BROADCAST engineering

AN INTERTEC PUBLICATION

July 1988/53

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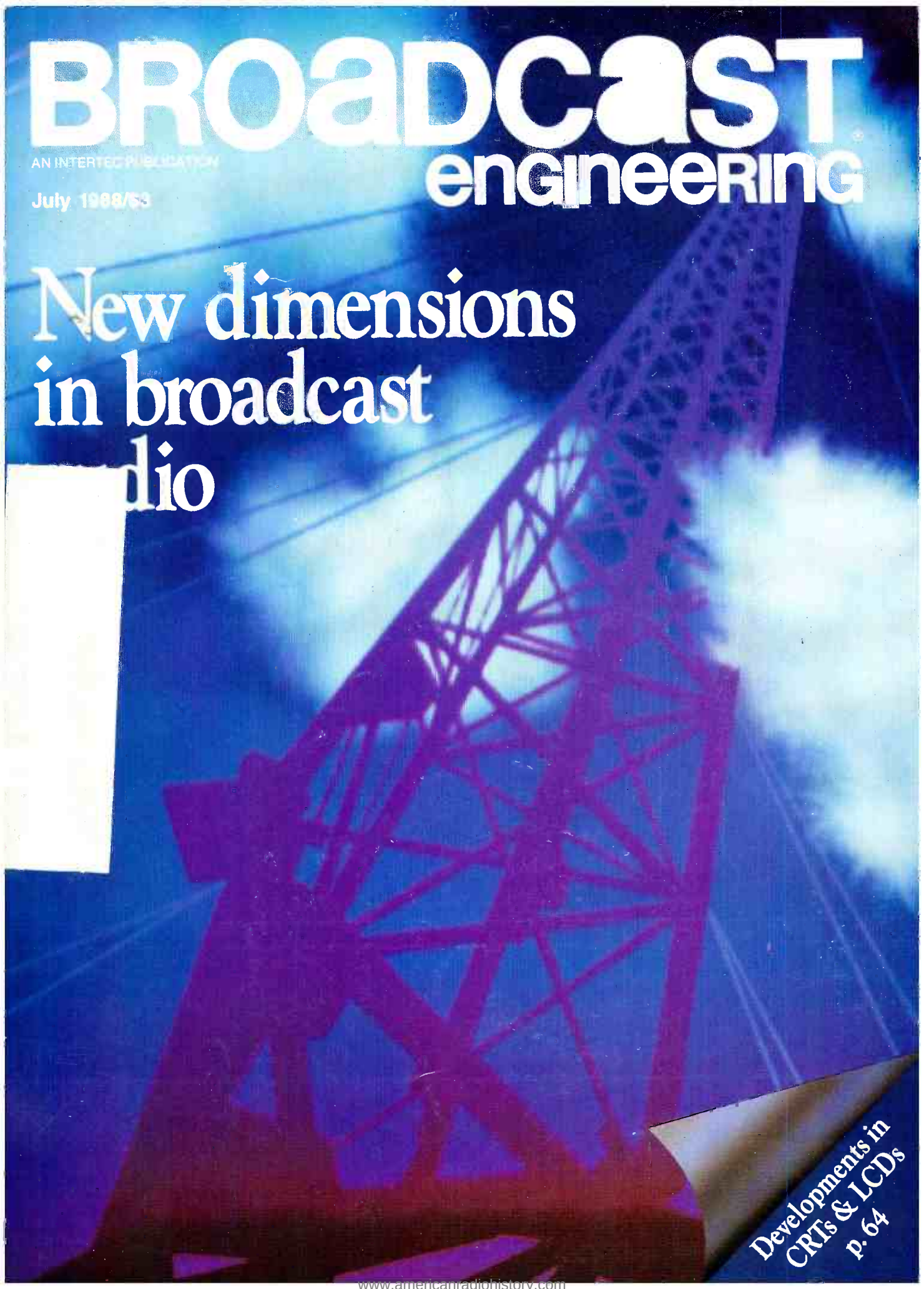

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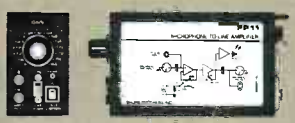

