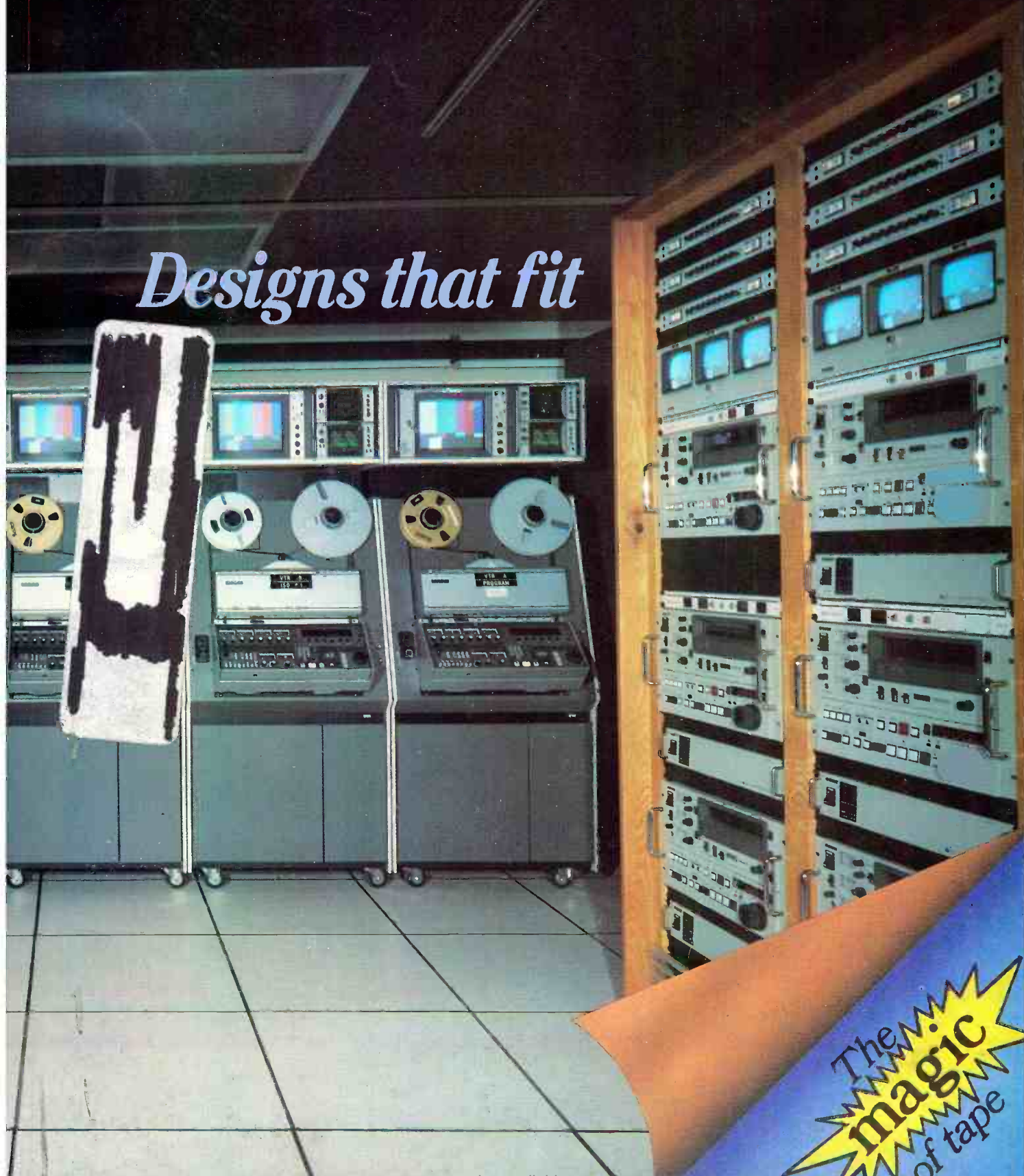


BROADCAST[®] engineering

May 1985/\$3

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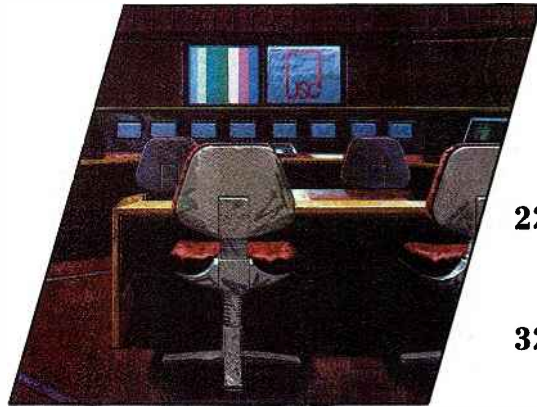
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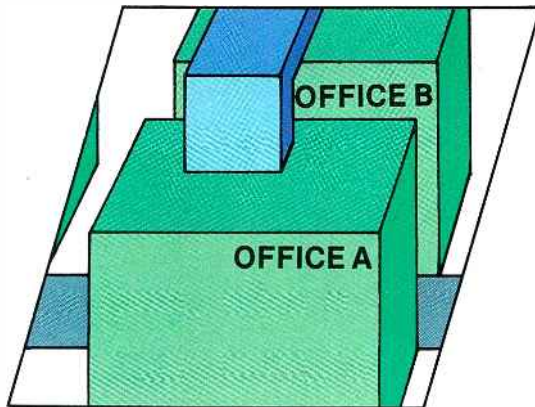
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 **Hitachi**

ATSC recommends HDTV standard

The U.S. Advanced Television Systems Committee (ATSC) High Definition Television Technology Group, chaired by Renville H. McMann, vice president, Advanced Television, CBS Technology Center, Stamford, CT, approved a list of recommendations on a worldwide HDTV studio standard in late March. This action will form the basis of the ATSC's recommendation to the U.S. State Department in preparation for a meeting later this year of the CCIR, a worldwide organization to which the United States and 156 other countries belong.

The group recognized "that a worldwide standard is desired" and recommended that the standard be 1125 lines, 60 fields per second, 2:1 interlace, and have an aspect ratio of 5.33:3. It also recommended that work continue on other parameters including colorimetry, gamma and constant luminance.

It further recommended that work continue during the next CCIR cycle on 60/Hz 1:1 progressive scanning.

"The ATSC is recognized as the pre-eminent authority in the United States on advanced TV systems," said ATSC Chair-

man E. William Henry. He also said that the Society of Motion Picture and Television Engineers (SMPTE) had provided valuable input in these deliberations.

Readers respond to Strictly TV topics

Some reader responses on some recent TV topics in **BE** are worth sharing. In "Transmission Standards: A Reign of Confusion," (January) one reader pointed out the PAL-M variation. PAL-M is a 60-field system with a 3.5761149MHz color subcarrier and a H/Sc relationship of 909/4. The horizontal line frequency is 15.734 (as in NTSC) but the typical PAL 25Hz offset is not used.

To a former FCC FM/TV specialist, the horizontal sync interval in "Inside TBCs" (February) should be clarified to coincide with present FCC standards. The writer suggests three other pulse widths should be given. Sync to end of burst may have a maximum of 7.94µs; the breezeway between sync and burst has a minimum of 0.38µs; and the sync rise time is a maximum of 0.254µs between the 10 percent and 90 percent points.

Although RS-170A uses half amplitude points to measure pulse durations, FCC

rules use a reference at 10 percent into sync. Always refer to the FCC when making timing adjustments. Non-standard or out of tolerance values could result in an FCC citation.

Finally, in "Piezo-electric?" in the February issue, a choice of words generated poor DT (dynamic tracking). The track angle recorded in Type C format does not vary. When non-standard speeds are involved, an apparent discrepancy from the angle confronts a non-dynamic tracking head. Correction voltages to the DT head result in proper tracking as seen in scan B.

WOSU/BE sponsor '85 conference

The Fifth Annual WOSU/Broadcast Engineering Conference, co-sponsored by the WOSU stations and **Broadcast Engineering** magazine, will be held July 23-25, at the Fawcett Center, Columbus, OH. The registration fees will be the same as last year. For registration and exhibitor information contact John Battison, director of engineering, WOSU Stations, 2400 Olentangy River Road, Columbus, OH 43230. The phone number is 614-422-9678. I:-~)))))

BROADCAST engineering

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What we print

This issue of **Broadcast Engineering** marks a milestone in our efforts to bring technology into focus for our readers. May 1985 marks our 26th year of publishing. It also marks the beginning of a new graphic design for the magazine. We devote this month's column to discussing with our readers *what we print*.

A trade journal is more than simply words and pictures on a printed page. It is *readers*. Readers who find they can rely on the publication to provide them with useful, accurate and timely information on topics important to their daily work. This has been the goal of **BE** since its inception.

The theme dates back to our first issue. In an introduction to the broadcast engineering community in the May 1959 issue, then editor and publisher D. E. Mehl stated the goals of the new magazine:

"In this day of rapid technical developments, it is difficult to keep informed of the many technical phases of the industry. The goal of **Broadcast Engineering** is to bring to its readers as much technical information on current developments as possible so that all may benefit from their ideas, and to make that information available to everyone who desires it."

The goal is just as important today. In recognition of the needs of the reader, we have taken a hard look at our editorial coverage of the broadcast industry with an eye toward improving what we print. You have seen in recent issues the results of that examination. Feature articles now concentrate on equipment design, operation and maintenance more than ever before. We believe this back-to-basics approach results in a magazine that is more useful to you, the reader.

Our graphic redesign, which we launch with this issue, updates the look of the magazine to the new editorial style already in effect. The goals of the redesign are to make **BE** easier to read, more informative and more appealing to the reader. The graphic design of a trade journal, while often subtle, can be critically important to the ultimate readership of individual articles. The best article in the world is of little value if it is not read by its intended audience.

A part of this new look involves new titles for the *AM Stereo Update* and *Satellite Update* columns. They have been re-named *re: Radio* and *Satellite Technology*, respectively. The new designations give us greater flexibility in the subject areas covered in the columns.

Although graphics are important to any magazine, content is always our top concern. Our goals are accuracy, completeness and fairness in coverage of all topics. We take seriously what we print.

We are also proud of our publication. The editorial staff of **Broadcast Engineering** has been awarded a coveted *Certificate of Merit* in the annual Jesse H. Neal Award competition, sponsored by the American Business Press. Often hailed for its pre-eminence as the "Pulitzer Prize" of the business press, the *Neal Award* is the business publishing industry's salute to the outstanding efforts of individual editors. Our editorial staff was named to receive a Certificate of Merit for an editorial titled, "AM Radio: Where Do We Go From Here?" The column discussed the future of AM radio and outlined the steps that led to the problems that standard broadcasting is facing today. The editorial was carried in the February 1984 issue.

So, why is this important? Because we care about what we print and the industry that we serve. We demonstrated it with the **BE** proof of performance program for FM, launched last summer. We will demonstrate it again with proof programs for AM and television in the coming months. And we will continue to demonstrate it with practical, usable editorial features in every issue.

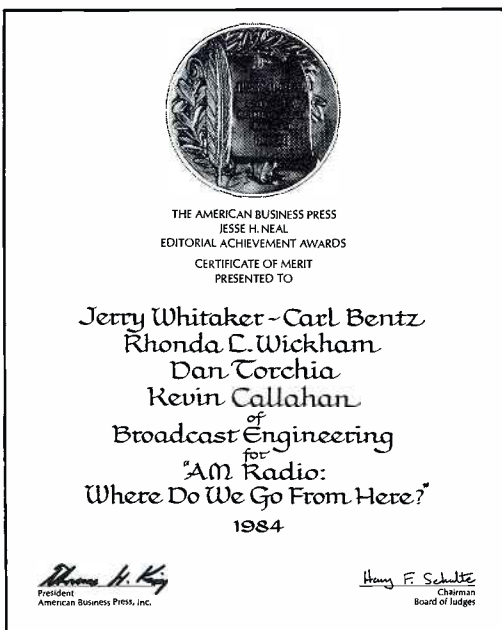
As always, we welcome feedback on how we are doing and how well we are serving our industry. We value your comments, suggestions and criticisms. They enable us to produce a better product. They also help us to gauge where the broadcast industry is, and where it is going.

This month, as we begin our 27th year of publishing, we thank you for your continued support. We want you to consider **BE** *your* book. This is the ultimate goal behind what we print.



Jerry Whitaker
Editor

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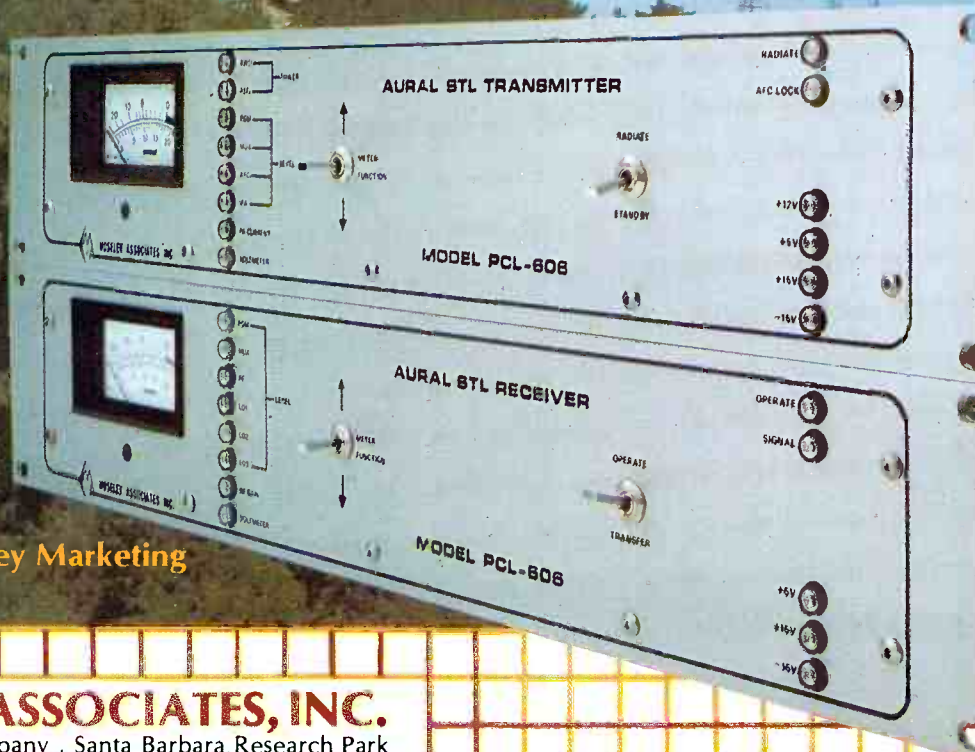
There's a jungle in the Angeles National Forest. Most of the broadcast transmitters for the greater Los Angeles area are at this single site on Mount Wilson. That means intense competition for both bandwidth and audience. The vast majority of Mount Wilson-based broadcasters choose Moseley because the PCL-606 and PCL-606/C Studio-Transmitter Links are tough, proven winners in both respects.

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Paving the way for 80-90

By Harry C. Martin

In March, the FCC took several important steps toward implementing the 689 new commercial FM allocations created under Docket 80-90. However, it did not open any of the new channels for application at that time. The commission also changed its FM application procedures by finally placing a freeze on the filing of most FM applications.

Other commission actions included:

- **Window processing.** The commission amended its rules by eliminating the "A" cut-off list procedure and replacing it with a window processing procedure.

Under the new process, the commission will establish a 1-time application filing period—or *window*—for all existing vacant FM channels or modifications to existing facilities. Although the commission did not announce when the first filing window would open, it will probably be within 90 days. (According to the commission, approximately 78 FM allocations currently are vacant. When new FM allocations are made available, additional filing windows will be established.)

Under the window filing process, mutually exclusive applications will be subject to comparative hearings to determine the best applicant. If only a single acceptable application for an allocation is filed during the window, then that application would be granted. In the event a window closes and no acceptable application is filed during that period, a first-come-first-served policy would go into effect under which the filing of the first acceptable application would preclude any competing applications for an allocation.

- **FM freeze.** As of March 14, the commission instituted a freeze on the filing of applications for new FM stations or modifications to existing FM facilities. The freeze was to continue until 30 days after the commission's report. An order adopting the window processing procedure was published in the *Federal Register*. During the freeze, new or major modification applications were accepted

only if they were filed in response to an "A" cut-off list of pre-freeze applications. Minor modification applications were accepted during the freeze only if they were filed in response to applications on file as of March 14.

- **80-90 allocations.** The commission

All in order?

Although FCC inspections know no season, checking out the broadcast system is far easier during the warmer times of the year. Now is an ideal time to check your operation and make sure everything is in order should the FCC visit you.

Keep in mind that although many of the logging regulations have been eased, it is the broadcaster's job to keep the station operating within the bounds of good practice and within the license. No doubt the field engineer will be looking closely to see how well stations are handling their obligations.

Keep in mind that the FCC's purpose for monitoring and inspecting is to assure satisfactory public service. To that end, inspections, possible citations and perhaps fines may be levied to non-complying broadcast stations.

planned to determine this month which of the Docket 80-90 allocations would open up first. Through a lottery, the commission was to assign a number from 1 to 80 to each of the 80 commercial FM frequencies (Channels 221-300). That number will represent the order in which the channels will be made available for application. For example, if FM Channel 237A is assigned number 1, all Docket 80-90 allocations for Channel 237A would be included in the first group made available for application. It appears it will be mid-June, at the earliest, before the first applications can be filed.

- **Daytime preference.** The commission has also decided to give the licensees of daytime-only stations special consideration, under certain conditions, when they apply for FM stations. The comparative value of a daytimer's broadcast experience has been upgraded to the

same level as local residence and minority ownership. But to obtain this upgraded credit, the owners of a daytime-only station must (1) have substantially participated in the management of a daytime-only station in the *same* community as the proposed FM station; (2) have owned the daytime-only station for three continuous years before designation of the FM application for hearing; (3) have proposed to be integrated in the FM station management; and (4) have pledged to divest the daytime-only station within three years after the FM station goes on the air.

Comparative hearings will be used, at least initially, to determine who will be awarded the new stations. If the commission's processes become bogged down because of a flood of FM applications, applications filed during later window periods may be subject to lottery. The commission says it will announce what selection process will be used before a filing window opens.

- **Rulemaking petitions.** Finally, the commission announced that it has resumed acceptance of petitions to amend the FM table of assignments. A freeze had been in place for many months.

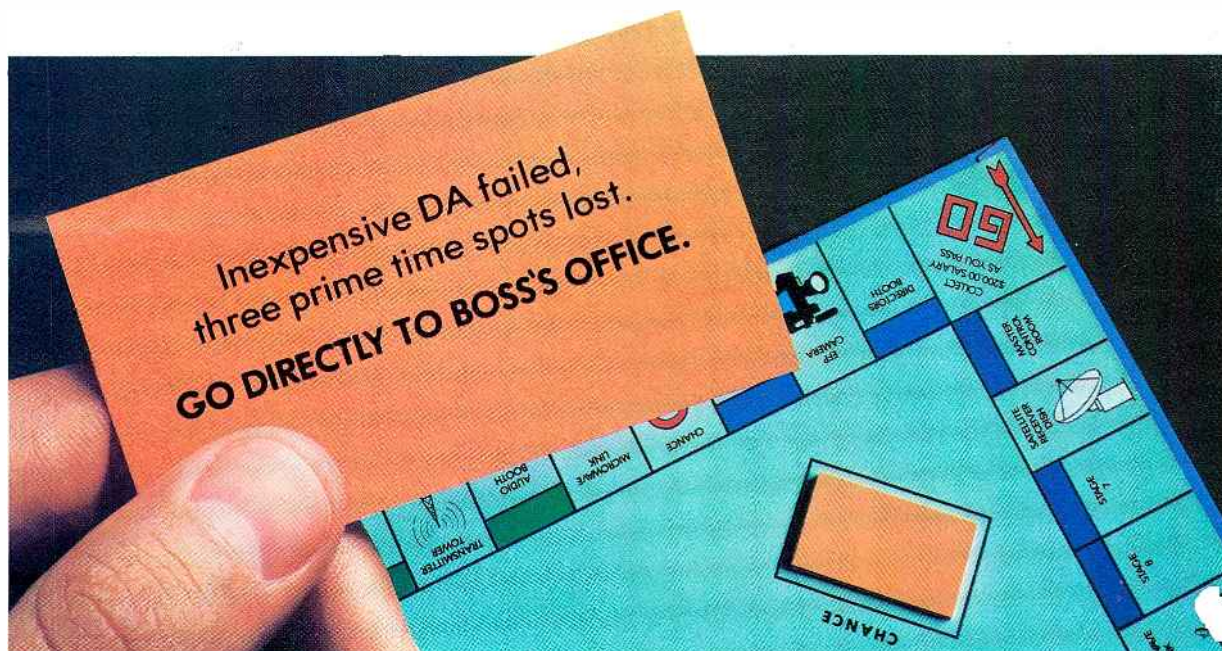
Blanking interval standards eliminated

The FCC has eliminated maximum vertical and horizontal blanking interval standards from its TV technical rules. The commission believes marketplace forces provide adequate safeguards in this area. Incorrect blanking interval timing affects only viewers of a particular station and not co-channel or adjacent-channel stations. Thus, picture quality for particular stations, not interference to others, is the issue.

This rule change should offer considerable relief to program producers. For the past several years, many stations have rejected syndicated programming because TV broadcast signal waveforms exceeded the maximum permissible values under the rules. Deregulation in this area will permit producers and broadcasters to work together to solve any problems that might occur.

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

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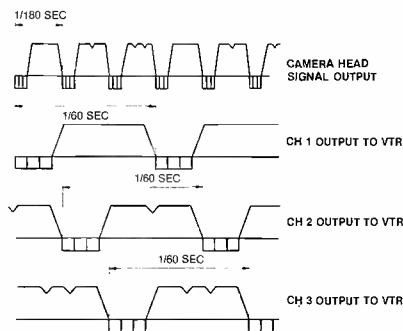
A movement in motion

By Carl Bentz, technical editor

Does HDTV appeal to the public? Industry observers believe a real demand for improved imaging exists. During the February SMPTE TV conference, recommendations to the ATSC committee on HDTV included a 5.33:3 aspect ratio, a 60Hz field rate and a preference toward sequential scanning. Still, HDTV must be sold to the viewers.

Talking with some viewers recently produced some surprises. Under better economic conditions, they said, they would consider purchasing a new receiver and the accessories needed for HDTV reception. Many said the price of current TV receivers is beyond their budgets. Rather than buying a new set, they would repair the current one if it failed, or in some cases do without.

SIGNALS FROM CAMERA



RECORDED TAPE PATTERN

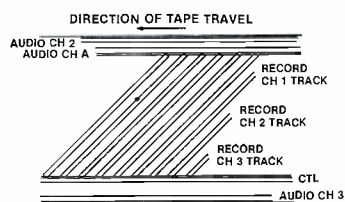


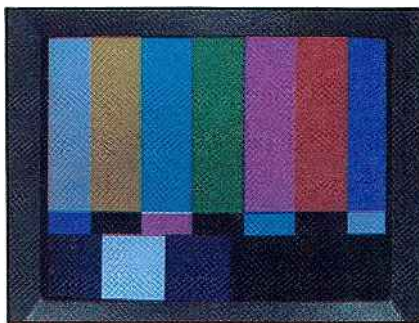
Figure 1. Generalized video signals of Super Motion camera and recording format.

Clearer competition

The 1984 Olympics coverage was the top TV sports event of the year. The varied arenas fascinated many viewers, as did the slow motion sequences.

Slow motion, first notably used at the Tokyo Olympic games, has been based on the videodisc recorder. Individual frames, recorded at a 3-frame/second rate, are reproduced at slower speeds. High speed motion shows as smear in each frame. Individual fields provide more clarity, but smear still exists.

In 1984, two approaches successfully reduced the smear effect of motion. One



increases the information seen. The second reduces image information sensed. The first produces exceptionally smooth slow motion, while the second provides sharpened images in real time playbacks as well as with typical slow motion systems.

During high speed motion, slight blurring occurs in a 1/60-second field. Tripling the scan rate of the camera (180 fields/second) decreases the amount of position change from field to field and thus smear. (See Figure 1.)

Video signals from the 525-line, 180-fields/second camera with A/D conversion and a field memory, yield 525-line at 60 fields/second. After encoding, three channels of video are applied to a VTR with three recording heads. The signals, staggered by slightly more than $21\mu\text{s}$, are written to tape moving three times faster than normal.

When the tape is reproduced at Type C play speed, the motion is one third normal. Because motion occurring between the original recorded frames is reduced, the result is greater clarity. (Figure 2.)

Higher definition appears on the viewer's screen with no investment by the viewer. The producer must invest in special cameras, processors and VTRs, but the amount is less than a proposed HDTV system. Tape reproduction is compatible with any C-format VTR, and, if dynamic tracking is available, speeds other than one-third normal are possible.

Shutter bugs

Another approach to clearer images requires modification to normal camera design, and may apply to a variety of cameras.* A rotating focal plane shutter breaks the optical path. Light that normally falls on the camera tube faceplate at all times is regularly interrupted at an adjustable rate from 1/500 second to 1/10,000 second. Object positions that occur when the shutter blocks the light are lost, along with the smear of those interim positions.

In theory, when the beam scans the camera tube, the slate is wiped clean with each 525-line pass. The time elapsed between reading (and erasing) any specific faceplate spot is an incredibly long 33.3 tms. A vast amount of movement can happen in that time. With a shutter chopping the light beam, faceplate exposure time is reduced. Interim motion smear is avoided. The output

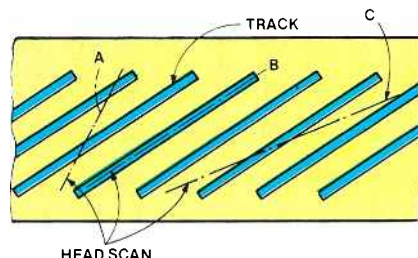
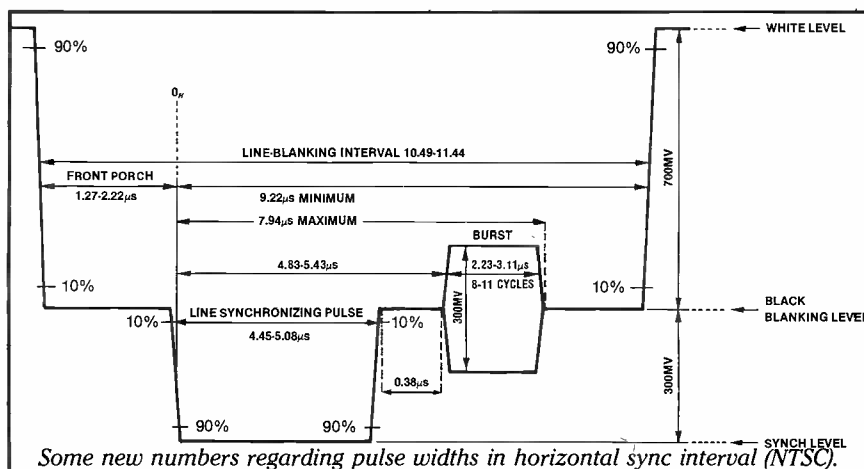


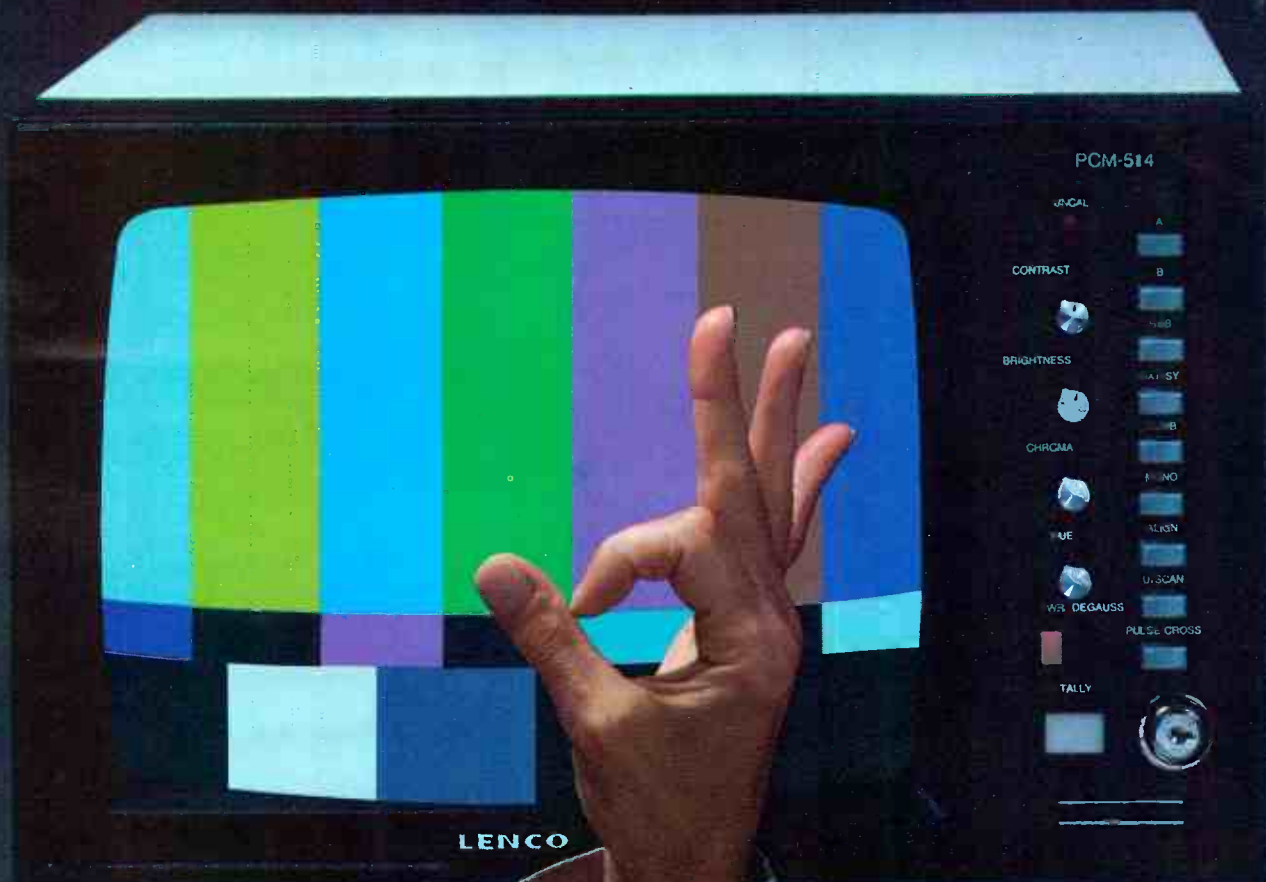
Figure 2. Possible apparent head scan tracks under varying tape speeds.

signal from the camera is standard NTSC.

Initially for motion analysis work, this type of system does make improvements in moving images. Also, high speed scanning or shuttered cameras allow transmission of a pseudo higher definition with current transmission equipment to current receivers.



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Maximizing AM modulation capabilities

By Bob Streeter

A conventional AM modulation monitor indicates the amount of envelope modulation of the transmitted carrier. An AM stereo modulation monitor, on the other hand, provides a readout of both envelope *and* angular modulation levels. Stereo monitors also provide for metering and test signal outputs of the demodulated left and right audio channels.

Some AM stereo monitors display the left and right output channels at half the modulation percentages normally found in an FM stereo monitor. This feature graphically displays the increased modulation capability afforded by AM stereo transmission. When the left or right modulation meter goes above 50 percent, it is indicating AM loudness enhancement resulting from *matrix* L+R and L-R audio processing.

There are other ways to examine the modulation of an AM stereo transmission system without the limitations of meter dynamics and modulation monitor peak *flasher* performance. The envelope can be examined with traditional oscilloscope techniques (trapezoid or envelope/time displays).

The stereo characteristics can be examined using a lissajous pattern scope display of the detected signal. The display can be set up by treating the AM stereo transmission system as the *unit under test* in a conventional X-Y oscilloscope setup (Figure 1). The left signal is fed to the vertical channel and the right signal is fed to the horizontal channel. For the display to make sense, the horizontal and vertical channels must be adjusted for equal deflections.

It is necessary to use caution when extracting information about modulation levels based on this method of measurement because of the physical rotation that may occur in the left (vertical) channel signal of the scope, compared to the right (horizontal) channel.

This effect implies that a 90° offset in the signal pattern exists, even though the



transmission system (unit under test) has no such offset. The effect is to give an incorrect length to the vector sum-and-difference information, as compared to the left and right audio channel data.

With the X-Y display properly set up, monaural center channel stereo L+R audio will be shown on the 45° line representing 0° phase offset. The length

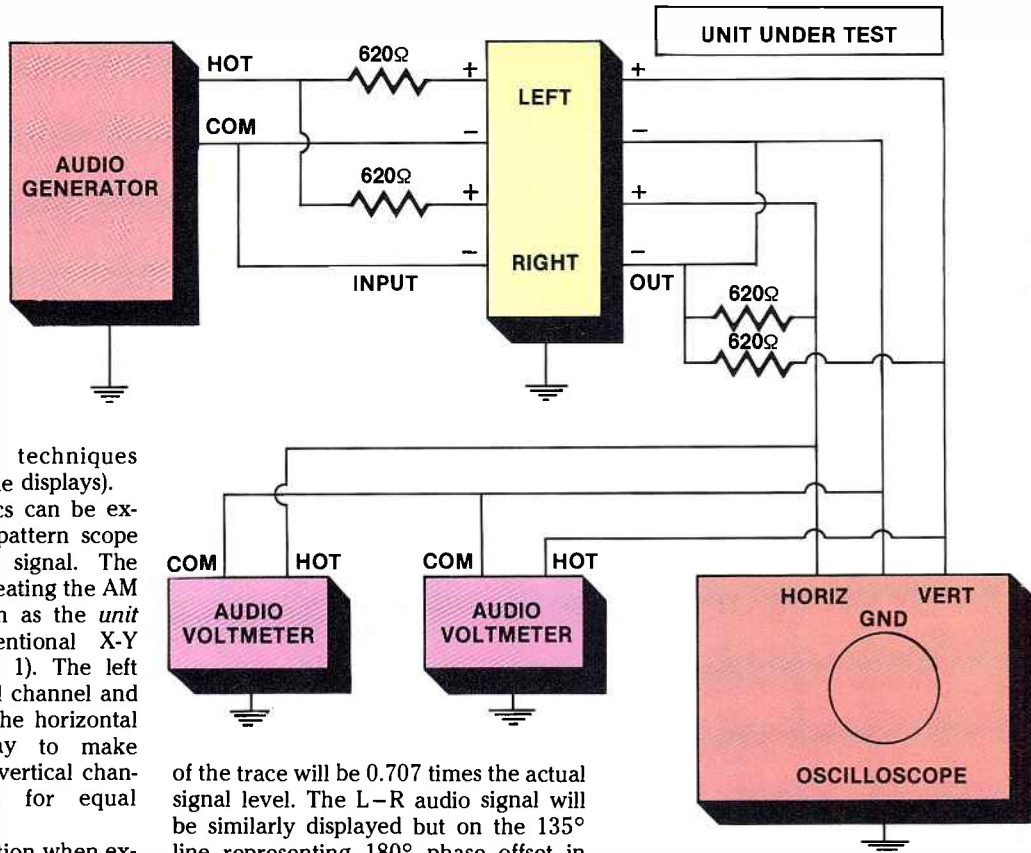


Figure 1. An X-Y lissajous oscilloscope display used for checking modulation levels of an AM stereo transmission system. Note that the unit under test is shown with single-ended inputs and outputs.

however, basic differences between AM and FM stereo that should be recognized. A correct understanding of AM modulation capabilities and audio processing requirements is necessary to achieve maximum performance from an AM stereo system.

Streeter is with the consulting firm AM Stereo, Fort Wayne, IN.



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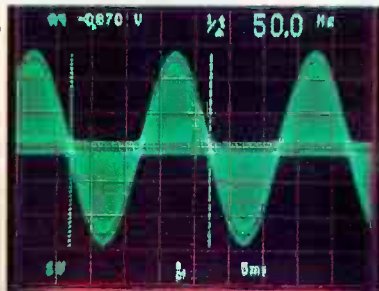
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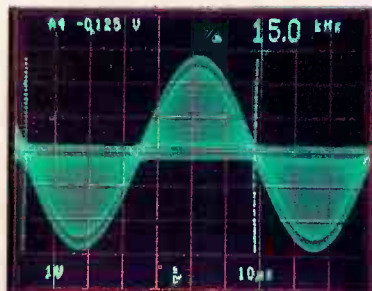
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The reception blues

Satellite communications becomes more fascinating as you consider the less than desirable factors that are involved. For example, the target at which earth stations are aimed is extremely small (invisible to the eye or telescope). Fortunately, the position of the satellite is well-controlled by station-keeping rockets that limit movement. Typically, the error is kept to small figure-eights around the intended location. Thus, once an antenna is aimed properly, there is little difficulty in positional alignment.

Finding a *look angle* for your antenna to a particular satellite can be approximated by using the graph on this page. Determine the site of your antenna on a map in longitude (degrees west) and latitude (degrees north) for the United States. From the table of *Satellite Orbital Positions*, determine the position of the desired satellite (degrees west).

Locate the difference in the two longitude numbers along the bottom axis of the graph and the site latitude along the right side. At the point where those two lines cross, you may determine the aiming elevation according to the arcs that terminate along the left side of the graph. The azimuth direction is shown by values along the top.

Uncontrollable factors

You can control the direction your antenna is pointing, but you have little control of other factors that cause signal degradation. Let us presume that all equipment is in top condition: that the LNA or LNC and receiver electronics are



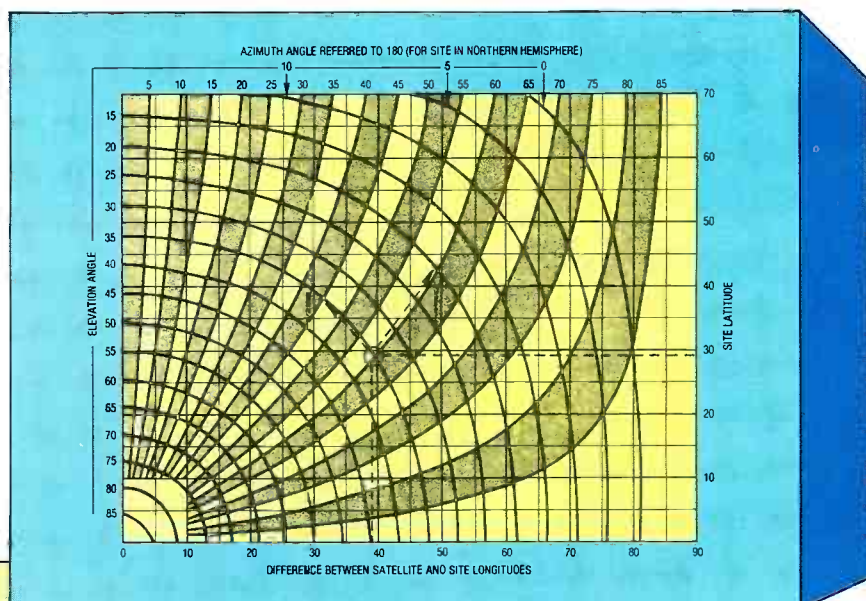
functioning properly; the dish is not riddled with bullet holes; and the deicer system reduces snow and ice buildup.

Your geographic location can affect reception. Footprints of the major satellites cover the nation with a usable signal. The signal level, however, is

greatest in the center of the coverage area and becomes increasingly weaker toward the edges. When your location is toward the edge, you may fall victim to other complications. Location becomes a critical factor in areas such as Maine and Alaska.

Atmospheric conditions do have a definite effect on signal reception. Let us see why. From a site in Kansas City, the look-angle elevation will vary from 22° to 45° as you scan the satellite arc. The antenna points upward at a reasonable angle.

In Anchorage, AK, however, a latitude of 61° means the receiving antenna will be pointed almost horizontally. The received signal must pass through more



Satellite Orbital Positions

Deg. West	Launch Date	Satellite	Band	Deg. West	Launch Date	Satellite	Band
67	10/85	Satcom 6	C	104.5	8/82	Anik D1	C
69	11/84	Spacenet 2	C/Ku	105	4/85	G Star 1	Ku
72	9/83	Satcom 2R	C	105	6/83	Anik C2 ³	Ku
74	9/83	Galaxy 2	C	109	11/78	Anik B	C/Ku
76	9/78	Comstar D3	C	110	6/83	Anik C2	Ku
77	9/85	Satcom Ku 2	Ku	111.5	11/84	Anik D2	C
79	6/74	Westar 2	C	112.5	4/85	Anik C1 ^{1,4}	Ku
83	1/82	Satcom 4	C	117.5	11/82	Anik C3	Ku
86	9/84	Telstar 302	C	120	5/84	Spacenet 1	C/Ku
87	5/85	Satcom Ku 1	Ku	123	6/82	Westar 5	C
89	8/85	Spacenet 3 ¹	C/Ku	125	5/85	Telstar 303	C
91	12/85	Westar 6S ²	C	127	2/81	Comstar D4	C
91	8/79	Westar 3	C	128	8/85	ASC 1	C/Ku
93.5	9/84	Galaxy 3	C	131	11/81	Satcom 3R	C
96	7/83	Telstar 301	C	134	6/83	Galaxy 1	C
99	2/82	Westar 4	C	139	4/83	Satcom 1R	C
103	10/85	G Star 2	Ku	143	10/82	Satcom 5	C

¹ Exact position to be determined.

² Replaces Westar 6, Westar 3 to be moved.

³ Anik C2 to be moved when G Star 1 is launched.

⁴ Temporary storage location.

atmosphere to be received in Alaska than for the Kansas terminal. Any foreign material in the air tends to diffuse or attenuate the received signals. Precipitation, dirt, smoke, etc., are all candidates for reducing signal quality.

High altitude sites and/or low look-angle situations (trying to see Satcom 1R from Bangor, ME) are subject to greater potential interference from other radio services as well. The extensive terrestrial communications networks in the 4, 6, 12 and 14GHz bands are all likely interference sources. Careful selection of the site is required, therefore, to reduce extraneous signal problems.

A final unavoidable problem is the *sun outage*. If the sun comes into the boresite in line with the satellite, the strength of the electromagnetic radiation of the sun overpowers that from the satellite. The result is a temporary loss of communications of approximately eight minutes duration.

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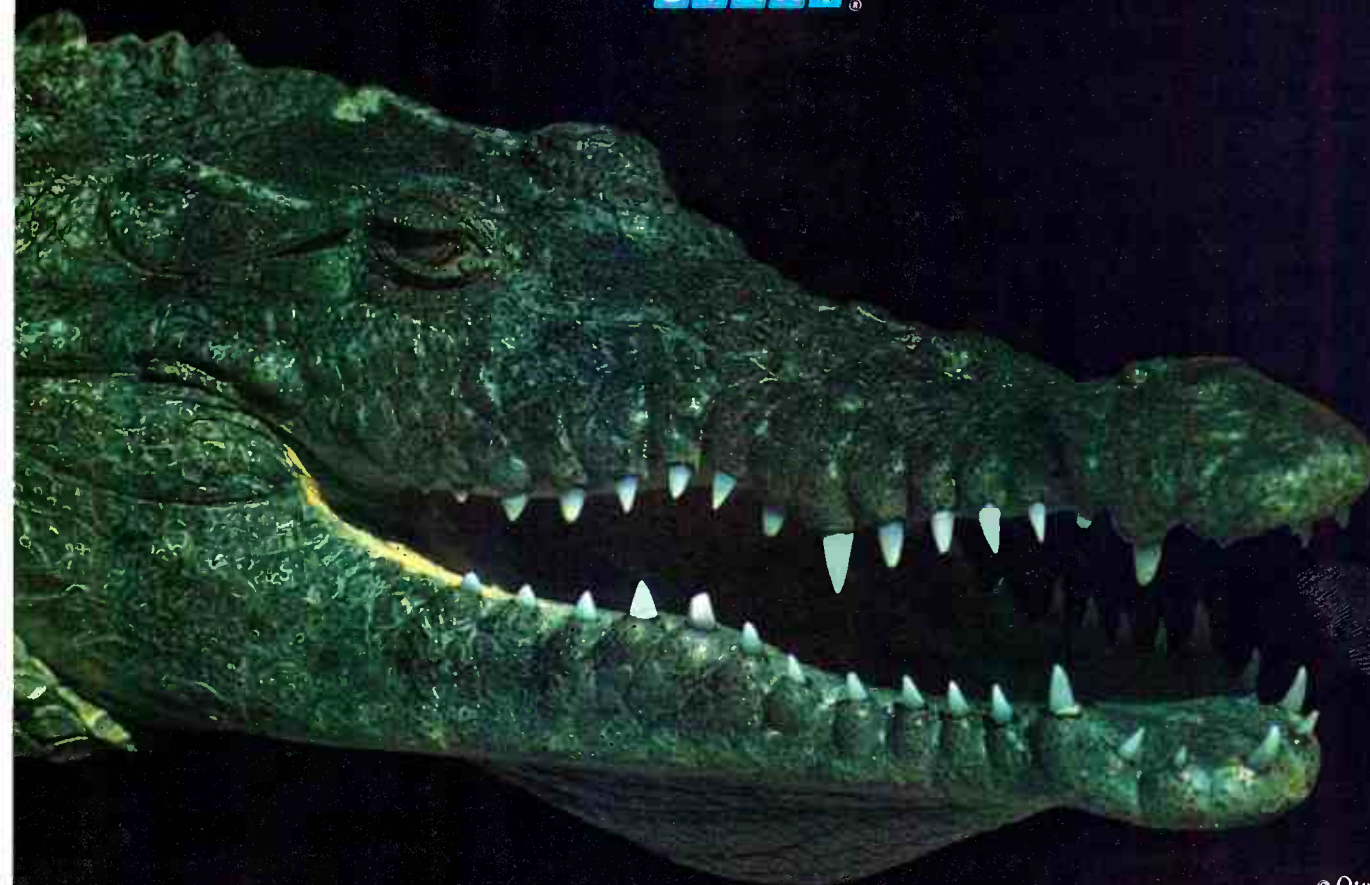
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1/2-wavelength cavity amplifiers

By Clarence Daugherty

A practical 1/2-wavelength PA cavity amplifier for FM service is shown in Figure 1. The rotary section of the plate resonant line, used to coarse-tune the cavity, functions as a variable inductor.

