interference from electrical devices.

United front

Although there may have been division on some topics at the convention, there was definitely enthusiasm for multimode receivers. Even though the broadcaster may have to choose between the two proponents of AM stereo, many attendees felt that the listener should not be asked to make that decision. There seemed to be a consensus that broadcasters must first present a united front to the receiver manufacturers. If the broadcasters would agree on some standards—perhaps even on a pre-emphasis standard—then it's possible the receiver manufacturers would also cooperate.

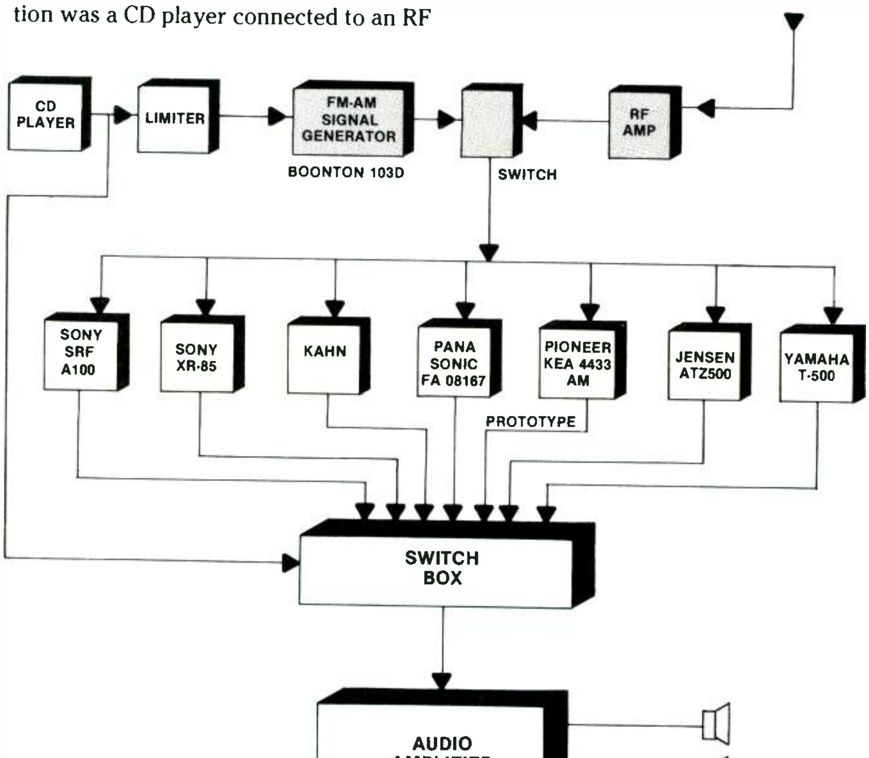


Figure 1. The receiver test setup used for the NAB AM Improvement exhibit.

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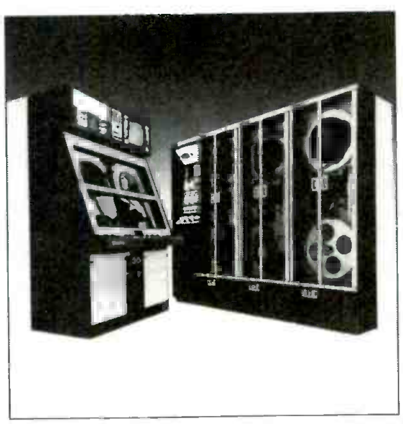

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People

Donald F. Bogue, general manager of Ampex Magnetic Tape Division, Redwood City, CA, has been promoted to vice president. During his nine years at Ampex, Bogue has held management positions including manager of financial planning, business manager for audiotape and director of marketing.

Beth Simon and **Bruce W. Goldstein** have been appointed positions at Audio Plus Video International, Northvale, NJ. Simon is Eastern sales manager and was a former account executive in the sales department in charge of customer relations. Goldstein is manager of film-to-tape services. He previously spent 11 years at EUE/Screen Gems.

Kinsley (Ken) D. Jones has joined Fidelipac, Moorestown, NJ, as marketing director. He will be responsible for coordinating distributor activities and heading worldwide marketing. He was a former district sales manager for Harris.

Michael Cowger, Ira Minkoff, Damian Delaney, Tom Jensen, Lynn Kennedy and **Thomas Gulinazzo** have been appointed new positions at Kliegl Brothers, Long Island City, NY, due to its realignment of sales territories. Cowger is director of sales; Minkoff is regional sales manager; Delaney is inside sales; Jensen and Kennedy are Midwest and West sales managers, respectively; and Gulinazzo is project manager.

Ernest R. Altschul has been appointed manager of commercial equipment engineering for the microwave equipment division of Varian Associates, Santa Clara, CA. He will direct commercial product engineering, enhance existing products and design new products to respond to customer requirements. He was with Aydin's energy division for 24 years, where he most recently served as executive vice president.

Walter E. Werdmuller has been named sales and marketing manager for the broadcast products division of Barco Industries, Charlotte, NC. He will be responsible for assembling a nationwide sales staff to build sales and service for the company's products. He has more than 12 years of experience in the broadcast and professional video industry.

Michael Goddard has been appointed national sales manager of Clear-Com, San Francisco, CA. His responsibilities include domestic and Canadian sales and marketing duties. He was a former national sales manager for Control Video.

Nigel Spratling has been appointed marketing manager for AVS. He is responsible for marketing the AVS standards converters and will work with Mike Ransome, sales manager, to ensure effective sales and product development. Spratling was a former sales and marketing director of Video Presentation Sales. He has engineering, general management and manufacturing experience.