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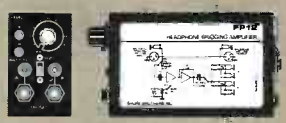

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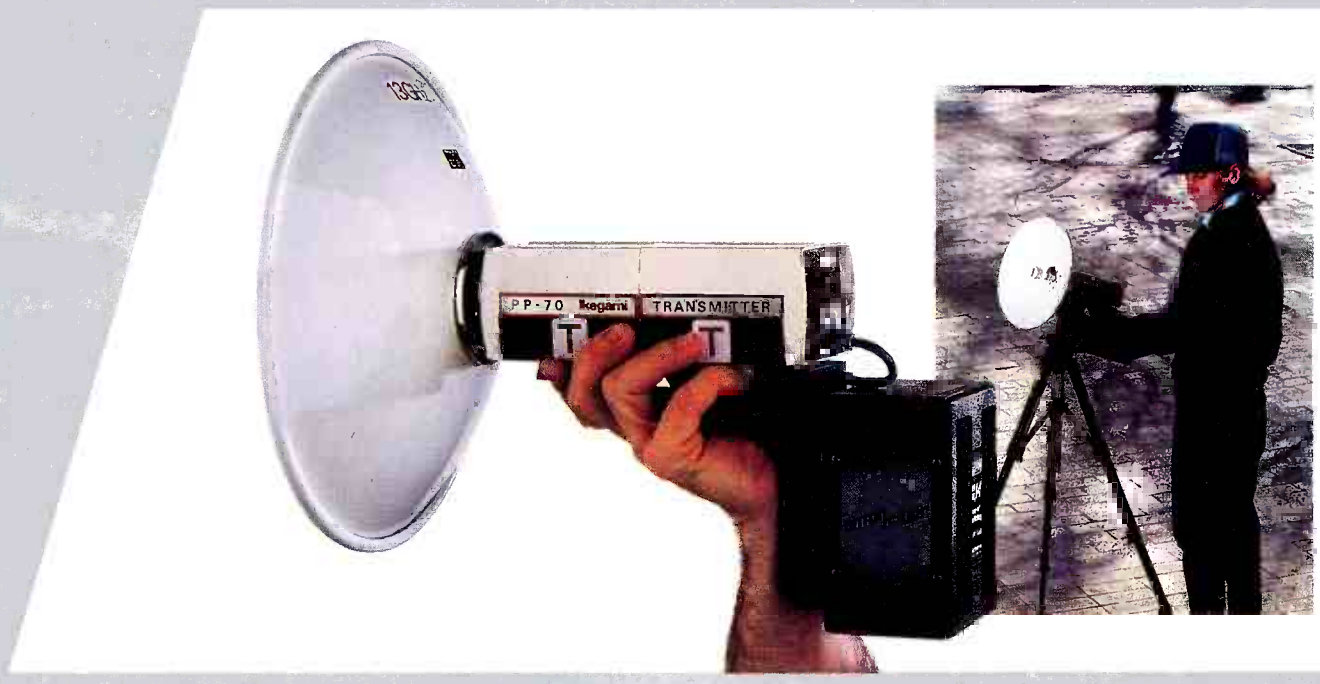

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AUDIO TECHNOLOGY UPDATE:

The quality of audio transmitted by radio and TV stations has never been more important than it is today. For radio stations, the on-air sound is their only product. For TV stations, the move to stereo has focused new attention on quality of sound delivered to consumers. In our coverage o audio technology, we'll examine the following topics:

OTHER FEATURES:

ON THE COVER

The performance of a broadcast station's audio system is more important now than ever before. Consumers know good audio when they hear it, and bad audio when they hear it. The standard for quality has been set by compact discs—a tough act to follow. This issue is designed to help stations meet audience expectations of high-quality audio. (Photography by Doug Schwartz, Flightspeed Graphics.)

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Experiments on synchronous AM

The National Association of Broadcasters has asked the Federal Communications Commission not to issue a Notice of Proposed Rulemaking for the use of synchronous AM radio transmitters until additional experiments are conducted.