RF current flows in the same directions through the transmission line and the rotary section. The magnetic fields of the two paths, therefore, add.

When the rotary section is at a maximum

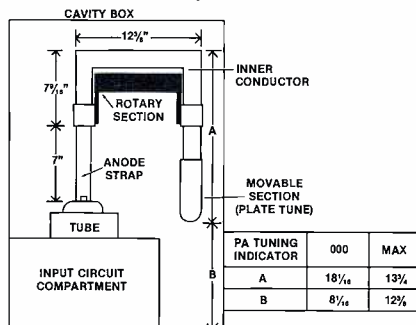


Figure 1. A practical FM 1/2-wavelength PA cavity.

imum height, the magnetic coupling between the main section of the transmission line and the rotary assembly is maximum. Because of the relatively large mutual inductance provided by this close coupling, the total inductance of these parallel inductors increases. This

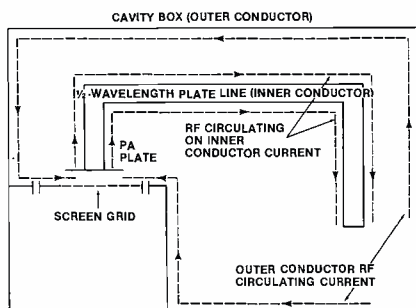
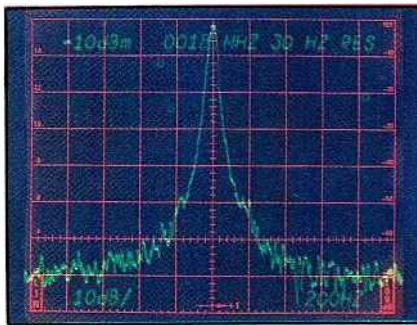


Figure 2. The circulating currents set up by an imaginary RF current generator located between the plate and screen grid.

electrically lengthens the transmission line and lowers the resonant frequency.

When the rotary section is at minimum height, the magnetic coupling between the two parts of the inner conductor is minimum. This reduced coupling lowers the mutual inductance, which lowers the total inductance of the parallel combination. Reduced inductance allows opera-



ting and capacitive coupling.

Capacitive coupling must take place at the maximum RF voltage point in the cavity. In our example, this point is located at the far end of the plate line.

Inductive coupling must take place at the point of maximum RF current. This area is located approximately 1/4-wavelength from the end of the inner conductor (Figure 3).

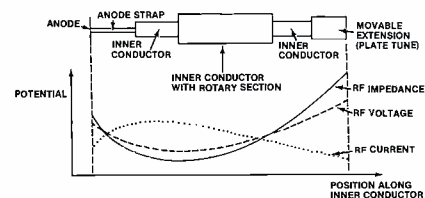


Figure 3. RF current, voltage and impedance for the inner conductor of the 1/2-wavelength cavity.

Plate tuning

The movable plate tune assembly shown in Figure 1 is located at the end of the inner plate transmission line. It can be moved up and down to change the physical length of the inner conductor by about 4 11/16 inches. This assembly is linked to the front panel plate tuning knob, providing a fine adjustment for cavity resonance.

RF circulating currents

Figure 2 shows the PA cavity RF circulating currents. The circuit impedance reflected back from the resonant circuit to the plate and screen circuit of the tube is 600Ω to 800Ω.

RF current leaves the plate and flows along the electrical 1/2-wavelength plate inner conductor. When the current reaches the far end of the plate line, current flow is stopped and a high RF voltage is developed between the cavity box (the outer conductor) and the end of the inner conductor.

As with any open transmission line, the high RF voltage developed at the end of the line pushes (reflects) the RF current back down the line to the plate. This establishes the RF circulating current, the same current that would be found in a conventional L-C tank.

If no load were placed on the resonant circuit, it would have an extremely high Q. The circulating currents would gradually dampen out over several cycles if the plate-screen circuit was to receive only one pulse from the grid.

As with any other transmission line, RF currents will flow in equal magnitude and opposite directions on the inner conductor and the outer conductor. The inner conductor determines the resonant frequency and the point at which the load is coupled to the circuit.

Coupling the load

Two methods can be used to couple energy out of the cavity: inductive cou-

In the 1/2-wavelength cavity shown in Figure 1, the two coarse tuning adjustments (the anode strap and the rotary section) are located just before and after the location on the line where inductive output coupling occurs. (See Figure 4.) Through proper combination of the coarse tuning controls, the point of maximum current can be placed exactly over the point of output coupling.

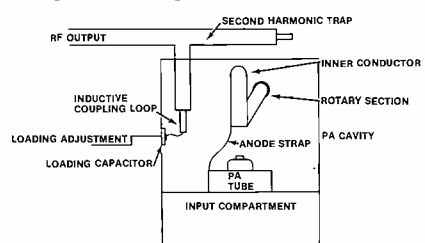


Figure 4. A side view of the 1/2-wavelength PA cavity showing the location of the inductive coupling loop.

At the far end of the plate line, RF current does not quite go to zero. RF voltage and impedance never get to maximum levels because of the capacity between the end of the line and the cavity box (outer conductor). This also has the effect of physically foreshortening (electrically lengthening) the inner conductor of the plate line.

Circulating currents and Q

The RF circulating current in the cavity is directly dependent on the loaded Q

Daugherty is senior technology instructor at Harris, Quincy, IL.

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Circle (111) on Reply Card

Troubleshooting hints

A plate supply overload can be caused by a number of component failures in a transmitter. In previous "Troubleshooting" columns, we have examined several potential causes, including antenna or transmission line VSWR, a faulty PA tube, arcing or component breakdown in the high voltage supply and control circuit failure.

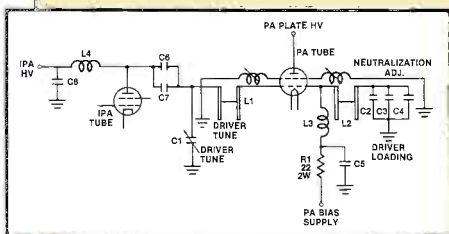
This month, we will concentrate on plate supply overloads that are caused by component failure in the PA tube grid circuit.

Grid circuit problems

Consider the following troubleshooting steps after first confirming that the plate supply trip-off is RF-based (not dc-based), that it is not caused by a problem in the load and not caused by a failure in the PA tube or its socket.

The PA tube may be checked by substituting one of known quality. When the tube is changed, carefully inspect the contact fingerstock for any signs of overheating or arcing. Be extremely careful not to damage the socket fingerstock when removing and inserting the PA tube.

The diagram below shows the input circuitry of a grounded screen, FM transmitter PA stage. Examine the grid



The PA grid input circuit of a grounded screen transmitter.

circuit. A short in any of the capacitors in the grid stage (C1-C5) will effectively ground the PA grid. This will cause a dramatic increase in plate current, because the PA bias supply will be shorted to ground along with the RF signal from the IPA stage.

The process of finding a defective capacitor in the grid circuit begins with a visual inspection of the suspected components. Look for signs of discoloration because of overheating, loose connections and evidence of package rupture. The voltage and current levels found in a transmitter PA stage are often sufficient to rupture a capacitor package if an internal short occurs.

Check for component overheating right after shutting the transmitter down. A defective capacitor will often overheat. Such heating can also occur, however, because of improper tuning of the PA or IPA stage or a defective component elsewhere in the circuit.

Before replacing any components, study the transmitter schematic

diagram to determine which parts in the circuit could cause the failure condition that exists. By knowing how the transmitter works, many hours can be saved in checking components that an examination of the fault condition and the transmitter design would show to be unlikely causes of the problem.

Check blocking capacitors C6 and C7. A breakdown in either component would have serious consequences. The PA tube would be driven into full conduction, and may arc internally. The working voltages of capacitors C1-C5 may also be exceeded, damaging one or more of the components.

Because most of the wiring in the grid circuit of a PA stage consists of wide metal straps (required because of the skin effect), it is not possible to view stress points in the circuit to narrow the scope of the troubleshooting work. Areas of the system that are interconnected using components that have low power dissipation capabilities, however, should be closely examined.

For example, the grid bias decoupling components in the diagram to the left (R1, L3 and C5) include a low wattage (2W) resistor and a small RF choke. Because of the limited power dissipation ability of these two devices, a failure in decoupling capacitor C5 would likely cause R1 and possibly L3 to burn out.

The failure of C5 in a short circuit would pull the PA grid to a near ground potential, causing the plate current to increase and trip off the transmitter high voltage. Depending on the sensitivity and speed of the plate overload sensor, L3 could be damaged or destroyed by the increased current it would carry to C5, and therefore, to ground.

If L3 were able to survive the surge currents that resulted in PA plate overload, the choke would continue to keep the plate supply off until C5 was replaced.

Bias supply resistor R1, however, would likely burn out because the bias power supply is generally switched on with the transmitter filament supply. Therefore, unless the PA bias power supply line fuse opened, R1 would overheat and probably fail.

Because of the close spacing of components in the input circuit of a PA stage, carefully check for any signs of arcing between components or sections of the tube socket. Keep all components and the socket itself clean at all times.

Inspect all interconnecting wiring for signs of damage, arcing to ground or loose connections.

Substitution

Substituting a new component for a suspected part can save time when troubleshooting. With some components, it is cost-effective to replace a group of parts that may include one defective component because of the time involved in gaining access to the damaged device.

For example, the grid circuit of the

PA stage shown in the diagram includes three doorknob capacitors (C2-C4) formed into a single assembly. If one device was found to be defective, it might be advantageous to simply replace all three capacitors.

These types of components are often integrated into a single unit that may be difficult to reach. Because doorknob capacitors are fairly inexpensive, it would probably be best to replace the three as a group. This way, the entire assembly is eliminated as a potential cause of the fault condition.

A good supply of spare parts is a valuable troubleshooting tool. In high-power transmitting equipment, substitution is sometimes the only practical means of finding the cause of a problem.

Many parts—particularly in the high voltage power supply and the RF chain—are difficult to test under static conditions. The only sure way to check the component is to substitute one. If the system returns to normal, the substituted component is defective.

Substitution is also a valuable tool in troubleshooting intermittent failures caused by component breakdown under peak power (or modulation) conditions.

The manufacturer's factory service department can often advise you on the recommended spare parts to stock. Obvious candidates for the spare parts inventory include components that are not available locally, such as high voltage fixed value capacitors and vacuum variable capacitors.

The past history of the transmitter is often useful in determining spare parts requirements of a particular piece of equipment. Compile a list of every component that failed from the station's maintenance log when considering spare parts requirements.

Next month, our examination of plate supply overload problems will concentrate on the output components in the PA stage.

Safety considerations

Any troubleshooting work on a transmitter should be done with extreme care. High voltages in a transmitter can be lethal. Such work should be performed only when a second engineer is with you.

Work inside the transmitter only after all ac power has been removed and after all capacitors have been discharged using the ground stick provided with the transmitter. Remove primary power from the unit by tripping the appropriate power distribution circuit breakers in the transmitter building. Do not rely on internal contactors or SRCs to remove all dangerous ac.

Be familiar with first aid treatment for electrical shock and burns. Always keep a first aid kit on hand at the transmitter site.

Do not defeat protective interlock circuits. Although defeating an access panel interlock switch may save work time, the consequences can be tragic.

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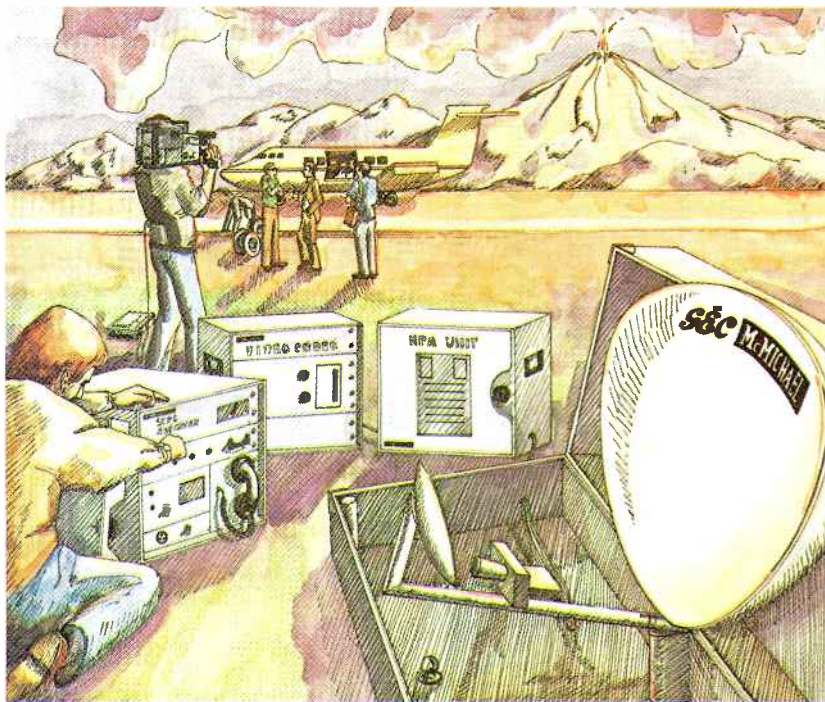
With GEC McMichael's unique Satellite News Gathering (SNG) FLY-AWAY, news events that previously could not be captured by existing television transmission systems can easily be covered "live," regardless of their location.

The entire FLY-AWAY system is compact and lightweight enough to be flown to remote locations in a private plane as well as by regularly scheduled airlines. Once on location, the SNG terminal can be quickly set up by as few as two men in ½ hour and powered by a hand-carried portable generator.

The entire FLY-AWAY system is compact and lightweight enough to be flown to remote locations in a private plane as well as by regularly scheduled airlines.

The SNG terminal equipment is packaged in three shock-mounted aircraft enclosures. The majority of which weigh no more than 80 pounds. Since the weight and size of the system are so attractive, it can easily fit into an econoline-type van, allowing rapid deployment for live satellite coverage of local events.

Designed for portability and quick, efficient set-up, the FLY-AWAY is composed of GEC-McMichael's unique elliptical Ku band antenna, uplink Ku band electronics and McMichael's own video compression bandwidth electronics.



Each of the three shock-mounted containers which make up the SNG system measures 27" x 24" x 21". The total system including uplink/receive electronics, antenna and portable generator weigh no more than 500 pounds total. The one-piece offset gregorian antenna measures 2 x 1 x .5 meters and weighs 90 lbs packaged. In order to ensure quick set-up time and retain critical surface tolerance enroute and during operation, the antenna reflector will remain in one piece.

The McMichael Ku band antenna is the heart of the FLY-AWAY system since it allows real-time transmission from anywhere in the world.

In the event of signal loss due to severe weather conditions or poor footprint locations, the GEC McMichael CODEC makes it possible for the operator to reduce the bandwidth. As a result, the system permits live video transmissions from any global location under practically any weather conditions.

GEC McMichael, a leader in Ku band satellite transportable technology in the United Kingdom and Europe for over 6 years, just recently introduced its line of broadcast products to the United States. The development of the portable SNG system resulted from the company's

expertise in Ku band transportable terminals, ACE standards conversion equipment and video bandwidth compression teleconferencing equipment.

To date, there is absolutely no better way to beat the competition to the scene than with the new FLY-AWAY Satellite News/Data Gathering System. For more information about this exciting live/remote transmission breakthrough, please contact GEC McMichael 8260 East Raintree Drive, Scottsdale, Arizona 85260. Phone: 602/948-7255 TLX: 6502246202

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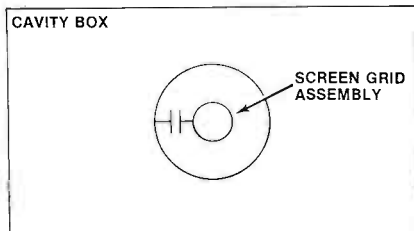


Figure 5. Adequate bypassing of the PA tube screen grid is important to proper operation of the cavity. If one screen bypass capacitor is used, as shown here, an uneven distribution of RF current will result.

of the cavity. It is usually much higher than the RF output current or the RF plate current. The relationship can be expressed as follows:

$$Q = \frac{Z_p}{X_L} \text{ and } I_c = I_p \times Q$$

where Z_p equals PA tube plate impedance, X_L equals equivalent inductive reactance of the cavity resonant circuit, I_c equals cavity RF circulating current and I_p equals RF output current.

When current flows on one conductor of a transmission line, an equal magnitude current flows in the opposite direction on the other conductor. This

means that a large value of RF circulating current is flowing in the cavity amplifier's outer conductor (the cavity box). All of the outer conductor's circulating currents start at and return to the screen grid.

The back access panel (door) of the cavity is part of the outer conductor and large values of circulating current flow through it, into it and out of it. The amplifier must never be operated with the back panel removed or any of the fasteners loose or damaged.

A mesh contact strap electrically connects the back panel to the rest of the cavity. If a fastener is loose or damaged, the back panel is loose or the mesh contact strap is damaged or defective, arcs will develop between the cavity box and the affected area of the back panel.

Once an arc occurs, the pitted surface forms an insulator that restricts the flow of RF current. The damaged surfaces can be cleaned, but the surface must be flat to insure a good electrical contact. Any pit mark on or under the mesh will cause a recurrence of the arc.

The screen grid

The screen grid is connected to the screen contact ring on the PA tube base by a cone assembly inside the tube. The purpose of the cone is to reduce stray inductance and lower the RF resistance

caused by the skin effect. To take advantage of this design, RF currents should flow evenly through all parts of the screen grid assembly.

In Figure 5, one screen bypass capacitor is used in the circuit. This would cause all of the RF circulating current to flow through one point of the screen grid assembly. The result would be increased skin effect losses and increased stray inductance.

If, on the other hand, the number of

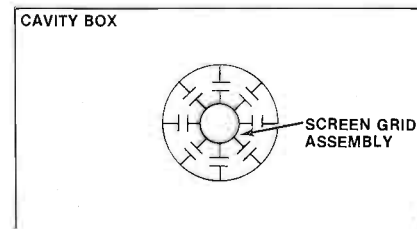


Figure 6. Eight evenly spaced screen bypass capacitors cause the RF circulating current to divide evenly around the PA tube screen grid assembly.

screen bypass capacitors was increased to two, the RF current distribution would improve. If eight bypass capacitors are used, as shown in Figure 6, the RF current would be evenly distributed throughout the screen assembly. This would result in less skin effect losses and lower stray inductance. [1:7-5)]

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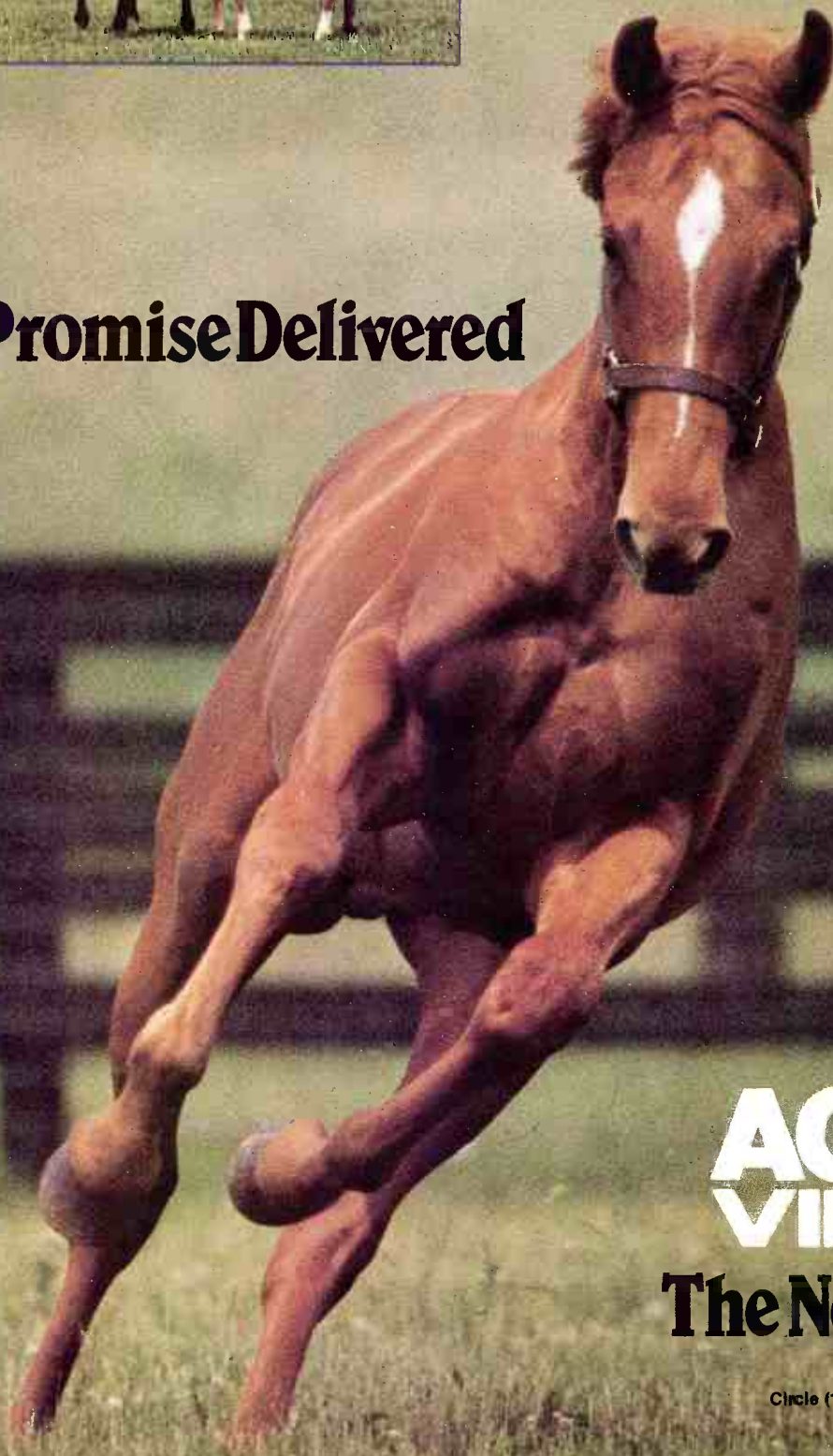
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Designs that fit

By Fred Powers

When management gives the go-ahead for a new facility design, don't be charmed by the lure of the "ultimate."

Most of us dream of having all the money it would take to build the ultimate TV facility. We hear or read about some superstation and find ourselves sighing and wishing our station could be like that one.

Many stations, lured by fantasies of state-of-the-art, have thought *big*, bought *big*, then thrown the project together. They end up with a facility full of nice toys that are impractical for meeting the station's needs.

The key to success is not so much having the dollars, as it is careful planning to make each dollar count. The ultimate facility is actually the one with a *design that fits*; fits not only the budget, but the needs of the market.

Constructing a successful TV production or broadcasting facility is a complex and demanding task. Whether you need a facility for broadcasting, production or post-production, you should be well-prepared before venturing into the world of high finance, architectural engineering and systems integration.

Before you spend a nickel for a purchase, you must know as much about your project as possible. Develop an insatiable thirst for information and get facts from as many different sources as you can. Define and research your market area, know your competition and their marketshares, and estimate your potential share of the market and sales volume.

Become familiar with professionals in the industry who may be available to assist you. Learn their salary levels and traditional benefits. Good management and operations personnel are vital in this industry. They are the key to a successful operation, are extremely competitive, and require considerable remuneration.

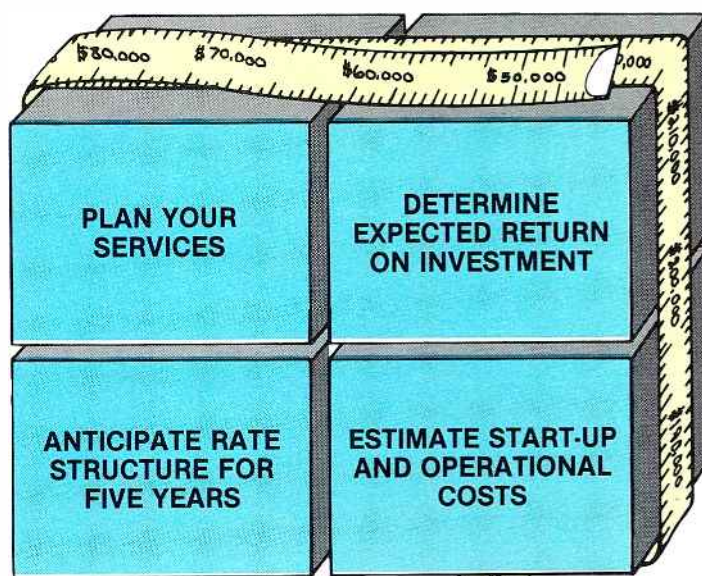
Financial planning

Funding your project will probably be your most difficult task. The money involved requires major commitments. Your plans should explore all potential funding sources. You might sell a portion of your equity to a venture capitalist, offer limited partnerships to raise the funds

for the venture, or approach a lending institution to finance the project. In the case of a loan, will you be able to collateralize it with your personal financial statement? A lending institution will require some form of collateral.

Business plan

Your business plan will become your blueprint and guide for all future decisions. In fact, without it, you may experience disappointment and failure. This tool is valuable for assisting you in making sound business decisions



Tailoring your business plan

because it begins with a comprehensive and realistic listing of the capabilities of your planned facility and the services you wish to provide the marketplace. The plan should be prepared and written from an investor's point of view. What is in it for the investor, and what will the return on investment be?

Because technology is progressing at an alarming rate, you will need to plan for the changes and expansions necessary to keep your facility current and competitive. You may discover that you cannot afford to offer all the services you would like in the beginning, but you can pare back your ambitions to an affordable level, and structure a growth

Powers is vice president of Centro Corporation of San Diego.

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Building a facility is an expensive endeavor. Planning is essential so that your design is not outdated by the time construction is completed.

plan to expand your future services.

After listing the capabilities you want to offer the marketplace, you need to determine your expected return on investment. This is the amount of compensation you expect to receive for the efforts and risks involved. This information will also be necessary to project the length of time required to repay investors or satisfy your debt service.

Next, determine your anticipated rate structure for all your services. In order to be competitive, use the prevailing rates in your particular market as a guide. Consider the value of the services, establish realistic deadlines for each area to become productive, and calculate the rate charged for at least a 5-year period with increases in productivity, sales and salaries. Factor in depreciation for each successive year.

With the information gathered during the research phase, estimate your start-up, salaries, operational, general and administrative (G & A) and sales and maintenance costs for the same 5-year period. Your projected sales, less your anticipated costs, will reflect the goals for your anticipated return on investment.

Even though the facts and figures you use in this formula are hypothetical, they must be realistic and achievable. It is interesting and exciting to play *what if* by changing some of the values in the formula and recalculating the figures to determine what effects they have on the results. A word of caution: Force yourself to be realistic and conservative while assembling data. It is easy to *develop* a

result that looks good on the surface, but is really not feasible.

Verification

Now is the time to verify the accuracy of some of your estimates. You can accomplish this by hiring a seasoned consulting professional or organization to assist in determining an anticipated budget for the project's start-up phase.

The budget should include all costs, from site preparation through completion of the building, all the electronic systems and interior furnishings. This information can be acquired through various sources, such as consultants, architects, engineering companies and interior designers. Some companies can provide the entire service, which eliminates the chance of gaps or omissions that might occur due to lack of communication between several sources.

Be sure you have developed your business plan before contracting this service. It is usually performed on a time and material basis. Entering into an agreement before developing your business plan is similar to hiring a cab to take you to an unknown destination. Before you know it, you will be lost, confused and deluged with questions. Meanwhile, the meter is running!

The results of this input will verify one of the major elements in your formula: the start-up costs.

Facility planning stage

The facility planning stage must be completed whether you are building a

new structure from the ground up or renovating the interior of an existing building. For a new structure, a site preparation estimate should be made. Obviously, your estimate can be more accurate if you have determined your building site, although a typical budget range can be determined by an experienced architect. If your plans are to construct a broadcast, production or editing system in an existing building, you will need to estimate the cost of renovating the interior walls, existing plumbing, wiring and air conditioning.

A preliminary floor plan should be developed, applying traditional facility use analysis and interior space planning criteria. This floor plan will be merely conceptual, identifying each room or space by name, number of square feet required, and physical relationship to all other areas of the facility. The plan will be utilized to determine your estimated construction costs.

You should solicit the services of professionals in each respective area to assist you in completing this final planning stage. They are experienced in their fields and can provide you with accurate estimates. Again, a single source is recommended to maintain consistency in the estimates.

Review

After reviewing the estimated construction costs, it is important to refer back to your business plan and to compare the estimate with the amount allocated in the start-up cost section. If the construction estimates are too high, you will need to re-evaluate your preliminary floor plan. Square footage and/or special features may have to be trimmed until the construction costs are in line with the business plan.

Funding

Now comes the difficult part: Funding your project. All of your research and planning will begin to demonstrate their worth. The investor or lender will expect this information in an organized and professional manner in order to determine the risks and the opportunities for success. A well-written business plan that communicates the risk involved vs. the potential return on investment will go a long way toward expediting a loan or an investment.

Operational plan

After securing your financing, you will need to develop a sound operating plan. This will include a cash flow analysis, performance and growth analysis. Your operating plan will be critical in determining your anticipated needs and assisting you in making future decisions.

Good management of this plan is also

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critical for realizing your goals. Consult your existing or anticipated management team to strengthen the plan. If they are involved in the plan's creation, they will be dedicated to its success.

Site selection

Your facility, whether it is new construction or an existing building, should be away from loud sound sources, such as airports, industrial areas and railroad routes. Another reason to stay away from heavy industry sites is that sporadic power surges can occur in such areas.

It is also a good idea to investigate the electrical service available in an existing building. A major TV facility can demand a surprising amount of power. If the building is not supplied with sufficient electrical service, a significant expense may be lurking around the corner.

When selecting an area within an existing structure, beware of locating critical studio or production spaces near elevators, rest rooms, equipment rooms or any other potential vibration and/or sound sources. It is not uncommon to experience annoying or unacceptable levels of vibration being transmitted through the structural members of a building. In general, most existing buildings were not constructed to house a teleproduction or broadcast facility. If a vibration does exist, its source is usually a mechanical device or system, such as an air conditioner or electrical transformer. A structurally bound vibration source must be identified and treated by isolating it from the building's structure.

Structural members should still be acoustically treated when they exist within critical operational or studio spaces. Unexpected or temporary vibrations can seriously affect production schedules by injecting annoying frequencies into studio or audio production areas.

Acoustics, HVAC and lighting

The performance specifications for the facility's acoustics, lighting and HVAC (heating, ventilating and air conditioning) are critical. They depend on, and are influenced by, each other. The amount of heat generated by the people in each area, the quantity of equipment in operation and the wattage of lighting being used are all factors in determining the amount of air conditioning required to maintain the spaces at proper operating temperatures. Other elements are also factored in, such as the size, number and location of windows, the type of insulation used, altitude, humidity and typical temperature range for the area. An experienced mechanical engineer will address these requirements, but only if supplied with the environmental characteristics desired for the facility's interior.



Courtesy of Centro

The facility should be located away from loud sound sources.

The acoustics of studio spaces are affected by the HVAC system because it performs its function by circulating conditioned air. If not properly engineered and balanced, the air movement will create annoying and, in some cases, unacceptable noise levels. To prevent this, the HVAC system must be engineered to move large volumes of properly conditioned air at very low velocities.

A change in concept that alters the size of the space, the number of people, the amount of operating equipment or lighting will influence the size of the HVAC system necessary for the facility. As the size and velocity of the HVAC system increases, the level of undesirable noise will increase. All the elements are interdependent, and once the system has been designed, one element cannot be changed without seriously affecting the others.

There are two different acoustical requirements for interior spaces of a facility. In some areas, it will be necessary first to acoustically isolate the space from all other areas of the facility. Second, the shape, size and treatment of the surfaces within the space are critical in controlling the audio performance. Consultation with an experienced acoustician is important to ensure that critical areas of the facility will function as intended.

Project construction

After you have solicited the proposals, selected the company you want for the project and awarded and negotiated the contract(s), it is imperative that project milestones are identified and established. These milestone dates must be constantly monitored to ensure compliance with the contract and projected completion date. The project coordinator will be responsible for tracking these deadlines.

There are companies that specialize in systems engineering. They employ pro-

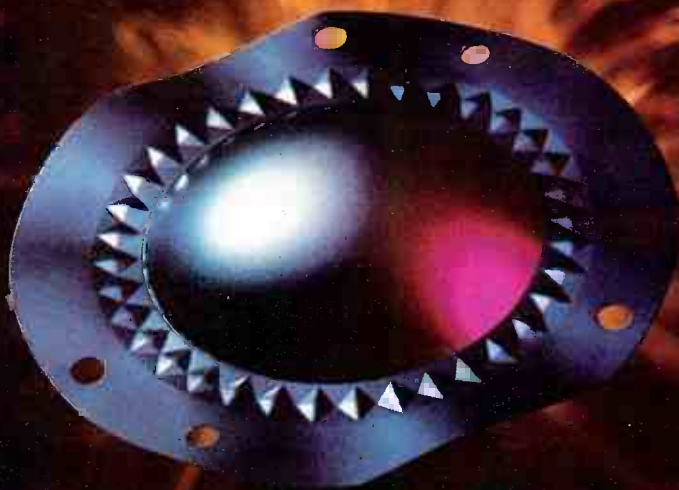
fessionals to identify all individual components of the systems, engineer the proper integration and provide detailed functional diagrams. This documentation is extremely important, for it is the *blueprint* for the electronic systems and will be used for maintaining, changing and updating the systems.

Ideally, you can hand over the responsibility of project coordination to the systems engineer, who can convey to an architect the technical and environmental requirements necessary for the electronic systems. Although they are trained and experienced in the areas of building codes, structural engineering and building architecture, many architects may not have the background necessary to understand and to appreciate the requirements and ultimate purpose of the facility.

Watch it happen

Even if you follow all of the recommended steps to the conclusion of the project, something unexpected will nearly always pop up. The secret is to anticipate potential problems. Then, when an emergency does arise, you will be able to react with solutions, rather than panicky attempts to keep the project from disintegrating.

If you contract with a single source who will organize and implement the project, you will be able to devote your efforts to necessary day-to-day operations. A typical teleproduction facility project is a major undertaking and deserves a full-time commitment for efficient, economical completion. Follow the guidelines, use good business sense and resist emotional decisions that can cause your plan to stray off course. Then the black ink will find a well-defined path right to the bottom line. And when that happens, you'll know that your design actually fits. [:-)]



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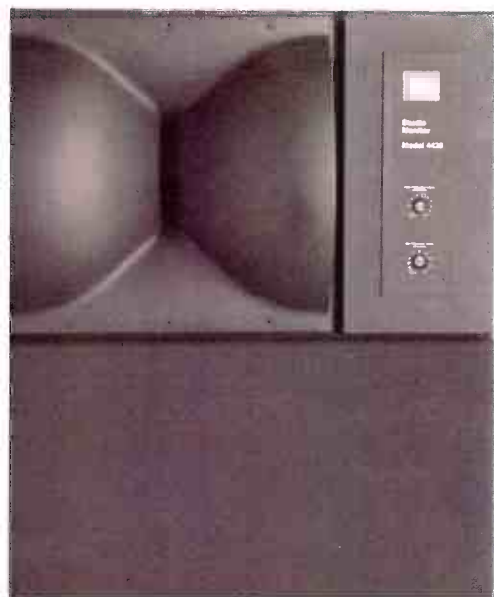
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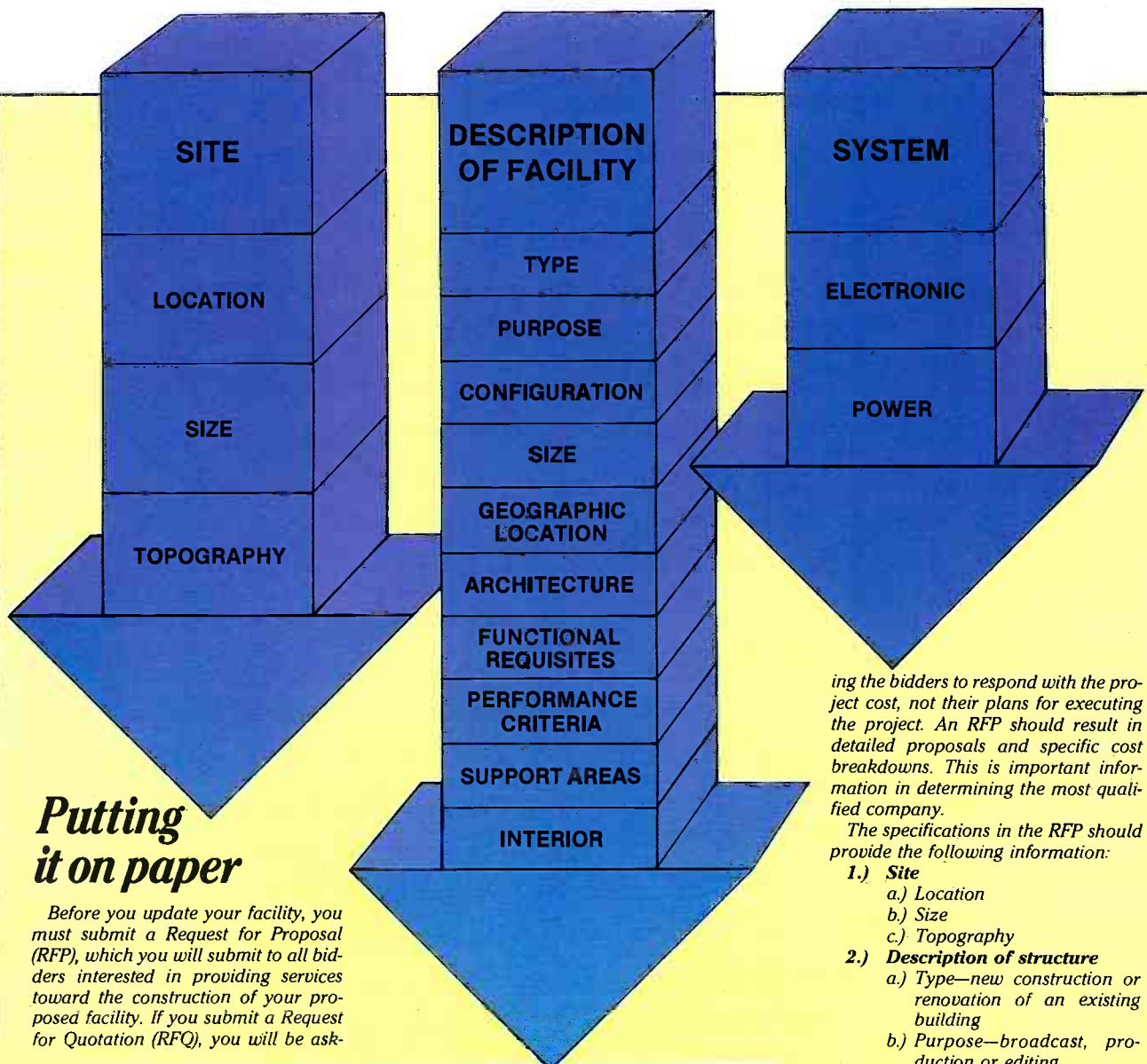
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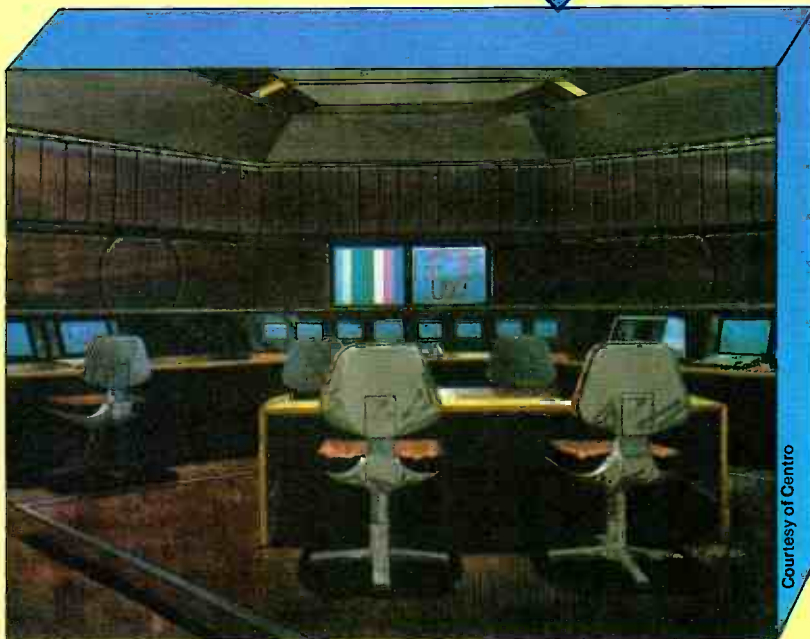
Putting it on paper

Before you update your facility, you must submit a Request for Proposal (RFP), which you will submit to all bidders interested in providing services toward the construction of your proposed facility. If you submit a Request for Quotation (RFQ), you will be ask-

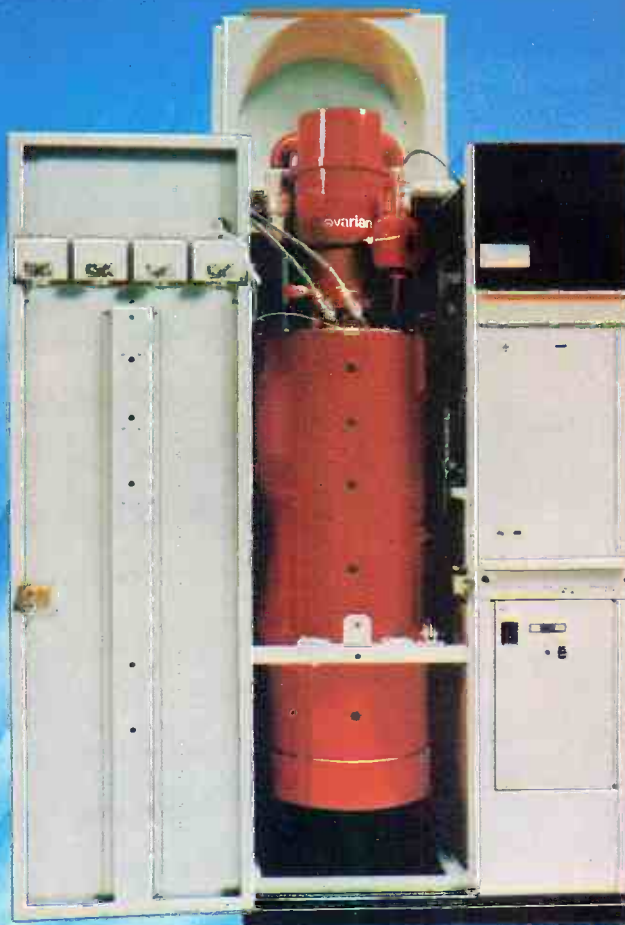
ing the bidders to respond with the project cost, not their plans for executing the project. An RFP should result in detailed proposals and specific cost breakdowns. This is important information in determining the most qualified company.

The specifications in the RFP should provide the following information:

- 1.) **Site**
 - a.) Location
 - b.) Size
 - c.) Topography
- 2.) **Description of structure**
 - a.) Type—new construction or renovation of an existing building
 - b.) Purpose—broadcast, production or editing
 - c.) Configuration—number of floors, multiple structures, etc.
 - d.) Size—square footage
 - e.) Geographic location—average high and low temperatures, humidity and altitude
 - f.) Architecture—theme or image (if applicable)
 - g.) Functional requirements—capabilities
 - h.) Performance criteria—air conditioning, acoustics and lighting
 - i.) Support areas—rest rooms, lounges, reception, storage and equipment rooms
 - j.) Interior—theme, environment and quality of finish and furnishings
- 3.) **Systems**
 - a.) Electronic—capabilities, configurations and operational requirements
 - b.) Power—type of service, conditioning, isolation, grounding and standby emergency power requirements



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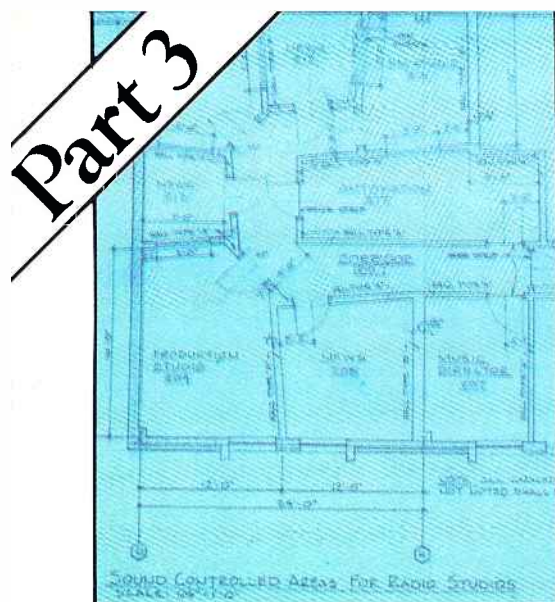


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May 1985 **Broadcast Engineering** 31



Studio acoustics

By Eric Neil Angevine, P.E.