Marty Frange and **Jon Teschner** have joined management positions at Aurora Systems. Frange is Northeastern regional manager. He was a former national sales manager of analog products for Panasonic. Teschner was Southeastern regional manager for ADDA.

Dom Saccacio has been appointed president and chief executive officer for Montage Computer, Hollywood. Before joining Montage, Saccacio had been president and chief executive officer of CMI/Trendata. He brings executive management experience in the manufacturing and marketing of computer and magnetic tape products.

Marty Blanchard, senior marketing analyst at Ampex Magnetic Tape Division, Redwood City, CA, has been named chairman of the Audio Video Statistics Committee of the International Tape Association (ITA). She replaces Paul Weber who recently retired from Ampex. Blanchard is responsible for overseeing the gathering of statistics from member companies and ensuring that the information is collected and distributed in a timely manner.

David K. Fibush has rejoined Ampex audio-video systems division, Redwood City, CA, as product manager for small format systems. Fibush was most recently director of engineering for ADDA in the Republic of Ireland. He held numerous engineering and management positions with Ampex from 1964 to 1983.

Robert A.M. Coppenrath, president and general manager of Agfa-Gevaert, Teterboro, NJ, has been elected to the board of directors of United Jersey Bank. Coppenrath joined Agfa-Gevaert in August 1969 and became its president in March 1970.

Tom Semmes has been appointed Southeastern sales manager of Rupert Neve, Bethel, CT. He has 15 years of broadcasting experience, and was former president of Tom Semmes Associates, an equipment brokerage firm, for the past three years.

Mike Bové has been promoted to senior technical service representative for International Tapetronics/3M, Bloomington, IL. He has been with 3M for six and a half years and previously worked for Sono-Mag. Bové's responsibilities include special projects, field training, testing products and customer interfacing.

Earl D. Harris Jr. has been named director of engineering for ElectroVoice, Buchanan, MI. He will be responsible for administering microphone, loudspeaker, electronics, military and aviation engineering divisions. Harris previously worked for Ehrhorn Technological Operations.

Mark Chew has been appointed as senior systems engineer for Microdyne, Ocala, FL. Chew will be responsible for design and application of satellite equipment for video and signal channel per carrier (SCPC) systems. Chew has 11 years of experience in video systems and SCPC communications at Scientific Atlanta and RCA Americom.

Herman Schkolnick has been appointed director of marketing and sales for Panasonic Broadcast Systems, Secaucus, NJ. In this newly created position, Schkolnick will be responsible for all marketing and sales for Panasonic broadcast video equipment and systems. He is a member of the Society of Motion Picture and Television Engineers, and brings more than 15 years of broadcast marketing experience to Panasonic.

J. Duke Brown has been appointed as sales and marketing manager for Scientific Atlanta's Satellite Communications Division. Brown previously worked at M/A-COM where he served 11 years in a variety of sales, marketing and business management positions.

Donald E. Rushin and **Joseph L. Leon** have been appointed to new positions at 3M's Magnetic Audio/Video Products Division for its broadcasting, recording, commercial and educational markets (BR/C&E). Rushin is marketing operations and international director. He will direct the marketing organization for the division's BR/C&E markets with responsibilities for international marketing in the professional business. Rushin has been with 3M for 26 years and was most recently international director for the division. Leon is sales director and is responsible for the division's professional sales force. Leon joined 3M in 1959 and was most recently director, professional markets for the division.

James A. Comella has been appointed product sales manager for EEV, Elmsford, NY. He is responsible for the sale of EEV's broadcast products in the Midwestern states. Comella has a varied sales background in the broadcast and video markets. Prior to joining EEV, he was employed as regional sales manager for CMX/Orrox, marketing computer assisted editing systems.

Brian James will join the staff of the National Cable Television Association, Washington, DC, as director of engineering in the Science and Technology Department. James has been employed in the cable TV industry since 1972. He was a former manager of standards and practices at Cablesystems Engineering.

Adrian Bailey has joined Digital Entertainment Corporation, a subsidiary of Mitsubishi Electric Sales America, as manager of the Pro Audio Group's United Kingdom operations. Bailey is based at Quad Eight/Westrex, a subsidiary of DEC, located at Greenford, Middlesex. Bailey joined DEC after holding several management positions at Neve International.

Saul A. Walker has been appointed vice president for product development and marketing for Straight Wire Audio, Arlington, VA. He is co-founder and former engineering vice president of Automated Processes, Inc. (API) and served five years as product and sales manager of Datatronix. In his present position, Walker's duties will include expansion in the design and manufacture of products for the broadcast and sound reinforcement markets.

James Wood Jr. has been appointed to head the pro video service division of JVC Service and Engineering. He has been a special products manager for the company since 1983 and prior to that, he was systems technical support manager for Harris.

Paul Stubblebine and **Karen A. O'Brien** have joined Monster Cable, San Francisco, CA. O'Brien has been appointed marketing manager, responsible for producing all new literature, developing advertising and promotional campaigns and coordinating trade shows. Stubblebine is sales manager, managing and coordinating the company's sales department.

Robert P. Hemenway has been appointed vice president of technical operations for Lake Systems, Newton, MA. Hemenway has been with Lake Systems since 1957.