Conceptually, synchronous transmitters would increase a station's reach over a wider range than is possible with a single transmitter, without causing interference to nearby radio signals. However, new interference would be caused within the station's existing service area.

The NAB said that some comments filed with the commission suggest a possibility of high-technology, space satellite-based synchronization of AM facilities. In addition, future fiber optics also may play a role in linking the transmitters.

According to the NAB, the reports have included some positive elements, but the record so far does not demonstrate consistent success with this technology.

The NAB suggested that when the FCC does issue a notice it should propose that:

- only primary stations own and operate the transmitters.
- these facilities be used only to "fill in" existing contours, rather than for "daisy-chain" expansions of a station's service area.
- AM stations using these transmitters not have the facilities "counted" in determining compliance with the FCC's 12-station ownership or duopoly rules.

By John Blau,
European correspondent

Astra is no alternative to TV-SAT

The failure of TV-SAT 1 has helped fuel the already heated discussion on the future of DBS in Europe, particularly in Germany. The European press has voiced strong criticism of supporting high-power satellites in light of improved medium-power satellite technology. Luxembourg's Astra has become a much-talked-about alternative. Nevertheless, a survey of several technical directors working for Germany's national broadcasting networks reveals that although many of these network chiefs acknowledge a setback for DBS, the majority of them continue to support this satellite technology, at least until the next launch.

Their support is based on two widely publicized factors. First, direct broadcast satellites, unlike the usual telecommunications satellites, transmit with higher power, enabling reception with smaller antennas (60cm). Second, direct broadcast satellites operating in the Ku-band (12GHz) can beam a footprint over an entire country to receivers en masse, but telecommunication satellites have to rely on cable distribution of decoded signals.

A growing number of technical network directors and broadcast engineers see a chance for medium-power satellites such as Astra if TV-SAT 2 and TDF do not get off the ground soon. In addition, improved

Continued on page 86

BROADCAST ENGINEERING

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BROADCAST ENGINEERING (ISSN 0007-1794) is published monthly (except in the fall, when two issues are published) and mailed free to qualified persons within the United States and Canada in occupations described here by Intertec Publishing Corporation, 9221 Quivira Road, Overland Park, KS 66215. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to **Broadcast Engineering**, P.O. Box 12960, Overland Park, KS 66212.

SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $25.00. Qualified and non-qualified persons in all other countries; one year, $30.00 (surface mail); $108.00 (air mail). Back issue rates, $5.00, except for the Buyers' Guide/Spec Book, which is $20.00. Rates include postage. Adjustments necessitated by subscription termination at single copy rate. Allow 6-8 weeks for new subscriptions or for change of address.