In many old movies, such as "Around the World in 80 Days," two people communicated between rooms in a large house using a speaking tube. The speaking tube was actually a small duct running from one room to the other. In other films, you may have seen actors eavesdropping on conversations through ventilation ducts. Both of these examples illustrate that sound will travel between rooms through ducts and conduits.

Even the smallest opening in a wall can create a significant sound leak. And although sound insulation is critical in a studio, it is impractical to build one without doors or windows. Equally ludicrous would be to contemplate a studio without heating, lighting, air conditioning and microphone cables. Yet, all of these necessary features can create sound leaks.

The biggest problems are caused by air-conditioning ducts. Because air-conditioning ducts connect the studio directly to a fan or air-conditioning unit, they may conduct fan noise into the studio. They may also connect two adjacent spaces and carry sound from one location to the other.

Mechanical equipment noise

Rule number one for keeping fan noise out of the studio is to locate the mechanical equipment away from the studio space it is designed to serve. Although this is contrary to energy-conscious design, it protects the studio from two sources of noise: the fan and the equipment. Mechanical equipment is inherently noisy, and mechanical equipment rooms are among the noisiest in the building. They should not, therefore, be located adjacent to studio spaces or other areas requiring little noise. Rather, there should be one non-critical *buffer space* between a mechanical equipment room and any acoustically critical studio space. Buffer spaces may be corridors, storage rooms or even offices with less stringent acoustical requirements.

Sound transmitted by ducts is reduced by distance, particularly if the duct is lined with a sound-absorptive duct lining. Circuitous paths are much better than straight ones because elbows and turns help to attenuate sound in ducts. The smaller the cross-sectional dimension,

the more sound attenuation will be achieved, indicating that flat rectangular ducts will transmit less sound than square ducts of the same cross-sectional area. Unfortunately, all of these factors also decrease friction in the duct, so a compromise must be made between the acoustical needs of the space and the mechanical engineer's requirements for an efficient system.

Moving air may generate noise levels approximately proportional to the fifth power of the linear velocity. Therefore, it is important to keep velocities low. Do not increase the air velocity in an effort to minimize the duct size.

Small systems make less noise than large ones. Although that concept is easy to accept, it turns out that they usually make proportionately less noise. That is, two small systems usually make less noise than one system twice as big. For this reason, it is often a good idea to use a small system to condition the acoustically critical studio spaces, rather than the large system that conditions the rest of the building. A second advantage is that the studio spaces typically require continuous conditioning, while the building system may shut down at 5 p.m.

Control of noise between rooms

Just as ductwork may conduct sound from a mechanical equipment room to acoustically critical studio spaces, ducts may also transmit sound from one studio to another. Consequently, it is important that studios not be connected by short, straight duct runs. It is a common practice in building construction to provide a single duct for supplying conditioned air to many adjacent rooms. In acoustically critical projects, such as broadcast studios, each room should have its own supply duct running from a common plenum or main duct at some distance. This keeps the duct size small and allows for more circuitous layouts, promoting minimal sound transmission.

A duct can transmit sound from one space to another without even being connected to one of the spaces. For example, noise may enter a duct located above the ceiling of a noisy room through the duct walls, and be transmitted to an adjacent space. Or a duct which

Continued on page 36

Angevine is principal consultant at Angevine Acoustical Consultants, West Falls, NY, and is BE's broadcast acoustics consultant.

"...performs accurately under any RF situation."

John Bortowski, chief engineer for radio station WLAK in Chicago, had a problem.

Will a frequency counter work under his adverse conditions? Here is what he told us.

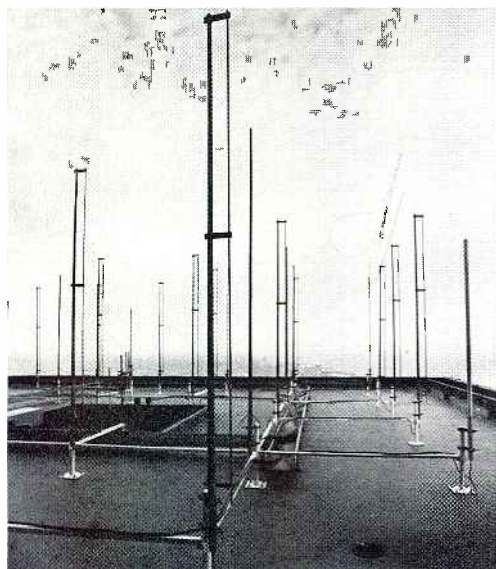
"To give you some background, WLAK is located on the 90th

floor of Sears Tower. Studios and service area are located a mere 30 feet from an antenna farm transmitting frequencies from 150 MHz to 800 MHz. Atop the building are two VHF, two 5 megawatt UHF and five FM stations.

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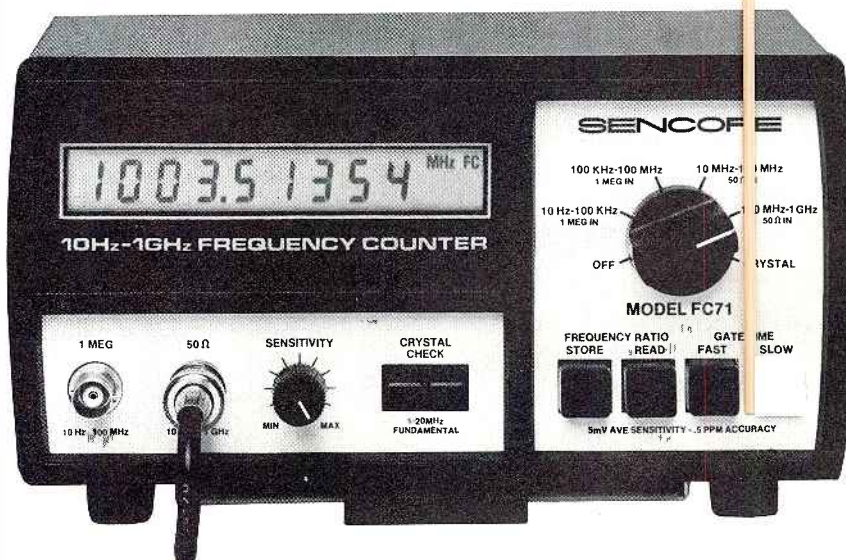
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Continued from page 32

serves a noisy space may carry sound which passes out of the duct through the walls above an adjacent studio.

To prevent the transmission of sound by these methods, two simple rules must be followed: All ductwork must be of sheet metal, which contains sound better than lightweight duct materials. Ductwork should run through non-critical, but quiet, buffer spaces or above a solid ceiling. (Because sound will penetrate acoustical tile, any plenum left above an acoustical ceiling must be considered to be part of the room.)

Sound can also be transferred between two ducts running side by side through a chase or ceiling plenum. This *crosstalk* is not only a serious problem, but is difficult to eliminate. It is just one reason the duct layout should be reviewed by your acoustical consultant.

Both the supply and return air must be ducted. The use of a ceiling plenum for

return air, commonly seen in modern construction, will create a significant sound path between rooms. The return ductwork must be designed just as carefully as the supply ducts. Sound will travel equally well in either. The idea that sound will not propagate in a return duct presupposes that the speed of the airflow (typically about 1000 feet per minute) is of the same order of magnitude as the speed of sound propagation (1100 feet per second).

Sometimes all of these precautions are inadequate in controlling sound through the mechanical system. When necessary, air-handling duct silencers, similar to automotive mufflers, can be used to reduce sound transmission through the duct system.

All of this assumes the use of a central forced-air heating and cooling system. Although several systems avoid the use of the long ducts that transmit sound between rooms, most of the alternatives

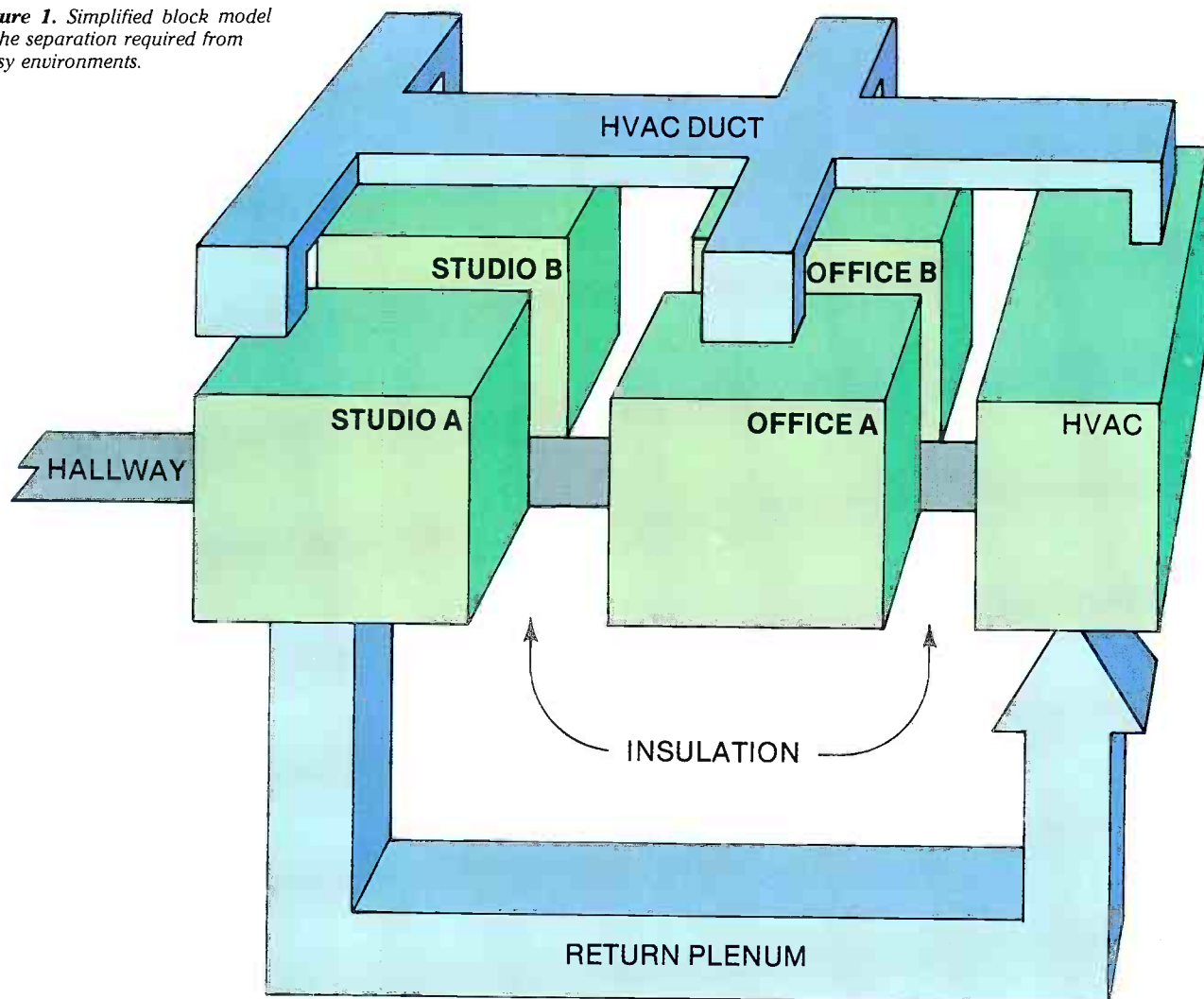
produce unacceptable noise levels within the conditioned space.

Electrical systems

Electrical systems may also cause sound paths between studios. If all wiring could be installed when the studio is built, the number of sound leaks could be reduced. However, most broadcast engineers realize that they can't predict all of the cabling possibilities they will ever need, so provisions must be made for future wiring installation.

The rules for laying out conduits and cableways are similar to those for air-conditioning ducts. The potential problems are fewer, because cableways are seldom as large as mechanical ductwork. But there is often a desire to connect two adjacent spaces directly by the shortest path. To avoid the major sound leak created by a direct connection between two adjacent rooms, it is recommended that all conduits run to a common panel

Figure 1. Simplified block model of the separation required from noisy environments.



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or electronics room. This way, each run is longer and more circuitous than a direct connection would allow.

Although the total area of cableways and conduits should be made adequate for all foreseeable future needs, don't overdo it. Each conduit or cableway is a potential sound leak. The more there are, the greater the risk of a problem.

When all wiring has been completed, seal the open ends of each conduit. Because the seal is only a temporary closure, it must be possible to remove it without a lot of effort. One common method is to stuff the open end with fibrous building insulation. Although insulation products are not particularly effective sound barriers, they are better than nothing.

It is also possible to terminate each conduit or cableway at an enclosed panel or box, thus closing the sound path.

You may want to run a cable between rooms without disconnecting it at either end. For example, a TV station may want to move a camera from one studio to another without disconnecting cables. This can be planned for during studio construction, by providing a cable tray in the floor, running through a doorway.

The removable cover should be of heavy material to form an acceptable sound barrier. Openings at either end should be just large enough to accommodate the cables.

Permanent wiring

Any penetration of a studio wall, floor or ceiling reduces the acoustical effectiveness of the enclosure. For this reason, surface-mounted light fixtures are superior to recessed luminaires. Each electrical receptacle or switch box compromises the integrity of a wall at a particular point.

Receptacles should not be placed back to back in a common wall. But any two receptacles on opposite sides of the same wall can create a sound path. Within the constraints of local electrical codes, you should avoid electrical outlets on both sides of a major studio partition.

If not carefully installed, microphone lines, on-air signs and monitor wiring can allow penetrations of the studio enclosure. When excessive sound transmission is noted, it is usually not the wall that is at fault, but the penetrations provided for the studio's mechanical and electrical systems.

Vibration control

Any mechanical equipment can impart vibration to a structure that supports it. A piece of mechanical equipment as large as an electric motor has moving parts, and these produce vibration. Unless you are careful when installing this equipment, vibration can be transmitted to the building structure and reradiated as audible sound. Under certain circumstances, this structure-borne sound can be acoustically amplified so that a small hum becomes a significant rumble.

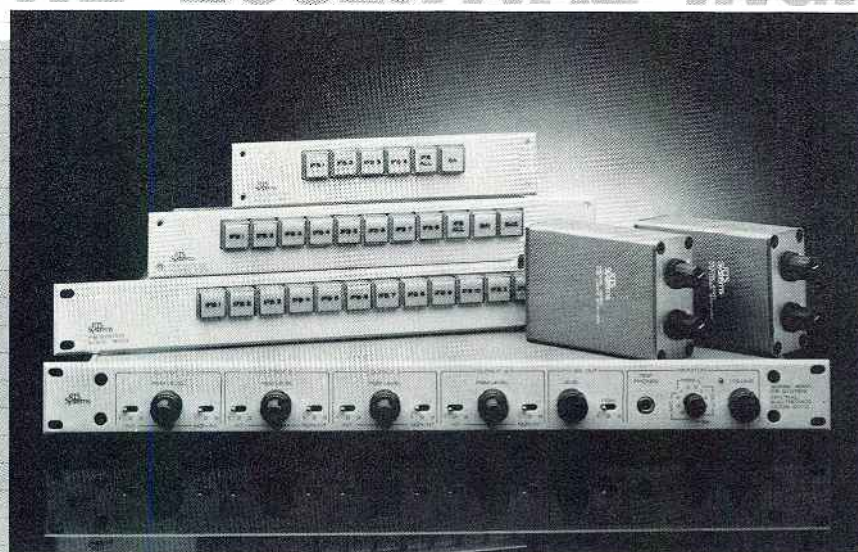
All mechanical equipment with motors or other moving parts should be supported on vibration isolators, carefully selected to be appropriate for both the machine's operating speed and weight. Piping, ductwork and electrical conduits connected to a vibration source must have flexible connections or vibration will be transmitted to other parts of the building through these paths.

No review of your plans can be too complete. No amount of construction inspection can be too much. It is the minor details that make a good studio a notable one. And it is the lack of attention to these details that can make any studio a disaster.

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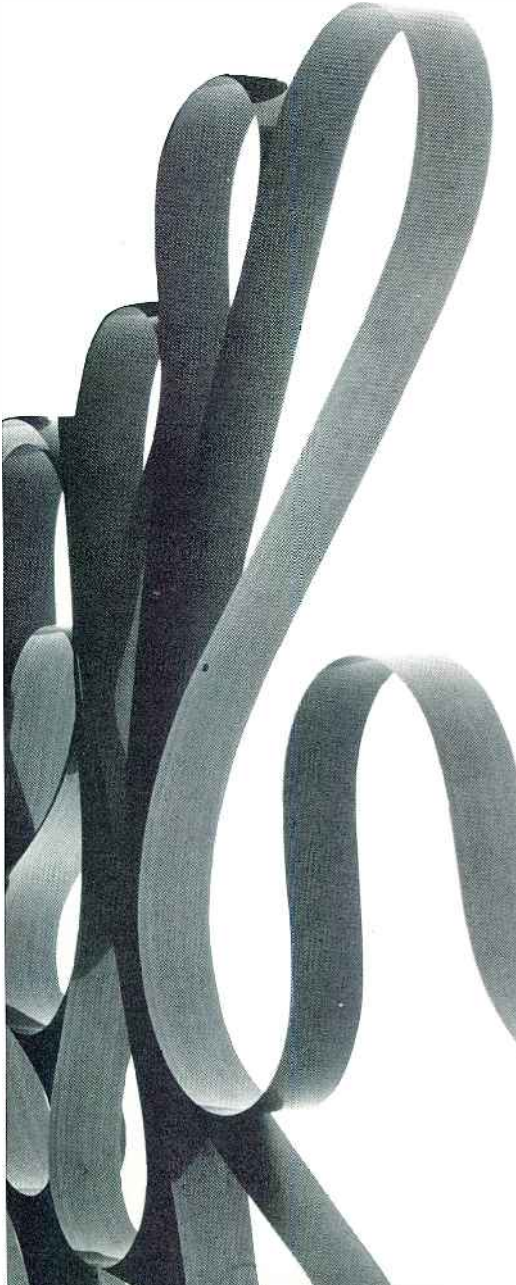
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The magic of magnetic tape

By Carl Bentz, technical editor

We use magnetic tape every day. But what is it, how does it work and how is it made?



More than 25 years ago, videotape appeared to rave reviews for TV broadcasting. Amazing though tape was, and is, the search continues for ways to improve the magnetic medium most used for storage of video and audio information. The quest includes tape as well as disk media, as computer peripheral devices become more commonplace in the broadcast arena.

What is tape?

The concept of tape is quite simple. A flexible strip is coated with a material that retains information in a magnetic orientation of metallic particles. Although the concept is simple, understanding magnetic media requires some knowledge of chemistry and physics, especially the subjects of plastics, electricity and, of course, magnetism.

How flexible must the strip be, and remain over time? What is the best magnetic material to include in the strip? What will make that material adhere to the strip? How is the recording medium protected from external and internal forces? These are the questions for which tape scientists seek new answers for audio, video and data storage media.

The backing

Ideally, tape and its contents are forever. What we record on this magic magnetic strip today must be retrievable at any point in the future.

(We assume availability of a reproducing machine

compatible with the format in which the data is stored.)

The strip must be of a material that will remain sufficiently flexible over time to allow its use with an appropriate playback system. But we cannot expect it, no matter how flexible, to withstand bending or creasing, which will cause deformation of the strip and disrupt the information stored on it. This material will provide support for the information storage layer.

The backing, or base film, is usually a complex organic polymeric material known as a polyester. Of several polyester backing materials in use today, one popular type is PET, or *polyethylene terephthalate*.

In order to qualify as a base film, the material must have a number of desirable characteristics:

- high physical and tensile strength;
- dimensional and compositional stability against temperature, humidity and chemical agents;
- low coefficient of friction;
- proper surface shape or smoothness;
- achievable uniformity in thickness; and
- manageable static electrical qualities.

Normal machine-operating conditions place a linear tension on the tape. In the Type C VTR, the amount of tension is about 6 or 7 ounces. This stress does not unduly strain the tape. Under startup and braking conditions, however, stress may increase a great deal. The result may be a stretching deformation. Some backing materials have a *memory* that allows recovery from increases in length. Generally, a force approaching 6 pounds will not produce a permanent deformation, because the memory can recover a stretch-induced length increase of about 5 percent.

A large, angled image of an Eastman Professional Video Cassette tape box. The box is black with a large orange diagonal stripe. The text 'Eastman Professional Video Cassette' is printed in white and yellow. A small Kodak logo is in the top right corner. The 'U-matic' logo is on the orange stripe. The 'KCS 20min. 20 Broadcast Quality EB-930' text is in the bottom right.

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Although it may not be obvious, stretching causes a reduction of the tape width. The dimensional change may allow undesirable side-to-side movement of the tape as it traverses the tape path. Also, stretching may reshape the tracks of recorded information. The resulting distortion is less noticeable in audio, but for video, the tape will probably not reproduce well. Tape that has suffered stretching (beyond the 5% mark) is probably permanently damaged and should not be used.

Ideally, tape will be used in controlled environments. In practice, it is exposed to wide ranges in temperature and humidity, particularly in remote production and ENG usage.

With reasonable variations, the physical size characteristics are expected to remain constant despite environmental change.

The backing must have a coefficient of friction that allows it to be pulled through the tape path by the capstan/

pinch roller or vacuum capstan mechanism of the VTR without slipping. But too much friction in other parts of the path would result in excessive wear or *stiction* (sticking) to mechanical parts.

The thickness of the backing should be consistent and the surface should be as smooth as possible. Changes in thickness produce instantaneous undesirable tensions, resulting in poor recording and playback signal quality. Head and tape path wear will also increase with any variations.

The oxide

The information-storing *oxide* layer contains compounds of iron, cobalt and, sometimes, chromium. These metals, some of their oxides and several other metallic compounds are referred to as *ferromagnetic*. In the presence of a magnetic field, such as in the *recording mode*, the metallic particles behave as miniscule bar magnets and align themselves to that field. When the field is

removed (the tape moves away from the recording head), the particles retain the orientation.

After a tape has been used, it is possible to rearrange the stored magnetic patterns by applying another field that overrides the recorded signal. This occurs during *erase mode* or when rerecording. How strong the magnetic signal must be to overcome the recorded signal is related to coercivity. The higher the coercivity value, the greater the ability of the tape to retain the recorded signal and the higher the frequency response.

Retentivity refers to the strength of the magnetic signal that remains on the tape when the tape has passed the recording head. The greater the retentivity, the greater the signal strength that can be read back from the recording. A high retentivity should also mean a larger S/N value and less noise in the reproduced signal.

The magnetic layer consists of metallic oxide particles, either in a suspension or

Making magnetic media

Magnetic tape and discs are composed of a base film to which magnetic layers are applied. The layers consist of magnetic particles in a powder form, a binder to hold the particles to the base film, a dispersant to uniformly spread the particles over the film backing and additives to prevent electrostatic charges, improve durability, reduce head wear and ease tape handling by the machine.

Mixing of these ingredients to form the magnetic pigment, or paint, is critical. The chemical composition of the solution is constantly monitored.

Filtering

The greatest enemy of tape is dust. Any undesirable particles must be removed from the pigment before it is

applied to the backing. Filtering removes the foreign objects that are more than a few microns in size.

Coating

After the base film is inspected for surface uniformity and filtered, one or more layers of magnetic pigment are applied. In the coating machine, a uniform layer of material is applied to the roll of backing, which may be more than a meter wide. Various rollers and scraping edges are used to achieve a smooth surface.

Before drying, a magnetic field is applied to the virgin material to orient the particles, which are at random on the surface. After orientation, all particles are aligned parallel along the length of the tape.

Drying and surface finishing

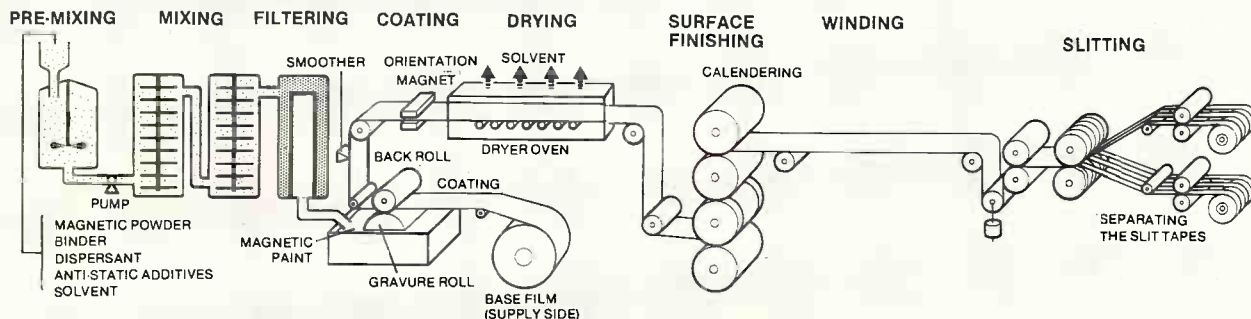
With the particles aligned, the web of material is passed through a high-temperature oven, where it is dried in dust-free air.

While still warm and somewhat pliable, the tape is moved through a series of calendaring rollers. High pressure and high temperature from these polished rollers create a glass-smooth surface to the tape.

Winding and slitting

With the tape material dried and the surface finished, the magnetic strip, up to a meter wide, is wound onto large rolls up to 50cm in diameter and weighing as much as 100kg.

The tape is divided into usable widths in the slitting process. In this step, the width of each section, the linearity of the sides and the sharpness of the cuts must be continuously monitored. Just one dull cutting edge could cause a large amount of unusable product. As the web is slit, the individual sections are wound onto open reels for inspection. The tape is eventually wound onto reels or into various cassette and cartridge containers.



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The design of such a processor is more an art than a science. It can't be done by a computer, no matter how powerful. It requires human taste, discrimination and, above all, *ears*. It also requires *time*. An audio processor rushed to market as an afterthought to a stereo generator design is not likely to serve well or long.

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a specially formulated alloy that is applied to the tape surface as a thin film. Various names are used by the manufacturers for their magnetic formulations, developed from a selection of five different materials. The names, depending somewhat upon the application of the tape, include:

- pure iron oxide, gamma- Fe_2O_3 ;
- pure magnetite, Fe_3O_4 ;
- iron oxide doped with cobalt oxide;
- ferrichrome (chromium oxide with iron oxide); and
- metallic alloys.

For most modern tapes, a variation of the cobalt-iron mixture is used. In the

choice of magnetic material, the particle size must also be considered. The maximum frequency that may be recorded is inversely related to the size of the magnetic particles.

The binder

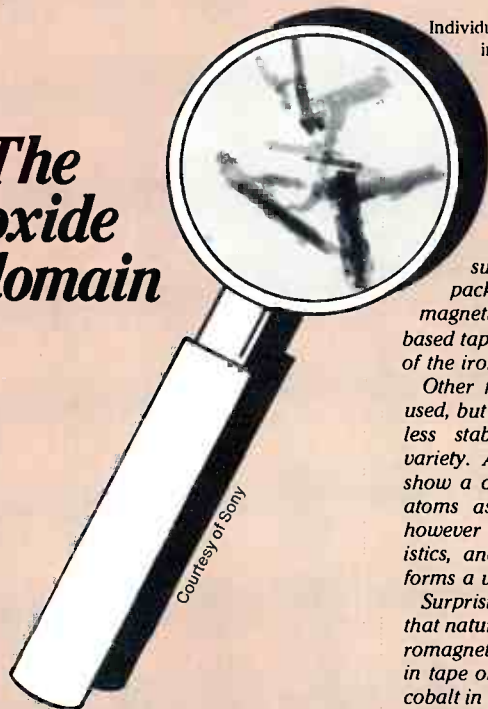
A *binder* holds the magnetic layer onto the backing and must retain its adhesive characteristics over time. The binder must set up, holding particles in place, but it cannot harden and become non-flexible. It should be relatively unaffected by realistic temperature and humidity ranges.

The binder begins as a liquid in which

the magnetic material is suspended. Popular binders include polyurethane, polyvinyl chloride (PVC) or polyacrylonitrile. The solution includes dispersion agents to keep the magnetic particles from clumping together. Other ingredients include lubricants, anti-static agents, anti-abrasive agents and anti-degradation agents.

The mixture, or formulation, of binder ingredients (including the oxide) is closely maintained to the specifications for a particular type of tape. Variation does occur however, so that specs from different batches may fall within a range of values. Occasionally, adhesive failure of

The oxide domain



Individual ferric oxide particles as used in 1-inch videotape.

sulate the iron, allowing better packing, but it also improves the magnetic properties. Nearly all iron-based tape formulas use cobalt doping of the iron oxide.

Other forms of iron oxide may be used, but Fe_3O_4 (magnetite) tends to be less stable than the gamma-ferric variety. A Berthollide form does not show a clear relationship of Fe to O atoms as Fe_2O_3 or Fe_3O_4 . It does, however include desirable characteristics, and when treated with cobalt, forms a usable recording oxide.

Surprisingly, nickel, a third metal that naturally exhibits the required ferromagnetic characteristics, is not used in tape or floppy disks. It is used with cobalt in the manufacture of rigid Winchester disks and provides very high data densities to be achieved.

From the introduction of magnetic recording, the gamma-ferric oxide (Fe_2O_3) has played a major role in information storage. This is the compound of iron that we call rust.

For tape, gamma-ferric oxide is grown to form acicular, or needle-like, crystals (see above). In some cases, there may be irregularities in the crystals, such as branching structures, called dendrites, or holes which prevent them from an orderly packing on the tape.

Cobalt

To get more regular or consistent particles, a small amount of cobalt may be added. The cobalt atoms grow into the iron crystal structure, filling in the gaps. Not only does cobalt encap-

Chrome

Chromium metal is not ferromagnetic, but the simple oxide CrO_2 is, and it possesses excellent characteristics for recording. Though small, the particles are long, thin and similar in appearance. The material packs well on the tape.

Chrome tape exhibits less bias noise in audio playback and less AM/FM modulation noise in video. Reduced bias noise is due to the smaller particles and the uniformity in size and shape. The result is less hiss in audio and less snow in video.

Modulation noise comes from irregularities on the surface of, or within, the oxide coating. AM modulation noise is related to bias and occurs

when a 0Hz or dc signal is reproduced. In audio, this type of noise manifests itself as crackling.

FM modulation noise is caused by varying tape-to-head contact because of imperfections in the magnetic coating or from varying frictional forces between tape and head. In audio, the result is a muddy or fuzzy sound. In video, it shows as chroma noise or slight shifts in color shade.



1 micron

Magnified particles of metal tape.

Courtesy of Fuji

Other materials

Metallic tape formulas promise an increase in data density over oxide types with recording wavelengths in a 1 micron or shorter range. The fine grain metal particles (shown above), when used on a VHS system with sendust heads at half the normal tape-to-head speed, have shown a +13dB increase in video output compared to oxide formulas. In comparison with a 6-hour VHS recording that requires 0.5m² tape per hour, the use of metal tape reduces tape consumption to 0.25 or 0.3m² per hour.

When a cobalt compound is vacuum evaporated onto the tape backing, a layer 1500 to 2000 angstroms thick may be obtained. Although not commonly available, this material permits recording with conventional heads. Recording wavelengths to 0.6 microns show a sensitivity of 11dB over the metal tape formula.

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Cetec Vega wireless equipment plays a prominent role in the sound production of the famous musical, CATS*. Jess Heimlich, sound engineer for the touring company, says, "Cetec Vega wireless systems are work-horses. They make my job a lot easier, and, more importantly, give me a feeling of security. They are subjected to the most unimaginable workout I have ever seen."

Cetec Vega wireless microphones have helped CATS in the winning of seven Tony Awards (including Best Musical, 1983) and the Outer Critics' Circle Award—Best Musical (1983).

The road company of CATS uses 14 Cetec Vega Model R-42 dual-diversity wireless receivers with Model 77/DII bodypack transmitters. The system features DYNEX®II, Cetec Vega's new standard in audio processing. Jess also has two backup Vega systems on standby. "These 16 sys-

tems have been on the road for over a year now, providing about 95% reliability. When you put your reputation on the line eight times a week, you want equipment that'll back you up. Vega's do. And, more importantly, when there is a problem, you want a company and its representatives to provide you with immediate service. Vega has given me both. Typically, repair turnaround time has been 36 hours!"

The road company's stage managers also use the Cetec Vega "Q" System full-duplex wireless intercom system, which interfaces to their Clear-Com wired intercom system.

In all, between 15 and 17 wireless microphone and intercom systems are used simultaneously on stage, without a trace of interference between systems.

Cetec Vega wireless systems are also in use at the newly opened

CATS productions in Los Angeles, Toronto, and Chicago, and on Broadway. Jess says, "In the last three years, I have used more than 30 Vega systems on four different Broadway Productions. The plain and simple truth is: they work...MORE RELIABLY, MORE CONSISTENTLY, AND MORE OFTEN than any other wireless I've ever used."

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"Vega's top-of-the-line wireless systems are great!" says Jess Heimlich, CATS' sound engineer, standing next to their rack full of Cetec Vega R-42 dual-diversity wireless receivers.

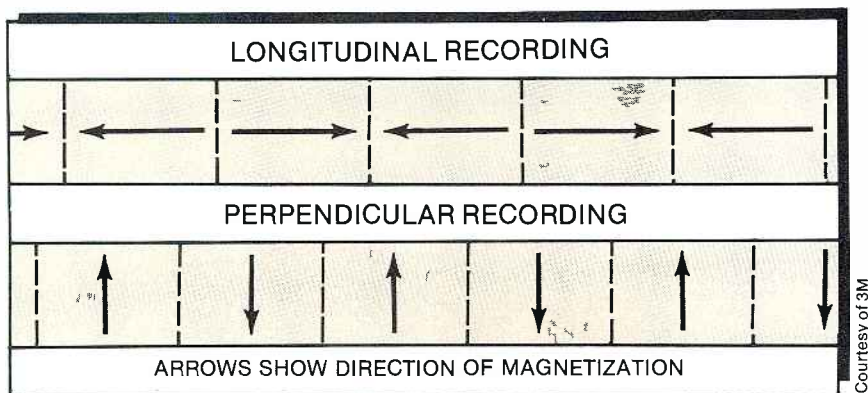


Figure 1. The geometries of longitudinal and perpendicular magnetic recording.

the binder results in a tape that sheds excessive oxide particles. Massive head clogging may be a sign of this.

Chemical or molecular bonding may be used for the adhesion of binder to backing. Some claim that chemical bonding materials can exude particles which add to head clogging. This is being researched.

A protective coating is applied over the magnetic layer to resist abrasion from audio and video heads under normal operating conditions. It may include anti-static properties to reduce undesirable stiction characteristics that impede smooth motion through recording and playback mechanisms.

The protective coating must be as smooth and thin as possible. Irregularities will cause added wear on recording or playback heads and other tape path parts. The thickness of the coating determines, in part, the ease with which information will be transferred from the recording head to the magnetic material. The closer the head comes to the oxide, the better the transfer. Variations in layer thickness produce changes in separation of the head and medium, resulting in variations in the recorded signal level.

Data density

Most recording orients the magnetic particles along the length of the tape, or longitudinally (see Figure 1). This restricts the density of information that can be packed on the tape. In other words, the finite physical size of the particles determines how many magnetic flux reversals or transitions (the frequency response) can be expected within a given distance along the tape. Particles for videotape typically measure about 0.24 microns in length. A diameter-to-length ratio of 1:16 is not uncommon.

Digital video and data recordings demand higher densities of information storage than analog audio or video signals. One way to increase the density is through *vertical* or *perpendicular* recording. When the tape is made, the magnetic material is forced to align vertically, the particles pointing from surface to surface, rather than along the length.

Research shows that a magnetic layer of cobalt-chromium as a continuous thin film offers ideal properties for vertical recording. A less expensive barium ferrite compound is promising, but is not as effective as the metal film.

The advantage of vertical recording over longitudinal methods is tied to the physics of ferromagnetism and a characteristic called the *demagnetization field*.

A magnet generates an internal field that opposes its primary field. The

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The Threat Abnormal voltage surges that occur on AC power lines, communications lines and data lines are a major cause of misinformation and equipment failure for the broadcaster. Broadcasting equipment is especially vulnerable, with tall antennas

reaching up into the skies and with electronic units of unusual sensitivity.

Difficulties manifest themselves in two ways: (1) as physical *damage*...this is obvious damage that occurs directly as the result of an electrical storm, or less obvious failures that seem to occur almost at random; (2) as *misinformation*...where the power surge is coupled into the equipment causing improper events to occur or incorrect data to be presented.

These problems are familiar ones to broadcasters. And now, with the ever-expanding dependence on computer control and the corresponding increase in the susceptibility of these sensitive devices to damage from voltage surges, overvoltages must be controlled and eliminated.

*Allen & Segall/IBM, 1974



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The Causes Transient power problems originate outside buildings from lightning, ground faults, and public utility switching, and inside buildings from inductive loads, transmitters, air conditioners, fluorescent lights, etc. A study at IBM* identified transients as the cause of 88.5% of all line disturbances. Transients, sudden and extreme "spikes" in voltage, can be as short as a few nanoseconds or as long as several milliseconds. Their effect can range from total failure to the gradual degradation and breakdown of electronic components or systems.

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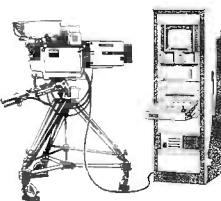
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strength of the internal field becomes stronger as the magnet becomes shorter. As the frequency of the recording increases, and the distance between magnetic transitions decreases, the demagnetization field becomes more intense. The effect is increased in longitudinal recording by the many neighboring particles in the oxide layer.

Reducing the thickness of the longitudinal recording layer will decrease the demagnetization. However, a side effect is a diminished signal. Also detrimental is an increase in the signal-to-noise ratio.

In perpendicular recording with particles oriented vertically, the opposite occurs. The self-demagnetizing effect of one region is opposed by fields from neighboring magnetic particles and regions, thus reducing the demagnetizing tendency. A thicker magnetic layer also decreases demagnetization, simultaneously increasing the signal strength and the S/N ratio. The higher reproduced signal allows much sharper magnetic transitions to be recognized, improving data density.

The importance of data density is realized by comparing C and VHS analog recordings. Typically, Type C recording operates at a maximum of about 26,000 magnetic reversals per inch in a longitudinal mode. VHS, with a shorter writing path for each video frame, packs a staggering 44,000 transitions per inch. Figure 2 (page 52) compares data densities of various media.

As we approach digital techniques in video, we will experience data streams of 200 to 300Mb/s. Work is proceeding on an encoding scheme to achieve a density of 100,000 bits per inch of tape, with each magnetic reversal being equal to one digital bit of information. If a track density of 2000 tracks per inch is used (and this is feasible), then an information density of 200Mb/in² is possible. This suggests that tape consumption for digital video recording could be approximately 1 in²/s, compared to a consumption of 10 in²/s with Type C recorders.

Shopping for tape

Much of the mystery has been removed from buying tape. In fact, the manufacturers have essentially reduced it to a question of application.

In audio work, one main point of choice is cassette length. C-60 cassettes, with 30 minutes per side, are suitable for much radio work. The C-90 units, with 45 minutes per side, match the LP record nicely for music.

Other considerations for audio involve the type of oxide used. You can choose Type 1, requiring normal bias; Type 2, needing a higher bias for the chrome

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3 ENG Audio—Sound Reasoning. High output and low distortion provides a rich, clean sound. Even after five generations, audio signal-to-noise exceeds BVU machine specifications.

4 ENG Antistatic Treatment—Quit Collecting Dust. Plastics are molded with an antistatic chemical to reduce static charge. This minimizes dust attraction, thereby reducing dropout build-up.

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particles; or Type 4, metal tapes. The use of Type 3, ferrichrome materials, is decreasing.

For TV production, length and prime use should be considered. Though standard products will satisfy most videocassette purposes, a more sturdy product is desirable for mastering applications.

Videotape purchasing is simplified at present by the lack of widely varying actual oxide types which would require

major changes in *pseudo-bias* adjustments. As metal types become more prevalent, such considerations may play a more important part.

Resist the urge to go bargain hunting. Attention to detail will lead you to an intelligent purchase. A close look at the cassette housing will tell the story of what is inside. A well-assembled housing shows that quality workmanship went into the entire product. On the other hand, a plastic housing that exhibits unusual

marks from a sloppy molding process could suggest that the material inside reflects the same lack of precision in manufacturing.

When planning a major tape purchase, talk with the primary manufacturers. Most will be happy to provide sample cassettes for your consideration. When the sample products match your needs, pursue your best deal. Be discriminating; shopping for the lowest price may mean buying the lowest quality.

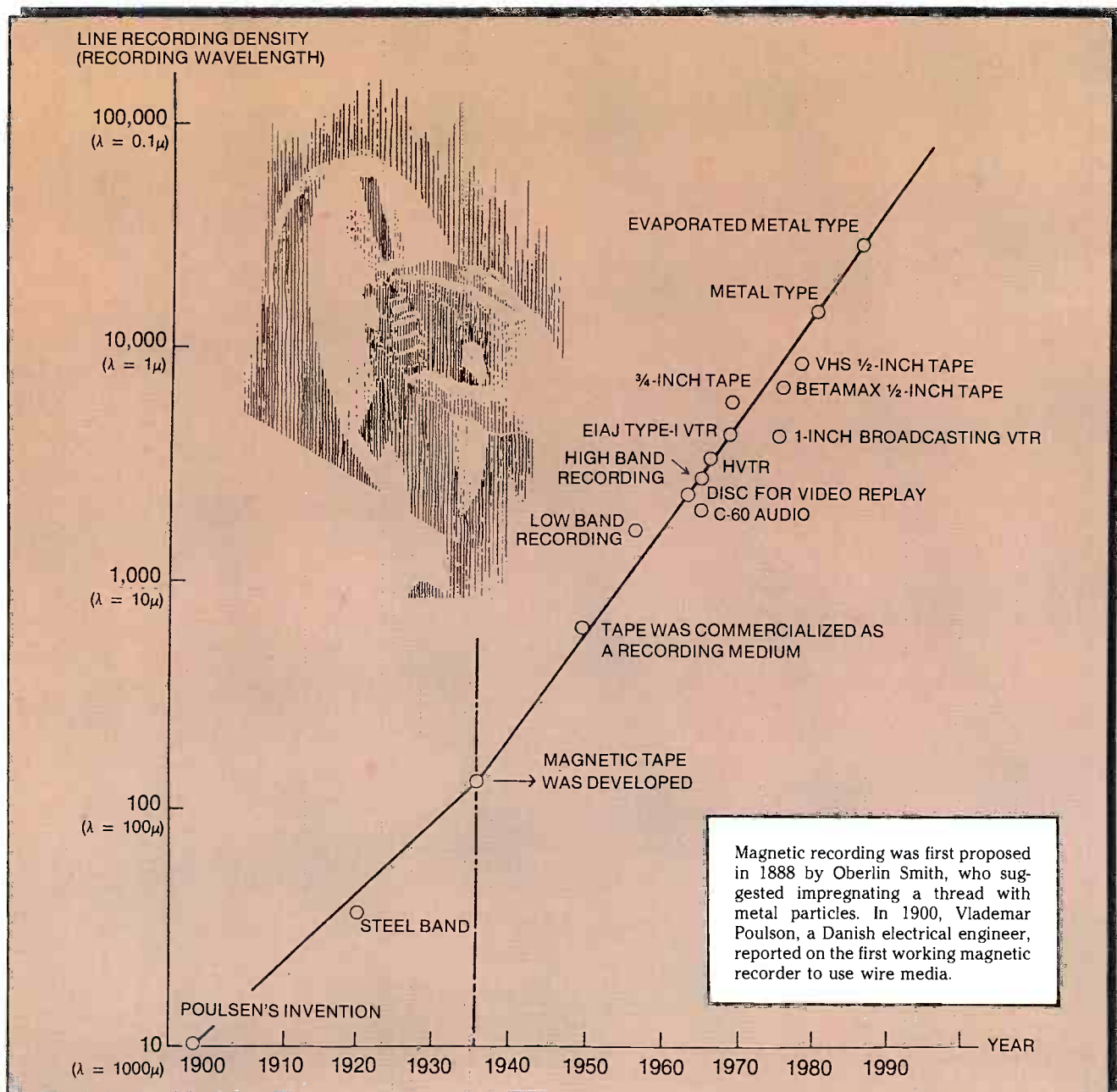
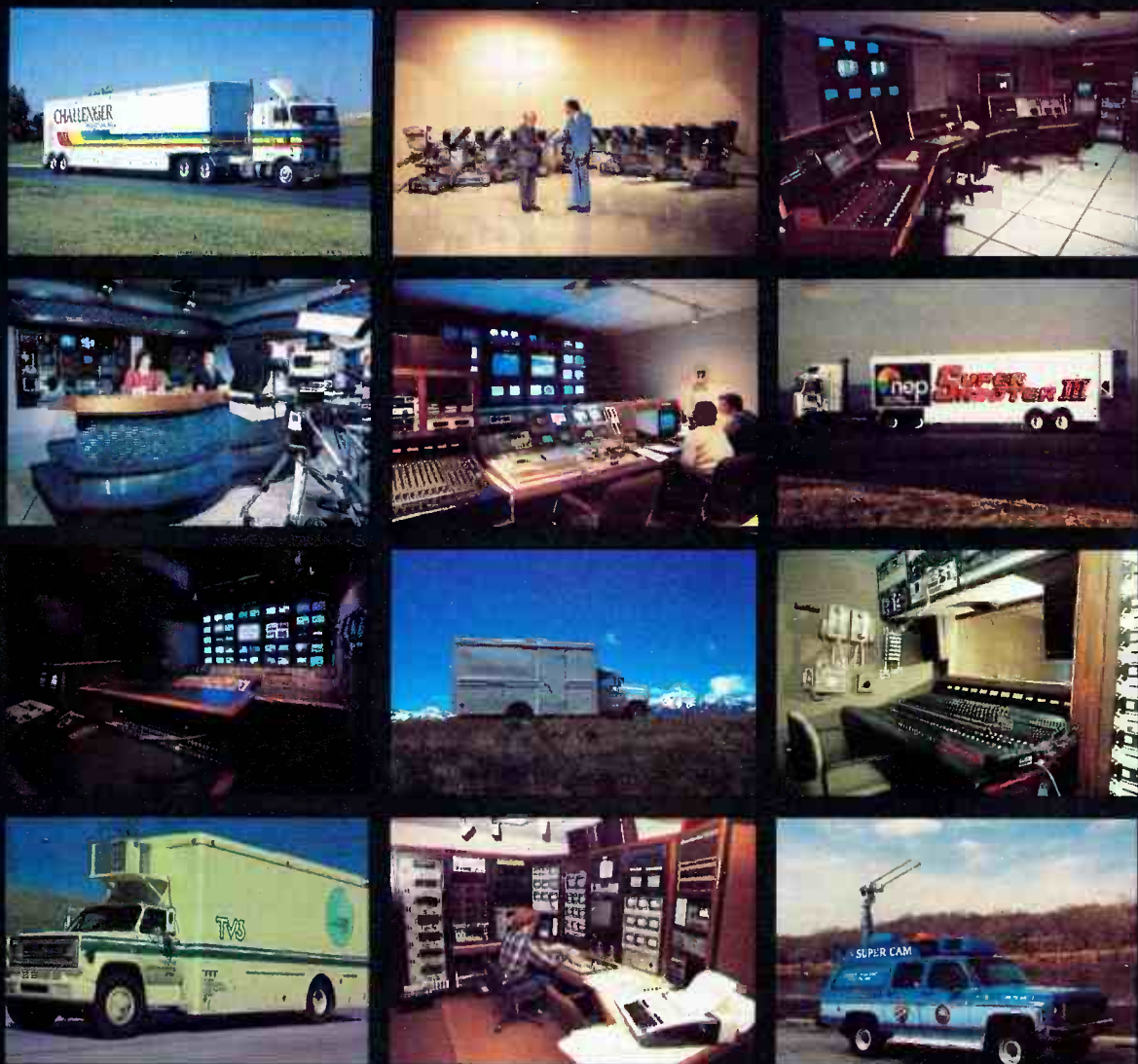


Figure 2. The evolution of recording density.