Christopher Louis Emery has been appointed technical service representative for video products for the Magnetic Tape Division of Agfa Gevaert, Teterboro, NJ. He will work from the company's Secaucus, NJ, marketing/training center and his territory will cover New York City, Long Island and northern New Jersey. Prior to joining Agfa, Emery was office manager trader for Jem Commodities.

Richard Voigt and **Joe Gerkes** have joined Image Video, Ontario, Canada. Voigt will serve as international marketing manager. He has operated in more than 48 countries during the past 15 years and has worked for Digital Video Systems. Gerkes is sales and marketing manager and will be responsible for overseeing all sales and marketing functions related to the U.S. market. He was a former sales and marketing manager for Digital Video Systems' studio products division.

Pat Jones has been appointed marketing manager of switch products for Switchcraft, Chicago, IL. He was a former central region sales manager with ITW Switches.

Scott Kaplan has joined the magnetic tape division of Agfa-Gevaert, Teterboro, NJ, as technical sales representative. He will provide technical and sales support for all tape products in Los Angeles and Santa Barbara, CA, and Hawaii. Kaplan was a former assistant sales director at Studio Film and Tape.

David Talbot and **S. Richard Ravich** have been promoted to new positions at AKG Acoustics, Stamford, CT. Talbot has been promoted to sales manager, professional products. He will be responsible for customer application training and dealer relations in coordination with AKG rep organizations. Talbot's efforts will be concentrated in the music and recording industries. Ravich has been promoted to vice president and general manager. He has been a top marketing executive for AKG for the past 11 years. He was a previous national sales manager for Stanton Magnetics.

Charles F. Riley has been appointed to establish the East Coast office of Merlin Engineering Works, Palo Alto, CA. He was former vice president of Tele-Color Productions and served as engineering vice president of Logos.

Charles D. Coyle and **Linda S. Commons** have joined Larcan, Ontario, Canada. Coyle is regional sales manager for the Western United States with 17 years of experience in the broadcast industry. Commons is sales administrative assistant for broadcast sales. They will be marketing Larcan's VHF television and FM transmitter to broadcast stations.

Scott A. Martin has joined Fidelipac, Moorestown, NJ, as sales director. He was a former radio district sales manager for the Harris Broadcast Group. Martin is a member of Sales and Marketing Executives Society of Broadcast Engineers.

Jim Butts has joined Horizon International, Phoenix, AZ, as product sales manager. He is responsible for sales, marketing and implementation and engineering services. In addition to his duties with Horizon, Butts is president of Aspen Grove Communications.

Andrew G. Da Puzzo and **Peter Jensen** have been promoted to new positions at Agfa Gevaert's Magnetic Tape Division, Teterboro, NJ. Da Puzzo is national marketing manager for audio products. He has been with the company for the past five years and recently served as audio product manager. Jensen is regional sales manager for the central region. He has been with Agfa for eight years and was most recently regional sales supervisor for the Midwest.

Robert N. Henson has joined Leitch Video of America, Chesapeake, VA, as director of marketing. Henson is responsible for all sales and marketing duties in the United States, and to strengthen the company's position in the marketplace.

Jack S. James has been appointed Southeast regional manager of Ampex Magnetic Tape Division, Redwood City, CA. He is responsible for supervising the sales activities of the region's sales representatives and for coordinating of customer service and product distribution operations throughout the region.

John Frazer has been appointed senior sales engineer at Sony Broadcast, UK. Frazer has more than 15 years of experience in the sound recording business. He will work out of Sony Broadcast's Basingstoke headquarters.

News
Continued from page 4

manufacturers to improve AM transmission and reception. The improvement subcommittee's November 1984 report urged the reactivation of the NRSC. In the report, the committee said that the AM industry could not, by itself, effectively implement a standardized pre-emphasis curve. Without the cooperation and participation of receiver manufacturers, any changes in broadcast signal processing would not provide the needed industry-wide benefits.

The first meeting of the NRSC committee took place in June in conjunction with the summer Consumer Electronics Show. At that meeting, the committee agreed to undertake the task of examining the possibility of recommending a set of standardized curves for both broadcasters and receiver manufacturers.

The NRSC met again in early September to begin setting up the framework under which it will operate. The most crucial question for the committee is what criteria are important to the selection of a pre-emphasis standard.

It is expected to take at least a year before a final decision can be made. Because any proposals coming to the committee will be voluntary, members will need time to evaluate the suggestions thoroughly.

Upon completion of the committee's work, NAB will publish the recommended pre-emphasis and de-emphasis curves.

NARTE sets certification deadline

The National Association of Radio and Television Engineers (NARTE) has announced the deadline for its grandfathered certification program. The certification program allows those holders of FCC licenses to receive NARTE certification if application is made prior to Jan. 1, 1986.

The NARTE certification program provides endorsements for both RF and non-RF-related work. RF endorsements include: radar systems, satellite systems, microwave, land mobile, cellular and broadcast AM, FM and TV. Non-RF endorsements include: telephone systems, switching systems, multiplex systems, administrative/regulatory and computer telecommunications.

NARTE is an organization of individuals involved in any of a number of telecommunications technical fields. The organization developed its certification in response to the FCC's dropping of the first class license. Persons interested in obtaining NARTE certification or membership should contact the organization at 503-581-3336. All applications for grandfather certification must be received by NARTE by Dec. 31, 1985.

Bogner makes antenna sales

Among recent sales of *Bogner* high-power TV broadcast antennas are channel 16, Key West, FL; channel 33, Shreveport, LA; channel 30, Ogden, UT; channel 68, Birmingham, AL; and channel 49, Irving, TX.