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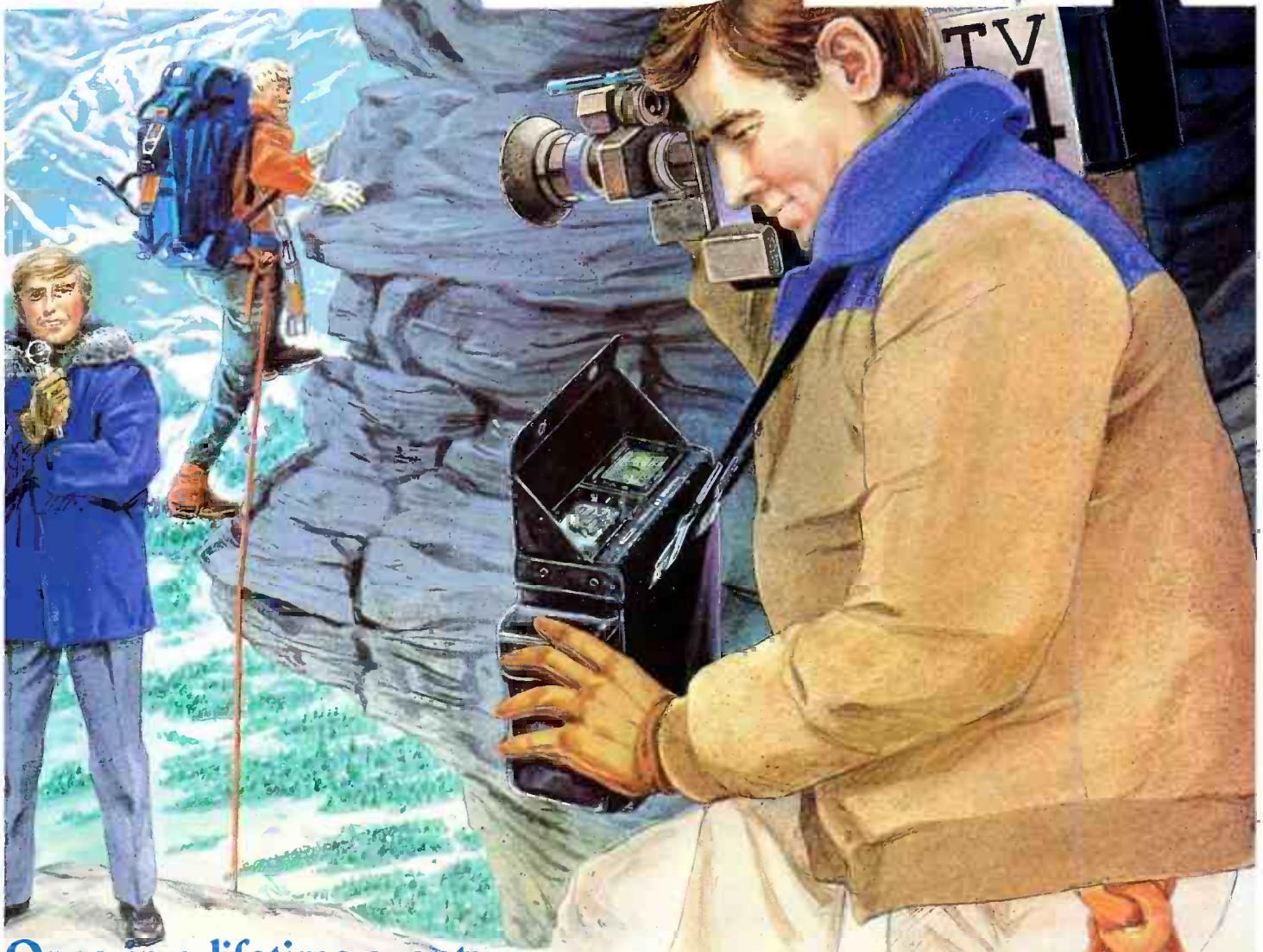

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AM: crisis or opportunity?

A guest editorial by Dutch Doelitzsch

The AM radio industry is in a crisis. The ratings tell the story: a national average of one AM listener for every three FM listeners. Erosion of the AM audience continues in all markets. Will 1988 be the year AM radio bounces back, or will the AM crisis eventually become the AM disaster?

What factors have contributed to the decline of AM radio? Is it that FM offers greater fidelity, stereo, reduced interference, less competition, wider coverage or better programming? Yes. All those things.

The AM band also is overcrowded, which adds greatly to the interference problem. The philosophy of "more is better" has led to substandard service and overcompetition. Instead of promoting better service, it is actually strangling the life out of local broadcasting.

An AM or FM operator struggling for survival is not likely to provide local news or responsive public affairs programming. Operational decisions will be based on cost, and program quality will be compromised. This approach promotes a survival mentality that subtly strips AMs of quality programming. What, then, are the solutions?

• We need standard-setting legislation. Radios must cover both bands and be continuously tunable, without AM-FM switches or designations. If a manufacturer incorporates stereo, then the radio must be capable of both AM and FM reception and must meet NRSC standards.

• The FCC should make a fivefold increase in the protected daytime contour. This would change the protected contour for most stations from 0.5mV/m to 2.5mV/m, allowing substantial power increases. The overall result would be higher-quality service to the core coverage area of stations, enhancing the public's perception of AM service.

• The FCC should eliminate protection for the 0.5mV/m 50% skywave service areas east of the Mississippi River Class I stations. This would allow new or improved nighttime service by hundreds of Class II stations. Also, virtually all AM daytime stations would be eligible for nighttime operation.