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Electrostatic forces

The plastics in magnetic tape backings, reels, carriers and cassette housings present a problem of static electric buildup. The problem is not the static itself. Rather, it is the dust and dirt attracted by the charge. This problem becomes increasingly serious as various video formats use higher signal-packing densities. Contaminants of dimensions larger than the spot to be read on the tape interfere with reproduction of the signal.

In the early '70s, the first step in reducing static buildup was the development of a stable, refined, conductive carbon black coating on the base material. This coating remains a preferred method of anti-static treatment for tape today.

The static charge surrounding recording tape has two sources. Part of the charge results from mechanical work dissipated in friction (triboelectricity) as tape and reels move within a cassette. Another source is an electret effect, resulting from the plastic-molding process that forms the cassette shell. The amount of the charge developed is related to the dielectric of the material used in the cassette.

Static surface potentials ranging from 1.5kV to 5kV are typical as a cassette is removed from its box, according to a study of tape from numerous manufacturers. This potential is from electret charging caused by the cassette-molding process. Levels on housings coming out of the molds range from 2kV to 20kV. These static charges are not self-dissipating. Static charges developed on cassette housings before and after rubbing on nylon carpet are compared at right.

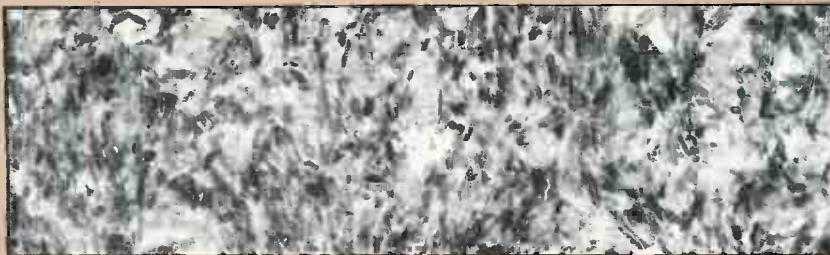
When the cassette is put into service, friction-induced potentials are added to already existing charges. The video-cassette becomes a magnet to dirt and dust. With these contaminants present, non-magnetic transient dropouts occur. In addition, abrasive action by the contamination begins along the tape path of the VCR.

A recent solution offered by one company is an electroconductive coating applied to all plastic parts of the cassette during its manufacture. The coating formula is prepared from ionic materials which conduct electricity much like the electrolyte of a battery. The water-based coating that dries on the plastic surfaces retains enough water to allow ions to move freely across the surface and effectively cancel the electrostatic effects.

A different solution used by another

company is to include the static dissipating material in the base resins used to mold the cassette housings, spools and other parts. The anti-static additives reduce the frictional buildup of static during the molding process, then continue to exude to the surface during the life of the cassette, providing long-term protection.

Not only do these two methods reduce static immediately after the cassette is manufactured, but the effect of the process continues well into the life of the cassette.



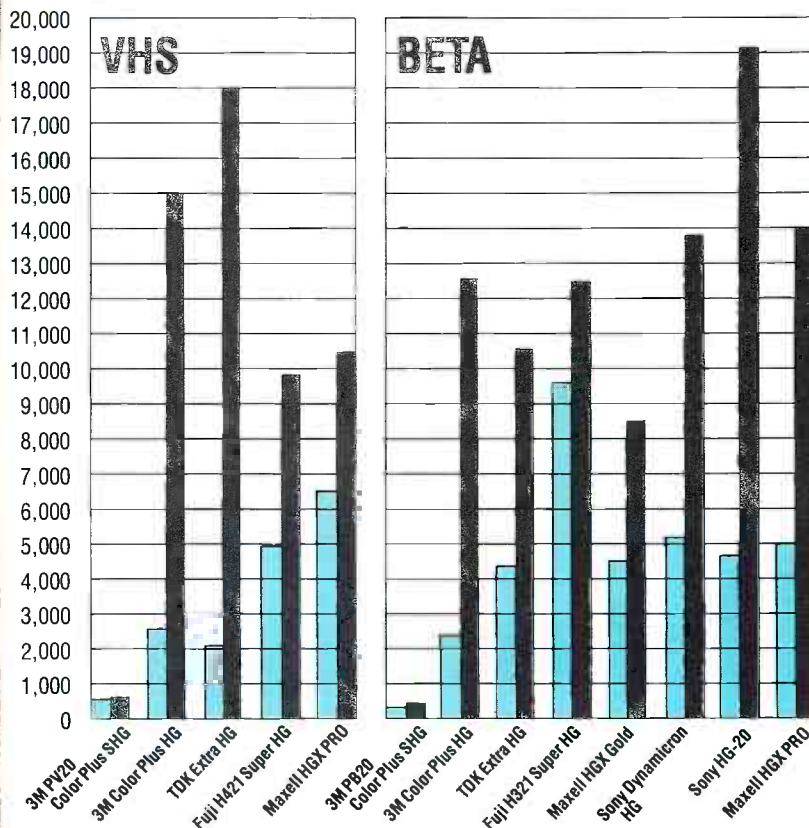
A cross section of 1-inch video-recording tape, magnified 20,000 times, allows oxide particles to be distinguished. The magnetic layer is slightly more than 5 microns thick.

Courtesy of Sony

Electrostatic Potential Measurements Professional VHS and Beta Cassettes

Initial¹ Electrostatic Potential (Volts)

Induced² Electrostatic Potential (Volts)



1. Values shown are highest obtained by scanning exterior of each cassette with Monroe Electrometer Model 175.

2. Charges induced on each cassette exterior by rubbing lightly on nylon carpet in five circular motions. Measurements made immediately after charge induction at relative humidity of 40%.

This bar graph shows electrostatic potential measurements of initial and induced static charges on various videocassettes.

Courtesy of 3M

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Tandberg's new Series TCD 900 is a superior and cost-efficient alternative to the (unprofessional) practice of using inferior home tape decks for Professional applications. These new Professional Cassette Decks offer unparalleled sound capability, advanced mechanical and electronic design, plus extraordinary control flexibility based on an 8-Bit microprocessor with 32K of EPROM memory. These are the type of quality products for which Tandberg is well known, and are designed and built in keeping with the company's more than 50-year reputation for quality, performance and long-term owner loyalty.

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TCD 910 is designed to replace both reel-to-reel and cartridge machines in many applications, and is capable of producing tapes at sound and silence levels beyond that required by broadcast and studio requirements. Combined with its extremely

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Features include:

- High precision, rugged 4 motor tape transport with direct load, instant access cassette positioning.
- Discrete three head system with built-in record azimuth adjustment is combined with Tandberg's proprietary Active Phase Correction Circuitry, exclusive discrete, wide band electronics, plus the highly regarded Actilinear II and Dynec systems. In addition, the latest generation Dolby B and C noise reduction processors are utilized.
- All audio circuitry uses high spec polypropylene capacitors and metal film resistors.
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current adjustment, with built-in oscillators.

- Optional RS 232 computer interface, infrared wireless and hard wire remote with fader start.
- Wide range of options and accessories.

TCD 911 Cassette Playback Deck

The TCD 911 offers the same quality of construction and design as the TCD 910. Its special features include:

- Playback pitch control.
- External playback azimuth control, for optimum performance from *any* pre-recorded cassette.

In a multi-deck studio situation, the TCD 910, combined with the TCD 911, makes for the ideal match of performance, reliability and price.

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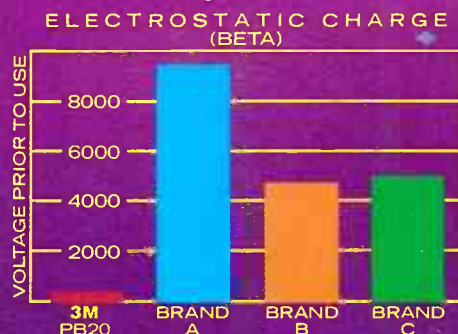
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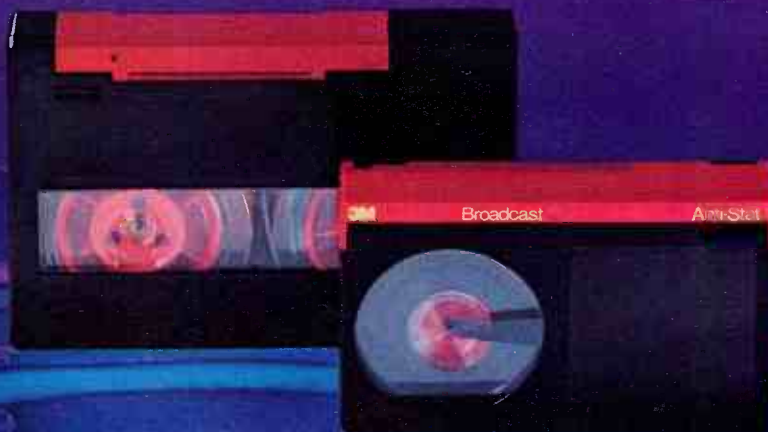
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The fundamentals of magnetic recording

By Carl Bentz, technical editor

Recording equipment has changed drastically over the years, but the underlying technology that makes magnetic recording possible has not.

Magnetic recording is based on the retentivity property of ferromagnetic substances. Magnetism is a result of the combined effects of the spins of electrons in the atoms of a ferromagnetic element, such as iron. Small segments of the element form into magnetic domains, each domain acting as a miniscule bar magnet.

In a demagnetized bar of iron, the domains point in random directions. They are positioned in such a way that the attraction from the north pole of any one domain is canceled by the south pole of another domain.

When magnetized, the domains align themselves, essentially in parallel, with the accumulated north pole effect at one end of the bar, and the south pole at the opposite end. The bar becomes one large domain.

The same effect occurs when electricity passes through a coil of wire, which has a magnetic field with north and south poles. The strength of the field is proportional to the number of turns of wire in

the coil and the amount of current flowing through the wire.

If an iron bar is placed through the coil (forming an electromagnet), the domains in the bar are aligned by the field of the coil. In essence, the bar becomes a conductor of the magnetic current, or flux. The result is a strengthening of the magnetic field. The pattern of the field

can be shown by scattering powdered iron filings on a sheet of paper placed over the magnet. (See Figure 1.)

A bar that is curved into a horseshoe or circular shape, as in Figure 2, will cause the strength of the field to concentrate near and between the two ends. Few lines of flux will be found outside the bar at any other location.

If a piece of material consisting of small iron particles (domains) on a strip of plastic (tape) is pulled past the gap between the two ends, the domains will be aligned by the field. The direction taken by domains on the tape will depend upon the direction of the north/south field at the magnet gap.

An alternating current flowing through the coil that creates the electromagnet will cause the north and south poles of the magnet to alternate. As the tape moves past the gap, the domains of the tape will indicate the alternation. Once past the magnetizing force at the gap, the domains on the tape retain their newly taken directions. (See Figure 3.)

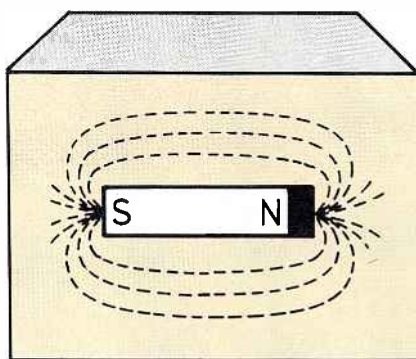


Figure 1. The magnetic field of a bar or electromagnet is seen as lines of magnetic flux which appear to flow through the bar, out at one end, curving back into the opposite end.

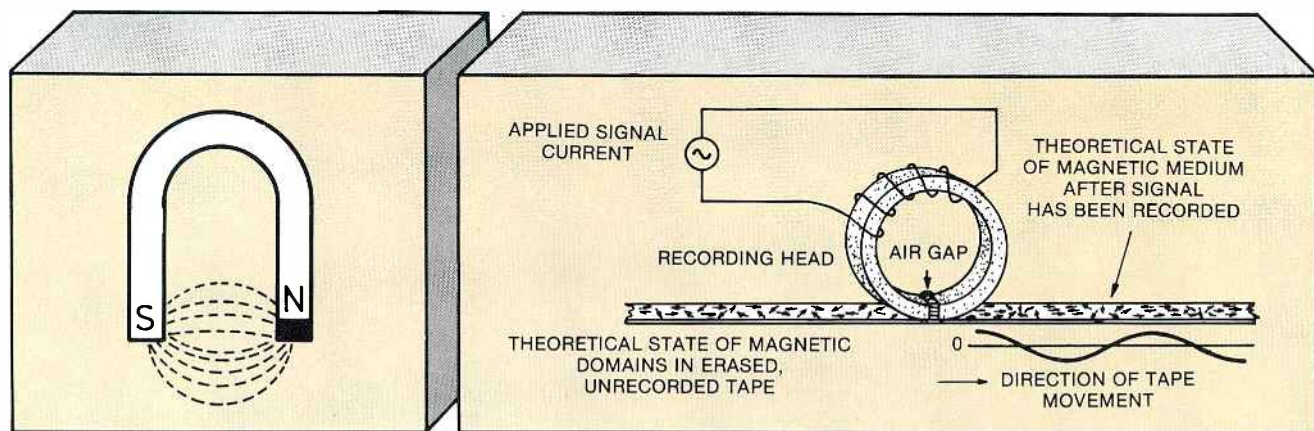


Figure 2. Bringing the ends of the bar closer together concentrates the flux between the ends.

Figure 3. Alternating current applied to the coil creates an alternating magnetic flux at the head gap. Domains on the tape moving past the gap are aligned by the flux.

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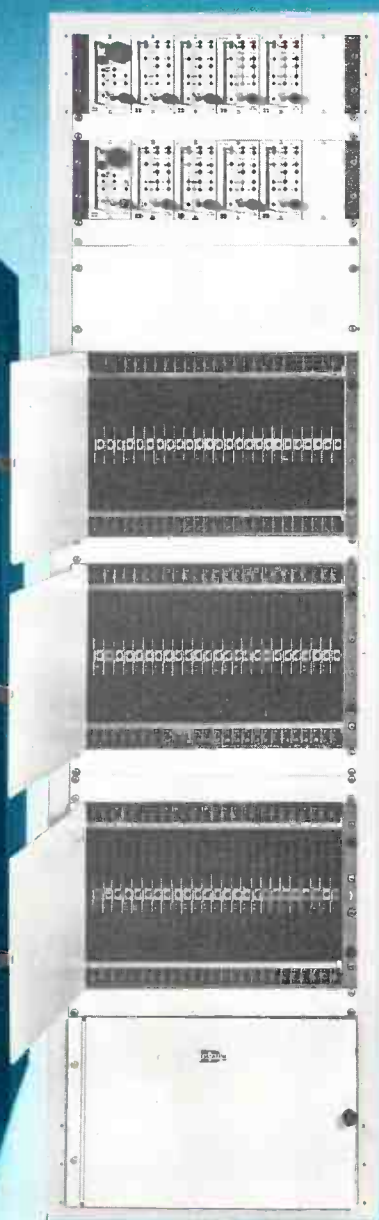
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Playback

If a coil of wire is connected to a voltmeter, as shown in Figure 4, and a bar magnet is passed through the coil, an electrical signal is induced into the coil. The direction the electrical current flows depends upon the direction the magnet moves. The strength of the current is related to the speed of the bar magnet movement, the number of turns in the coil and the strength of the magnet.

As shown by the example in Figure 2, by placing a curved bar of non-magnetized iron (the core) inside the coil, magnetic energy in the vicinity of the gap will generate an electrical current in the coil. If the magnetic energy is the information stored on a strip of tape, the electrical current induced into the coil of wire will be a representation of the recorded data.

Hysteresis: magnetic inertia

In Figure 5, the magnetizing force H in ampere turns is plotted against the density of the magnetic field (flux) in the ferromagnetic substance (tape). At point A, the magnetizing force has increased from zero to a level that causes the do-

main to overcome their inertia and begin to align themselves with the applied force. As the force is increased, eventually all domains are aligned parallel to the field produced by force H , point D. The tape is *saturated*. If the force H is returned to zero, most of the domains remain aligned, and a field B_r is stored on the tape. B_r is a measure of the retentivity of the tape.

When the magnetizing force H is increased in the opposite direction (see Figure 6) to an amount H_c , then the stored or residual magnetism is reduced to zero. H_c is a measure of the coercivity of the tape. If H is increased beyond H_c , a point of saturation will be reached with all domains aligned, this time in the opposite direction of the Figure 5 example.

Points A, B, C and D of Figure 5 represent the number of domains aligned. Because the line through them is not straight, the stored energy level is called a non-linear function of the magnetizing force. A signal recorded on tape in this manner would be non-linear or distorted. Note, however, that the section of the line between points A and C is nearly straight.

To overcome the distortion, a bias signal is recorded on the tape at all times. The information to be stored mixes with or modulates the bias signal. The bias forces the magnetizing force into the A-C linear part of the curve so that the recorded information more closely represents the desired recorded signal.

The bias frequency should be about five times the highest frequency to be recorded. If an audio signal of 15kHz is to be recorded, the bias frequency should be at least 75kHz.

The bias signal strength should be five to 10 times the peak amplitude of the signal to be stored. The result is a recording of high amplitude, low noise and low distortion—the desired characteristics.

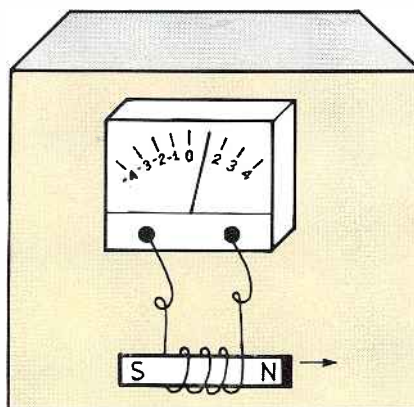


Figure 4. A bar magnet passing through a coil of wire that is connected to a voltmeter causes the meter to register an electrical current.

Head gap

The head gap must be wide enough for at least several cycles of information to

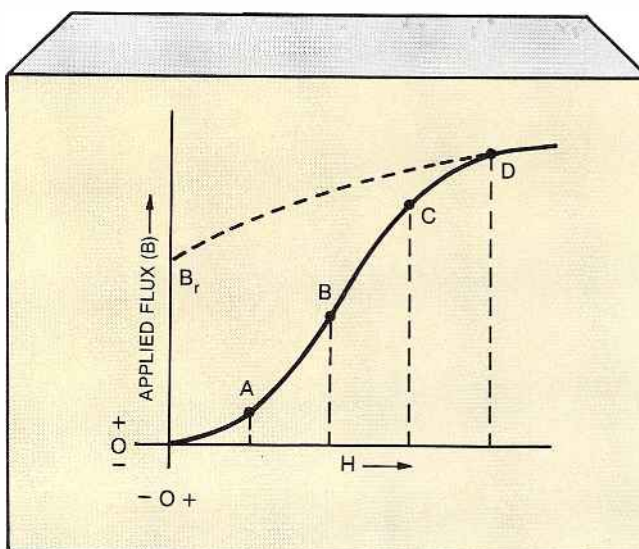


Figure 5. The BH curve for ferromagnetic material relates the alignment of domains to the magnetizing force applied.



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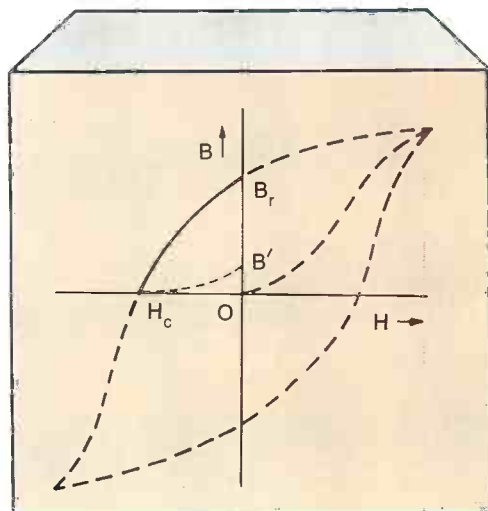


Figure 6. The BH curve relating the directions of force H and resulting field B is called a hysteresis loop.

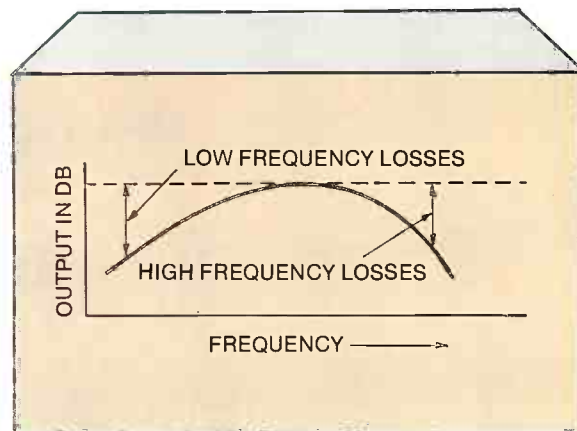


Figure 7. A generalized curve plots frequency response against signal output in dB units.

occur while the tape is at the gap in record. For playback, several cycles are also desirable, their combined magnetic energy providing a greater signal into the playback head. If the gap is too wide, the high-frequency response of the recording will be reduced. As the gap is reduced, the high-frequency response increases. The speed at which the tape moves past the gap is also a factor.

The signal induced into a head on playback is related to motion and the number of magnetic flux lines that pass

the head within a given length of time. A low frequency on tape provides fewer lines to be cut by the head, so the voltage is low. At a mid-frequency, more lines are cut per unit of time, so the output is greater. At high frequencies, the number of lines of flux seen by each end of the gap may be very different, and, as a result, cancel each other. Therefore, the high-frequency playback level will be lower than the mid-frequency level. (See Figure 7.)

Theoretically, if the wavelength of the

signal is equal to the width of the head gap, no signal is recorded. Under the same conditions in playback, no signal is reproduced. Thus, the size of the head gap is critical to the desired frequency response of the system.

Circuits in the recorder and/or player are designed to amplify low- and high-frequency signals more than mid-range signals. These circuits provide equalization and attempt to make the signal from the tape machine as flat as possible over the desired frequency spectrum. [:-(-)]]]]



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May 1985 **Broadcast Engineering** 63

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The care & handling of videotape

By Art Schneider, A.C.E.

How tape is cared for can make all the difference in how well it performs for you.

Videotape is the least expensive item in videotape production. Yet, once recorded, the tape represents the work of writers, musicians, actors, technicians and support staff; it is the end product of their talents, their time and substantial sums of money. Protecting this investment should be paramount to those working with the tape.

The quality of videotape has improved steadily since its 1956 debut. Extended wear, chroma noise reduction and greater S/N ratios are among the most noticeable improvements.

Although tape is manufactured with high standards, and quality testing is comprehensive, defects do slip by. For that reason, one of the first things you should do with a fresh shipment of videotape is verify its quality. If any problems are found and can be identified as manufacturing defects, notify the manufacturer. The makers want to know about technical problems with tape stock so they can correct them. They will exchange verified defective tapes.

Videotape does not degrade with age. With proper care and storage at the right temperature and humidity, picture and sound quality remains constant. In a recent test with tapes more than 25 years old, images and sound were as good as when they were recorded. Achieving that longevity was no accident.

Acquiring tape stock

If you work through a production house, you probably buy verified tape from the facility. You can bring your own tape, but keep in mind that no facility will guarantee your tape on its equipment. If a problem occurs with your tape, a production house will not usually accept responsibility. If problems result from tape furnished by the facility, it is a different story.

For the independent operation, the quickest way to evaluate tape is to record about a minute's worth of color bars and tone. During playback, any obvious defects will show up. The ideal check is to record the entire reel. However, this method is time-consuming and, as a result, quite expensive.

When it isn't practical to record an entire reel, spot it by recording about a

minute, starting about three minutes in and about every 20 minutes throughout.

Why three minutes? The first three minutes worth of tape is usually involved in test signals and will not be part of the program material. Also, this beginning segment is not necessarily representative of the quality of the entire reel. It should, however, be of high enough quality to allow a technician to set up a machine for playback.



The quality of any tape can be degraded by dust, dirt or contamination due to improper handling. The videotape editing bays in the newly designed facilities of KHS-TV (Channel 46), Ontario, CA, stress the concept of a clean environment.

Fresh from the box

Tape can be permanently damaged due to manufacturing defects, improper handling or misaligned equipment.

Improper tape slitting during manufacture sometimes occurs, especially in 2-inch stock. The evidence is found in audio playback as *wow*. Because there is no way to correct the flaw, the tape should be rejected. Another consequence of improper slitting is that poorly-slitted tape may, when wound, develop tiny wrinkles on its surface.

Oxide shedding may be caused by an ineffective *binding agent*, the glue that

holds the oxide to the mylar base. If you suspect the binder, check the batch number of each reel in question. Then notify the manufacturer, who can take steps to correct the problem quickly.

Sometimes a batch of tape has surface defects. These might be pitting, pinholes, scratches, wrinkles or oxide shedding. Holes and pitting probably originate when the oxide formula is sprayed onto the mylar base. For example, if a spray bar in the coating machine is clogged, the emulsion spray may not be evenly applied to the base.

Improper application of the iron-oxide mixture to the mylar base may result in excessive video and audio head wear. Videotape, if properly polished or burnished during manufacture, should not cause abnormal wear.

The S/N ratio of tape, the picture content as it relates to the amount of noise or *snow* in the image, depends upon the quality of the oxide formula of the tape. Maintaining exact specifications from batch to batch of formula is difficult, and variation should be expected. A reel of tape should not be rejected unless its S/N ratio does not meet minimum parameters set up by the manufacturer.

S/N problems can result from worn audio or video heads. Suspect heads should be replaced before you attribute these problems to the videotape stock. A VTR alignment tape will aid in verifying a worn head.

Static and stiction

A special anti-static backing is applied to tape to prevent static buildup. This buildup can result in *stiction*, a sticking or uneven travel of the tape as it passes through the transport. Without the backing, the tape tends to stick to highly polished surfaces of the transport. In effect, the tape becomes temporarily glued to the transport, and movement is prevented. The problem is most prevalent in low-humidity environments.

During manufacture, as the tape web is slit, each strand of tape is tightly wound onto separate metal reels. The anti-static backing prevents the base side of the tape from direct contact with the oxide emulsion surface of an adjacent layer and averts static buildup.

The backing, if improperly bonded to the base material, may shed. If that oc-

Continued on page 68

Schneider is BE's post-production consultant.

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dead issue.

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curs, loose particles are deposited on the transport. The result will be head clogs and possible tape scratching. Scratching may also occur during polishing.

Stiction sometimes results from oxide and debris that build up on VTR surfaces. If the machine is stopped, it may not start again until the tape contact is released by hand. You can avoid this by thoroughly cleaning the VTR before each new roll of tape is loaded.

Humidity may be related to stiction. If the humidity of the tape-storage and VTR environments is excessive (above 60 percent), the tape emulsion absorbs moisture, swelling the tape. Because the tape is now thicker, it places more tension on the video head, resulting in added head wear.

The clean machine

Many of the technical problems attributed to bad tape stock are actually caused by a dirty VTR. Just because the dirt isn't visible, doesn't mean it isn't there.

To ensure optimum picture and sound quality, 1-inch machines should be cleaned with each reel change. Cassette formats should be cleaned at least once a day in off-line environments. Mastering systems need more frequent attention.

Freon TF is a popular non-toxic

cleaner for metallic surfaces of the VTR. However, never use Freon to clean the rubber pinch roller. Use only alcohol, sparingly, to keep the roller clean and the surface dull enough to pull tape properly. If in doubt about cleaning materials and solvents, consult the manufacturer.

Cleanliness also applies when you are working with consumer equipment. If the picture becomes snowy or the sound is muffled, an oxide buildup on heads may be the cause. The buildup prevents proper head contact, a momentary problem for playbacks, but a hopeless situation for recording.

Scratching is surface damage caused by tiny nicks anywhere the tape comes in contact with transport surfaces. A more common cause is dirt. Just two minutes spent cleaning the VTR could prevent permanent scratch damage.

Tape vs. VTR

Confirm proper machine operation at least once a day. A test or alignment tape helps to verify that the machine and the signal path meet minimum standards. Careful observation of test tape playbacks can also detect video and audio head wear, reducing the possibility of subsequent inferior recordings.

A common flaw that occurs during recording is *dropout*. Dropout typically results from an unclean environment. A particle of dust, a worn head or a

momentary lack of head-to-tape contact leaves a spot unrecorded. Rerecording the spot should correct the problem if the dropout is not caused by a tape defect.

On occasion, the sensitivity adjustment of the VTR time base corrector could cause dropout. Readjustment of the TBC may be needed.

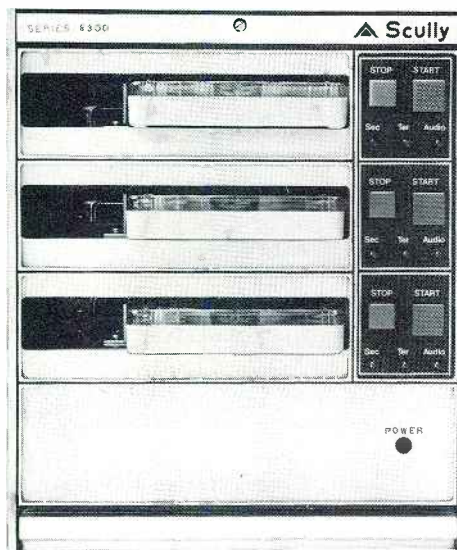
If the tape is a dub from a master, and if the master also includes the momentary lack of video signal, special skill may be required in order to correct the flaw.

Differential phase and gain errors are problems that usually become apparent during dubbing. They are related to adjustments of the playback VTR electronics. For corrections, the machine should be properly set up and the dub rerecorded.

Signal levels, if higher than generally accepted, may generate distortion in audio or video. Too low a signal level may produce dark, grainy pictures. Low audio results in increased hum and noise.

Consider whether the size and construction of the reel is appropriate for the VTR. On older machines, a 6- or 8-inch plastic reel may not have sufficient mass for proper holdback tension in fast-forward and rewind modes. For use with small plastic reels, a special metal flange has been designed to add mass to the supply reel. The flange attaches to the outside of the reel after the tape is mounted on the machine.

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Improper tension is a major cause of tape damage. Too little tension in any mode results in poor tape wraps, and can eventually cause wrinkling. Too much tension, on the other hand, can cause the tape to be stretched and even broken. A stretched tape may result in lost tracking or other signal breakup. Once tape is stretched, the signal it contains could be irretrievable.

On any video recorder, worn or misaligned pinch rollers should be replaced or aligned as quickly as possible. As a roller wears, it becomes glazed, and does not grab the tape properly, resulting in slippage during record and playback. Misaligned rollers may cause

wrinkling of tape, making it unusable.

A reel of tape that has been sent out of house should be checked, upon its return, for notes from other operators. There may be indications of problems or defects that should be corrected before the tape is used again. Look carefully for water damage, which will usually make a tape unusable.

Tape should be stored with the reels standing vertically, never horizontally.

Check tape reels for possible rim damage. Nicks, dents or warps along the rim are indications that the reel may have been dropped. Rim impairments can tear tape or cause it to run off path guides. The tape should be carefully

wound onto another reel.

On and off the machine

When threading tape on a machine, never use adhesive tape to attach the end to the takeup reel. During rewind, the tape end will always move through the transport, passing by audio and control heads and perhaps catching in the video head. Damage to the heads could be permanent, or at the least, result in expensive repairs.

Trim the ends of worn or wrinkled tapes. Wrinkled material could spell destruction when the end whips through the head area during rewind.

Make certain that reel hub locks are tightened securely. If loose, a reel may spin on the hub and cause mistracking or tape damage due to stretching or cinching. On vertically mounted VTRs, the hub locks keep the reels from falling off the machines.

Before recording on or playing back a videotape, wind the entire pack end-to-end to repack the material evenly. Loosely wound videotape on a reel of any size stores potential energy that can cause severe damage to the tape during acceleration.

When a reel is taken off of a machine, secure the end of the tape. There should never be a loose end to flop around inside the storage container. However, only adhesive tapes designed to be removed without leaving a residue should be used. Standard transparent, electrical or masking tape are not acceptable. They leave residues that adhere to the heads, accelerating head clogging and posing other potential problems.

With VCRs, be sure the cassette carriage is in good shape and properly aligned. Always insert the cassette into the machine carefully. Check that the tape-threading mechanisms work without wrinkling the tape.

Splice advice

Tapes that are one inch or smaller should not be spliced, except in dire emergencies. If the ends are torn cleanly, you might attempt a splice, but only with proper splicing material. Overlap jagged ends, then trim evenly and abut them before applying the splice.

If the original master is torn, you may have no choice other than splicing. If the tape is an edited master, you should copy and re-edit onto a different reel. Make the program repairs through electronic editing.

Helical scan recorders do not welcome physical tape splices. Some type of picture disturbance will always be apparent. Rerecording may not correct the problem, because the extra thickness of the splice changes the tape's characteristics.

Environmental problems

Tape is susceptible to moisture, which

Continued on page 74

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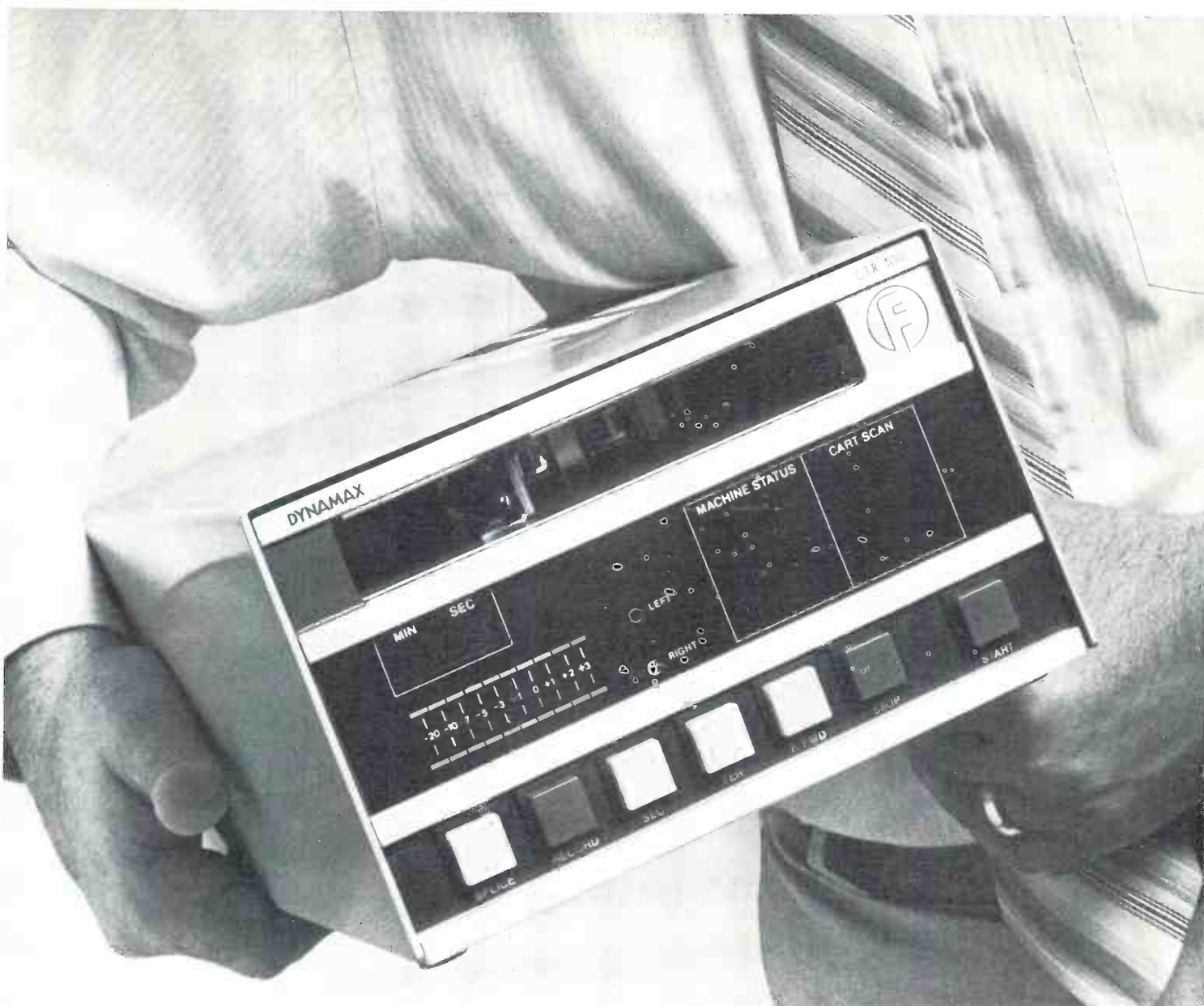
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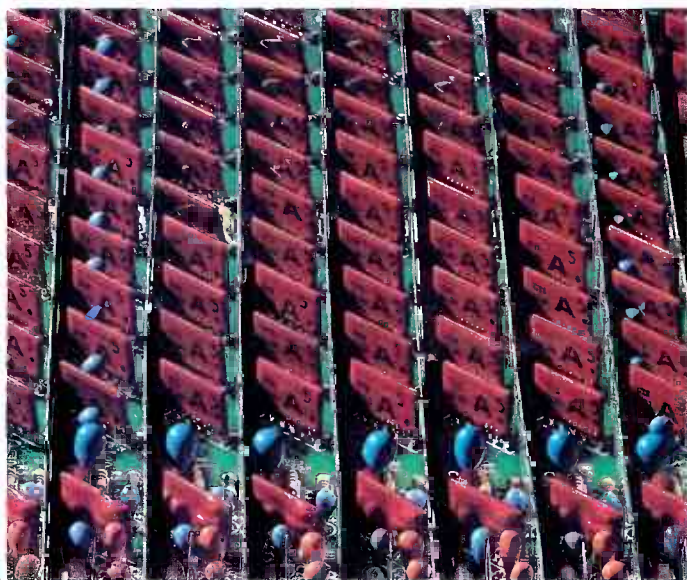
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DETAIL

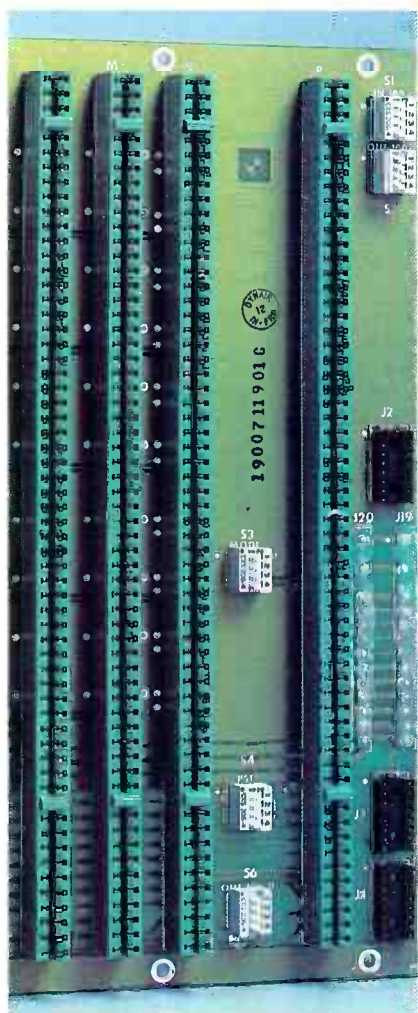
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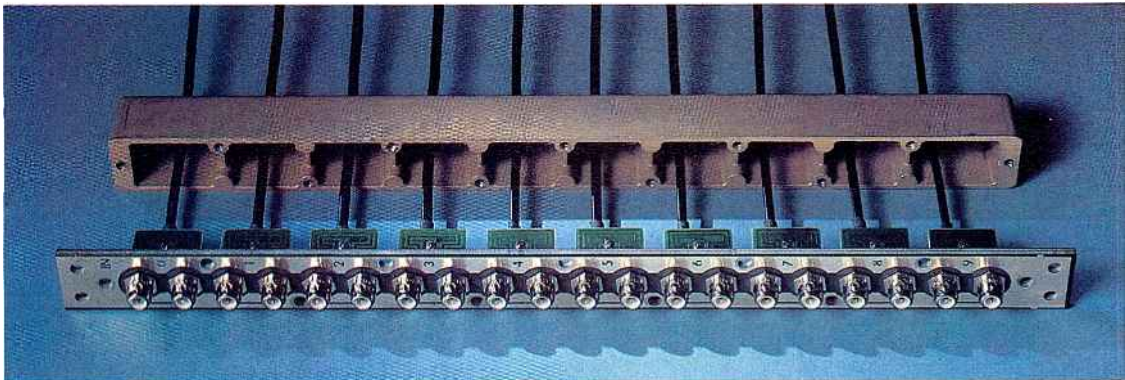
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connectors — true 75 ohm devices. To further tie things down the terminator is a fixed resistor, not a twiddle stick used to compensate for component and production variances.

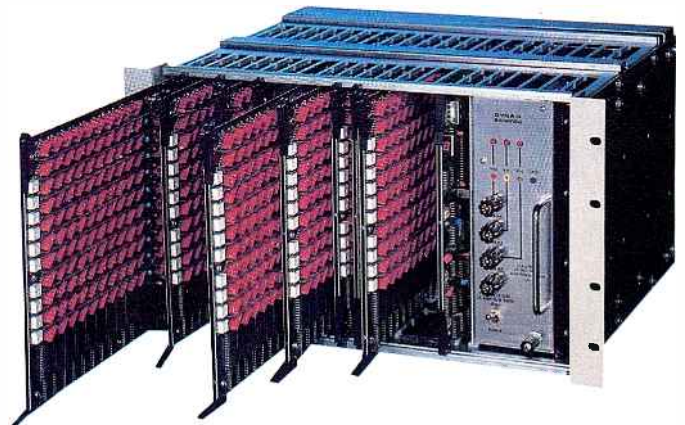
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can be absorbed into the emulsion layer. Moisture in a short-term situation is not harmful, but if the humidity is sustained above 50 percent, head wear and stiction increase. Ambient tape-storage room temperature should be between 65° and 75°, with 68° being almost ideal.