TAJ Soundworks uses Monster Cable

TAJ Soundworks, San Francisco, recently completed an extensive wiring system using professional sound cables from *Monster Cable.* The cables connect an MCI 528 console to a wide variety of tape machines, including mag film transport. as well as the console to and from the outboard equipment, such as noise gates, DDLs, harmonizers and EMT echo chambers. Also wired with Prolink are the studio's custom monitors, microphone lines and the guts of the console and mag film transports.

SatCom and PBS sign agreement

Radiation Systems Inc., Norcross, GA, has announced the signing of an ordering agreement for earth station antennas with the Public Broadcasting Service (PBS). The 2-year agreement calls for RSI's subsidiary, SatCom Technologies, to supply and install model 920CS 9.2m transmit/receive antennas and receive-only antennas. The first release under this agreement is for a motorized uplink antenna for the PBS main origination terminal located near Washington, DC. This facility provides programming to PBS TV stations via Westar IV.

PBS plans to purchase additional antennas for itself and on behalf of PBS member stations across the country. This agreement is part of public television's efforts to upgrade its antennas in preparation for FCC 2° satellite spacing requirements, which become effective Jan. 1, 1987.

Puerto Rico selects Sony ENG system

WPRV-TV, channel 13, the newest TV station in Puerto Rico, has selected a *Sony Broadcast* Betacam ½-inch system for ENG. The station is equipped with Betacam players, recorders and 11 camera/VTRs.

KSTP-TV, of St. Paul, MN, has changed its broadcast image by adding Betacam teleproduction capabilities for ENG. With 25 camera/VTRs in the field, the station has 10 editing suites with various Betacam playback and editing decks and BVH-2000 1-inch VTRs for complete interformat compatibility. The station is part of the Conus Network established by Hubbard Broadcasting.

BE to equip Thai FM stations

The Royal Thai Air Force has awarded *Broadcast Electronics,* Quincy, IL, a contract to equip six new stereo FM stations in Thailand, the largest export order ever received by the company. The contract includes six model FM-1.5A 1,500W transmitters, antennas and complete studio equipment. The new stations are an expansion of the RTAF broadcast facilities.

Receipt of this contract follows the final delivery of equipment for three 300kW FM stations in Taiwan and the shipment of 23 model FX-30 exciters to Korea.

Bosch announces Japanese market distributor

FOR-A Company, Japan, has been appointed exclusive agent for *Robert Bosch GmbH.* The agreement covers all Bosch broadcast products, including the FGS-4000 computer graphics system and the FDL-60 CCD telecine system, which will be included in FOR-A's booth at this year's Interbee Exhibition in Tokyo.

Glen Glenn receives Otari

Glen Glenn Sound, Hollywood, has taken delivery of its 14th Otari MTR-90 multichannel recorder. The all-Otari facility was one of the first film/teleproduction houses to purchase MTR-90s. Everything Audio, Otari's southern California dealer, has serviced the account for several years.

Sony delivers 2-track machines

Sony, Park Ridge, NJ, has announced that it is producing its PCM-3000 series DASH ¼-inch format digital audio recorders at its Fort Lauderdale, FL, manufacturing facility. Recorders include the 7½ips PCM-3102 and the 15ips PCM-3202. Deliveries of the PCM-3202 are scheduled to begin in 1986.

SSL announces console orders

Solid State Logic (SSL), Oxford, England, has announced the initial orders for its new broadcast consoles. The British Broadcasting Corporation has awarded a contract for four SL 5000 M series consoles to equip two of BBC television's post-production suites.

SSL also announced the first American order for the series. NBC Radio News will be receiving a 40-channel version with a mixture of mono and stereo facilities plus eight independent main outputs (IMOs), to be placed in a Burbank, CA, studio. This studio will gather feeds from different sources, process them for recording or live distribution, and then re-transmit them via satellite to the NBC Radio News Network master control room in New York.

Ampex to supply videotape

Ampex Magnetic Tape Division, Redwood City, CA, has announced it has signed a 1-year agreement to supply Media Central with professional broadcast quality videotape. Ampex will provide Media Central's broadcast stations with Ampex 196 1-inch, 197 ¾-inch, Ampex 188 Beta and Ampex 189 VHS videotape.

Penny & Giles address

Penny & Giles, manufacturer of audio attenuator products, has a U.S. sales and service office at 2716 Oceanpark Blvd., Suite 1005, Santa Monica, CA 90405. The telephone number is 213-393-0014.

Thomson-CSF answers order

Ivory Coast has ordered a short-wave 500kW transmitter together with the associated equipment and antenna system from *Thomson CSF.* Digital technology is employed in the PDM, which offers switch-mode modulation, flexibility and tuning precision. The audio signal is digitalized then processed by a series of preprogrammed microprocessors. A TV screen coupled to a built-in self-test system and an optional printer allows close system surveillance and rapid intervention in case of system fault.

Harris acquires ADDA

Harris, Melbourne, FL, has recently acquired product rights, inventories and equipment of ADDA. Manufacturing of some of the ADDA products will be transferred to the Harris Video Systems operation, located in Mountain View, CA. Harris also plans to offer parts and repair services for selected products that were in the ADDA line.

CRL purchases assets

Circuit Research Labs, Tempe, AZ, recently purchased certain assets of MicMix Audio Products, manufacturer of audio sound reinforcement equipment. These assets consist of inventory, patents, licenses, contract rights and business name.