• The 1,600kHz-1,700kHz band should be used as an allocation tool, aiding in the establishment of fair and equitable distribution of AM service. After operation on both bands for several years, an AM could switch to the new frequency, ceasing operations on the old frequency. This would permit orderly transition to the new band while reducing interference on the current band.

• The duopoly restriction for AM stations should be lifted. The number of radio signals in a given market is less important than the number of independent operators. If solid, experienced, successful broadcasters were allowed to pursue a marketplace solution, as the newspapers and magazines have done, they could provide a more diversified service to the public through the programming potential of multiple transmitters.

• The FCC should issue no new AM licenses, except in cases in which at least 50% of the proposed coverage is for an unserved area.

• The FCC should adopt stringent manmade interference limits. Without such limits, the AM band is in danger of becoming nothing but a sea of buzz and hum.

AM broadcasting has reached the critical point. If broadcasters, the FCC and Congress fail to correct the deficiencies in the AM delivery system, it will be a disservice to both the industry and public. However, by providing a quality delivery system and functioning in a truly free marketplace, programmers will win back a substantial share of AM's lost audience. They can turn the AM crisis into the AM opportunity.

Doelitzsch is president and general manager of WDDD-AM and FM, Marion, IL.

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"Syndex" rules to be reinstated

By Harry C. Martin

The FCC has announced that it is reinstituting its syndicated program exclusivity ("syndex") rules for TV stations. Under these rules, a TV station will be able to bargain for, and enforce, program exclusivity rights against cable TV systems in its market.

The commission is requiring that certain specific language, set forth in its rules, be included in new program contracts in order to enforce syndicated exclusivity. (Existing contracts must say that exclusivity provisions apply if the commission adopts the new rule; otherwise, a statement must be obtained from the program supplier confirming the intent to confer exclusivity.)

Cable systems with less than 1,000 subscribers will not be subject to the new rules. Also, they do not need to delete programs that generally are available off-the-air (for example, if the system is within the Grade B contour of the station carrying the program, or within an area where that station's signal is significantly viewed).

The new rules generally limit exclusivity to the geographic market of the local station (within 35 miles), but "superstations" will be able to contract for program exclusivity in their national markets. During the first year of a program's syndication, both broadcasters and syndicators can exercise the exclusivity rules. Thereafter, only broadcasters can apply the rules.

To exercise any exclusivity rights, broadcasters must provide details of their exclusivity rights to affected cable systems within 60 days of signing such a contract, and, in no case, less than 60 days before the exclusivity commences. The new rules will go into effect one year from the date they are published in the Federal Register.

LPTV filing window

From June 15 to 24, the FCC opened a national filing window for new and major applications for low-power TV and translator stations. The procedures established for it will be used for future windows. They were as follows:

- An applicant could file no more than five applications during the window. In addition, no person or entity was permitted to hold a 1% or greater interest in any more than five applications submitted during the window.
- The applications were filed at a specified location in Pittsburgh, rather than at the FCC offices in Washington, DC.
- Applicants were required to use the February 1988 edition of FCC Form 346, and only that version.
- Each application had to be accompanied by a separate filing fee check for $375. Single fee payments for multiple applications were not accepted.
- Beginning with the June window, the commission agreed to consider terrain shielding in connection with requests for waivers of technical acceptance requirements. Previously, the commission used a go, no-go approach in applying its contour-overlap interference-protection standards.

The commission continued to apply its "complete and sufficient" standard for applications. Even minor errors on FCC form 346 can result in dismissal, with no fee refunded and only limited appeal rights available.

Change in minimum power requirements for Class A FMs

The commission has modified its rules allowing Class A FM stations to provide the same range of coverage from very high antenna sites as they may currently provide at lower elevations. The provision is designed to permit any Class A FM station, regardless of its effective antenna height, to operate with less than the normal minimum power, provided its coverage equals or exceeds that of a Class A station operating with the normal minimums.

This action was taken in response to a petition for reconsideration of the commission's Second Report and Order in MM Docket 86-144. In that proceeding, the rules were amended to include a specific method for classifying an FM station according to its effective transmitting power and antenna height. For Class A stations, the minimum power established was 100W. From a very high elevation, a Class A station operating with 100W might exceed the 24-kilometer maximum permitted distance to its 1mV/m contour. The rule change just adopted permits such stations to go below the minimum if necessary.