Dirt and dust are the greatest causes of excessive head wear. The VTR room should be kept clean and dust-free. Racks and VTR cabinets should be wiped clean with a damp cloth at least once a month to prevent dust buildup.

If the installation uses computer flooring, lift the panels at least twice a year and carefully vacuum the area beneath. Preventive maintenance helps to ensure consistent quality. Remember, it is less expensive to keep the VTR environment clean than to replace heads or to recover damaged program tapes.

Smoking should not be allowed in a tape room. Microscopic ash particles can cause severe video dropout and head wear. The same caution applies to floppy or rigid disk equipment. A dirt or ash particle caught on a magnetic head may result in a head crash, causing lost data and irreparable damage to the head and the disk.

Finally, clean hands are essential when working with VTRs and tape. Oil and dirt from the hands could contaminate the

transport surfaces. Dropouts are guaranteed if grease or body oil contaminate the tape. Always wash your hands before handling tape.

Name that tape

Have you ever hunted high and low for a tape, only to find it right under your nose with an incorrect label? Proper labeling avoids a good deal of lost time.

The reel and the storage box should contain identifying labels. Whether written or preprinted, the following information should be included:

- name of the program, commercial or segment;
- name of the producer;
- part number of any material longer than the length of one reel;
- running time of the recorded material for edited masters, copies of edited programs, commercials or film transfers;
- generation of the tape (indicated as original or edited master; dupe, sub-master or protection master; or film transfer master);
- dub number, if it is a copy of an edited tape;
- reel number, if needed for use in editing;
- date of the recording;
- VTR number for reference for possible technical problems, with operator's name or initials;

• type of audio system: mono, stereo, Dolby or flat;

• Type B or C for 1-inch tape, Type M or VHS, Beta or Betacam for ½-inch materials;

• the number of passes in playback, especially for syndicated items; and

• signal standard: NTSC, PAL or SECAM.

All of this information should fit on a 1" x 6" label. But, if it doesn't, use more than one. Some labels have check-off boxes to make label-marking easy for the operators.

Tender loving care

To maintain quality in videotape operation, be sure the VTR is in good working order. Clean it regularly and use an alignment tape to verify proper operation. Evaluate the tape to be used. Provide a clean environment for optimum performance of the tape and VTR.

Use labels to identify the contents of a reel of tape. This ensures that what you want is what you get. However, take care with adhesive materials. Labels should not be allowed to touch the tape, and only recommended adhesives should be used to secure the end of a reel of tape.

Remember that videotape is the entire representation of your production investment. Although it is manufactured to high standards, it is destructible. I-Z-)))

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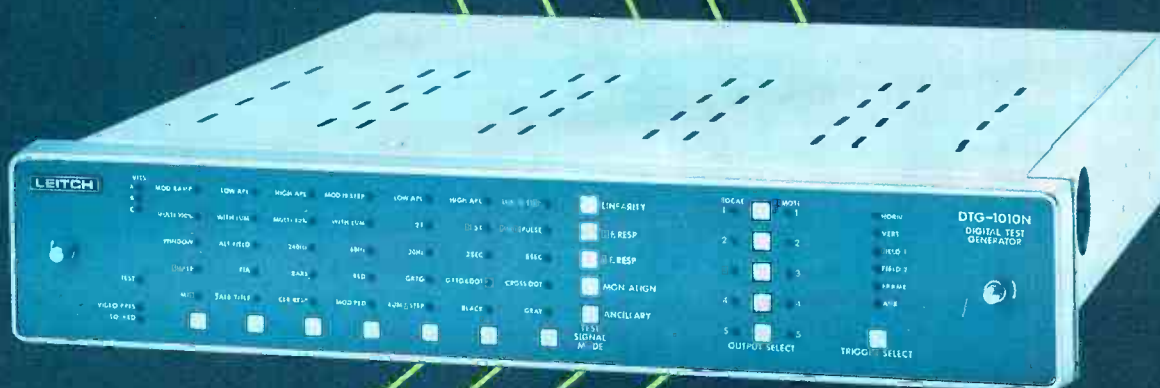
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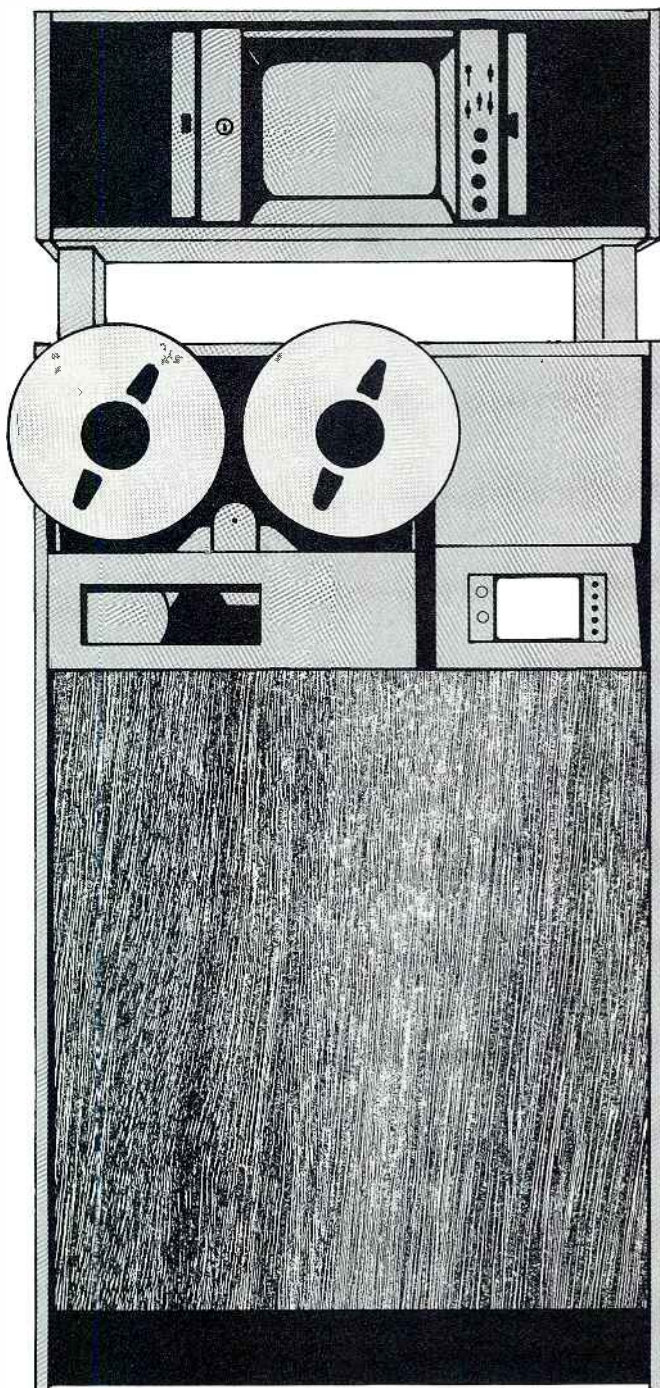
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VTR equipment developments

By Carl Bentz, technical editor

Refinement, enhancement and evolution keep videotape recorders working into the future.



Since the introduction of videotape in 1956, we have seen so many improvements in the recording art that we now can seriously ask, "is it live or is it VTR?" Thanks to videotape, we can view our favorite programs when we want to, and as often as we want to. And in our ever-shrinking world, the tape replay takes on a significant role, bringing us events from around the globe and archiving today for tomorrow's viewers.

Although information storage by magnetic means began in 1928, the introduction of the VTR required new developments in recording media. Improvements in videotape continue today, paralleling the evolution of the VTR.

Large formats

For many years, 2-inch quadrature recorders were the primary means of storing video on tape. Outliving a 2-inch, and early 1-inch, helical scan attempt, quad machines now are slowly succumbing to the 1-inch helical B and C formats. The change to helical formats offers more than the financial benefits of less expensive equipment and tape.

In the quad system, each of the four heads laid 16 lines of a 525-line frame onto the tape with each head pass. A total of eight revolutions were needed to create an entire frame. Because the tape moved longitudinally during those eight passes, no reasonable means of developing still frames or slow motion was possible without using additional equipment.

Type B and C formats offer video bandwidths that now surpass those of quad and, by writing an entire video field per head pass, allow still-framing, even without a TBC for non-broadcast use. Besides still images, the helical scan system allows non-standard motion in forward and reverse through the use of dynamic or auto scan tracking heads. Special time base correction controls the instantaneous positioning of the head and handles the necessary switching to form a complete frame from a single field off of the tape.

A logical step from the playback still-framing is single-frame recording for

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— David Hooge, Chief Engineer KEYC, Mankato, Minnesota

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animation. Whether animated objects are real, manipulated items or whether they are images from a graphics generator, storing individual frames directly to tape saves time over film-animation techniques. This is particularly true when the sequence is ultimately for TV use.

Recently, modified scanning systems have allowed VTRs to become part of improved slow-motion systems, while retaining their normal functions. A specially designed camera system is needed for the effect, although the VTR provides both special- or normal-motion playback. The 1984 Olympic games will be remembered in technical circles for this innovation.

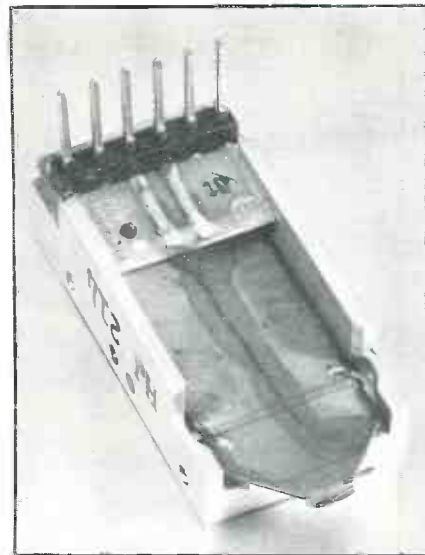
And the tape narrows

It is interesting to note that a smaller tape format ($\frac{3}{4}$ -inch) actually entered the broadcast field (in 1971) before 1-inch. Part of the popularity of $\frac{3}{4}$ -inch is its relative portability over 1-inch and 2-inch tape. A problem with it, however, is the *color under* recording method, which places mixed color components on a 688kHz carrier and frequency-modulated luminance with the sync tip at 3.8MHz on the same record channel. Interaction between the two signals results in interference through the composite video-encoding process.

Keeping the color components separated from luminance, however, has caused smaller formats to become valuable to broadcasting. The $\frac{1}{2}$ -inch Betacam and M formats keep R-Y/B-Y or I/Q components separated from themselves and from the luminance. Luminance and chrominance are recorded through separate channels onto their own tracks, compared to $\frac{3}{4}$ -inch single-channel approach. Although Betacam alternates the R-Y and B-Y signals, M format records both color components simultaneously on well-spaced RF carriers through the color channel. The separation allows wider bandwidths for each component, thus improving the resolution over the $\frac{3}{4}$ -inch systems.

Complete production systems, from the camera with a detachable VCR, to editing systems, to automated playback systems, are available in both current $\frac{1}{2}$ -inch systems. Bandwidths approaching 4MHz (+0.5dB, -6dB) for Betacam and 3MHz (0, -3dB) for M format closely rival other recording systems.

The latest $\frac{1}{2}$ -inch format to emerge is M-2, which uses metal particle tape in a VHS cassette package. M-2 format is incompatible with other $\frac{1}{2}$ -inch systems, representing a stand-alone system capable of a 4.5MHz bandwidth (0, -3dB) in Y/U/V components.



Courtesy of Ampex

A close-up view of an automatic scan tracking head shows the metalized plating on the piezo-electric elements of the head mount. Without this technology, many of today's VTR features would not exist.

This system operates separate luminance and chroma channels with time-division multiplex-processing of the color. As with the other $\frac{1}{2}$ -inch systems, no subcarrier is present to create more interference. In a departure from Beta and M, the M-2's recording time per

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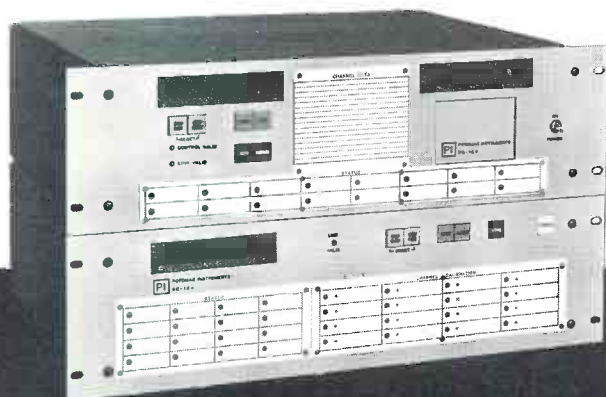
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cassette is 65 minutes, compared to approximately 20 minutes for the others. Space in the VHS package can accommodate an additional 30 minutes. Don't plan on toting an M-2 system in the field on an over-the-shoulder strap, however, as it is not a portable format.

Of interest, particularly for ENG shoot-and-show operation, in which limited generations are likely, is the 1/4-inch format. With detachable recorders and field editors, as well as studio units, this smallest format parallels the 1/2-inch products.

Two variations of 1/4-inch have been suggested, both involving component

technology. To date, neither format has received industry standardization. At least part of the delay is due to questions about machine interchange and the multigeneration capabilities.

A bit of digital

In the near future, digital recording promises to become more prevalent, at least in the production industry. Digital recorders, based on a 19mm (3/4-inch) format that has been selected as a world standard to simplify information exchange, record both audio and video during a helical scanning head pass.

The movement to digital recording by

the general broadcast industry is not expected to take place for some years, however. The cost of the equipment is one factor that will delay wide acceptance. Digital techniques will, however, allow a large number of generations of programs to be made before image degradation becomes visible.

Disc, etc.

Will the videodisc replace the VTR? There are definite advantages to disc operations. One benefit is that any video field on the disc may be accessed at random almost instantaneously. A reel of videotape, however, is a serial memory, and we must work our way through all frames leading up to the desired one.

Two major factors may make an impact on the use of VTRs. One is the time capacity of discs, but a much larger storage capacity will be required before they become widely popular.

The second factor is that of reusability. At present the DRAW (direct read after write) disc systems are being used in conjunction with editing to speed the edit-decision process. In order for discs to become popular for broadcast use, however, we can expect to wait a few years until the rewritable disc comes of age. One approach to rewritable discs suggests that writing will be through optical means, while erasure will be a magnetic process.

Tape friendly

The continued downsizing of equipment and increasing information density of tape is only one aspect of equipment development. Operation of today's VTRs is simplified through the use of microprocessors. So-called *intelligent* systems allow the equipment to be programmed to handle various tape types. Diagnostics in the control system can even tell the operator where the VTR has failed.

More attention has been paid to tape-handling characteristics in the latest models as well. After the greatest enemy of videotape, dirt, comes physical damage caused by too much tension and general rough handling. Servo systems now keep a constant, reasonable tension on the tape. The servos simplify operations in automation and editing in which operators may not be standing by the machine at all times.

As quad VTRs still reproduce many of our programs, and while there are various other formats available, it is presumed that 1-inch B and C formats will be around for some time. Continued refinements in circuitry and mechanics will give them ever-wider bandwidths, more gentle tape handling, and extended capabilities. No one is prepared to say that 1-inch will last as long as its 2-inch predecessor, but the prognosis is good.

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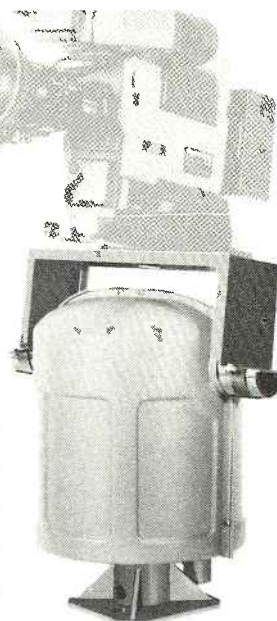
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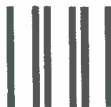
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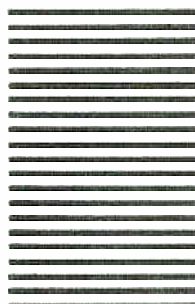
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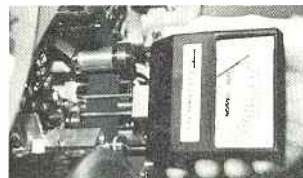
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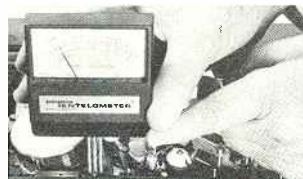
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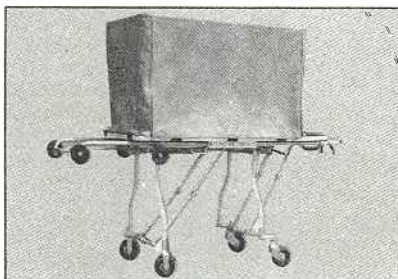
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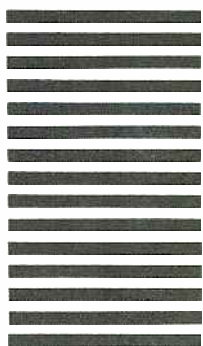
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Take charge

Don't accept substandard performance as the inevitable trade-off of cartridge tapes. Eliminate it with a Harris Phase Fixer audio time base corrector. Contact Harris Corporation, Studio Division, P.O. Box 4290, Quincy, Illinois 62305. 217/222-8200.



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Circle (50) on Reply Card

The birth of helical scan videotape recording

By Peter Hammar

Developing the technology to make helical scan videotape recording work was no easy task for broadcast industry pioneers.

Most BE readers know the history of the German AEG Magnetophon audio recorder, its importation into the United States in 1945 and the subsequent development of audio magnetics in this country. Many have also heard the story of the first experiments with videotape recorders (then known as TVRs, not VTRs), starting in 1951 at Crosby Electronics, RCA and the BBC. And the tale of the first commercially successful Ampex *quadruplex* VTR in 1956 has been handed down to two generations.

But few know the real story behind the birth of helical scan videotape recording.

In the beginning...

Magnetic helical scan patents go back at least five decades. The first proponent of commercial helical scan was Eduard Schueller of AEG in pre-war Berlin. Schueller invented the basic ring-shaped head that most audio recorders still use today. In 1936, Schueller patented a spinning head for the "Tonschreiber Berta," an audiotape recorder designed to compress and expand speech on playback.

In the early 1950s, engineers at Crosby Electronics, RCA and the BBC were using fixed heads for their experimental VTRs. They found the electromechanical problems of spinning video heads too complex to be cost-effective. One RCA engineer, Earl Masterson, applied in 1950 for a patent on a theoretical helical scan video recording process, but the video team at RCA in Camden did not use the idea.

Even before the six-man Ampex VTR development team created its successful transverse scan machine in 1956, one member, Alex Maxey, was working on different ways to scan magnetic tape to generate video pictures. Maxey correctly theorized that a more continuous scan of the tape would ultimately produce superior video pictures, eliminating the banding caused by the segmented quadruplex format. The machine would

be simpler and cheaper to build than the transverse scan *quad* method.

Though he finally settled on a slanted video track recording on 2-inch tape, Maxey first tried many other scanning methods. The most unusual involved wrapping wide videotape into a barrel shape, like a sausage wrapper, with the video head spinning inside the tube to create a continuous spiral track.

VTRs to this day. The length of a single scan made exact playback tracking difficult. The helical scan was especially sensitive to the imperfect tape motion inherent in all magnetic recorders.

To the marketplace

Maxey's VTRs made good enough pictures during the late 1950s to convince Ampex to press on with a commercial



The Ampex Museum of Magnetic Recording features exhibits from 1911 wire equipment to state-of-the-art helical scan video recorders. Author Peter Hammar examines a 1969 Studer C-37 studio mastering machine.

In 1956, Maxey produced a working prototype of a helical scan videotape recorder, a monochrome machine that used 2-inch tape. The electronic circuitry and the writing speed of the helical heads closely resembled the new Ampex transverse scan VTR.

Maxey's prototypes suffered from the same problems that affect all helical scan

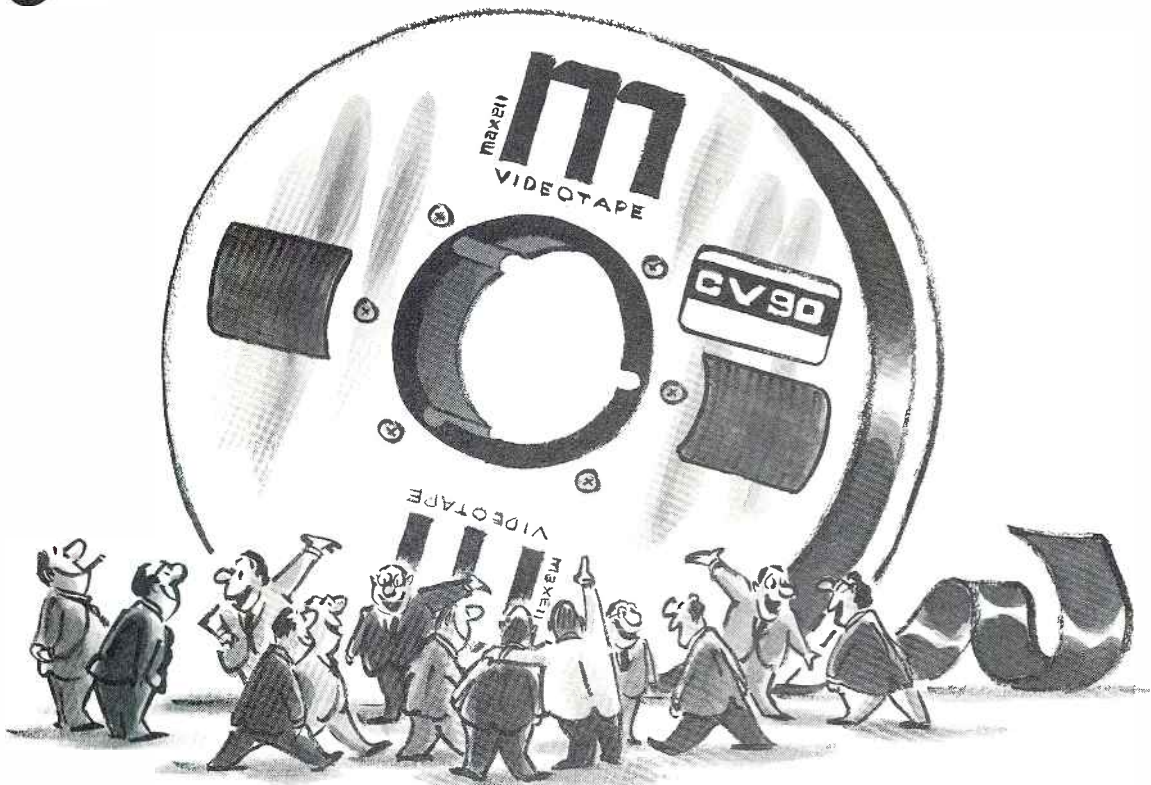
helical scan recorder. The possibility of videotape recording that was free from banding, less complex and capable of slow motion was sufficient reason to keep trying.

In January of 1961, commercial helical scan recording began in America with the introduction of the first Ampex production helical VTR, the monochrome VR-8000. Like its prototypes, the VR-8000 used 2-inch tape. (It was followed two years later by the smaller VR-1500 and VR-660.)

That same month in Japan, JVC introduced its version of the helical VTR, the Telechrome model 770. The Japa-

Hammar is consulting curator of the Ampex Museum of Magnetic Recording. Special thanks to TV historian Albert Abramson of Van Nuys, CA, for his assistance in preparing this article.

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May 1985 *Broadcast Engineering* 87

nese Victor machine actually reproduced color video. The Sony Toshiba and RCA helical machines that appeared later that year reproduced black and white, like the Ampex.

The Japanese had begun helical video experiments in the early 1950s. By 1955, Dr. Norikazu Sawazaki, of Toshiba in Tokyo, had built an experimental helical scan videotape recorder, with each head scan creating one field of video. Toshiba demonstrated Sawazaki's prototype in 1959 in Japan, and offered a commercial version in November 1961.

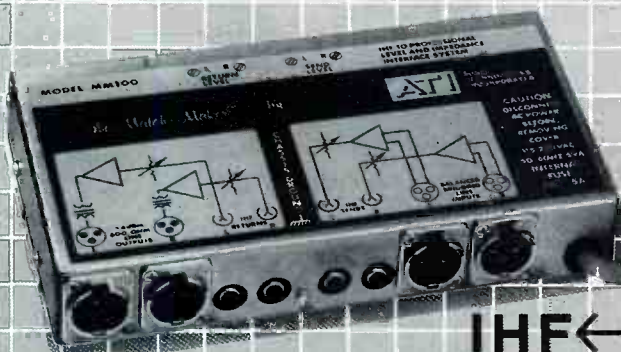
Sony had been building consumer audiotape recorders since the end of World War II. Seeing the potential of low-cost video, Sony entered into an agreement with Ampex in 1960 to license patents to start an industrial/consumer line of videotape recorders. About 10 months after the introduction of the Ampex VR-8000, Sony brought out its SV-201, a helical VTR that also used 2-inch tape.

Because no analog VTR will make stable pictures without FM recording, all of the Japanese machines licensed the American patents on FM recording and

Serial #1 of the Ampex model 200, shown here in January 1948 with its chief designer, Harold Lindsay, was the first commercial audio magnetic recorder made in America that met professional specifications.



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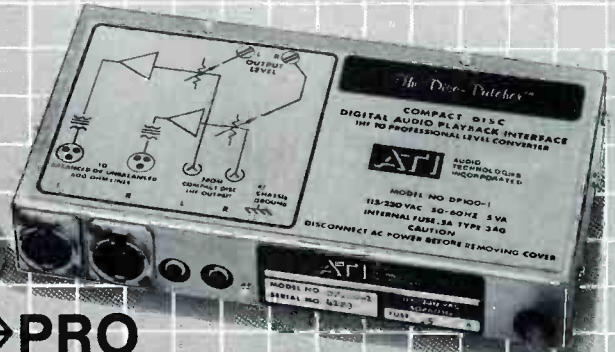
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16-TRACK REALITY

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- rock stable 3-motor transport mounted on a 1/4" machined alloy plate
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- multi-pin connector for video interlock synchronizers
- Killer Sound

Why even consider a re-built old 2" machine? At two, three, even four times the price, it won't sound as good as the B-16. And it won't even perform as well as the B-16, configured with some of the options.

For example, the model with independent tape monitoring is really a whole package:

- direct drive capstan motor with phase locked loop speed control
- 7" rack mount unit with 16 independent channels of decode & reproduce (defeat switch)
- remote control unit with individual track select buttons, headphone jack and level control, line out jack and a VU meter for fast alignment

You'd have to pay almost ten times the price of a B-16 to get this kind of dedicated monitoring function. Tape reproduce is entirely separate from the record/sync electronics.

Which makes the compact B-16 perfect for live audio and video remotes. It even has handles.

And it's as easy to use as it is to own. You can expect nice user-friendly touches like:

- blinking track numbers for record ready status
- real time tape counter with search-to-zero from either direction
- servo control over reel rocking in edit mode
- spot erase capability
- coarse and fine pitch controls with blinking LED for ON status
- optional full function remote control and auto locator

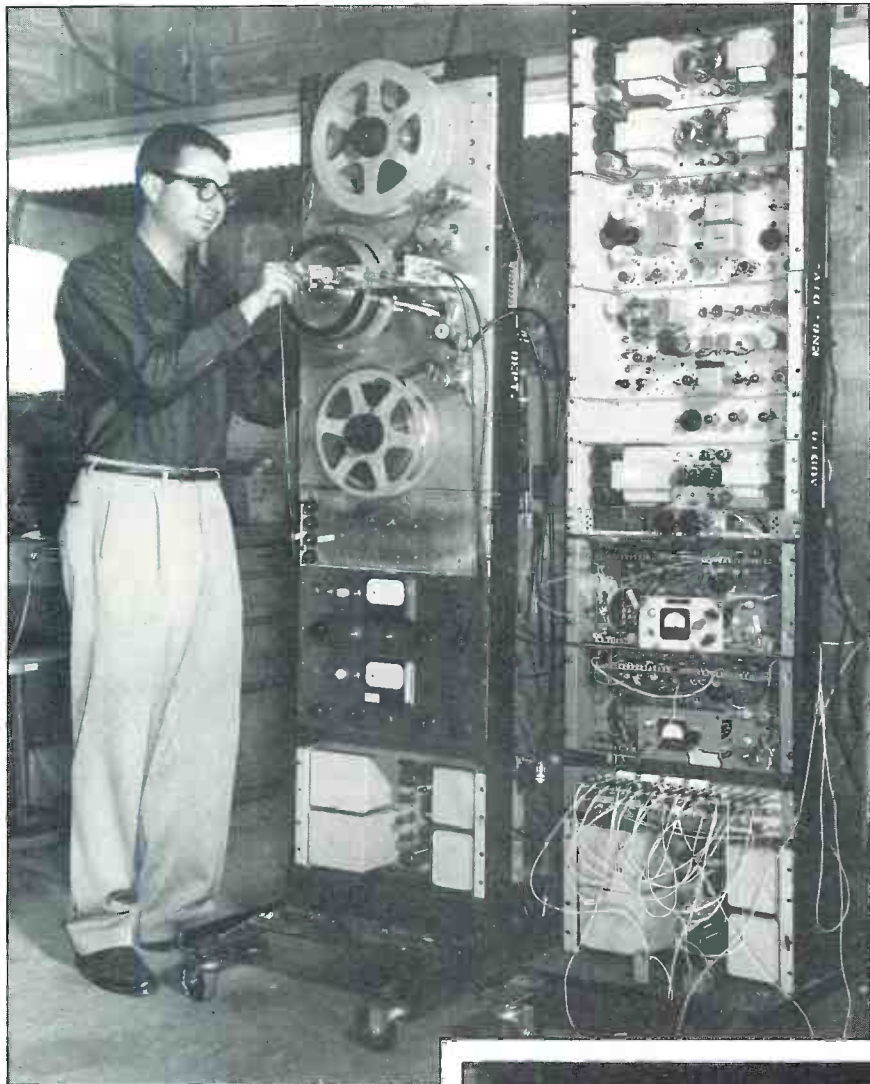
Increase your audio production capability while decreasing your costs. You'll not only save on your initial investment, but operating costs as well — both tape and maintenance.

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Video pioneer Alex Maxey is seen here (circa 1957) with one of his early prototype helical VTRs. Note the large scanning drum in the center and the 2-inch tape.

In January 1961, Ampex introduced America's first commercial helical scan VTR. Note the 1960 prototype in the background. The same month, JVC introduced a helical machine in Japan.

spinning head technology. FM video still forms the basis for all analog video-recording methods in use around the world.

By 1964, several VTR manufacturers were offering helical scan recorders that used 1-inch tape. The world's first 1-inch machine, the MVR-10, came from Machtronics of Palo Alto, CA. Sony followed the same year with its EV-200 industrial series, and Ampex entered the fray in 1965 with the VR-7000, the first of the Type A format VTRs.

Today's SMPTE Type C format originated in 1977 with the society's merging of the Type A format of the Ampex VR- and VPR-series and Sony's 1-inch format technology derived from its UV- and BVH-series. Another major analog VTR format, the segmented helical 1-inch Bosch Type B, used mainly in Europe, was originally patented at Ampex in 1956 by the American "father of helical scan," Alex Maxey.

Enter the TBC

The digital time base corrector, or TBC, easily counts as the most important

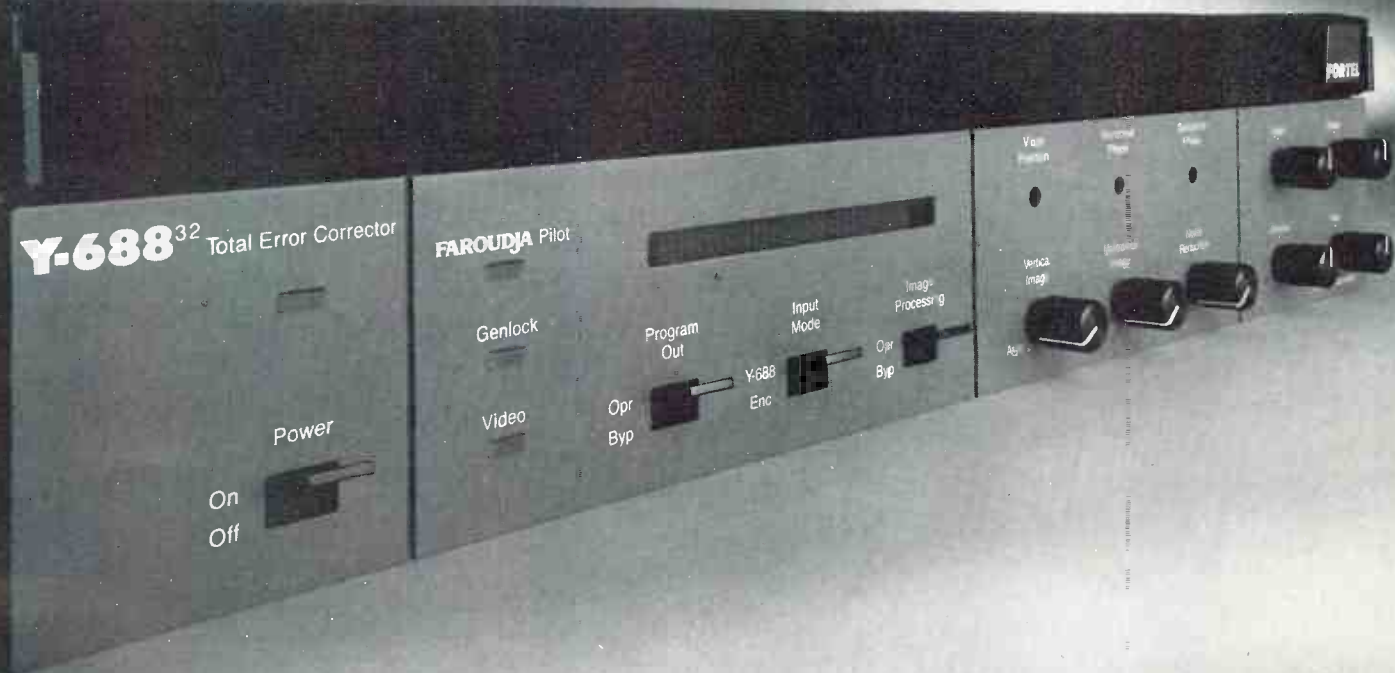


development in helical recording since the first commercial machines were introduced. Today's digital TBCs have eliminated the familiar characteristics of

early helical scan: generally unstable video, limited interchangeability, jittery slow motion, and if you were lucky

Continued on page 94

STILL NO COMPARISON



A lot of companies are talking about component processing, but FORTEL has proven the power of "dub" input and output by producing superior picture quality with the Y-688³² Total Error Corrector. The Y-688³² TEC gives you the best picture quality possible from 3/4-inch VTRs. Split-screen tests show there's still No Comparison between pictures from the Y-688³² TEC and any other TBC or synchronizer.

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Exclusive DYNA-TRAC™ dynamic tracking makes the Y-688³² the perfect companion for Sony BVU-820™ VTRs. This feature delivers quality pictures from **full-reverse speed to 3X forward speed**, including stop action and slow motion. The high speed shuttle provides viewing up to 40X normal speeds in forward and reverse.

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Circle (54) on Reply Card

There's more to than meets

Producing effective multichannel sound isn't easy. Though the procedures borrow heavily from recording studio and film sound techniques, audio for video is a specialist art with a unique set of requirements.

As its early practitioners have discovered, the inherently complex process of stereo teleproduction and post-production can be made even more difficult by cobbling together a collection of modified equipment in the hope of serving these advanced needs.

While makeshift arrangements may satisfy the technical minimums of the task, they introduce tradeoffs in operational flexibility and efficiency which can ultimately affect both production quality and costs.

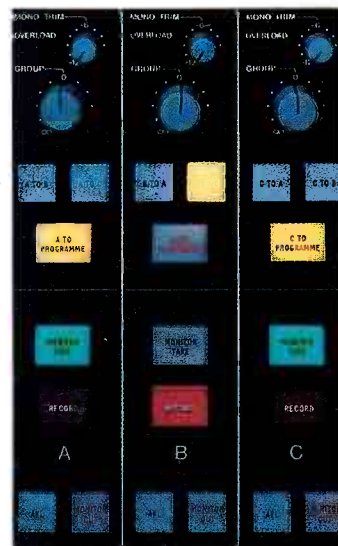
Fortunately there is an alternative, developed for the leading post-production houses and refined in collaboration with major broadcast organizations throughout the world: The SL 6000 E Series Stereo Video System from Solid State Logic.

SSL Puts it all Together

The SL 6000 E Series is a thoroughly integrated system designed specifically for the stereo video environment. Combining the most advanced aspects of multitrack, motion picture and broadcast audio technology, it provides extensive signal processing, routing and mixing capabilities as well as comprehensive machine control and communications—all commanded by a single operator at a logical, unified control panel.

SSL's multichannel mix matrix allows separate stereo music, effects and dialogue mixes to be created at the same time as the stereo program mix. In live production, multiple stereo splits or mix-minuses can be structured at the touch of a button. Mono composites of each mix are always available, and a mono programme feed is provided. Advanced formats such as stereo plus a secondary audio programme or centre-channel dialogue are also supported.

Changeover between live and post-production modes and different output configurations is instantaneous. The rigid architecture of ordinary consoles is replaced with patchfree audio subgrouping and pushbutton signal processor routing, allowing the engineer to customise the signal flow for each project.



Stereo Television to the eye.

Meticulous electronic design creates the shortest signal path for each requested function, allowing SSL to maintain a dynamic range and bandwidth that far exceeds the performance of even the best 16-bit digital recorders, converters and routing switchers.

Complete Machine Control



The SSL Stereo Video System also provides the operator with central control of up to five synchronised audio, video and film transports. Cue points are stored and called by timecode, foot/frames or key words.

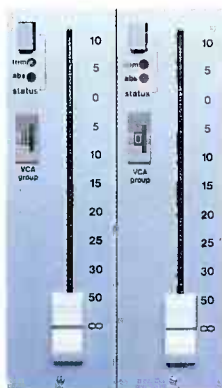
The SSL Studio Computer provides complete list management with floppy disk storage, video display and hardcopy printouts. Distributed processors ensure rapid search and lock-up. There's even a Sync Preset function which automatically calculates offset values between reels and stores these for subsequent setups.

Dynamic Mixing Automation

The machine control functions are integrated with SSL's audio mixing software to provide powerful, versatile and efficient assistance. Engineers can retain their existing mixing methods, or supplement them with simple yet powerful new routines that allow unlimited frame-accurate mix revisions to be performed with outstanding results and uncanny speed.

SSL's computer assisted rollback and pickup recording enables mixes to be assembled within the automation itself, using traditional techniques. Video layback can then take place in a single first-generation pass, directly from the multitrack!

Beyond fader automation, the SSL System optionally provides programmable parametric equalisation, dynamic stereo panning, and multiple Events Control of up to 32 external devices — each with its own pre-roll memory.



Total Recall™

SSL's Total Recall computer records the settings of every control on each I/O module. A high resolution display of the stored values interacts with the console, allowing fully detailed setups to be restored to a control accuracy of a quarter dB. Total Recall greatly reduces setup time, maximising productivity and creative continuity.



Stereo Perspectives

Not all stereo channels were designed to serve video requirements. Only SSL provides parametric stereo EQ, filters, compressors, gates and expanders on stereo inputs as standard, along with image width and stereo reverse controls. There is no easier or more effective way to match music, ambience and effects perspectives with television images.



Get the Full Picture

As you can see, there is a lot more to producing stereo television than meets the eye. To help you get the full picture, Solid State Logic has published a forty-page colour booklet which thoroughly explains the functions, applications and operation of the SL 6000 E. If you are involved in television production, outside broadcast, video post-production or music video, we'd like to send you a copy. Just drop us a line or give us a call.

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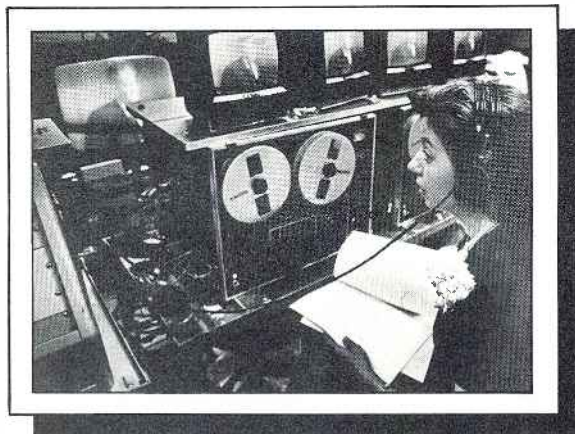
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During the 1960s and into the 1970s, 1-inch helical scan VTRs were used mainly in educational and industrial video applications. Sony EV-210s are seen here in use (circa 1968) in an ETV studio at Union Carbide in New York.



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Everyone knows the benefit of a well designed coaxial loudspeaker... a single-point sound source. Until now, the most popular coaxials presented severe power limitations... had to have "trick" crossovers... and needed time compensation. Gauss technology has changed all that.

The new Gauss 3588 is the first computer designed coaxial. But, we know computers can't hear, so we used a panel of "golden ears" at the fall AES to help determine the final sound of the loudspeaker. This combination of computer design and great ears gives you a coax with the sound and the power you want!

With a conservative power rating of 200 watts RMS, this new Gauss coaxial has been tested to 750 watts delivering clean sound... and can "coast" along at control room levels still delivering great sound. Metric sensitivity is 95dB for the low frequency and 109dB HF.

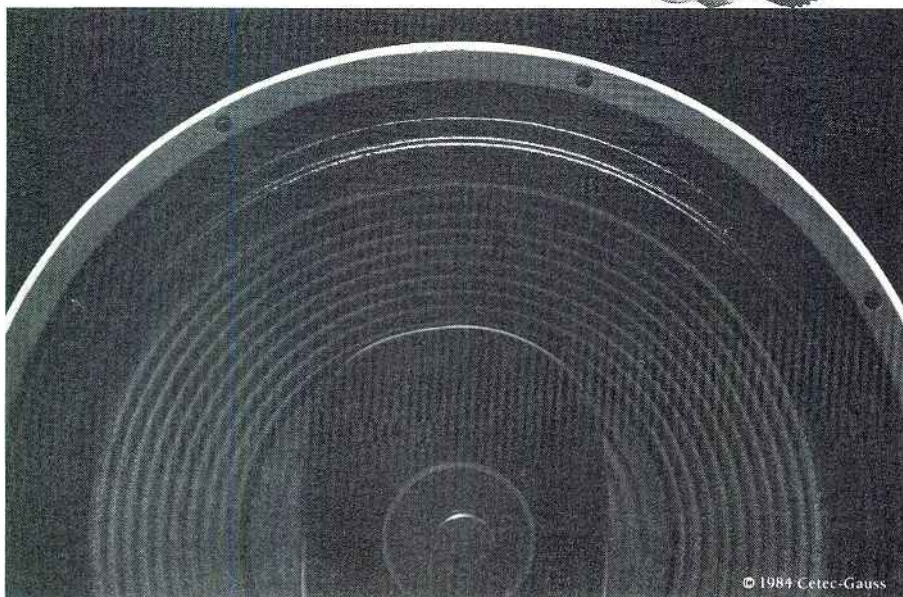
Because of our proprietary design parameters, both drivers are virtually in the same acoustic plane, eliminating the

need for costly time compensation networks. For bi-amp operation, you can use any standard professional quality crossover.

The unique *cosh* horn was designed using Gauss's exclusive Computer Aided Time Spectrometry (CATS™) program. This design provides an extremely stable image... reduced second harmonic distortion... and virtually no midrange shadowing.

For additional information on the new Gauss coaxial loudspeaker, call or write Cetec Gauss, 9130 Glenoaks Blvd., Sun Valley, CA 91352, (818) 875-1900. Or better yet, hear it at a selected sound specialist soon.

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Circle (62) on Reply Card

enough to achieve it at all, stop action with large *noise bars* across the picture. If you turn off the digital time base corrector on a modern helical VTR, defeat the *automatic scan tracking* and kill the color, you can roughly simulate early helical scan videotape recording!

The analog TBC, called Amtec, perfected in 1961 in Redwood City for *quad* VTR use, would have been too big and expensive to create a sufficient *window* to correct the huge time base errors inherent in helical recording.

The American company Consolidated Video Systems offered the first commercial digital TBC in 1973. Digital time base correction allowed helical scan recording to come of age, clearing up many of the picture stability problems that had plagued the format for 15 years.

From the mid-1960s, special recorders using coated metal discs, such as the Machronics MDR-10 and the Ampex HS-100, had provided broadcasters with stop-action video and about 30 seconds per disc-side of slow motion, two impossibilities with segmented quad recording. Helical scan theoretically offered engineers recording that was free of banding and capable of slow motion and stop action; but the engineers had to find a way to make the playback head follow the erratic magnetic scan track laid down during recording.