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Circle (112) on Reply Card

Portable multifunction mixer

Panasonic has introduced the WR-133 Ramsa multifunction portable mixer. The mixer's eight channels are equipped with electronically balanced XLR inputs and transformer-balanced outputs. Input channels 1 through 4 offer a separate phono input position, each with a magnetic cartridge pre-amp, to accommodate two stereo turntables. These channels have a sensitivity range of −80dB to +10dB, while channels 5 through 8 have the same lower sensitivity, but will accept high-level inputs of up to +20dB. The 6-position input level master will accommodate signals along the full −80dB to +20dB range.

The mixer uses dual concentric equalizer controls for a 15dB boost or cut at the 10,000Hz and 50Hz levels. The mixer contains two auxiliary sends to route signals other than the main mix to appropriate sources, permitting on-stage monitoring in cases where the mix should differ. Additional functions include a mono output, an effects send control, input fader, pan control, peak level indicator and monitor select. It comes with a transport case, but can be rack-mounted in permanent installations.

Circle (365) on Reply Card

Digital effects processor

Lexicon has introduced the PCM-70 digital effects processor with dynamic MIDI (musical instrument digital interface) control. Software packages, in the form of plug-in chips, can be changed as new programs become available. Thirty separate programs are incorporated into the package.

The dynamic MIDI concept is fully compatible with other MIDI equipment. It enables remote control through a MIDI keyboard or other MIDI control devices. Ten effects or reverb parameters can also be assigned to a controller or keyboard. The parameters can be varied dynamically through the controller and can be assigned to vary with key velocity, pressure or aftertouch.

The unit offers complete user control of all functions with a 16-character fluorescent alphanumeric monitor display. The front-panel controls consist of dedicated keys and a soft knob which can be assigned to as many as 10 separate control parameters simultaneously for a grandmaster control.

Circle (364) on Reply Card

Omnidirectional dynamic microphone

Shure Brothers has announced the SM63L omnidirectional dynamic microphone, an elongated version of the SM63 mic. It has an omnidirectional pickup pattern and is 3½ inches longer and lighter weight than the SM63. The mic features low-frequency rolloff and a mechanical isolation system for handling noise. Other features include a humbucking coil that minimizes noise from electromagnetic hum fields, a built-in breath and pop filter, a Veraflex grille that will not dent or rust and a champagne-colored finish.

The mic is available in two versions: the SM63L-LC (supplied without cable) and SM63L-CN (supplied with a 25-foot Triple Flex audio connection cable with professional 3-pin connectors). Both models include an accessory windscreen and a swivel adapter for stand-mounting.

Circle (366) on Reply Card

Videotape storage cabinets

Luxor has introduced a locking drawer cabinet that provides extra security for VHS or Beta videotape storage. Five different models available in five different colors will accommodate from 30 to 144 tapes. The cabinets also are stackable.

Circle (351) on Reply Card

Chase synchronizer system

Audio Kinetics and *Tascam* have announced the Pacer and Code 1 chase synchronizer systems. Pacer and Code 1 are single-rack units compatible with all international time codes. An internal time-code generator is capable of jam-sync operation and can be locked to house sync or an external video source. The twin dynamic readers are capable of reading code from 1/20 to 80 times play speed in both directions.

The synchronizer is a hard-lock system with chase capability offering slave machine control with the optional control pad or via the RS-232C/422 computer port. Automatic calibration with battery backup and automatic offset calculation can be manually trimmed by frame and subframe. The system is designed for a wide range of applications from locking up two ATRs to adding audio to a control track editing system or to ¾- to 1-inch production suites.

Circle (360) on Reply Card

Time code autolocator

Otari has introduced the model CB-120 autolocator for use with the MX-70 multichannel recorder, the MTR-10/12 series II and new MTR-20 2- and 4-track mastering recorders. The autolocator is designed to make audio for video production more efficient by taking over the routine tape operator functions of storing and locating specific locations on the tape. With the optional time-code reader/generator installed, the unit brings the precision of SMPTE edit code to the auto-record punch in/out process.

Features of the unit include punch-in rehearse mode, optional RS-422 serial interface, 99 memories with 10 single button store/search memories, repeat looping, head and tail guard points, adjustable preroll and review, three user-defined functions, two event relays, footswitch punch-in, search-start, review, cue shuttle lever, built-in hours, minutes, seconds/frames calculator and a non-volatile memory.

Circle (350) on Reply Card

Distribution amplifiers

Grass Valley Video Systems has introduced the series 32 line of 32-output distribution amplifiers. The modular DAs are packaged in a 1-rack unit steel frame with redundant power supplies. The power supply system includes a monitoring circuit with a relay closure for an external alarm. All components are standard items with no custom or selected parts.

The DAs can prevent the risk of failure of looped multiple amplifiers or unwanted variation between outputs. Modules are available for video, balanced audio (+24dBm) or stereo audio (+10dBm) with differential inputs and current limit protected outputs.

Circle (359) on Reply Card

Stereo submixer

Solid State Logic has introduced the stereo submixer. This stand-alone 19-inch rack-mountable unit is based on two sections from the SL 5000 M series audio production system.

Each submixer holds one SL 554 master and up to eight SL 504 input/output modules. Additional 4U high frames holding up to 10 I/O modules can be cascaded to provide any number of inputs. The master unit features four stereo mix groups with electronically balanced outputs, rotary attenuators and stereo AFL from every group. Twin 12-segment LED bar graphs provide output metering. A stereo headphone amplifier and jack also are provided.