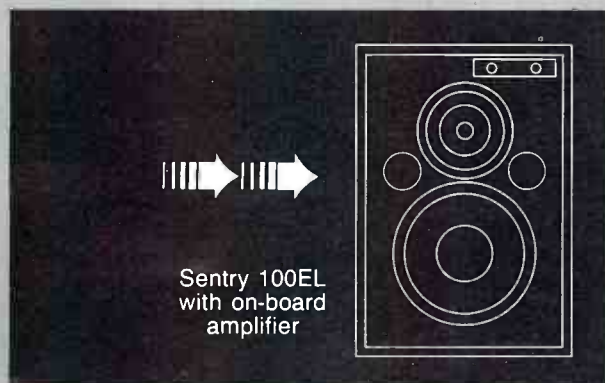
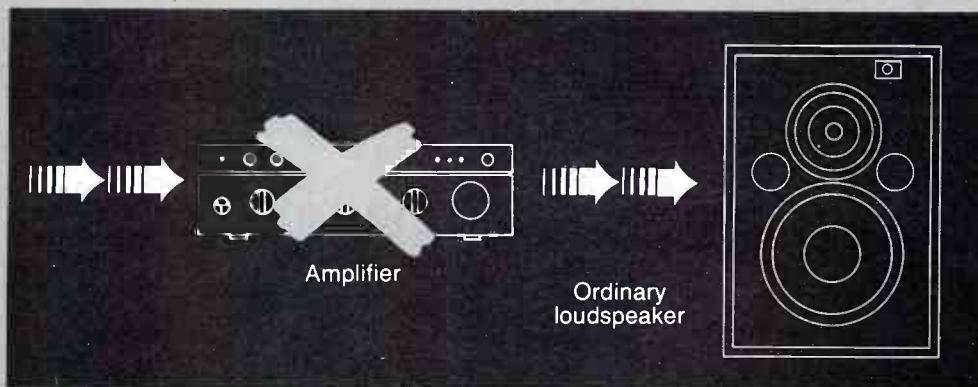
The answer to increased helical stability in slow-motion and stop-action modes was the use of a flexible playback head that could physically bend to follow the wavy helical track. Ampex engineers trademarked their *dithering* head invention as *automatic scan tracking* or AST. By the beginning of the 1980s, helical scan VTRs with AST technology and the digital TBC had largely replaced the bulky slow-motion/stop-action disc recorders.

Today, most professional and all consumer videocassettes use the helical scan format. Sony originally designed its 3/4-inch videocassette for consumer use. In 1970-71, Sony set its sights on the educational and industrial markets where the 3/4-inch cassette format began to flourish. Like the 1-inch open-reel helical formats, the digital TBC allowed the serious use of the cassette for broadcast electronic news gathering, field production and even direct on-air use.

With their digital TBCs, advanced electronics and revolutionary head and scanner designs, today's helical scan recorders offer quality undreamed of in the 1950s when engineers built their first slant track VTR and watched the picture jiggle and dance on the screen. Digital technology has certainly changed magnetic recording for the better. !:~>)))

Editor's note:

The Ampex Museum of Magnetic Recording is located at Ampex Corporation, 401 Broadway, Redwood City, CA 94063. For tour information call 415-367-4151.



Finally, a Monitor System with the Power to Make Things Easy

Imagine a monitor speaker that provides its own power. Fits in tight spaces. Simplifies setup. And reproduces sound with test-equipment accuracy.

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Also, by requiring less hardware—fewer cables and connectors—the 100EL keeps setup simple

and reduces potential interconnect problems. And there's no possibility of power loss caused by resistance from a lengthy speaker cable.

The on-board amplifier in the 100EL makes it ideal for single-channel monitoring. Why buy one speaker and an extra amplifier channel, when the Sentry 100EL does the job all by itself? And because amplifier power is perfectly matched to the speaker system, there's no chance of damage from inadvertent signal overload.

But convenience and trouble-free operation are only part of the package. Like all Sentry designs, the 100EL offers uncompromised accuracy. So you can be certain of quality sound.

The Sentry 100EL - with the power to make your job easier. For more information, write Greg Silsby at Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107.



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Maintaining audio recorders

By Brad Dick

Regular maintenance is the key to reliable performance from reel-to-reel audiotape recorders.

For many of us, tape recorder maintenance is a required part of our regular duties. We go about it without giving much thought to why we do what we do. If you have been repairing and maintaining audio recorders for a long time, consider this article a review. If, however, you are relatively new to the broadcast or recording business, read on carefully. What follows is *Maintenance 101*, a basic course in the alignment of reel-to-reel audio recorders.

Mechanical condition

Start your maintenance routine by checking the mechanical performance of the tape recorder. No matter how superior the electrical components of a recorder, if the tape movement is not carefully controlled, the resulting audio performance will be inferior.

Before any adjustments are made on a tape recorder, it must be thoroughly cleaned and degaussed. Using isopropyl alcohol (or another approved chemical) and a cotton swab, clean the tape path,



Reel-to-reel tape machines should be checked on a regular basis for top performance. The results of each set of measurements should be kept on file as a means of detecting developing problems in a particular machine. KANU engineer Jerry Hetherington checks one of the station's recorders.

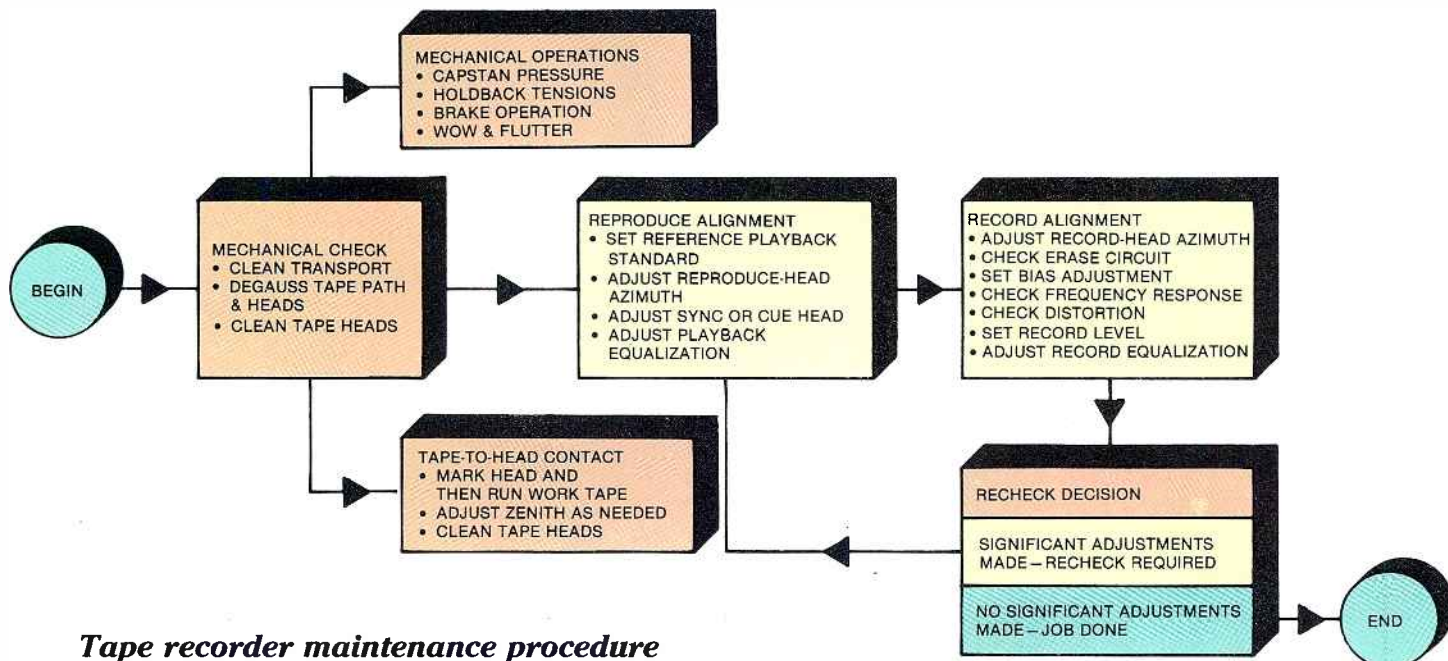
heads, rollers and tape-balance arms. Do not use too much liquid near the bearings in the capstan or rollers. If the cleaner gets into the bearings, they will deteriorate.

The tape path should be completely degaussed with a professional tape-head degausser (Figure 1). Any residual magnetism will limit the overall performance of the recorder, and could damage, or even destroy, your test tapes. Be careful not to scratch the recorder tape heads when passing the degausser near them. When you turn the degausser *on* or *off*, be sure it is at least three feet away from the recorder.

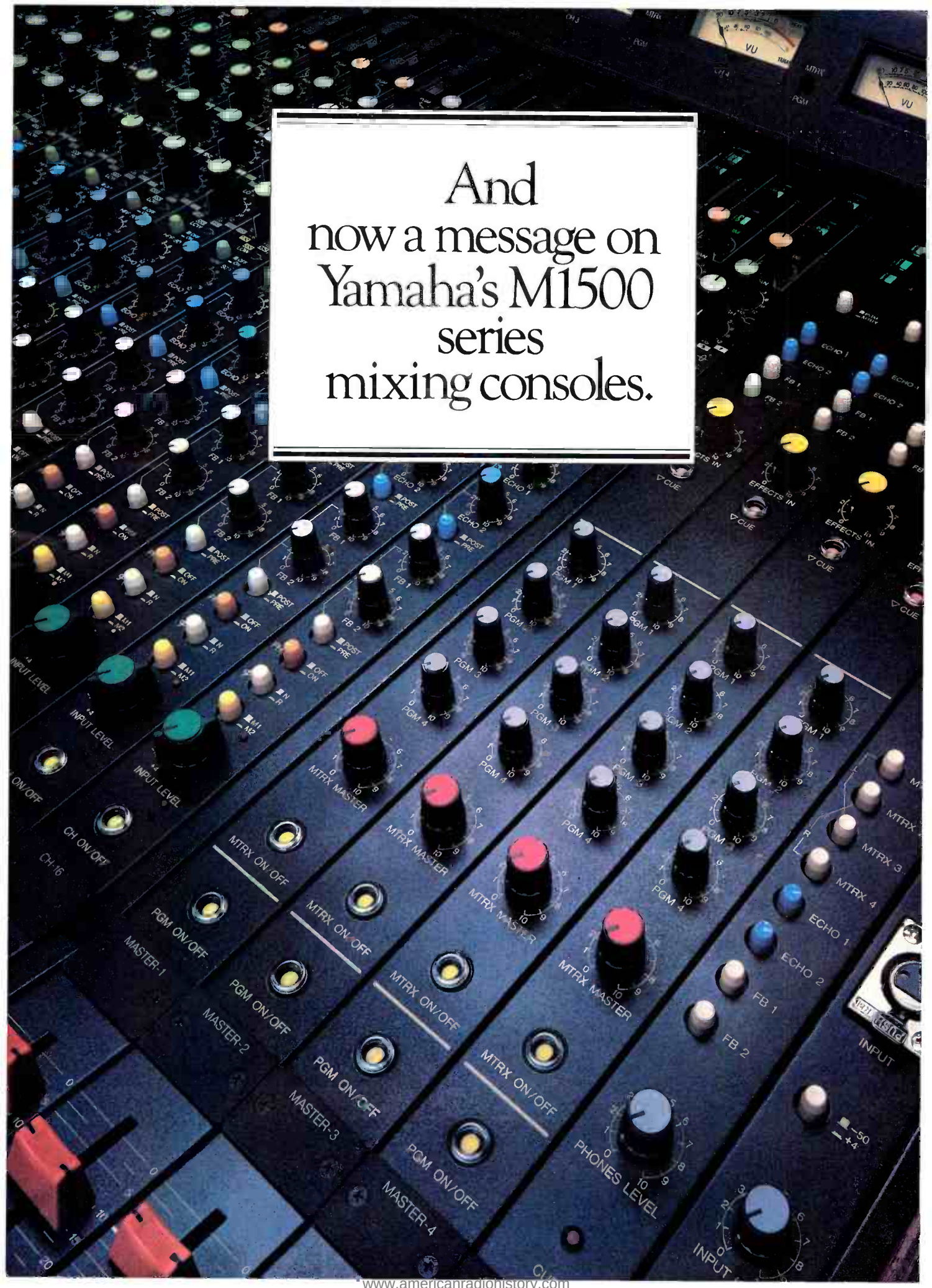
With these tasks completed, you are ready to examine the moving tape path. Check the capstan pressure, holdback tensions and brake operation. The tape should shuttle and stop smoothly without excessive tension. The mechanical operation of the recorder must be correct before any electrical adjustments are attempted.

If you have a flutter meter, measure the wow and flutter. If you don't have a meter, listen to the flutter tone on the test tape. You should be able to detect

Courtesy of Bob Pearson and Jerry Hetherington.



Tape recorder maintenance procedure



And
now a message on
Yamaha's M1500
series
mixing consoles.

M1516A



GENERAL SPECIFICATIONS

FREQUENCY RESPONSE +0, -3dB, 20Hz to 20kHz; +0, -0.5dB, 30Hz to 15kHz.

TOTAL HARMONIC DISTORTION (THD)*

Less than 0.5% @ +10dB, 20Hz to 20kHz. Less than 0.1% @ +20dB, 50Hz to 20kHz.

HUM AND NOISE* (20Hz to 20kHz, 150Ω source, Input Selector set at "-60")

- 128dBm Equivalent Input Noise (EIN);
- 95dB residual output noise with all Faders down.
- 73dB PROGRAM OUT (77dB S/N); Master Fader at nominal level & all Input Faders down.
- 64dB PROGRAM OUT (68dB S/N); Master Fader and one Input Fader at nominal level.
- 73dB MATRIX OUT; Matrix Mix and Master controls at maximum, one PGM Master Fader at nominal level, and all Input Faders down.
- 64dB MATRIX OUT (68dB S/N); Matrix Mix and Master controls at maximum, one PGM Master Fader and one Input Fader at nominal level.
- 70dB FB or ECHO OUT; Master level control at nominal level and all FB or ECHO mix controls at minimum level. (Pre/Post Sw. @ PRE.)
- 64dB FB or ECHO OUT (68dB S/N); Master level control and one FB or ECHO mix control at nominal level. (Pre/Post Sw. @ PRE.)

MAXIMUM VOLTAGE GAIN (Input Selectors set at "-60" where applicable)

PROGRAM & MATRIX 84dB; Channel In to the corresponding output. EFFECTS 20dB; Effects In to PGM Out.
FB & ECHO 94dB; Channel In to FB/ECHO Out. SUB IN 10dB; Sub In to PGM Out.

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Master phantom power switch. When an individual Input Phantom switch is also On, voltage is applied to pins 2 and 3 of that input's balanced XLR connector.

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M1532 55 3/4" W x 36 3/4" D x 14 1/2" H 231 lbs.

*Measured with a 6dB/octave filter @ 12.47kHz; equivalent to a 20kHz filter with infinite dB/octave attenuation.

The specs shown are for the 16-channel M1516A console. When you need the same outstanding performance but more channels, there's the 24-channel M1524 and the 32-channel M1532. All three mixers have remote rack-mounted power supplies and are ideal for just about any fixed or portable sound reinforcement or broadcast application.

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Circle (58) on Reply Card



Figure 1. Demagnetize the head assembly with a tape-head degausser before putting a test tape on the machine. Be careful not to scratch the head surface when performing this step.

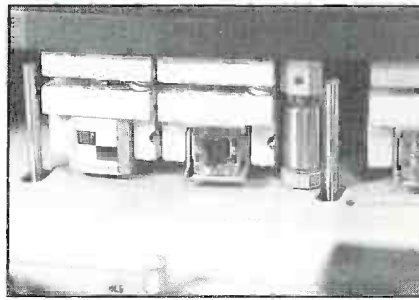


Figure 2. Check for proper tape-to-head contact by marking the head with a soft felt-tip pen and then carefully playing a work tape over the head long enough to wear away the marking at the contact point.

any gross wow and flutter problems. On older machines, wow and flutter are usually due to worn mechanical parts. On newer machines, errors in the capstan servo circuits can cause it.

Finally, check the tape-to-head contact. With a soft felt-tip pen, color over most of the tape-head surface area, as shown in Figure 2. Carefully place your work tape on the machine and play the tape long enough to wear away the pen marking.

As you examine the wear marks on the heads, you should see an obvious rectangular pattern centered on the head gap (see Figure 3). This wear pattern indicates proper tape-to-head contact. A trapezoidal pattern, on the other hand, indicates that the head *zenith*, or tilt, is incorrect. If necessary, adjust the zenith until the proper pattern is obtained.

A note of caution: If the tape head is worn to the point that a groove is visible, do not attempt to correct the tilt. To do so would only worsen the performance of the recorder.

Reproduce alignment

The playback amplifier is the first electronic system that should be adjusted. With a standard alignment tape, adjust the playback calibration to 0VU using the reference level tone. This calibrates the VU meter to a standard level. The remaining sections of the recorder are then adjusted to this standard.

Most stations use the NAB standard of 185nWb/m or the optional elevated level of 260nWb/m, which provides 3dB more output. On those recorders having a *sync* or *cue* channel, use the same level set tone and calibrate sync or cue outputs from the record head to the standard.

After the reproduce output level has been set, the tape-head *azimuth* can be adjusted. Using the azimuth section of the alignment test tape, observe the output of the recorder on an oscilloscope. While watching the scope, adjust the reproduce-head azimuth to obtain a display similar to that shown in Figure 4 (for 2-channel machines). Notice how the ellipse runs from the lower left- to the upper right-hand corner of the screen. Try

to maintain the ellipse equally on both sides of the 45° line representing a perfectly phased signal. This will ensure that any subsequent phase shifts will at least center around the 0° error point.

Figures 5 and 6 show the 15kHz test tone output of a recorder with approximately 90° and 180° phase shift between channels.

If the recorder has a sync or cue output from the record head, use the same procedure to align the record-head azimuth.

The adjustment of playback equalization (EQ) is straightforward. Using the

standard alignment tape, adjust the frequency-response level set tone to a convenient reading on your test meter. Play the tape and note the difference between the reference frequency, usually 700Hz, and 10kHz. Adjust the playback equalizer to meet the manufacturer's specifications.

Resist the temptation to try to adjust for flat response out to 15kHz. This would probably result in significant bump in frequency response between 5 and 8kHz. Before rechecking the 0VU reference level, run through all of the spot tones to verify that no bumps have resulted from the EQ adjustment.

Record section

Feed a -10VU level test tone at 15kHz into both channels of the recorder. While observing the output of the recorder on an X-Y scope display, adjust the record-head azimuth for minimum phase shift. This is the same procedure used with the playback-head azimuth adjustment, but this time you are using your own tape and oscillator for the test signal.

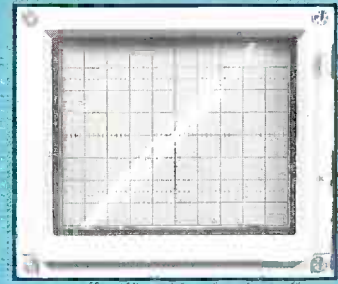
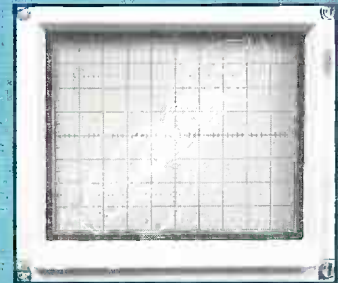
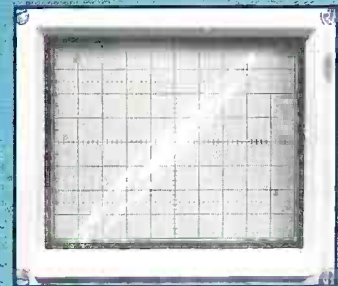
Check the erase circuit by recording a

The effects of azimuth misadjustment

The tape-head azimuth adjustment is more important than many engineers may realize. Many monaural AM radio stations and some TV stations will have to deal with azimuth problems as they commence stereo operation. These problems are commonly found in cartridge machines, which are more prone to azimuth errors than modern reel-to-reel recorders. The scope photos show the effects of azimuth adjustments on L=R stereo material.

The first photo shows a vocal track recorded on a properly aligned machine. Notice how the waveform follows the basic 45° line seen on a sine wave X-Y display. This is what you should see if you want your monaural listeners to receive an undistorted sound.

The next two photos show a tape machine with approximately 60°, then 100° of azimuth error. Such errors are not uncommon in cartridge systems. They may also be found in poorly maintained reel-to-reel machines. Advertisers listening to their commercials on a monaural receiver are not going to like what they hear if the machine is this far out of adjustment.



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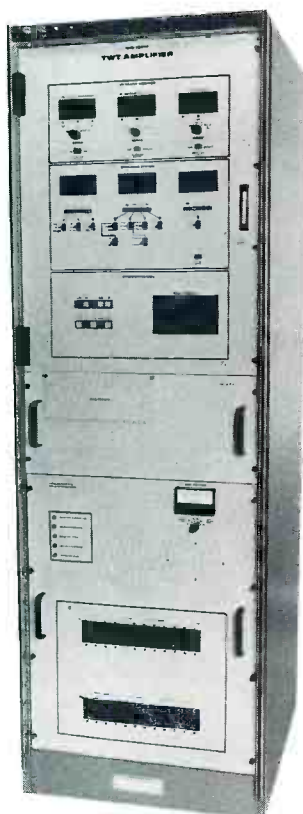
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Figure 3. A properly adjusted tape-head wear pattern using the procedure described in Figure 2 (and the text).

1kHz tone at 0VU for several minutes. Recue the tape, then place the machine in record with no input signal. Measure the residual noise level. The signal shown on the test meter will be the sum of the remaining 1kHz tone, tape hiss and residual bias noise. If record bias leakage masks the actual noise floor, record over the original tone with no signal, back up the tape and play it while measuring the erase-level noise floor.

Bias adjustment

While in the record mode, measure the output signal level and adjust the appropriate bias trap control for minimum bias signal leakage. This level should be very low; be sure you are actually monitoring bias noise and not tape hiss.

With an input level of -10VU (7½ ips) at 700Hz, place the machine in record.

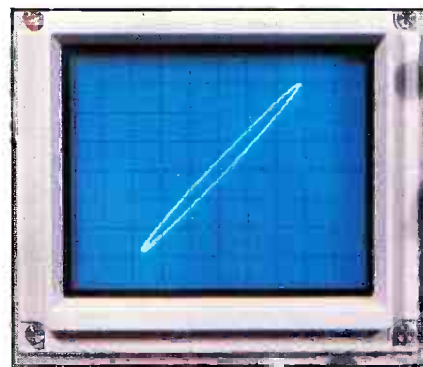


Figure 4. The oscilloscope pattern obtained with a properly aligned reproduce head.

While watching the output level, adjust the bias for maximum output. Switch the oscillator to 20kHz and check the frequency response. For recorders that do not have record EQ adjustments, the only means of manipulating high-frequency performance is the bias control. While monitoring the output at 20kHz, adjust the bias for best response.

Bias adjustment causes a great deal of debate among engineers. This procedure should guide you in the right direction to adjust for high-frequency performance and minimum distortion. If you have the recorder's instruction manual, use it. Because there are many factors in-

Continued on page 104

Circle (59) on Reply Card

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When hundreds of users worldwide told us what they wanted in a one-inch VTR, we listened closely and then designed and built it. It's our new VPR-6, the easiest VTR to operate, service and maintain of any in its class. And it's in the price/performance ratio that most users want.

Smart, yes. Complicated, no.

Intelligent but not intimidating, the new VPR-6 offers features that allow you to get the job done more productively. For example, virtually all machine setup procedures can be done at the highly efficient control panel. Most board-edge controls typically found in VTR's have been eliminated.

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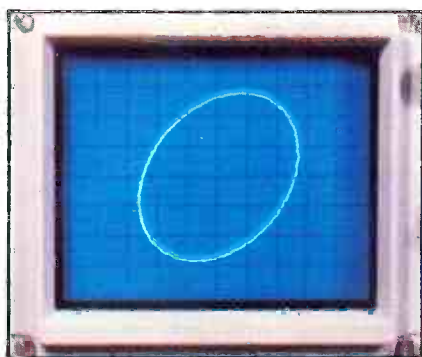


Figure 5. The scope pattern of a machine with approximately 90° phase shift due to incorrect adjustment of tape-head azimuth.

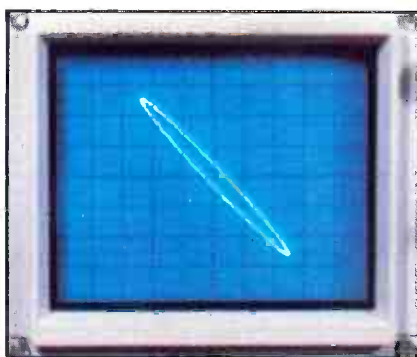


Figure 6. An oscilloscope trace showing azimuth misadjustment of 180°.

Continued from page 100

involved, the manufacturer is in the best position to advise you on how to make the bias adjustment.

Figure 7 shows the effect bias has on the high-frequency response of a tape recorder. The upper trace shows the frequency response for a recorder with the bias adjusted 1dB before peak. The center graph represents bias at the peak point. The lower graph shows the bias adjusted for 1dB after peak. Practice will aid you in adjusting the bias and high-frequency equalization controls for the best compromise between flat frequency response and minimum distortion.

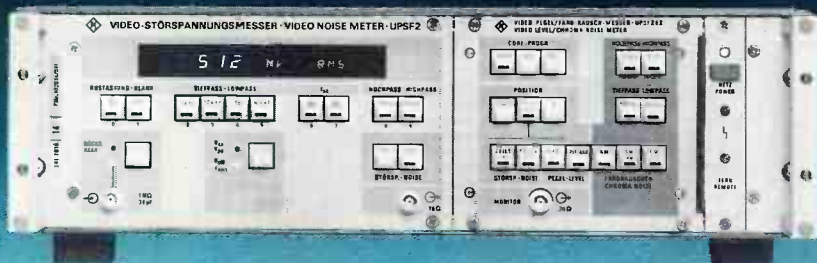
After the bias has been set for a specific type of tape, calibrate the bias meter for a reading of zero. This is only a relative indication, but it is helpful if, later, you want to set the bias to a different level for another type of tape.

Record calibration

Apply a 700Hz tone to the recorder input. While watching the output level on the VU meter (with the machine in the record mode), increase the input signal until the output reads 0VU. Switch the

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Table 1.

Suggested test equipment for proper maintenance of reel-to-reel tape machines.

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- REPRODUCE ALIGNMENT TAPE
- HAND TOOLS
- AUDIO FREQUENCY OSCILLATOR
- TAPE-HEAD DEGAUSSER
- WORK TAPE
- SPRING SCALES
- TENVELOMETER
- FLUTTER METER
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PREFERRED EQUIPMENT

- SWEEP ALIGNMENT TAPE
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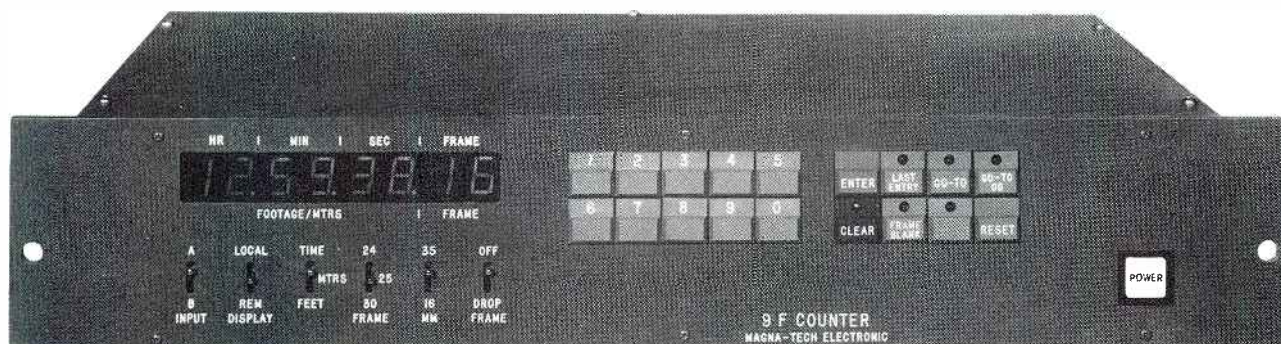
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Digital storage is closer than you think

By Jerry Whitaker, editor

Digital audio has made a significant impact on radio broadcasting in the short time it has been available, but we have only seen the beginning of the digital revolution.

Visualize, if you will, the radio station of the future. The year is 1995. All programming material, commercial messages and disc jockey announcements are stored in a central digital file that may be called upon by any studio at any time. The system has no moving parts, save the hard disk drives. Given proper care, the software (programming) should last indefinitely. None of the pops, scratches or skips common to disc recordings. No wow and flutter, azimuth or tape head alignment problems either.

The station is—in effect—built around a big digital audio well.

Our futuristic radio station, like most predictions, has its roots in the reality of today. The central audio library just described is available now as a more or less off-the-shelf item for those who have the desire and financial resources to implement such a system.

For the broadcast industry, digital audio recording and storage holds great promise. Instant access to a large, centrally located source of degradation-free high-quality audio is what most engineers expect digital technology to eventually bring to radio stations.

The architecture of a digital audio storage system does not necessarily lend

Figure 1. The concept of a centrally located audio library system for an AM-FM station. Note that the library is shared by all studios at the facility.

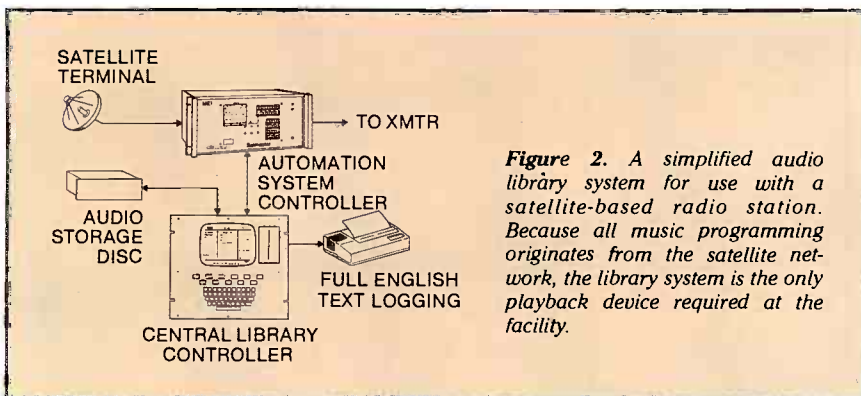
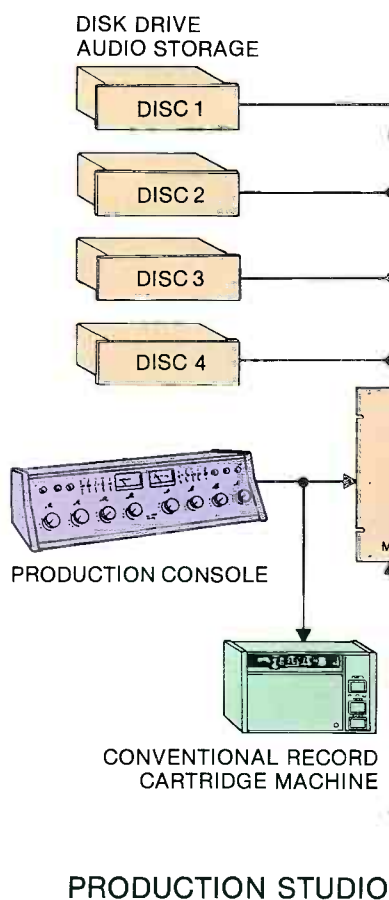
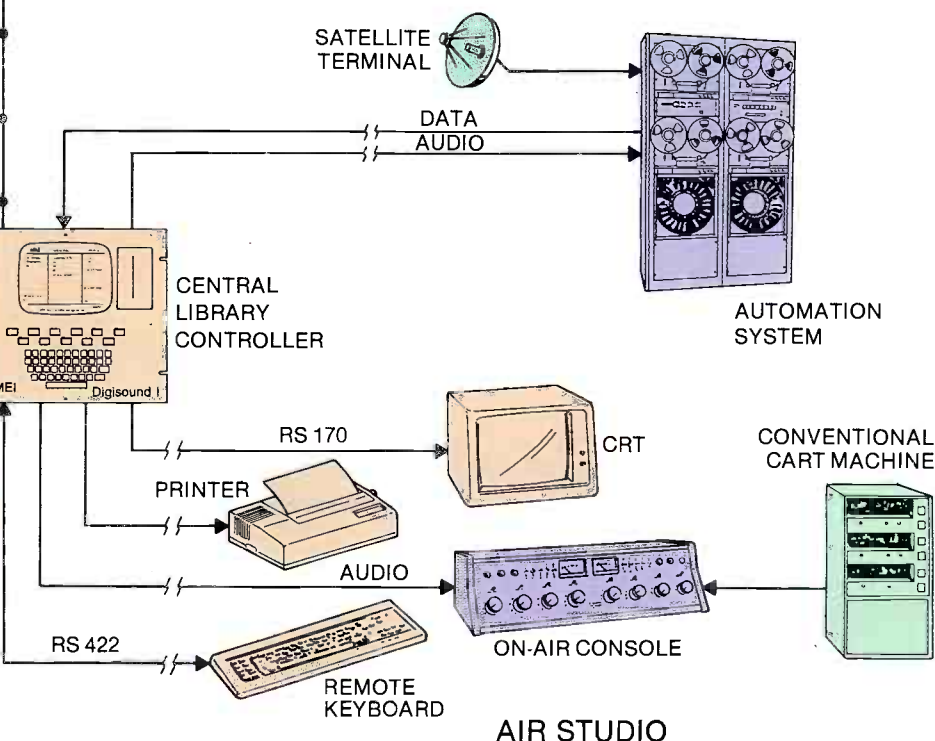


Figure 2. A simplified audio library system for use with a satellite-based radio station. Because all music programming originates from the satellite network, the library system is the only playback device required at the facility.



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But the secret is not so well kept. Other broadcasters have discovered they can have all these benefits and *still* get elevation and directional patterns to meet their needs. WHRO, Norfolk, Virginia; KPBS, San Diego, California; WSRE, Pensacola, Florida; and WSMH, Flint, Michigan are others on the growing list of stations transmitting with a Harris Wavestar. Because it's made of waveguide, the Wavestar's power handling capability can be as much as 300% higher than conventional coaxial antennas.

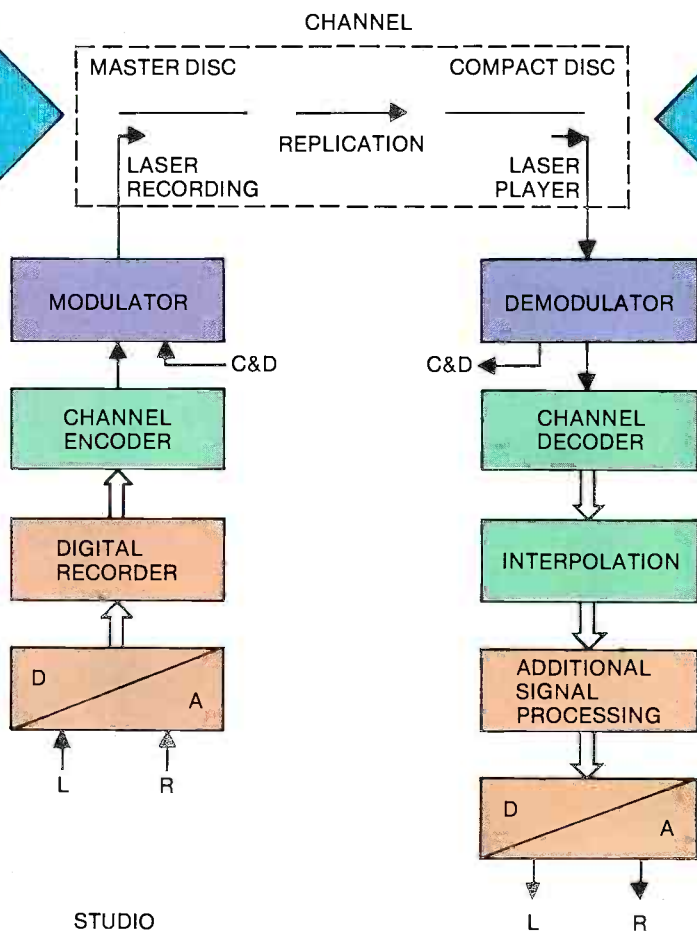
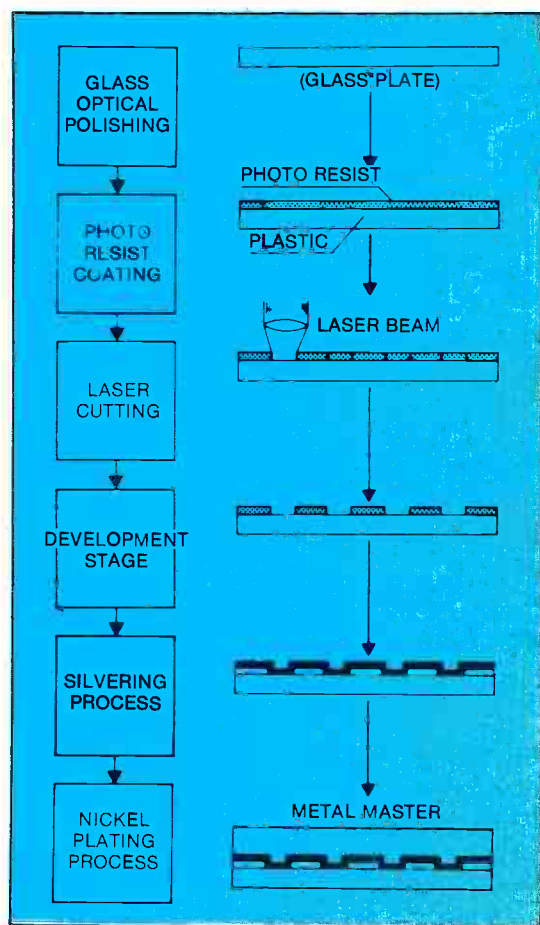
That's why another station, WTIC-TV, Hartford, Connecticut is using its new omni-directional Wavestar with a channel 61 240 kilowatt Harris transmitter, without fear of antenna burn-out.

If you want to control maintenance costs, increase safety margins and maximize performance, you want a Harris Wavestar slotted waveguide UHF antenna. Contact Harris Corporation, Broadcast Transmission Division, P.O. Box 4290, Quincy, Illinois 62305. 217/222-8200.



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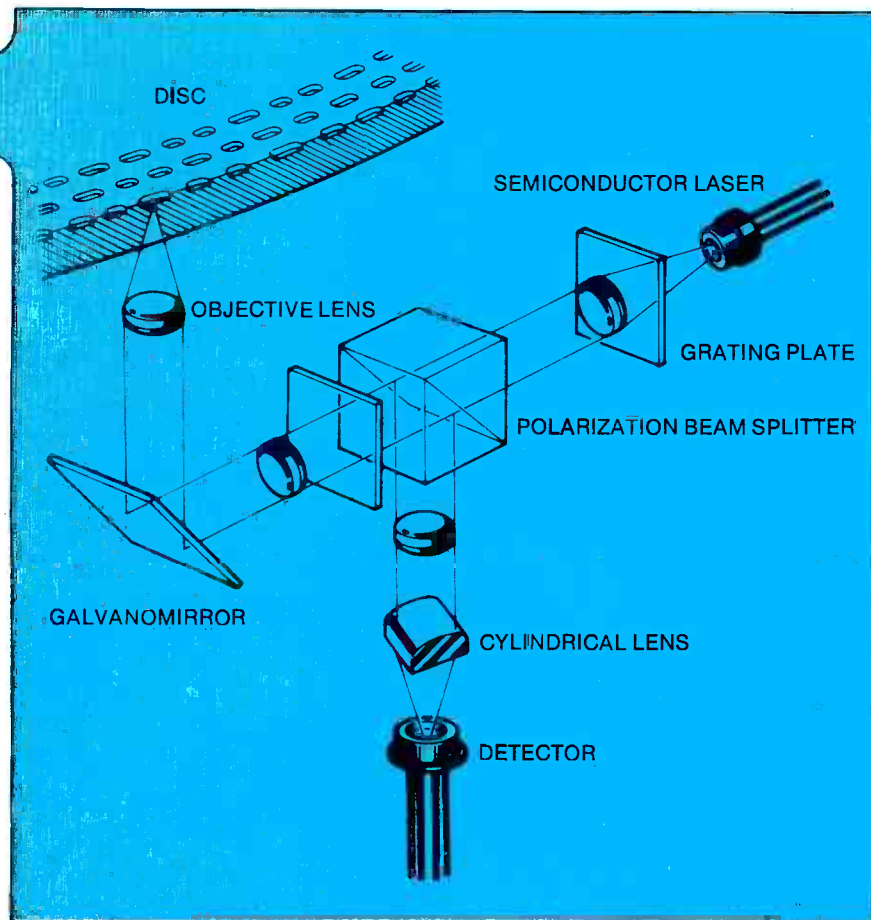


Figure 3. The basic steps in the generation of a compact disc and the architecture of a CD player.

itself to the familiar form of a random-access cart machine.

The first generation of digital audio random-access systems treated program material as mere data to be retrieved from a computer, like any other string of data. It could be a list of credit card holders, a magazine mailing list or a cut from Michael Jackson's "Thriller" album. The machine didn't care.

Newer systems are more sophisticated in terms of data retrieval. They simulate the mechanical and electro-mechanical cartridge and reel-to-reel systems that broadcasters know and trust. User interface with the digital system is a critical element in the ultimate acceptance of large-scale digital storage systems at broadcast facilities.

The benefits of digital

Recording audio material in the digital domain has a number of advantages, including degradation-free duplication, indefinite storage capability and increased system reliability because of fewer moving parts. Central storage systems available today offer random access of stored material of various lengths, similar to the familiar random-access multiple-

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cartridge reproducers currently used by broadcasters.

The number of *trays* in the system can be adjusted to the user's requirements. The digital storage element allows an upper limit on the total storage time, but does not restrict the number of trays created within the time limitations of the system. Segments of various lengths can be grouped according to the requirements of the station.

With proper interface equipment, the central library can be accessed by various studios at a facility. This makes it unnecessary to physically pull a car-

tridge from the air-play rack for previewing or to manually change commercial announcements as they are updated or replaced.

As advances in technology allow more data to be packed onto digital discs, the program storage length times of central library systems will increase. One digital storage system unveiled at the 1985 NAB convention provided up to 44 minutes of monophonic (22 minutes of stereo) recording time using a single 330Mb Winchester-type hard disk drive. The system can be expanded to a maximum of 176 minutes (nearly three hours) by

adding three more disk drives. The concept of the central storage digital library is shown in Figures 1 and 2, page 108.

Digital audio systems provide a wealth of interface options. Logging, system interrogation, file sorting, sequence playing and commercial schedule supervision are just some of the control options available to stations using a central library.

The subjective fidelity of digital audio—a bone of contention a few years ago—is almost a moot question now. Wide and flat frequency response throughout the audio band, negligible distortion and low noise floors (or *quantization noise* levels) are typical of equipment available today.

Perhaps the toughest test for digital audio was the inauguration two years ago of digital transmission for the major satellite-based radio networks. Although the input audio sampling rate is only 32kHz, the technical quality of the signal is exceptional. Most central storage systems use a higher sampling rate, such as 44.1kHz.

Compact disc

The digital compact disc (CD), little more than a novelty a few years ago, has become an important ingredient in radio programming. In many major markets—and small markets too—you don't have to listen long to a music station before hearing a selection "direct from compact disc." From its humble beginnings at the start of the decade, CD programming has become a significant slice of the music pie at many stations. Some stations report using CDs to reproduce fully a third of their music programming on a daily basis.

The compact disc is the first experience many station engineers have with digital audio. Most stations have one or more CD players for use on the air or in the production room. The widespread use of CDs merit a closer look at how the system works.

From a systems point of view, the CD was designed on the basis of communications concepts, including demodulation, error correction and detection, interpolation and bandwidth expansion (to ease D/A conversion requirements). The CD system can be considered simply as a transmission chain that uses reception and demodulation techniques that are the inverse of transmission and modulation. (See Figure 3, page 110.)

Making the disc

After final mixing in the studio, the two audio signals (left and right) are converted from analog waveforms to a digital bit stream by an analog-to-digital (A/D) converter. The sampling frequency is 44.1kHz, which allows maximum recorded audio bandwidth of about 20kHz. The two signals are uniformly quantized into 16 bits, allowing the conversion noise level to be suppressed by

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more than 90dB, with respect to the peak signal level. Theoretically, a total harmonic distortion figure of 0.005% can be achieved with such a system. Channel separation of 90dB also is possible. A digital audio recorder preserves the audio mix on tape for later recall.