Each SL 504 I/O module provides an electronically balanced line input, a transformer-coupled mic input with a 90dB gain range and a ±10dB fine trim control, which operates on

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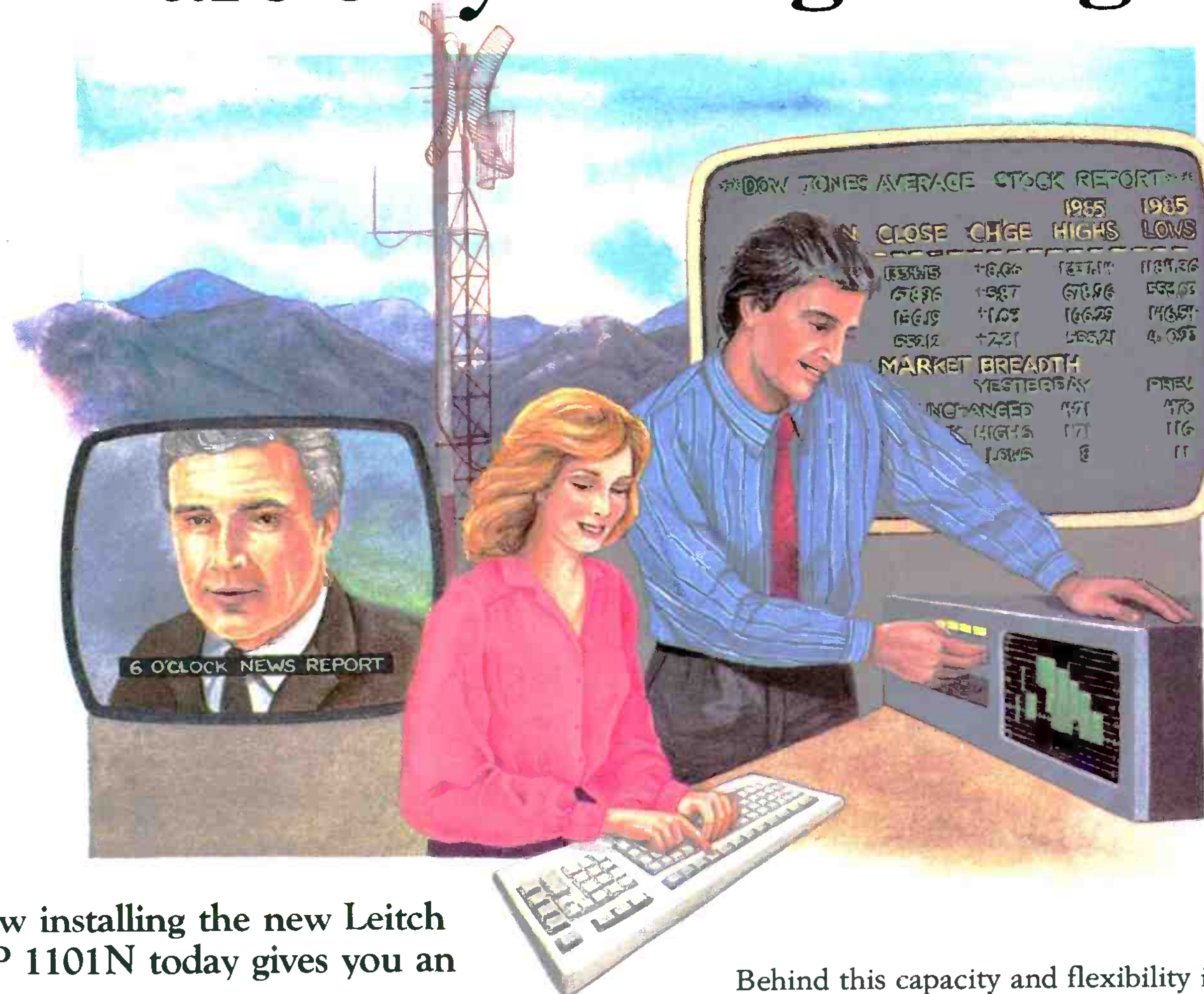

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Behind this capacity and flexibility is a combination of advanced techniques -- microprocessor control, digital technology and the most recent developments in analog circuit components.

The new Leitch VIP 1101N also offers comprehensive self-diagnostics including set-up and timing modes. Two vertical signal inputs are standard. But the VIP 1101N is expandable to nine inputs -- a feature unique to Leitch. It is also programmable up to 4 fields.

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either mic or line signals. Output level control is provided by a precision 65mm Penny & Giles linear fader. The electronically balanced outputs may be routed to any of the four stereo mix groups on the SL 554 master cassettes individually or by central assignment. Direct output feeds are available either pre- or post-fader. The submixer may be manually operated or linked with the SSL instant reset computer of any SL 5000 M series console.

Circle (361) on Reply Card

Field expandable console

Mitsubishi Pro Audio Group has introduced Quad Eight's Westar console. Console frame sections, patchbay, meter sections, plug-in interchangeable equalizers, pre-amplifiers, VCAs and faders are modular in design. Lightweight bolt-together frame sections of eight I/Os each make the console available in 20-, 28-, 36-, 44- and 52-I/O-channel configurations. All interconnections are through-shielded ribbon cables. The modular PC card patchbay expands with the number of inputs.

The input/output modules use a dual in-line design with line trim, equalizer, filter, eight echo/cue sends and fader switchable between the main channel and the monitor/mixdown channel. Each module is selectable to any of 24 mixing buses with odd/even panning. Transformerless or transformer pre-amplifiers with single or dual inputs, VCA circuit and equalizer are plug-in units.

A floating meter bridge houses a 60-segment LED bargraph meter system selectable to VU, peak, VCA level or ⅓-octave spectrum analyzer.

Circle (358) on Reply Card

Microprocessor-controlled recorder

Studer Revox has introduced the A810 microprocessor-controlled recorder. Different head configurations on the 4-head, plug-in headblock provide flexibility for recording, playback and machine synchronization with Neopilot, FM pilot and SMPTE time code.

The primary stereo audio version, the A810-2-TC/FM/NEO VUK, allows the user to record and reproduce stereo audio with time-code information. When supplied with an external code source, this version also can perform immediate replacement of FM Pilottone with SMPTE code.

The A810-½-NEO/FM/TC VUK has playback-only capability for all formats (mono or stereo audio plus Neopilot, FM Pilot or SMPTE code) without changing headblocks. For monophonic applications, the A810-1 PVUK provides recording and playback of audio with Neopilot signals.

Film audio versions retain all features of the standard A810, including programmable front-panel function buttons, four speeds, digital setting of audio parameters, advanced phase compensation in audio electronics, automatic system self-diagnosis and precision milled die-cast transport chassis.

Circle (363) on Reply Card

Multi-use professional mixers

Panasonic has introduced a set of Ramsa compact multi-use professional mixers, including one with a built-in amplifier: the portable WR-XO1 and the WR-PO1. The WR-XO1's eight stereo and four balanced mono inputs permit the simultaneous connection of a complete range of program sources. This capability enables various audio tracks to be mixed in audio-video and audio post-production.

The mixer employs an auto mute function that reduces a stereo program source without adjusting the fader levels. Muting is adjustable from −6dB to −20dB, so that the stereo signal can be reduced or eliminated. The mixer uses stereo faders and built-in compressor on mono channels to produce high-quality sound. With the fader, the level of each stereo input channel can be controlled from the master fader. All mono input signals are routed through the compressor, to prevent distortion and smooth out the wide dynamic range of the human voice.

The WR-PO1 offers the same features as the WR-XO1, but adds a built-in, 200W-per-channel power amplifier to expand mobility and flexibility. It also is equipped with a road case.

Circle (357) on Reply Card

Electronic production peripherals

Otari has introduced the EC-201 time-code reader and the EC-102 stand-alone synchronizer. EC-201 features the capability to read LTC in a range from 1/20th to 60 times speed, an LED display that is user-selectable to alternately display the hex user bits (with tally), balanced XLR-type I/O with reshaped time-code output of +4dB and ac mains operation via a plug-in transformer or internal battery.

Additional features include a hold button with 2-color tally to indicate run/hold mode (also serves as a power-on indicator, user-selectable time-out that will turn off the LED display when no code is present). EC-102 is a compact, self-powered (110/220) 1¾" x 19" standard rack package that houses a high-performance synchronizer. The device is specifically developed to interface with these Otari tape recorders: the MTR-10/12 series II, 2- and 4-channel master recorders; the MX-70 multichannel 8/16 channel recorders; the MTR-20 4-channel master recorders and the 5050 Mark III series.

Circle (373) on Reply Card

Noise reduction package

Dolby Laboratories has introduced the XP series multitrack noise reduction package. The series contains up to 24 channels of Dolby A-type noise reduction. The 4-band low-level signal processor offers 10dB signal-to-noise ratio, crosstalk and print-through improvement.

The series features a power supply and dedicated noise reduction circuit design rather than carrier card/plug-in assemblies. The series also features detented calibration trim controls, discrete FET noise reduction control switching and individual channel hardwire bypass.

Circle (354) on Reply Card

Wireless microphone

Sony Professional Audio Division has introduced the WRT-67 UHF dynamic wireless microphone. The mic operates on the same frequencies as the WRT-57 electret condenser wireless mic. The mic is suited for studio recording environments where multiple microphones are used.

The mic offers wide dynamic specs and features a dynamic mic capsule, which eliminates disruptive breath pop and helps control feedback. The mic incorporates a 3-position (0dB, −10dB, −25dB) pad switch to prevent overload distortion at high pressure levels. The mic uses AA-size batteries.

Circle (368) on Reply Card

Microwave antenna

Spatial Communications has announced the Microtenna, an MMDS/ITFS multichannel TV microwave receiving antenna. The unit combines a dielectric lens antenna with an integrated downconverter.

The small antenna is 4½ inches at its base, is 15 inches long and weighs 1.5 pounds. The antenna provides more than 56dBi gain for specific MMDS/ITFS channel groups in the 2,500MHz to 2,700MHz band. It provides more than 48dBi gain across the entire band. The antenna also has a 25dB front-to-back ratio.

Compared to conventional parabolic-reflector antennas, the Microtenna's small profile presents less wind resistance and virtually eliminates ice loading. An integral downconverter directly couples to the antenna driven element, eliminating the use of cable or waveguide and the resultant signal losses at microwave frequencies. A noise floor of 3dB is exhibited at the converter output.

Circle (355) on Reply Card

Studio mastering tape

The Magnetic Tape Division of *Agfa-Gevaert* has announced the PEM 469 standard bias mastering tape in a 2-inch width. The tape gives clean reproduction using standard bias. Improved headroom allows for a wider dynamic range for critical recording applications. Print-through assures minimum pre- and post-echo. The tape also offers an advanced binder. It is available in ¼-inch and ½-inch reels and hubs, and 1- and 2-inch-width reels. The 2-inch tape comes in a 5,000-foot length on a 14-inch reel for long play applications.