The channel-encoding step is part of the disc mastering process. Digital data from the recorder is encoded into the standardized CD format, and error-detection and correction information is added. The CD transmission channel is protected against errors by adding parity bytes derived in two Reed-Solomon

FREQUENCY RANGE	COMPACT DISC	12-INCH LP
DYNAMIC RANGE	20HZ-20KHZ	30HZ-20KHZ
S/N RATIO	>90DB	< 55DB (1KHz)
CHANNEL SEPARATION	>90DB	~60DB
HARMONIC DISTORTION	>90DB	25-35DB
WOW AND FLUTTER	< 0.01%	0.2%
PLAYING TIME	0	0.03%
	60 MINUTES	20 MINUTES/SIDE

Courtesy of NAP Consumer Electronics

Table 1. A comparison of the typical performance of a compact disc and 12-inch LP record.



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error-correction encoders, and through the use of the well-known communications technique of *interleaving*.

Interleaving is effective because the CD system exhibits error modes that are usually burst-like in behavior, and this process spreads the potential errors over a longer period of time. The output of the channel encoder is combined with digital control and display (C & D) information and fed to the modulator stage. The C & D data contain music-related information and a table of contents.

A scheme called *eight-to-fourteen modulation* (EFM) is used in CD systems to achieve high-density recording, while maximizing the performance of the optical servo system. In EFM, a group of eight bits (called a *byte* or *symbol*) is mapped into 14 channel bits. It can be shown that there are 267 different 14-bit sequences that meet the run-length constraints of the CD system, 11 more than are needed for unique mapping of eight bits. The extra 11 can be discarded.

The output of the EFM modulator contains the encoded audio data (arranged in digital *frames*), parity bytes and C & D bits. To this signal are added so-called *merging bits* and a *synchronization pattern*. The final result is a sequence of frames transferred to the master disc at a channel rate of 4.32Mb/s.

CD optic system

Mechanical cutting systems are impractical for production of compact discs because the *pits* and *flats* (data encoding) are too small to be mastered reliably through mechanical means. CD masters are, instead, produced using a glass plate coated with a photo-resistive material that is exposed to a modulated laser beam. The laser is used to encode the pit areas, which correspond to the presence or absence of digital signals.

A development and silvering process then follows, which produces a glass master. This master is pressed against a nickel plate to make a reversed copy of the photo-etched depressions. This process allows the production of a metal digital master for use as the mother element for the production stamper.

At the reproducer, an optical laser beam system reads the presence or absence of the signal pits contained in the CD. These readouts take the form of variations in reflected waves to the photodiode detector, which are converted into digital data and fed to the CD system demodulator. The lack of any physical contact between the disc and the pickup element necessitates the use of a dynamic-tracking servo system for the CD optic assembly.

Decoding the data

The demodulator stage performs the inverse operation of the EFM modulator through the use of a look-up table. Control and display information is stripped off of the data stream for use by the player's supervising microprocessor.

The channel-decoder and interpolation stages are the elements concerned with error detection and correction. The ability of the CD system to detect errors is dependent on the number of errors (or erasures) that simultaneously must be corrected (or recreated). Generally speaking, there is a trade-off between error correction and detection. The larger the correction capability of a system, the smaller the detecting capability.

An undetected error that passes to the output can result in an annoying audible click. Detected erroneous data, however, can use interpolated sample values to cover the missing information, making the error inaudible. The error-correction method of last resort is muting, which is usually inaudible if the muting duration does not exceed a few milliseconds.

After error correction, the digital signal is ready for the processing steps that will convert it to an analog format. The digital-to-analog (D/A) conversion system includes a factor-of-four bandwidth expansion circuit. This expansion is realized through interpolation of the signal samples during processing. This interpolation differs from the error-correction methods described previously in that it is used for signal enhancement, rather than signal correction.

A digital low-pass filter attenuates frequencies above 24kHz by approximately 50dB and supplies the resulting signal to a D/A integrated circuit, which outputs an audio signal. The audio is filtered by an analog low-pass filter and delivered to the output port.

Performance

The improved performance of a digitally based audio system over its analog counterpart is a strong argument for moving into the digital domain. Table 1 illustrates dramatically the improvement in performance that can be achieved by using a CD player rather than a standard 12-inch LP record. Note the increase in CD dynamic range (90dB

as opposed to 55dB) and the greatly increased channel separation (90dB as opposed to 25-35dB).

This comparison probably represents a worst-case analysis of the performance of two competing storage systems. However, digital audio storage usually offers improved performance over more advanced analog storage media, such as audiotape. This improvement may or may not be perceptible to the listener, but it is usually measurable to the engineer.

Digital audio storage systems, similar to their analog counterparts, have strong

points and weak points. The systems will surely coexist in the broadcast industry for some time to come, as the marketplace weighs the relative benefits of each method of storing audio. [:-)]]

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Technical Training Manual for the Compact Audio Disc Player, NAP Consumer Electronics Corporation, Jefferson City, TN.

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Field report

Sony Betacart

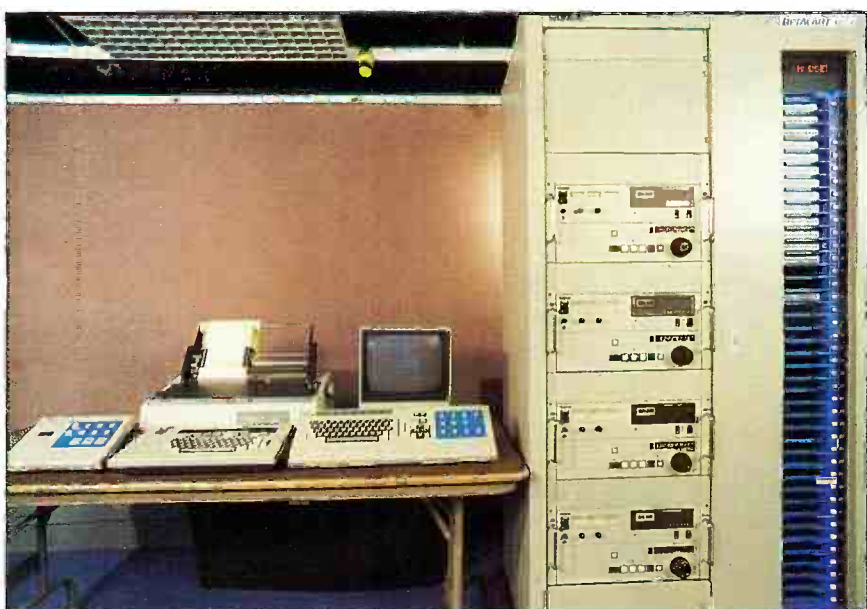
By David Sit

The Sony Betacart is a new generation multicassette playback device. Conforming closely to SMPTE recommendations on multicassette development, the system is designed as a successor to 2-inch ACR/TCR systems.

Betacart is not only an improvement in the area of video picture quality, it also addresses some of the limitations of the 2-inch cart systems.

Available in playback-only and play/record configurations, the system includes a 40-bin tape compartment, a central elevator and four tape decks. Because it uses standard Betacam technology, recording can be done entirely off-line without tying up the entire unit, hence the playback-only version.

Sit is chief engineer at WNET-TV, New York.



Courtesy of WNET

The Betacart system, under test, is set for operation.

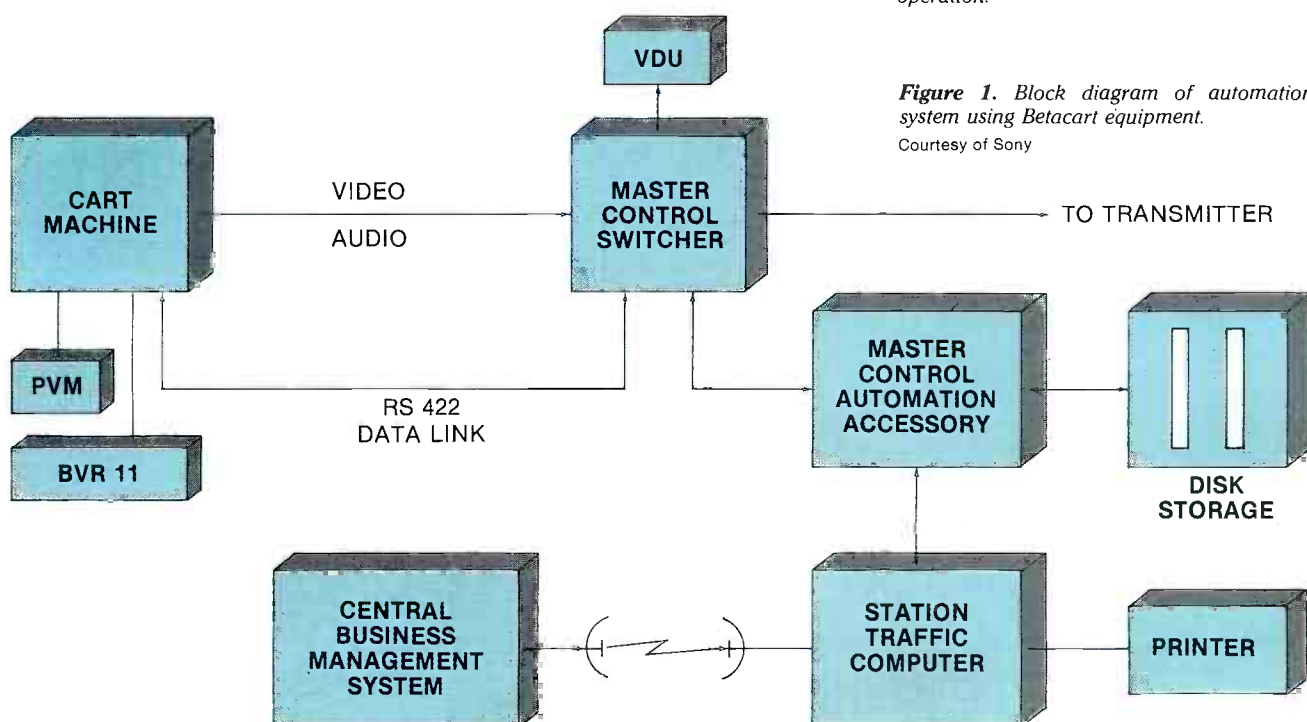


Figure 1. Block diagram of automation system using Betacart equipment.

Courtesy of Sony

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	E6G-265	61829			
	E6G-270	59636			
	E6M-597	62456			
	G6R-896	59246			
	H6E-283	55892			
	H6J-368	64300			
	H6T-890	59472			
	P6Q-624	64066			
	G5D-155	62554			
	H6J-367	55907			
	H6J-371	59991			
	J6A-2	57805			
	D6V-817	42279			
	F3Q-730	59386			
	D6V-815	41416			
	E6G-273	47349			
	J6A-7	59067			
	E6G-266	57026			
	P6W-1297	57865			
	H6C-161	26683			
	J6A-6	31752			
		49355			

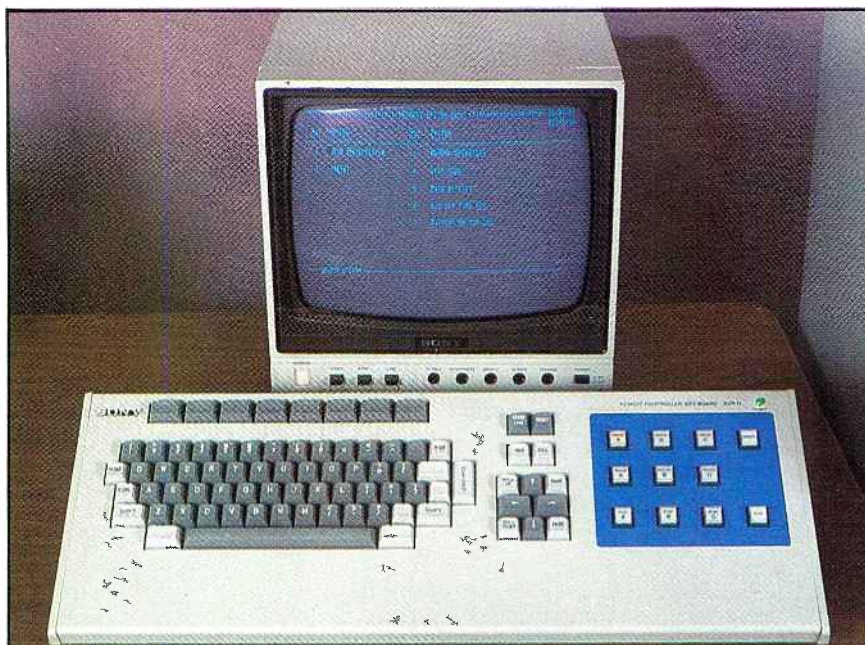


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The main computer terminal serves as an interface with the operator.

Tape used in the system is the standard ½-inch Betacam cassette.

Computer control

A CRT and terminal serve as the interface with the operator. The terminal supports various functions, such as creating

an actual play sequence. Each element of a playlist can be selected by inputting only the ID story number. Other information will be extracted from a bar code label on the cassette.

There are the expected software features, such as inserting or deleting an element from the list. A *revise* function permits the user to change or override

bar code information. For example, the duration of a station ID could be changed from 15 to 10 seconds without having to change the label.

There are two other ways that the sequence play list can be entered into the computer. First, a host computer used by the station can download information through an RS-422 serial data port. The second method uses an off-line computer to create the sequence files on micro-floppy (3.5-inch) diskettes, which can then be read by the Betacart computer.

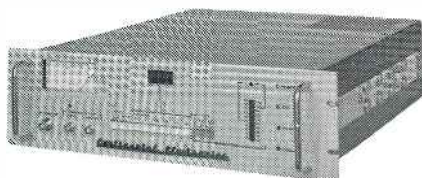
As of this writing, the disk device is not available, but is expected soon. If desired, a port is available for printed *as-run* logs.

Cassette identification

A separate computer and printer setup generates the bar code labels, which are a vital part of the Betacart operation. Each cassette is identified by a bar code. The label contains an ID number, description, SMPTE time code of the starting point and the duration. These parameters are entered manually into the bar code computer.

The operator has a choice of entering an out-time or cut duration. In and out points of the tape can also be read directly when the time code output of a Betacam playback deck is connected to the bar code system. With all four param-

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More Pro Features. The A725 has three pairs of outputs: balanced XLR ("4"), fixed level unbalanced, and unbalanced with front panel level control. The A725's disc transport is built on a die-cast chassis for long-term stability, and the rack mount flange is standard.

A Display of Intelligence. The A725's four mode liquid crystal display shows elapsed time of track, elapsed time of disc,

remaining time on track, or remaining time on disc. A bar graph gives additional information on tracks remaining or approximate elapsed time, depending on display mode. When indexes are accessed, index numbers are also displayed.

The Programming Department. Programming controls (lower left) may be used to pre-select up to 19 separate steps, including nearly every conceivable combination of repeat, skip, loop, and autostop functions. A protective cover is provided to prevent unauthorized use of these controls. A serial data port allows linkage to external computer control systems.

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ters entered, the printer generates a label that is placed on the back edge of the cassette.

Loading the system

The tape compartment can accommodate 40 tapes at a time. As the tapes are placed in bins in the system, a bar code reader scans the label. That information is stored in the computer to provide a map of all pertinent data regarding the current tapes.

With a sequence list composed, active cart bins have a red warning light activated to deter removal. If removal does occur, a warning buzzer and an error indication on the CRT are turned on.

If a cart has been removed from its bin by the elevator en route to one of the tape decks, a locking mechanism prevents the operator from inserting another tape in the empty bin. In an emergency, an unlabeled tape can be played back by specifying it on the sequence list.

The central elevator, with its bar code reader to identify tapes, transports the tapes to and from the tape compartments and the decks. Two cassettes may be in the elevator simultaneously. When a tape has finished playing and is ejected, the next tape for that deck is held within a second compartment of the elevator.

After the tape has been ejected, the elevator inserts the next tape into the deck immediately. This cuts the cycle time to change tapes to a minimum.

The elevator aligns itself to the tape compartment and the decks through an initialization process. Mechanical tolerance values of each of the four decks are stored in the computer memory, so no mechanical alignment procedure is necessary if decks must be replaced.

The decks

Four playback decks used in the Betacart system are BVW-11 machines. They differ from the standard BVW-10 players with the addition of a freeze frame capability. This allows freezing of the play sequence at any point to cover common on-air logistics, such as long announce copy or late programs.

The decks are side-loading machines, specifically designed for access by the elevator. The signal outputs from the playback decks are routed to a 4x3 audio/video switcher.

Operational concerns

Betacart is designed to service more than just station breaks. It comes with two versions of software—the commercial software for breaks and an ENG package for news. In the commercial mode, all playback decks are routed to one output channel. For ENG use, the software gives a choice of any of the three output channels.

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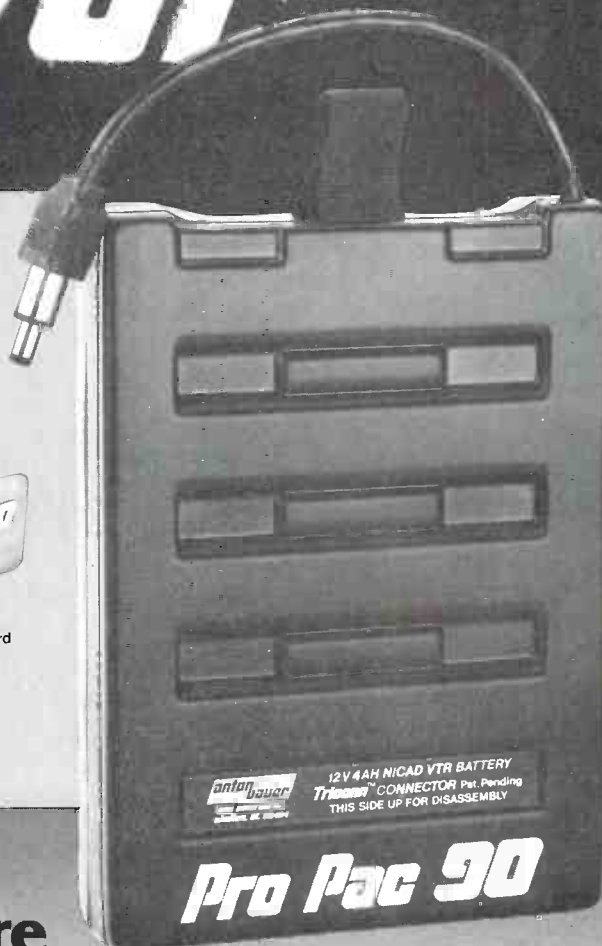
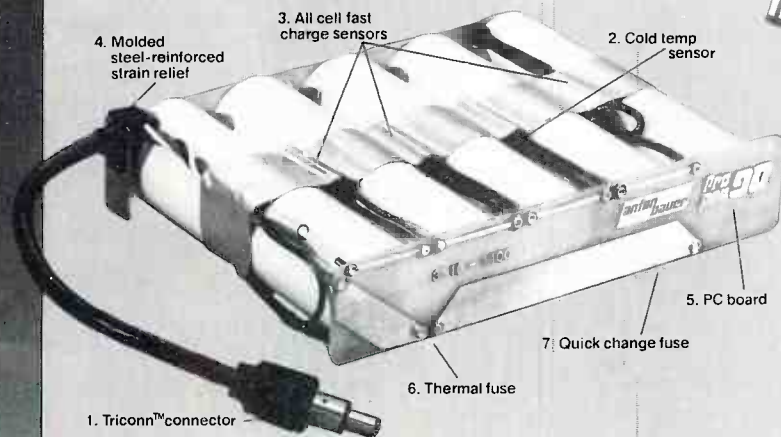
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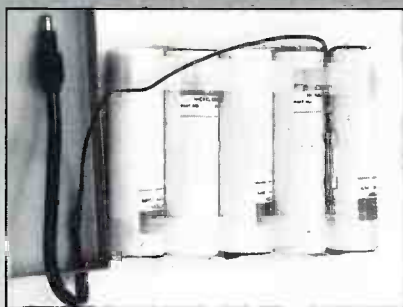
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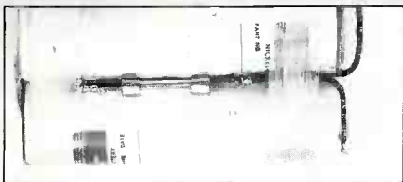
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prototype units from the NAB '84 convention as an evaluation and test unit. It was tested for eight months, while several important issues were closely observed.

The first factor evaluated was reliability. Can this system stand up to daily heavy use? We examined each component of the system for expected failure rates and, more important, backup and recovery expedencies. An integral diagnostics routine self-tests most of the system. Informative error messages, such as loss of control of a tape deck or an elevator problem, are displayed.

The 40-bin tape compartment is redundant, as a typical station break would

A separate computer and printer are used to produce bar code strips for the cassettes.



RELIABILITY

PROJECTED MEAN TIME BETWEEN FAILURE (PRELIMINARY)

FAILURE TO THREAD IN A BVW 11	1 : 300,000
FAILURES IN THE ELEVATOR	1 : 50,000
FAILURES IN THE BIN	1 : 3,000,000
BAR CODE READER ERRORS	1 : 3 X 10 ⁸

LIFE EXPECTANCY

ELEVATOR MOTOR	10 YEARS
TIMING BELT	5 YEARS
ELEVATOR	5 YEARS
BINS	5 YEARS

Table 1. Estimated reliability figures for selected components.

BVW-11 cassette decks are side-loading models with dynamic tracking and still frame capability.



Circle (78) on Reply Card

Wipe out one-inch



Garner 1400
One-inch video
tape eraser

If you've made the decision to invest in state-of-the-art one-inch technology, remember, the quality of your production is only as good as the tape you start with. That's why many studios control tape expense without sacrificing production quality by using a Garner one-inch bulk eraser to quickly degauss high coercivity tape. Only Garner has the magnetic coil design that concentrates the erasing flux to wipe out recorded material by -90dB — cleaner than new!



VTR Erasing

Erasing tape on your VTR increases head wear, ties up expensive equipment, and can take hours to erase, sometimes without delivering complete erasure of audio and control tracks.



Other Bulk Eraser

Bulk erasures not expressly designed for high-coercivity 1-inch can take up to four times longer and can't match Garner's -90dB erasure quality.



Garner 1400

Only Garner offers erasure quality, speed, easy operation and durability—backed by a full two-year warranty.

Call our toll-free number today for a free brochure on the 1400 or any of Garner's other bulk erasers for video, audio or computer recorded material.
Toll-Free 800-228-0275

garner industries

TELEVISION TECHNOLOGY CORPORATION



A good place for your RADIO station to look for equipment.

Television Technology has been manufacturing TV and FM Translators and Low Power Television Transmitters since 1967. In that time we have gained a reputation for simple and reliable designs that offer the highest level of performance available from existing component technology.

But, Television Technology Corporation is also a RADIO equipment company. Our Wilkinson Radio Division offers a complete line of FM Transmitters from 10 watts to 60 kilowatts, including the FM-3500J, 3.5 kilowatt FM transmitter, the first of a complete line of transmitters we think will change a lot of ideas about what's important in a broadcast transmitter. Wilkinson also offers simple, reliable AM Transmitters from 125 watts to 100 kilowatts.

Television Technology also offers a complete line of audio consoles, cartridge machines, and reel to reel decks made by our AMPRO/Scully Division.

So when you're looking at new equipment for your radio station, don't forget the television company that thinks a lot about radio, too.

TELEVISION TECHNOLOGY DIVISION – TV & FM Translators & LPTV

**WILKINSON ELECTRONICS DIVISION – AM & FM Transmitters &
Line Surge Protectors**

AMPRO/SCULLY DIVISION – Audio Consoles & Audio Tape Equipment

**SATELLITE TECHNOLOGY DIVISION – Satellite Earth
Terminal Systems and Transmission Systems**



Wilkinson Radio Division

2360 Industrial Lane
Broomfield, Colorado 80020
(303) 465-4141
TWX: 910-938-0396

probably not require more than 10 tapes. Four playback decks are more than sufficient. Three decks would usually not pose any cycle time problems.

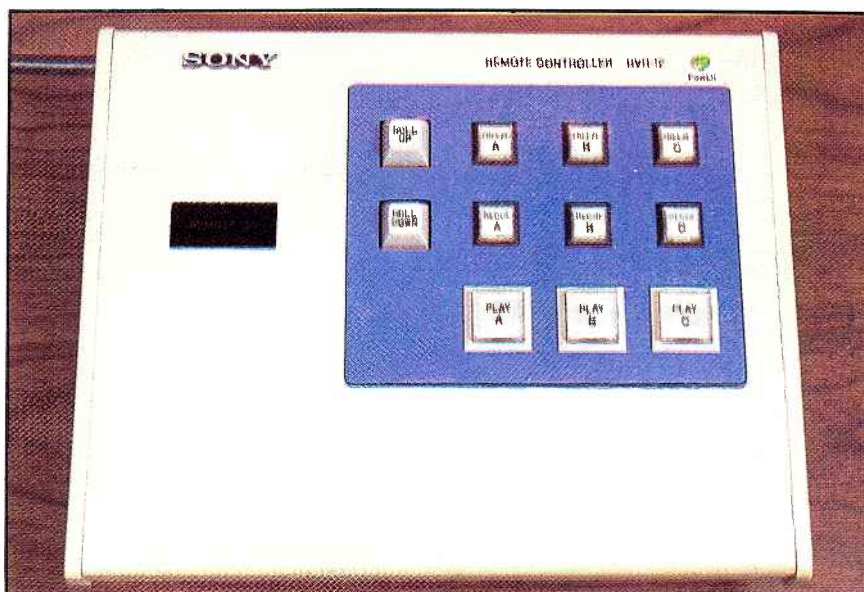
A spare deck can be replaced and aligned within minutes. That leaves the central elevator as the only non-replaceable component. A simple, but effective, solution, however, is to pull out the tape decks halfway to their locking positions and insert tapes manually.

After an initial failure of early dynamic tracking designs on the BVW-11s, the prototype had no other mechanical problems. Software bugs discovered and reported to the manufacturer were fixed by software updates.

Besides reliability, we looked into the implications facilitated by such an automated device. With cycle time problems a thing of the past, short duration elements can be put in the middle of a station break. Short elements can also be contiguous without problems.

The Betacart could drastically change the on-air look of station breaks. The length of each element is limited only by the length of the tape, which at present is restricted to a maximum of 20 minutes. Sony and 3M are working to develop a 30-minute version.

When that becomes available, the bulk of the station's local origination operation can be played back entirely from the



In addition to the main terminal, a remote controller allows the operator to have system control.

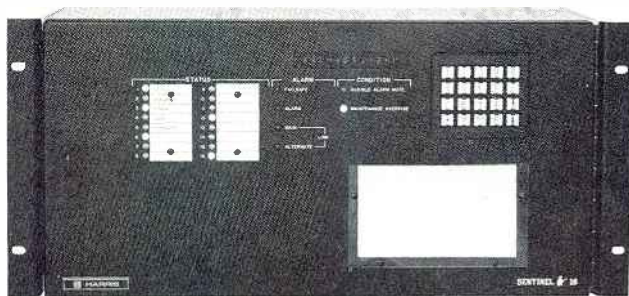
system. Programs of 30 minutes or less will be treated as a single cut within a station break. The system could prove a cost-effective means to station automation for most local stations.

Saving tape

A means of saving space and consolidating spots was found. Because the bar code label determines the segment

or cut within a tape, 10 promos for a program series can be put on the same 20-minute cassette. As only one episode is promoted weekly, an updated label is generated each week to select the next cut on the tape.

With Sentinel 16 Remote Control, There's No Cause For Alarms!



As an intelligent remote control system, the Sentinel 16 can be programmed to react to changes in the operating environment. It will attempt to solve problems before they require operator intervention. When critical parameters go outside your pre-determined limits, Sentinel 16 doesn't just sound an alarm. It automatically makes the required adjustments! What's more, the Sentinel 16 packs more features in nine inches of rack space than its competitors.

- Easy to use, easy to set up
- Can be expanded into a complete ATS system
- Compatible with Harris and other transmitter manufacturers

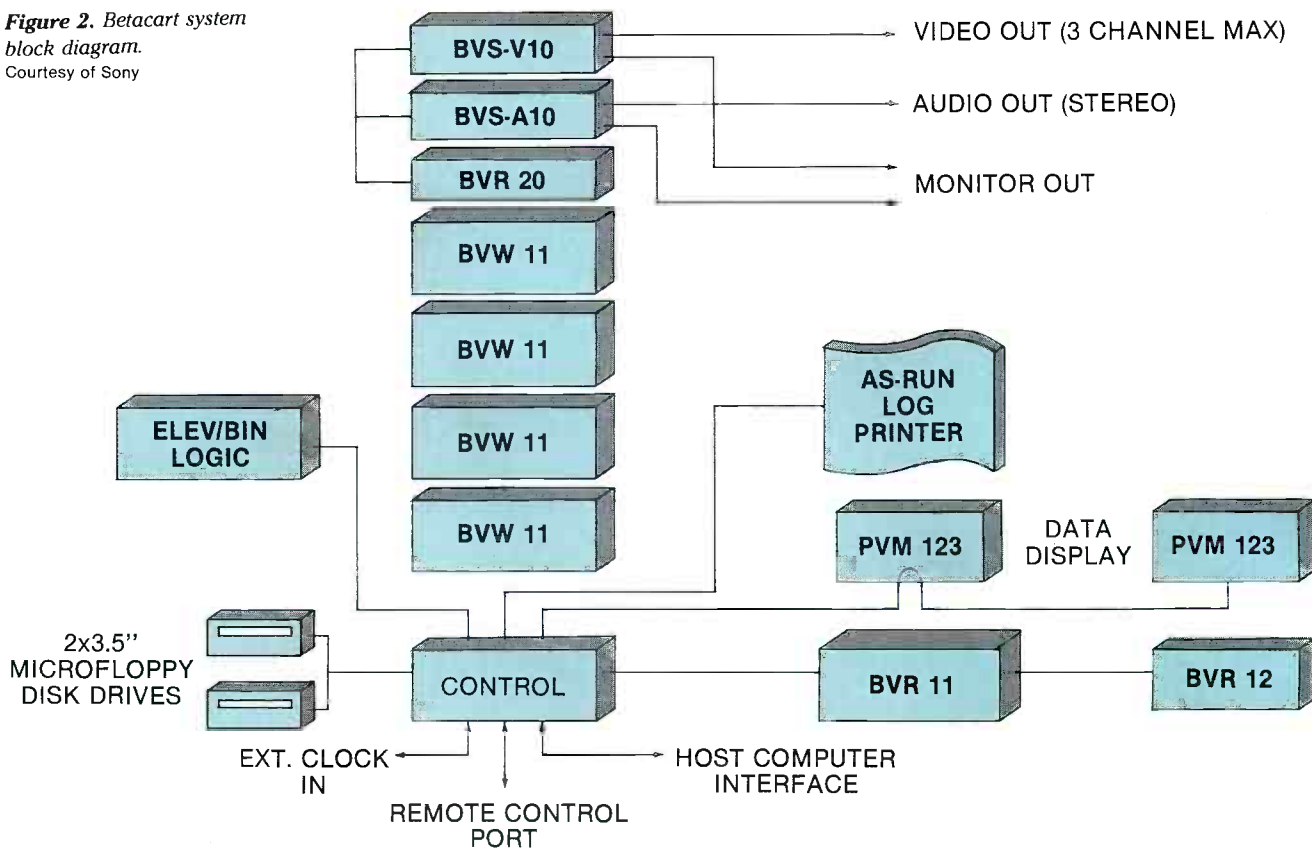
Like to relax a little? Contact Harris Corporation, Studio Division, P.O. Box 4290, Quincy, Illinois 62305. 217/222-8200.



For your information, our name is Harris.

Circle (80) on Reply Card

Figure 2. Betacart system block diagram.
Courtesy of Sony



Affordable Random Access Video Cart Systems

Cost effective, modular, and expandable



Component Switching and Processing

Modified 3/4" U-Matic Players with Y-C/DOC outputs or 1/2" Type M with YIQ outputs are switched through our vertical interval Matrix Switcher into a component TBC.

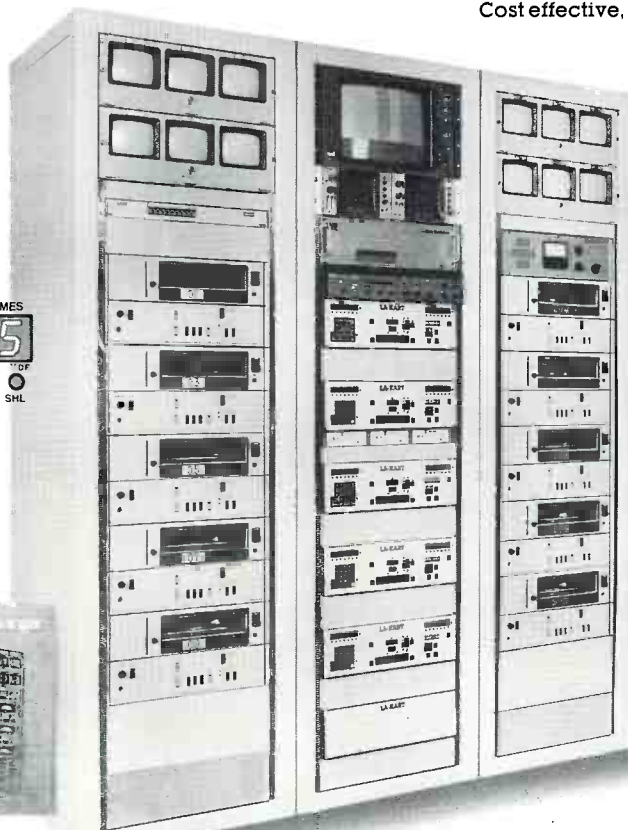
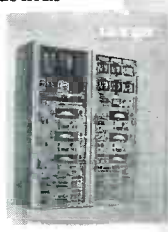
Automatic Directory Reading

Cassettes are loaded randomly into any empty deck. They rewind automatically to the head and the directory, containing a 4-digit reel ID number with precise start and finish times of each segment according to their location with reference to SMPTE time code is read into memory. The status indicating ID found and VTR location is displayed on the terminal.

Send for Brochure

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Choose from 1" Type C, 3/4" U-Matic, 1/2" Type M, or any combination.

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Or more with 68K Multi-Event Programmer and Disc Drive.

The computer identifies, searches out, and activates tape segments to be cued and aired in the order scheduled.

Lease Plans Available

LA-KART™

LAKE SYSTEMS CORPORATION

Prices Start at \$89,900

Circle (81) on Reply Card

Tape cost savings is also an advantage. Compared to \$25 to \$30 each for 2-inch cartridges, a 10-minute Betacam cassette costs about \$8. A 5-minute length cassette should reduce the price more.

Because the Betacart handles the tapes more roughly and, in spot playing applications, requires many more passes than ENG, it is vital that the tapes meet stringent standards. WNET is presently using both Sony and 3M Betacam cassettes successfully.

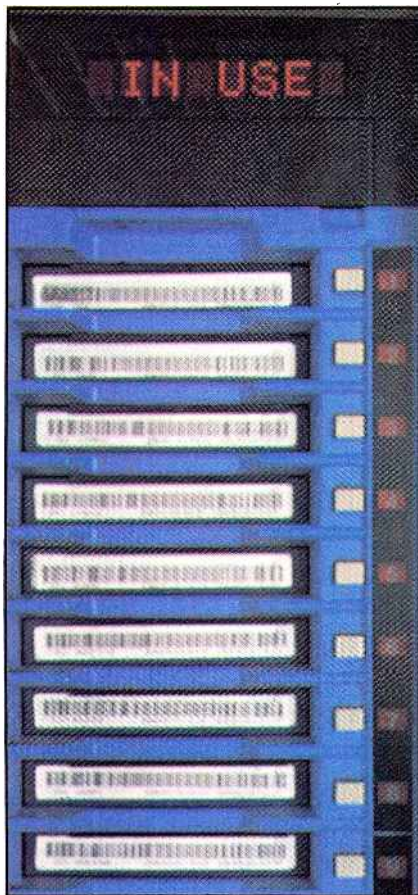
On the air

We decided to give the Betacart system its acid test on November 30, 1984. Its on-air debut was the station break at 1:57 p.m. The break consisted of two program promos, a short piece on a museum exhibit, a station ID logo and an underwriter funding credit.

The entire break went off with flying colors and every observer present not only marveled at the quality of the picture, but at the ease and efficiency of the operation.

Operationally, the system is a breeze. Only an ID/story number needs to be in-

In the tape compartment, the top cassette bar code is purposely mutilated with pen marks. The bar code reader has no problem deciphering the information.



put into the computer for each element. Total duration of the station break is calculated automatically from the bar codes. Countdowns for each element and the total elapsed time are constantly displayed on the terminal CRT, enabling the director to easily track timing between programs.

Successor to 2-inch

The Betacart system is a quantum leap from 2-inch cart systems. Its signal quality and operational versatility evoke far-reaching implications through its myriad uses. By using standard Betacam tape, it provides a system that is compatible and expandable with an entire family of products. With the advent of our Betacart, we are planning to change the on-air look of WNET to a more concise and crisp format.

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 load 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**. | : 7 :))) |

Our Sentinel-48 Will Change The Way You Look At Remote Control!



Now use color to highlight your complete transmitter and status information. Alarm conditions are shown in red and normal conditions are shown in green just the way you'd design a system for yourself! The Sentinel-48 is *EASY* to operate by pointing with our unique light pen rather than typing commands.

- Easier to use than any other remote control on the market
- Control multiple remote Sentinel-48 or Sentinel-16 sites
- Can be expanded to radio ATS system
- User programmable at an affordable price

Any way you look at it, the Sentinel-48 can do the job! For a new perspective on remote control contact Harris Corporation, Studio Division, P.O. Box 4290, Quincy, Illinois 62305. 217-222-8200.



For your information, our name is Harris.

Show preview

Montreux to host 14th show

By Carl Bentz, technical editor

Hundreds of interested observers and participants of the broadcast and CATV industries will gather for the Montreux TV Symposium and Technical Exhibition June 6-12. More than 160 manufacturers from around the world plan to present their product lines in the exhibit halls for this 14th biennial event. A full schedule of technical seminars has also been planned for the 7-day period.

Following the opening session on Thursday, June 6, the *Impact of Microelectronics in Broadcasting* will be the subject of a roundtable discussion. Participants will represent Austria, France, Germany, Great Britain, Japan and the United States.

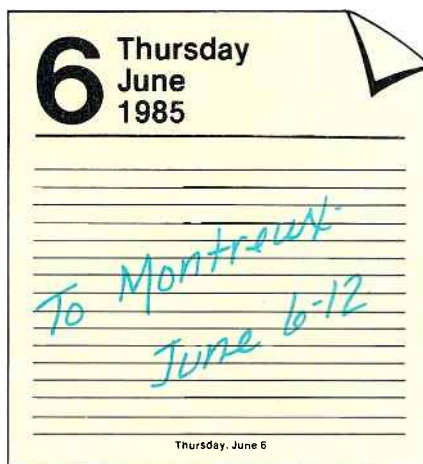
A major event on Sunday morning will be *The Viewer's Choice*, a colloquium with a panel evaluating the impact of new technologies with respect to the home viewer and the result for mass communications. Demonstrations of the new technology are planned.

Broadcasting

General broadcast subjects on Thursday, Friday and Saturday will include *ENG Equipment Innovations*; *TV Production and Post-Production Systems*; *Terrestrial Transmission*; and *Recording and Processing in the Digital Component Domain*.

The ENG discussions will involve new equipment and tape innovations, and TV production and post-production will consider experiences in analog and digital techniques. Other possible topics are cameras, telecines, still-stores, slide scanners and editing systems. Reports of experiences with digital and component systems are also planned. Digital recording and processing will address the latest work with digital component VTRs, switchers, encoders, decoders and image processing of component signals.

Scheduled transmission topics will provide a view of terrestrial television in Europe today and tomorrow. Developments in klystrons and system optimization of pulsed klystron will combine with



adaptive precorrection for TV transmitters to round out the session.

Broadcast and CATV

Several joint broadcast and CATV sessions are planned for Saturday, Sunday and Monday. Of particular interest will be *Direct Broadcasting and Distribution Satellites and Equipment*. Various subjects include performance and economic considerations of current satellites, the satellite payload, the uplink equipment, design of outdoor DBS receiving equipment and C- and Ku-Band small aperture dishes for CATV. TV reception of the European Communication Satellite (ECS) will be discussed.

Another joint session will examine the topic of *Extended TV and HDTV Systems, Studies and Equipment*. The possibilities of an intermediary enhanced system will be discussed, and experiences with HDTV production should prove enlightening. Standards conversion, the studio camera and a slide scanner will highlight some equipment considerations. A discussion of the approaches to HDTV will encompass a 2-channel system, sequential and interlaced scanning and studies in extended definition. This is sure to answer some questions and generate many more.

The place of *Computer Graphics, Animation and Special Effects*, a topic of general interest, will be included in the joint sessions.

CATV topics

The Monday through Wednesday meetings will be aimed more specifically at the CATV industry. *Programming and Marketing* subjects will precede discussions of the *Advances in CATV Networks*, which will center on 440MHz systems and modular switching, including interactive capabilities. *Optical Broadband Networks* will investigate multichannel operation with optical transmission equipment. *New or Extended CATV Services and Evolution of Home Terminals* will address the various ways that CATV can serve the subscriber. Also discussed will be *Interactive CATV*.

To register

Interested individuals should contact the event management at: International TV Symposium and Technical Exhibition, P.O. Box 97, CH-1820, Montreux, Switzerland.

Because of a possible shortage of housing facilities, you should contact the event management as soon as possible. The Telex contact numbers are 453 283 ITVS and 453 222 OTM.

A registration fee of 320 Swiss francs (approximately \$120 U.S.) is required, with no additional fee for spouses. [:-)]]

Addressing HDTV

Perhaps the most significant topic at Montreux will be HDTV. An entire day's program is being devoted to various aspects of extended television and higher definition systems. Direct broadcasting will also be covered as a probable distribution method. These sessions follow several recent actions on improved definition TV.

The SMPTE working group on HDTV has recommended the use of a 1125-line, 60-field world standard. The U.S. Advanced TV Systems Committee agrees with the SMPTE recommendation and took that word to the mid-April European Broadcast Union technical committee meetings in Spain.

Following the meetings, EBU announced that it will continue to work with specialists from around the world toward establishing a CCIR recommendation for a world standard. Using the 1125-line scheme, a 2:1 interlace and 5:3 aspect ratio, it appears the 60Hz factor is a major concern to EBU participants. The field rate factor is presently top priority in further studies.



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No one ever said getting a story was easy. So you want a 1/2-inch tape that makes the effort pay.

You want a 1/2-inch tape that can take the high-speed transport of systems like the Sony Betacam™, or M-Format equipment. One that survives editing hazards like constant shuttling and quick stops. Which means you want a cassette with a precision-engineered transport mechanism, and a videotape with a unique DUROBACK backcoating that keeps the tape on track.

When it's air time, you want a 1/2-inch tape that will deliver the best performance possible. Which means a tape with outstanding video and color S/N performance, regardless of how many times the tape is used. It also means a tape with the absolute minimum number of dropouts even after extensive use, thanks to special anti-static leader and trailer tapes.

Finally, you want a 1/2-inch tape with extremely low wow and flutter, so that stereo broadcasts sound as clear as they look.

In short, you want Fuji's H421 and H321 1/2-inch professional videotape. Because Fuji's 1/2-inch tape is the shortest distance between just getting the picture and getting it just right.

For more information on Fuji 1/2-inch professional videotape, call your Fuji representative. He'll go to any length to tell you what you want to know.



FUJI

Nobody gives you better performance.

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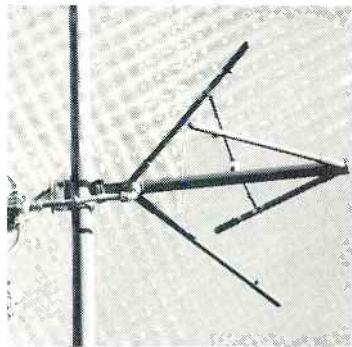


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In today's competitive FM market, you have no reason to consider an antenna that's not the very best. That means a tried and proven Cetec antenna. Over one thousand JSCP Penetrators have built this reputation, and other Cetec models support higher or lower power requirements.

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People

Kyoshi Seki, president and CEO of Matsushita Electric Corporation of America (MECA), has announced the resignation of **Raymond A. Gates** from the position of president and CEO of Panasonic Company. Panasonic Company, a division of MECA, markets Panasonic and Technics brand consumer products.

Bill Ludwig and **Harris Rogers** have been named regional managers for Abekas Video Systems, Foster City, CA.

M. Michael D'Amore has been appointed director of marketing for Ampex Corporation's Audio-Video Systems Division (AVSD), Redwood City, CA. D'Amore will be responsible for marketing the complete line of Ampex videotape recorders, switchers, editing and special effects systems.

Steve Fox was recently promoted from sales engineer to the position of manager, customer applications for Wegener Communications, Norcross, GA. Fox will be responsible for the management of sales engineering which includes pre-sale customer inquiries and order placement. He joined Wegener in October 1982.

Hitachi America, Ltd., Tokyo, announced the appointment of **Tsuneo Tanaka** as president of Hitachi America, Ltd. Tanaka replaces Katsuaki Suzuki who has returned to Japan. Before coming to the United States, Tanaka was appointed general manager of the international sales division of Hitachi, Ltd., in 1981, where he oversaw the export of power systems and equipment, industrial machinery and plants. Before that he was appointed general manager of international sales division in 1979, and was responsible for the export of computers, office automation systems, automotive components and other equipment.

O.G. "Bud" Mills has been appointed Southeast regional sales manager, professional products for Ikegami Electronics, Maywood, NJ. Mills will have sales management responsibilities for Georgia, Florida, Alabama, North Carolina, South Carolina, Tennessee and Puerto Rico encompassing Ikegami's complete line of professional broadcast products.

John Fitzpatrick has been appointed Eastern district manager for Lenco, Jackson, MO.

Fitzpatrick will be responsible for all sales activities to distributors, OEM and direct sales in the metro New York area. His area of coverage will include the five boroughs of New York: Long Island;

northern New Jersey; Westchester County; and Fairfield County, CT.

Philip M. Ritti has been promoted from marketing manager of videotape products to director of marketing at the Ampex Magnetic Tape Division, Redwood City, CA. Ritti assumes responsibilities for the development of all international and U.S. strategic planning and marketing programs at the Ampex Magnetic Tape Division.

Shinichi "Sam" Okamoto has been named president of Sharp Manufacturing Company of America, the Memphis-based manufacturing division of Sharp Electronics Corporation. Okamoto succeeds Toshio "Kenneth" Toda, who returned to Japan as deputy group general manager of the Osaka-based parent company's integrated circuits group.

In a recently concluded arrangement, **Dick Swettenham**, has joined forces with Audio+Design Calrec, Los Angeles, to run the new Los Angeles office. The primary function of the new facility is to provide on-the-spot sales and support for the range of Calrec mixing consoles and microphones as well as processing equipment from Audio+Design.

Lyle O. Keys and **J. Paul Kinloch** have been named to the board of directors of Chroma Digital Systems, Santa Clara, CA. Keys was a founder of both Telemation and Utah Scientific, and currently serves as president of Utah Scientific, headquartered in Salt Lake City, UT. Kinloch is currently managing director of the investment banking division at Lehman Brothers, Los Angeles.

Scientific-Atlanta, Atlanta, has announced the promotion of **Robert C. Hyers**, **Randall W. Rhea** and **Nigel Seth-Smith** to principal engineers.

Hyers, assigned to the instrumentation division, has been with Scientific-Atlanta since 1967. Rhea is assigned to the communications division and is involved in the development of customer premises satellite terminals for business data. Seth-Smith, the chief engineer for the digital video systems division in the broadband communications group, has led the design team in the development of SA B-MAC, a new satellite transmission system for video, audio and data and the associated integrated circuits for a low-cost implementation.

Don MacClymont and **Steve Stephens**, both formerly with Beston Electronics, have been named vice president and secretary-treasurer, respective-



GET THE PICTURE

With the Schwem Gyrozoom 60/300™ Image Stabilizer Lens



Now, truly stabilized optics. The new Schwem Gyrozoom 60/300 Image Stabilizer Lens fits most $\frac{2}{3}$ " ENG cameras and eliminates virtually all image vibration. Smooth footage is obtained when shooting from any moving vehicle—helicopter, truck, boat, motorcycle—even on foot—whether the camera is hand-held or on a tripod. The image is stabilized optically—not with braces or brackets.



Zoom from 60mm to 300mm. This lens enables you to shoot close-up from 1000 feet with a perfectly steady image. It is ideal for newsgathering and sports coverage.

Compact and lightweight. The Gyrozoom weighs in at approximately 6 lbs. Power drain is only 1 additional minute/hour.

Easy to operate. There's no special training required. It is as easy as 1. Attach 2. Aim 3. Shoot.

American quality backed by a full warranty. Fully warranted for 6 months with an optional service contract after warranty period.

To get the picture, you have to see the picture. Call Schwem Technology today to arrange a free demonstration.
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SCHWEM
TECHNOLOGY

Ivan Barton has been appointed national manager, federal marketing programs, Sony Video Communications Division. Barton will be responsible for implementing national and regional marketing programs to the federal government. He will be based in Sony's Lanham, MD. federal marketing office.

Thomas A. Schillinger, chairman of the board of Sennheiser Electronic Corporation, announced the appointment of **Andrew A. Brakhan** as president and chief executive officer.

Friedrich will be responsible for all facets of the marketing functions for Fuji's consumer and industrial magnetic tape products businesses. Major areas include the development of business plans both long and short term and supervision of the product management functions, advertising and promotions.

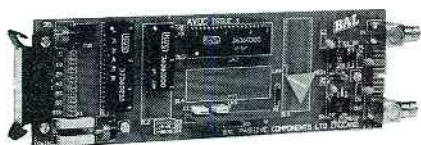
The Boston-based IGC, a group comprised of scientists, investors and legal, financial and marketing specialists, has been internationally recognized for its sponsorship of in-depth studies and conferences in electronics and imaging technologies. The purpose of the Amsterdam conference was to provide an extensive overview of laser optical/video-disc systems, particularly in interactive applications.

Walker will concentrate on marketing The Boss, the computer-controlled audio editor developed by Alpha Automation, and enlarging the market penetration for Sonex and Sound-Tex, Alpha Acoustics' line of sound reduction products.

Before joining Thomson-CSF, Brill was senior camera product manager for Ampex Corporation, Redwood City, CA; held several positions in audio/video engineering for CBS Television Network, New York City; and recently was national sales manager for Clear-Com Intercom Systems, San Francisco.

New Media Graphics Corporation, Burlington, MA, announced the appointment of **Martin Oakes** as senior vice president, sales, responsible for all domestic and international sales. [E:)]))

DL 605 SERIES

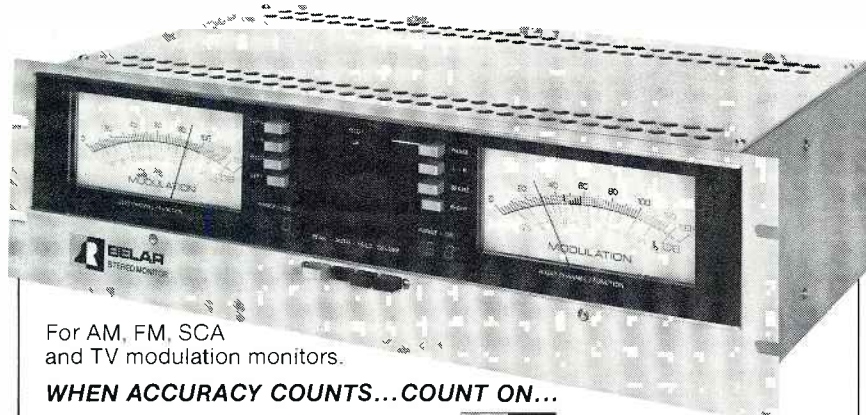


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- one video channel per board
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TASCAM's complete audio system brings video production in-house with ease and economy.

Eliminate Outside Production Costs. Move Inside With Tascam.

You've been thinking about making the move to in-house video. Or expanding your present modest set-up into a fully professional environment. You've had to depend on outside sources for on-line work. And possibly off-line as well. You've been watching money drain out of your budget. Lots of it. Money put to far more profitable use in-house.

Now you can bring your production inside. Allowing yourself the control, time, and creative flexibility your work deserves. TASCAM is ready to help you make the move. Quickly. Easily. Economically.

From training to point-of-purchase videos, from the assembly line to the board room, TASCAM recorder/reproducers and mixers give you the dependability, quality and versatility essential to keeping pace with the rigorous demands of SMPTE production and post-production.

Our 58 recorder/reproducer syncs you into video interlock with a single connector. This rugged 1/2" 8-track gives you the performance capabili-

ties and engineering depth of a 1" machine. But at a fraction of the cost. Full microprocessor 3-motor servo control provides unsurpassed editing speed and precision, taking you rapidly to the point you're after and stopping on the dime.

Our 58's unique Omega Drive ensures smooth tape handling and uniform tape tension. It keeps tape from stretching or bouncing no matter how often you start and stop. And assures clear, clean signal reproduction.

The 58 links superbly to a complete TASCAM system. Our M520 mixer gives you the fast signal routing, logical, easy-to-use board layout, and full creative control vital to your professional video productions.

And when you're ready for layback, our 52 provides exceptional mastering capabilities, with the same dependability, accurate SMPTE control, and precise audio performance as the 58.

For less elaborate productions, our 4-track 44B keeps SMPTE up to speed for fast editing. Or integrate it as a mastering machine for layback from multi-track.

When you've got to balance sophisticated audio capabilities against your

budget constraints: Don't! TASCAM offers the uncompromising audio quality and sturdy reliability of equipment costing much more. At any

price, TASCAM is the professional's total audio system for video interfacing. At this price, what are you waiting for? Your TASCAM dealer has full details or write TASCAM, TEAC Professional Division, 7733 Telegraph Road, Montebello, CA 90640 (213) 726-0303.

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Compatible with any professional system.

TASCAM
TEAC Professional Division

Circle (121) on Reply Card

May 1985 **Broadcast Engineering** 133

CBS selects GWSC for uplink facilities

CBS has selected Group W Satellite Communications (GWSC) to provide uplink facilities for satellite distribution of the CBS Television Network. According to the long-term agreement, GWSC will provide four 2-way channels of uplink and downlink ground segment services to the CBS Television Network, directed at CBS-leased transponders on the Telstar 301 and Telstar 302 communications satellites. It is expected that by December 1986, the service will be expanded to provide additional 2-way channels.

NRK takes ADS 1 telecines

The Norwegian state broadcasting authority *Norsk Rikskringkasting (NRK)* has taken delivery of its first two Rank Cintel ADS 1 telecines.

These telecines will be located at the NRK studios in Oslo where they will be used with NRK's existing MK IIIC flying spot telecines.

The telecine is specifically designed to meet the requirements of broadcast TV stations and incorporates features such as multiplex operation and electronic dirt and scratch concealment.

Taft and SSS launch teletext service

Taft Broadcasting Company, Cincinnati, OH and Satellite Syndicated Systems, (SSS), Cincinnati, OH, have launched Electra, Taft's new national teletext news service. Electra is produced by Taft at WKRC-TV, in Cincinnati. The station has been broadcasting a local edition of Electra to area residents

since July 1982.

The Electra service features immediate updates on fast-breaking national and world news, plus around-the-clock coverage of sports, business and weather. Viewers can select stories by entering a 3-digit code on a remote-controlled keypad/channel selector. Electra, the only nationally broadcast World System Teletext (WST) service in the United States, is available without charge to anyone who receives WTBS's satellite signal and has a WST decoder.

Four companies add ACE

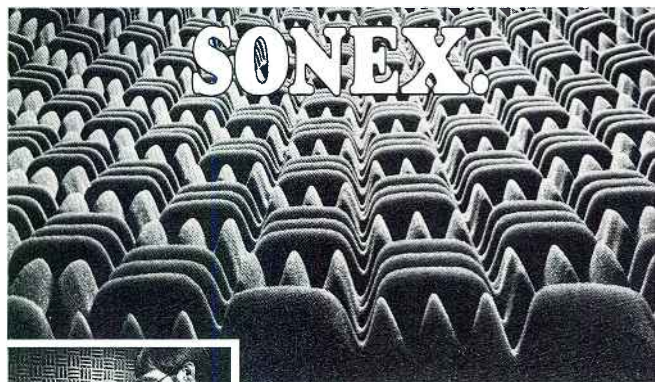
GEC-McMichael, Scottsdale, AZ, an international manufacturer of broadcast and studio production products, has received four major orders for its ACE 4-field digital standards converter.

The unit will be added by Turner Broadcasting/Cable News Network, Atlanta; Magno Video, New York City and The Video Tape Company, Hollywood. Turner Broadcasting will use the converter in its expansion of programming of CNN to Europe. Magno Video and The Video Tape Company will be expanding their existing standards converter business with the ACE to accommodate those customers who need material converted by only an ACE.

English firm opens in U.S.

An American marketing subsidiary of *Aston Electronic Designs, London*, opened in March. *Aston Electronics* was formed to sell and service the Aston line of character generators in the United States and Canada. John Holton will serve as president of the American subsidiary, which has offices at

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The new subsidiary will market the Aston 3 character generator. Features of the Aston 3 include left to right crawl, multirow crawl, row compress and row expand capabilities and left and/or right justification. Options include an automatic subtitle controller, font composer for special logos, memory recall keyboard and an animation programmer.

ADC changes name

Stockholders of *ADC Magnetic Controls Company, Minneapolis*, approved a proposal to change the company's name to ADC Telecommunications, Inc. at the 1985 annual meeting of shareholders held on March 26, 1985, in Minneapolis. ADC Telecommunications designs, manufactures and markets a wide variety of electromechanical and electronic products for the telecommunications, broadcast and data communications industries.

TAK acquires interest on Comprompter

Comprompter, La Crosse, WI, designer of electronic newsrooms for the broadcast industry, announced that TAK Communications, Vienna, VA, has acquired one-third interest in the company.

Comprompter ENR is a computer-based broadcast newsroom system that electronically prepares, organizes and presents the newscast. The company also markets a similar Commercial Producer's version and Totaprompt, a portable computerized electronic prompter for ENG/EFP mini-cameras.

TAK Communications, which owns and operates one radio station and four TV stations, is owned by Sharad K. Tak of Potomac, MD.

Thomson develops Singapore metro's monitoring system

Thomson Video Equipment, a subsidiary of Thomson-CSF, has been awarded an extensive contract to develop the video monitoring system for the Singapore metro on behalf of a French group led by Jeumont-Schneider. It covers 660 color TV cameras connected by an optical fiber transmission system to a central control room where 12 images selected from 522 video sources may be displayed simultaneously. The images from the cameras on the platforms are also transmitted by microwave to the trains for display on monitor screens.

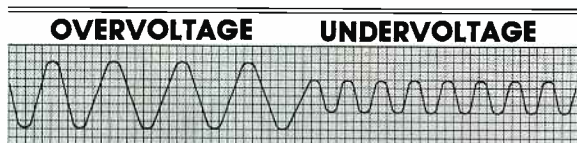
The underground in Singapore has 44 stations and four lines of differing lengths, with the longest measuring 26km. All the stations on each line are connected to the control room by a network of 12 optical fibers in parallel arranged to give an optical bus.

NDR orders Betacam equipment

Following negotiations with *Sony Broadcast's Branch in Cologne*, Nord Deutscher Rundfunk (NDR) has recently placed an order for Betacam equipment.

Equipment to be supplied includes BVW-3AP camera/recorders, supported by BVW-10 players, BVW-40P editing recorders, BVU-800 series high band U-matic recorders, BVE-800 edit controllers and a wide range of accessories.

NDR is the public service broadcasting organization cover-



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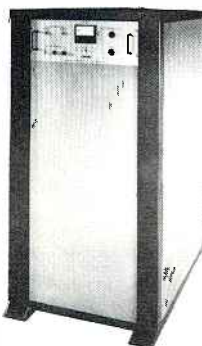
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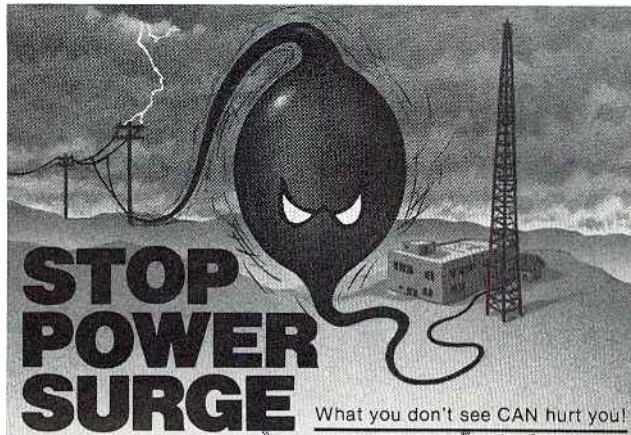
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ing northern Germany with regional offices in most major cities in its service area.

Japanese firms buy VTRs

Ampex Corporation, Redwood City, CA, has sold 30 of its VPR-6 VTRs to a variety of broadcast and production house customers in Japan.

Japanese companies choosing the VPR-6 include NHK, Pioneer, JVC, Matsushita, Toyo Recording, Nippon Columbia, Tel Tech and ABC Eigaisha. The VPR-6 made its world debut at the International Broadcasting Conference in Brighton, England last September. It combines many of the features of Ampex's VPR-3, along with the tape transport and mechanical design of the VPR-80. The VTR is built at the Audio-Video Systems Division's state-of-the-art manufacturing facility in Colorado Springs, CO.

Unique Recording installs Solid State Logic

Unique Recording Studios, New York City, has installed a fully computer-assisted Solid State Logic SL 4000 E series master studio system.

Unique's SSL features 48 channels with total recall capability and the SSL studio computer for tape machine management and computer-assisted dynamic mixing. This combination will give Unique the ability to recreate complete details of all console setups, allowing their clients to modify mixes at any time.

Northwest Broadcast Systems changes name

Northwest Broadcast Systems, Seattle, has announced its recent name change to RF Specialties of Washington. John Schneider, president, said the name change was primarily a result of the company's association with the RF Specialties Group, and its growing emphasis on the sale of RF-related products for AM and FM stations.

The RF Specialties Group is a new association of broadcast equipment dealers around the country specializing in RF-related products. The other dealership organizations are also expected to change their names to reflect membership in the group.

ITN installs new editing systems

Independent Television News (ITN), London, recently installed six Convergence ECS-104 videotape editing systems. The equipment was supplied and installed by Acquis Limited, the London-based sister company of Convergence Corporation, Irvine, CA.

The system offers the same capabilities as the ECS-224 editor and is being used

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by ITN with 1-inch C-format and high band in mixed systems. The comprehensive list management included in the ECS-104 gives ITN the capability to re-edit news and news feature stories easily and quickly, and offers fast creative editing. The editors are used for both ITV and Channel 4 news programs on a daily basis.

Shook/Magnetic Media deliver ENG van

The ENG van featured at the recent RTNDA convention in Shook Electronic Enterprises' booth is the second facility Shook and Magnetic Media have delivered to Texas Publishing Company's low power TV group in Northeast Texas.

Shook manufactured the unit using a Ford E-350 chassis. It was completely self-contained and included microwave with a 30-foot mast.

Magnetic Media supplied the latest state-of-the-art electronic equipment for Shook to install. The system included Hitachi's Z-31 broadcast cameras, Cross-point 6112 switcher and Sony videotape editing equipment.

This second facility will be used at the Rose Channel in Tyler, TX. The first unit went to Channel 18 in Cumby, TX, and is presently being used as an ENG/EPF studio facility.

KTRK-TV receives ENG mobile facility

KTRK-TV, Houston, TX, recently received their ENG mobile facility. They plan to install their own electronic equipment and be on the road with the van in the near future. Shook Electronic Enterprises of San Antonio, TX, built the custom van complete with microwave and 42-foot mast.

M/A-COM MAC opens customer training center

M/A-COM MAC, Burlington, MA, has announced the opening of the MAC Training and Conference Center. This 1200-square-foot audio-visual facility is located in the M/A-COM complex.

It will provide comprehensive training to customers in the areas of system design, microwave radio theory and system maintenance repair. The seminar objective is to provide customers with the expertise to operate and to maintain M/A-COM MAC products in the field.

OSRAM names rep for video product line

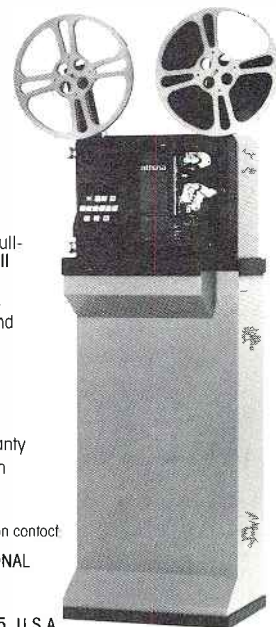
In a move to expand distribution of the company's video product line, Osram Corporation, Newburgh, NY, has named Video Components, Spring Valley, NY, as authorized national rep for Osram video products.

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The LDK 26 using 18mm Plumbicon tubes, offers LDK 6 performance and

many of the same advanced features.

The LDK 614 is the portable partner for either model, using the same triax cable and control panels. For maximum flexibility the portable partner can be used as a self-contained camera for ENG type applications.

Already hundreds of users worldwide have discovered for themselves the LDK 6 family's superb quality, flexibility and low cost ownership.

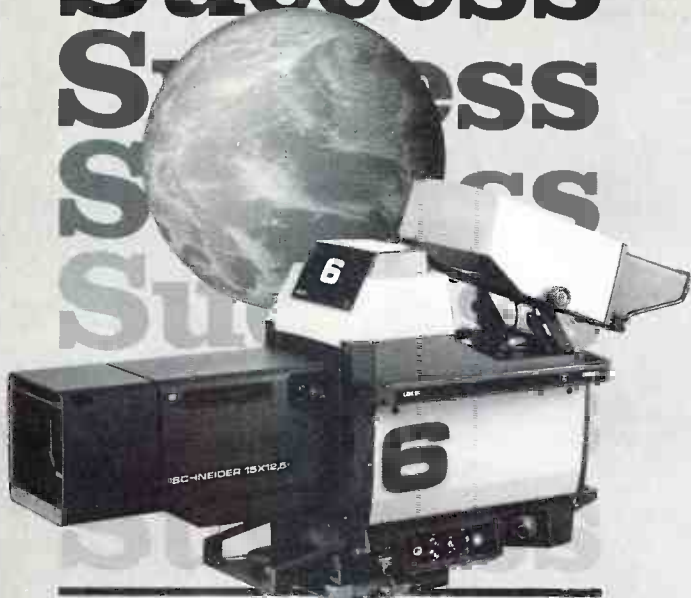
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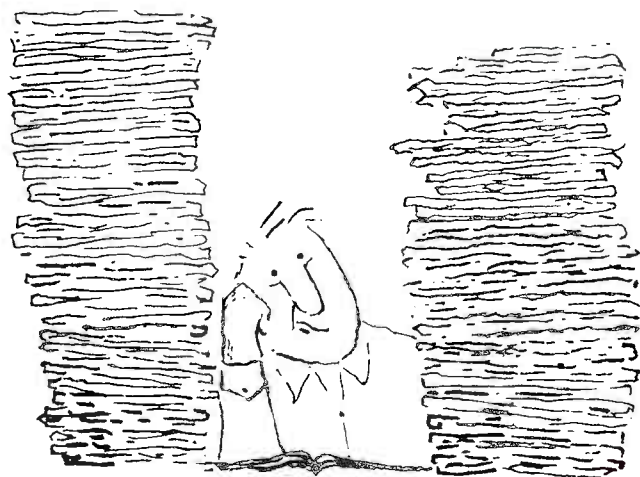
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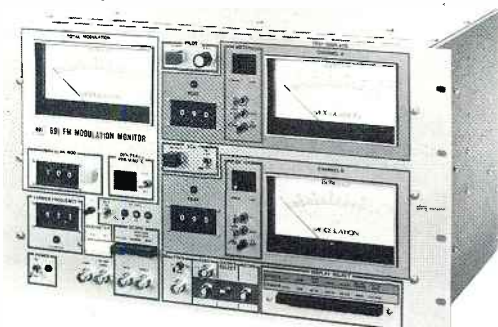
A color-coded system ties together the associated displays, switches, and jacks for a particular function or test. Select your test by pushing a color-coded button and simply read the results on *all* of the indicators. It's as easy as it sounds.

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Video Components will handle Osram's entire video line, including video lights and accessories.

RCA offers satellite syndication system

RCA American Communications, Princeton, NJ, has announced that it is offering TV program syndicators a distribution system to access commercial broadcast TV stations via its Satcom Ku-band satellite system early in 1986.

RCA Americom will use two 45W transponders on its Satcom K-2 satellite, scheduled for shuttle launch this December. To implement the system, RCA Americom is providing a Ku-band antenna/receiver package to commercial TV stations. The package is designed so that the TV station can receive high-quality syndication signals from each of the two transponders. Delivery of the antenna/receiver packages will start this summer.

RCA Americom's Ku-band spacecraft has been assigned orbital slots of 67, 77 and 87 degrees west longitude. Carrying 16 transponders each with 45W power, the satellites will be the most powerful U.S. domestic spacecraft in service following their launch. Markets to be served, in addition to broadcast and syndication services, include Satellite Master Antenna Television, direct-to-home TV distribution and private voice, video, data and teleconferencing services for business and government users.

WOSU/BE sponsor '85 conference

The Fifth Annual WOSU/Broadcast Engineering Conference, co-sponsored by the WOSU stations and **Broadcast Engineering** magazine, will be held July 23-25, at the Fawcett Center, Columbus, OH. The registration fees will be the same as last year. For registration and exhibitor information contact John Battison, director of engineering, WOSU Stations, 2400 Olentangy River Road, Columbus, OH 43230. The phone number is 614-422-9678.

Readers respond to *Strictly TV* topics

Some reader responses on some recent TV topics in **BE** are worth sharing. In "Transmission Standards: A Reign of Confusion," (January) one reader pointed out the PAL-M variation. PAL-M is a 60-field system with a 3.5761149MHz color sub-carrier and a H/Sc relationship of 909/4. The horizontal line frequency is 15.734 (as in NTSC) but the typical PAL 25Hz offset is not used.

To a former FCC FM/TV specialist, the horizontal sync interval in "Inside TBCs" (February) should be clarified to coincide with present FCC standards. The writer suggests three other pulse widths should be given. Sync to end of burst may have a maximum of 7.94ms; the breezeway between sync and burst has a minimum of 0.38ms; and the sync rise time is a maximum of 0.254ms between the 10 percent and 90 percent points.

Although RS-170A uses half amplitude points to measure pulse durations, FCC rules use a reference at 10 percent into sync. Always refer to the FCC when making timing adjustments. Non-standard or out of tolerance values could result in an FCC citation.

Finally, in "Piezo-electric?" in the February issue, a choice of words generated poor DT (dynamic tracking). The track angle recorded in Type C format does not vary. When non-standard speeds are involved, an apparent discrepancy from the angle confronts a non-dynamic tracking head. Correction voltages to the DT head result in proper tracking as seen in scan B.

Purchase of ISI results in name change

The purchase of *Industrial Sciences*, Gainesville, FL, and subsequent name change to Intergroup, Video Systems, has

been announced by Gregg Smith, the new president of the reorganized firm.

Changes instituted by the new management are a tripling of the research and development staff, the addition of a manufacturing engineering staff, and improved manufacturing procedures with increased emphasis on quality control. As a demonstration of confidence in their products, Intergroup has instituted a 30-day, no questions asked return policy and a 5-year limited warranty on everything they make. The policy is part of a larger effort to improve service to Intergroup customers.

Intergroup, Video Systems manufactures a complete line of teleproduction video and audio equipment.

RCA adds KC to satellite network

RCA American Communications, Princeton, N.J., has announced an \$8 million investment to provide satellite private line voice and data services to businesses in Kansas City in April.

The facilities consist of a satellite earth station connected via a microwave link to a central terminal office in the Bryant Building downtown. Through these facilities, businesses in the Kansas City area can transmit voice, data and facsimile messages via private line to 17 other major business centers in the United States.

Marconi installs VOA transmitter

A Chelmsford-based British company is to supply Voice of America (VOA) with a shortwave transmitter to be installed at Greenville, NC.

The order, won by Marconi Communication Systems of Chelmsford via their U.S. office, marks the start of re-equipment for VOA's multimillion-dollar modernization program.

The transmitter, B6127, will be built by Marconi in Chelmsford and installed by their engineers with a team supplied by Aydin Systems Division of San Jose, CA.

McHale accepts 400th ADO

The 400th Ampex Digital Optics (ADO) system has been installed at McHale Video Services, Honolulu, HI. The company will use the ADO primarily in its work with local advertising agencies. McHale's clients include Aloha Airlines, Hawaiian Air, Mid-Pacific Airlines and MacDonald's.

Gotham sells out to Gexco

Stephen F. Temmer, president of Gotham Audio Corporation, New York, has announced the signing of an agreement turning over all business activities of its wholly owned subsidiary Gotham Export Corporation retroactive to Jan. 1, 1985 to a new company named Gexco International.

Gexco is owned by Paul Goldstein, vice president of Gotham Export Corporation for nearly 19 years. Gexco will continue the export representation of manufacturers such as Lexicon, Switchcraft, MRL and Valley People.

The company's address is 317 St. Paul's Ave., Jersey City, NJ 07306; 201-653-2582.

Sound Genesis to handle time code module

Sound Genesis, San Francisco has been appointed the Northern California dealer for TimeLine's new Lynx Time Code Module. Introduced at the October 1984 AES Convention, the module is four independent functional units in a single enclosure: wideband SMPTE time code reader, multistandard SMPTE time code generator, audio/videotape machine synchronizer and SMPTE 422 communications controller for use with external editors.

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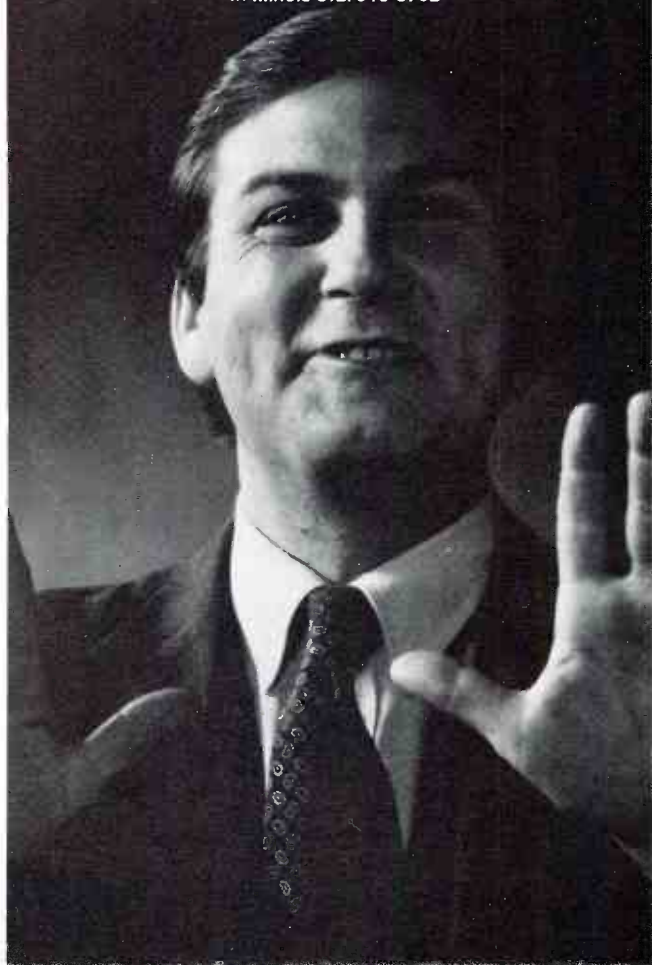
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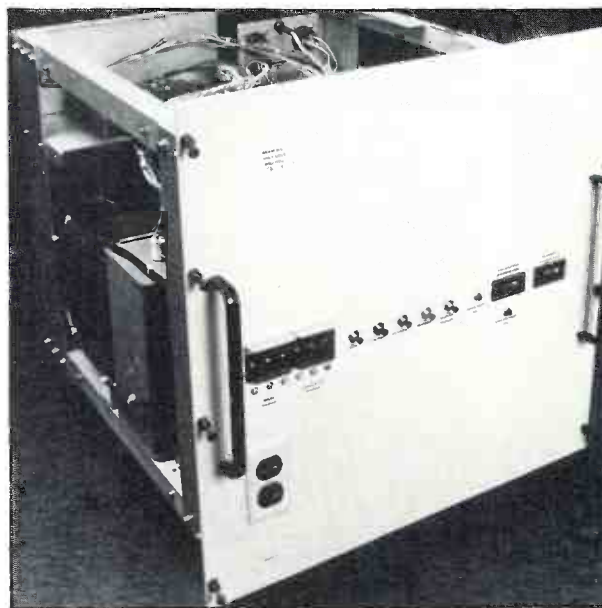
Microwave FM transmitter



A low-power microwave transmitter from *International Microwave* with a power output of 100mW (+20dBm) is designed for short haul, line-of-sight communications. The transmitter operates in the frequency range from 6.5GHz to 18GHz. A remote head is available. Designed as a companion to IMC's LCR series receiver, this transmitter can be used with a standard FM receiver or with a multichannel link receiver. The LCT transmitter measures 11.25" x 5.00" x 6.35". Up to three units can be accommodated in a single rack, or the LCT transmitter and the LCR receiver can be mounted together in one 19-inch rack.

Circle (316) on Reply Card

Beam supply drawer



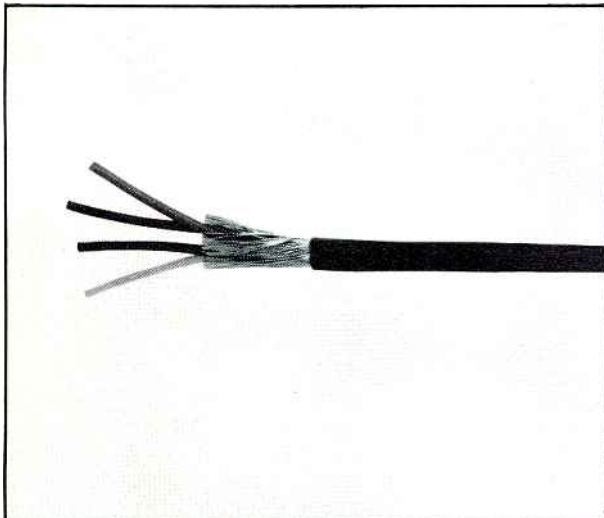
MCL, designers and manufacturers of RF components and systems for satellite and other applications, has announced the availability of an SCR regulated beam supply drawer for MCL's Klystron high-power amplifiers series 10000.

This supply drawer has wheel mounting for installation ease (front wheels have swivels), easy maneuverability, maximum drawer weight of 450 pounds, and includes elapsed time meters for both filament and beam operating hours. It has subsystem circuit breakers which are mounted on the front panel; 115Vac standard utility outlets with separate feed 10A capacity and has an SCR regulation circuit which provides variable boost series aiding. The circuit provides ± 25

percent regulation over ± 11 percent line variation. The SCR circuit output constitutes 12.5 percent of overall beam voltage; has beam supply ripple of less than 20Vac on 8300Vdc.

Circle (319) on Reply Card

High-definition cable



Mogami Products Division has introduced a miniature cable for improving the audible quality of professional and industrial audio systems. The 2799 cable is 0.126 inches in diameter but contains four high purity 60-strand copper conductors twisted together in a quad configuration. When used as a single balanced cable, it is equivalent to a 22-gauge wire. Because of the small size, the cable is ideal for pulling through conduit and for use in high-density rack and console systems.

Using the quad design technique, the cable offers an economical method for reducing electromagnetic induction and crosstalk from problem sources such as motors, light dimmers, power lines and high level adjacent signals.

Circle (321) on Reply Card

Radio computer system

The Broadcast Micro Division of *Data Communications* announced three versions of its BIAS PC radio computer system. The product has been expanded to serve a variety of radio market sizes for sales, traffic and accounting applications. Each is IBM PC-based and is offered as an off-the-shelf or turn-key package. Models include small market, single user and multiple user.

The *small market* radio is based on the IBM-XT, and is trimmed down from the full size system. Its target is small radio stations not needing the system's reporting and accounting features.

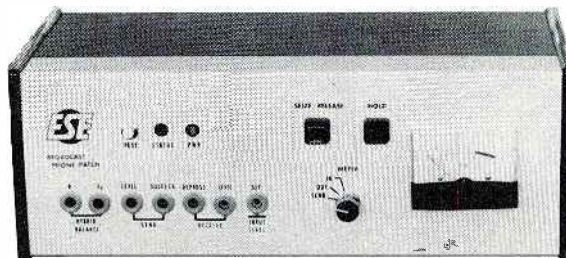
The *single user* radio contains the complete offering of programs for sales and traffic departments. Features include traffic, billing, logging, availabilities, orders, sales management reporting, invoices, affidavits and accounts receivable. Other programs include music format control, word processing electronic spreadsheet and communications. The IBM PC-XT or IBM PC-AT-based single user system may be upgraded to the multiple user version.

The *multiple user* radio includes all the features of the single user with the capability to add workstations onto the central processor. An IBM PC-AT serves as the CPU with terminals or other IBM PCs acting as remote workstations. Several users may share the system simultaneously.

Circle (322) on Reply Card

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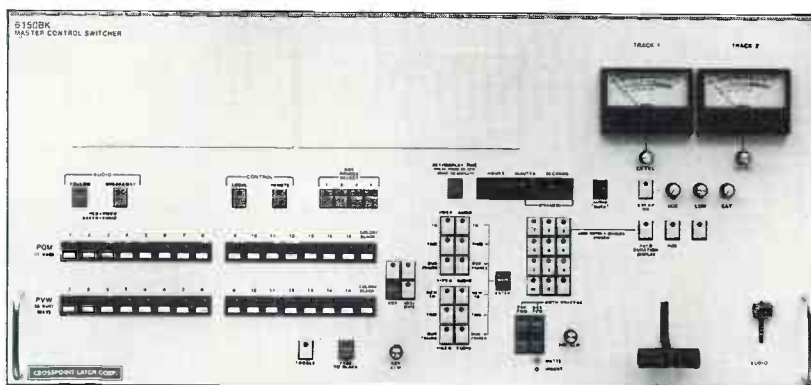
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TO ENSURE UNINTERRUPTED DELIVERY TO NEW ADDRESS, BE SURE TO AFFIX LABEL FROM COVER IN SPACE PROVIDED AT RIGHT AND ANSWER ALL QUESTIONS.

- check one box only
1. Please check the ONE type of facility or operation that best describes your business classification:
- Low power TV station
TV station
AM station
FM station
AM & FM station
TV & AM station
TV & FM station
TV, AM & FM station
CATV facility
Non-broadcast TV including
closed circuit TV (CCTV)
Recording studio
Teleproduction facility
Microwave, relay station
or satellite company
Government
Consultant (engineering or
management)
Dealer, distributor or manufacturer
Other: Specify

2. If you checked 20 through 26 above, which of the following best describes your over-the-air station: (Check only one.)
- Commercial
Educational
Religious
Campus low frequency
Community
Municipally owned

3. Check the category that best describes your title: (Check only one.)

Company management—chairman of the board, president, owner, partner, director, vice president, general manager (other than in charge of engineering or station operation management) and other corporate and financial officials

Technical management & engineering—technical director or manager, chief engineer, other engineering or technical titles

Operations & station management/production & programming—VP operations, operation manager/director, station manager, production manager, program manager, news director and other operations titles

4. **IMPORTANT: Check the statement that best describes your role in the purchase of major communication equipment components and accessories.**

Make final decision to buy a specific make or model
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☐ 32

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Station or Co.

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☐ B
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☐ D
☐ E
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- ☐ A
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- ☐ C
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R55

- Please check the ONE type of facility or operation that best describes your business classification:

19 ☐ Low Power TV Station	29 ☐ Recording Studio
20 ☐ TV Station	30 ☐ Teleproduction Facility
21 ☐ AM Station	31 ☐ Microwave, Relay Station or Satellite Company
22 ☐ FM Station	32 ☐ Government
23 ☐ AM & FM Station	33 ☐ Consultant (Engineering or Management)
24 ☐ TV & AM Station	34 ☐ Dealer, Distributor or Manufacturer
25 ☐ TV & FM Station	
26 ☐ TV, AM & FM Station	
27 ☐ CATV Facility	
28 ☐ Non-Broadcast TV including Closed Circuit TV (CCTV)	☐ Other _____ (Please specify)
- If you checked 20 through 26 above, which of the following best describes your over-the-air station: (Check only one.)

A ☐ Commercial	C ☐ Religious	E ☐ Community
B ☐ Educational	D ☐ Campus Low Frequency	F ☐ Municipally Owned
- Check the category that best describes your title: (Check only one.)

A ☐ Company Management—Chairman of the Board, President, Owner, Partner, Director, Vice President, General Manager (other than in charge of Engineering or Station Operation Management) and other Corporate and Financial Officials
B ☐ Technical Management & Engineering—Technical Director or Manager, Chief Engineer, Other Engineering or Technical Titles
C ☐ Operations & Station Management/Production & Programming—VP Operations, Operation Manager/Director, Station Manager, Production Manager, Program Manager, News Director and other Operations Titles
D ☐ Other: Specify _____
- IMPORTANT: Check the statement that best describes your role in the purchase of major communication equipment components and accessories.

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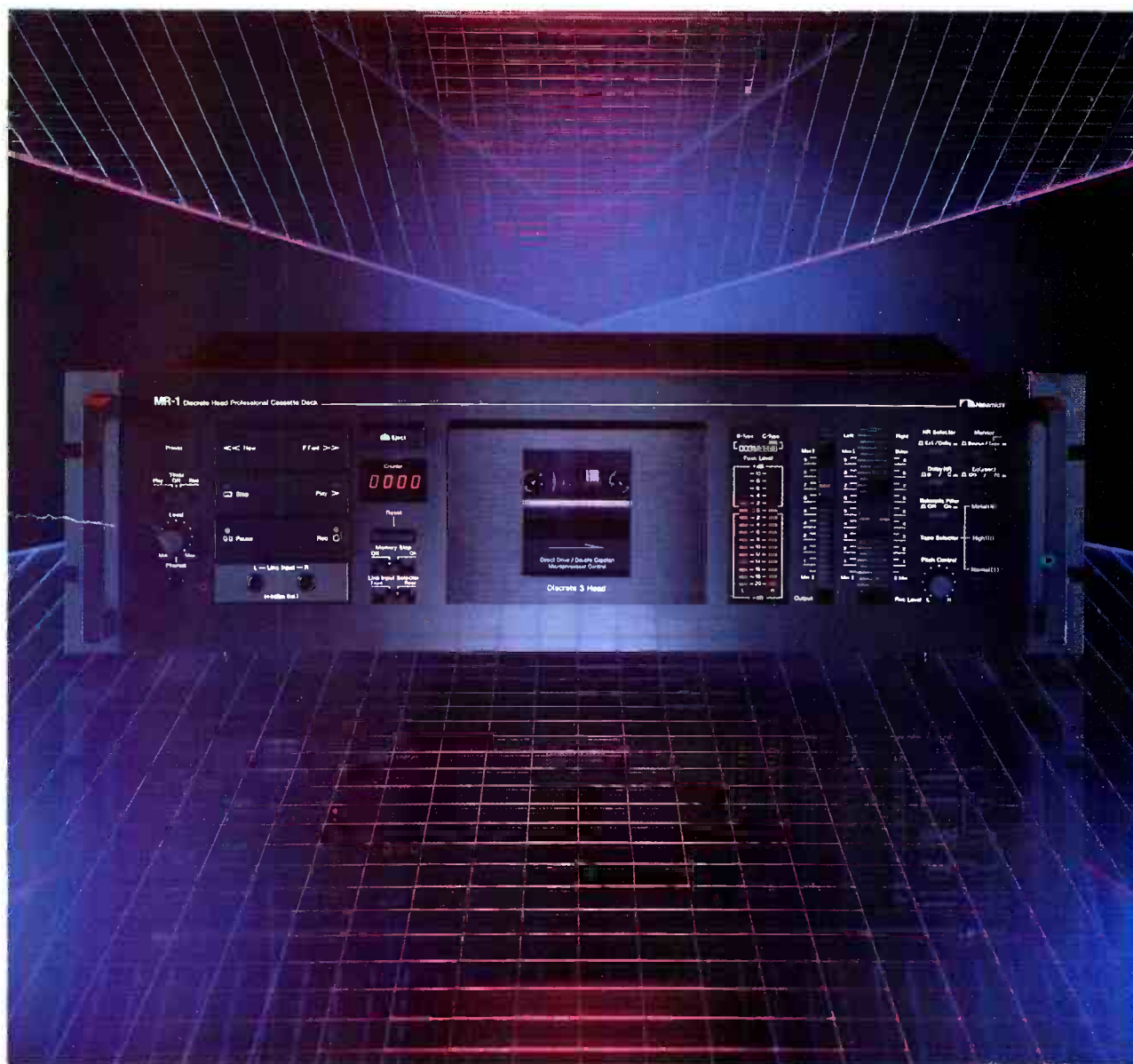
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Introducing the MR-1 Discrete Head Professional Cassette Deck—
From Nakamichi—the company that created the cassette revolution!

The MR-1—a *professional* deck with front and rear
balanced inputs, unbalanced inputs, balanced and unbalanced outputs,
linear-scale peak-reading meters, independent
Tape and EQ selection, Dolby-B and -C NR, provision for external NR,
remote control, EIA rack mount and more!

The MR-1—with an Asymmetrical Dual-Capstan Direct-Drive Transport with
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The MR-1—with the legendary Nakamichi Discrete 3-Head recording system
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The MR-1 Discrete Head Professional Cassette Deck—
From Nakamichi—the company whose profession is recording!



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This advanced custom Ward-Beck 40-input stereo TV production console, combining mono and stereo mixing facilities, is now operating at WFMY-TV in Greensboro, North Carolina.

When WFMY decided to move into stereo television production they asked leading manufacturers to submit designs and bids on this project. Ward-Beck's inclusion in this select group brought Harte-Hanks Communications the benefits of innovative and extensive engineering expertise employing sophisticated modules well-proven under the rigorous demands of the major networks.

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First by Design.

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