Circle (372) on Reply Card

Telephone line surge suppressor

Perma Power Electronics has announced the model PD 200 Tele-Line surge suppressor, to protect communications equipment from power surges or voltage spikes. The system is a wall plug-in unit and provides full protection, even if the surge arrestor at the primary telephone service entry is non-functional.

The system employs a 3-element gas tube and three metal oxide varistors (MOVs) in a coordinated circuit. The system connects to the power line ground through a power receptacle. A front-panel indicator confirms that the proper ground connection has been made.

The system provides normal/metallic (line-to-line) and common/longitudinal (line-to-ground) protection modes, with a clamping voltage of 180V and a let-through voltage of 350V peak maximum. Response time is 5ns. Pulse life is 10,000 cycles and the peak current is 2,500A. The suppressor has a tan plastic housing that measures 3⅛" x 4¾" x 2¼". It is equipped with two R-11 modular Tele-Line jacks and has a 1-year warranty.

Circle (353) on Reply Card

Cassette deck

Studer Revox has introduced the B215 cassette deck, which features a comprehensive alignment system to calibrate the deck. Operating under microprocessor control, the automatic alignment uses test tones at 400Hz, 4kHz and 7kHz frequencies to set bias and equalization. The 20-second procedure aligns the two stereo channels independently. Once the calibration is complete, the setting may be stored in digital memory for instant recall. Settings for up to six different tape formulations may be stored.

The recorder is a 3-head design with a microprocessor-controlled 4-motor transport. Two direct-drive dc motors are used for tape spooling, while two quartz-locked Hall-effect motors are used to drive the dual capstans. The die-cast transport chassis has a hinged headblock for stability in the head azimuth plane.

Other features include Dolby B and C noise reduction, Dolby HX pro headroom extension, two memory autolocate buttons, automatic start-of-record locate, loop mode, elapsed time counter, automatic computation of elapsed time on partially wound cassettes, automatic record fade-in/fade-out, infrared remote control capability and bidirectional serial data bus for external computer control. Frequency response is 30Hz to 20kHz signal-to-noise ratio of better than 72dB and wow and flutter of 0.035%.

Circle (374) on Reply Card

High-energy digital audiotape

Ampex Magnetic Tape Division has announced enhancements to Ampex 467 high-energy digital mastering tape. Changes in the 10½-inch and 14-inch reels of ½-inch and 1-inch 467 tape have been made to ensure tape protection. The new reel style will feature a solid back flange and a 2-windage hole front flange for better protection of the sensitive tape edges during handling.

The tape length on 14-inch reels of ½- and 1-inch 467 digital audiotape will be increased from 9,200 feet to 9,700 feet, providing users with 64 minutes of recording time at 30ips. This increase will assist in synchronizing the audio and video portions of 60-minute programs during post-production editing.

Circle (369) on Reply Card

Power amplifier

Sony Professional Audio Division has introduced the TA-N7050 power amplifier. With a maximum power rating of 45W per channel rms into 8Ω or 70W per channel into 4Ω, the unit is intended for master monitoring in audio production. Other applications include sound reinforcement and audio conferencing.

Frequency response is within ±0.1dB from 20Hz to 20kHz. Harmonic distortion is less than 0.1% and S/N is rated at 114dB. A bridging circuit for high-power applications allows monaural operation of 150W rms into an 8Ω load, while automatic short circuit protection shuts the amp down in the event of a shorted output. LED indicators on the front panel alert the operator to overload, signal presence and signal clipping conditions. The unit measures 19⅛"x13½"x17¾" and weighs 27 pounds and 9 ounces.

Circle (367) on Reply Card

Studio mastering tape

BASF has introduced Studio Master 911 tape. The tape is a ferric formulation that is compatible with all of the popular products used in American recording studios. A 2-inch tape will be offered in 2,500- and 5,000-foot lengths; 1-inch tape in 2,500 feet on NAB hubs or NAB metal reels; ½-inch tapes in 3,280 feet and ¼-inch tapes in both 2,500- and 3,280-foot lengths. Measured at a bias ratio of 0dB, the formulation has a maximum output level of +12dB with 3% THD at 1kHz. Total harmonic distortion at 320nWb/m is −70dB, and weighted dc noise is −54.5dB. Signal-to-noise ratio is listed at 76.5 and print-through is 57dB.

Circle (375) on Reply Card

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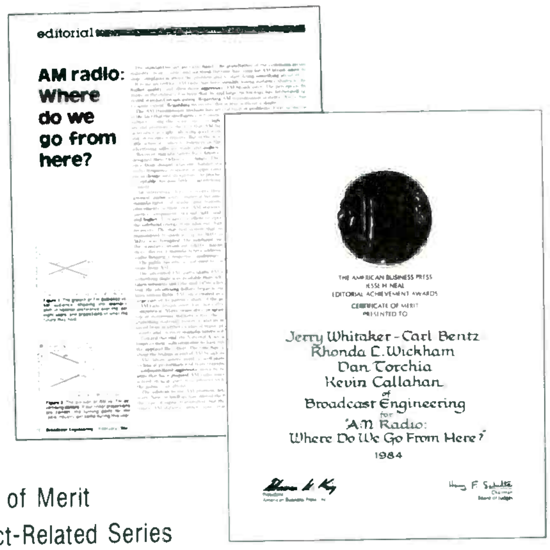

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