FM "downgrading" procedures to be changed

The commission is proposing to allow downgrading of FM channel classes, in certain circumstances, merely through the filing of an application. Currently, to reclassify an existing FM allotment to a higher or lower class, the rules require that the FM Table of Allotments be amended through a rulemaking proceeding.

Under the proposed procedure, an existing station would be able to downgrade its class of channel (which might be necessary to make a change in transmitter location, for instance) by filing a minor change application. Such applications would not be subject to mutually exclusive proposals.

In the case of applicants for new stations, downgrading could be accomplished only if no acceptable application for an existing, higher-class allotment were received during the relevant filing window period. Thereafter, any potential applicant desiring lesser facilities would be permitted to file. Such applications would be treated on a first-come, first-served basis. Downgrading of vacant channels may be desirable because of site-availability problems or economic viability concerns regarding the higher class.

Under the proposed procedures, the FM Table of Allotments would be amended upon grant of a construction permit for the lower-class facility. At that point, the commission would no longer protect the original higher-class allotment at the reference point. Rather, potentially conflicting applications and rulemaking petitions would have to provide interference protection to the construction permit based on its lower-class channel allotment. If the permit were revoked later, the downgraded class would be retained in the Table of Allotments.

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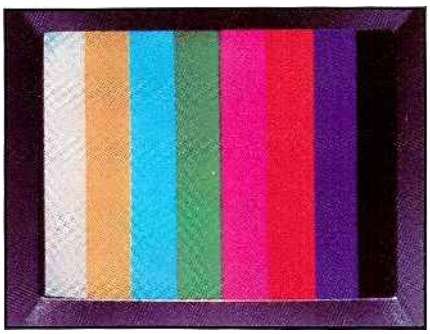

A little TLC for tape will pay off

By Michael Wilke

Videotape is an integral part of the total recording system. It deserves as much attention as the recorder. Perhaps it deserves more, considering its somewhat fragile nature. Proper handling, recording and storage not only extend the life of a tape, but also eliminate many problems associated with its use.

Environmental concerns

Proper tape care begins with the studio environment. Humidity, temperature and cleanliness are critical factors. Relative humidity should remain low, but not below 35%. Higher humidity, greater than 45%, reduces headlife measurably. Keep in mind that tape absorbs moisture. Dramatic changes in humidity alter the tape dimensions and may cause increased friction in the recorder tape path.

Closely associated with humidity is temperature. The ideal temperature for tape is from 65°F to 70°F (18°C to 21°C). Cool temperatures usually are related to low-humidity conditions, and high temperatures, as in a hot production van, are often associated with high humidity. Moving tape from a remote production vehicle into a cool editing suite could cause problems. If possible, acclimate the tape for 24 hours in the studio environment.

Ideally, the air-conditioning system for areas where tape is used will create positive pressure. This reduces potential contamination. The air filter should remove particles as small as 0.3 microns.

Studio cleanliness begins with the floor. It should be a hard surface that is easy to mop, or it should be covered with an anti-static carpet. A vacuum cleaner, fitted with a filtering system that does not blow dust back onto the surface, should be used regularly.

Food and cigarettes do not belong in the studio. The possibility of residue getting onto tape surfaces may seem unlikely, but what about that syrupy spilled soda or the salt from potato chips? The particles from cigarette ash, 99 times smaller than a human hair, can result in major dropouts. Exhaled smoke can settle on tape surfaces, creating a contaminant layer between the recording head and tape that reduces the output level.

Tape handling

Even in ideal environments, tape falls victim to improper handling. Fingerprints or dust on the tape backcoating are as potentially damaging as they would be if they were on the oxide. Contamination transfers to the oxide surface when the tape is rewound on a reel.

Reels should be carried by the hub to avoid deforming the flanges. Bent flanges can damage tape edges. Reels, especially used, empty ones, should be cleaned thoroughly with an approved solvent. Remove any remaining "moisture" immediately with an absorbent, lint-free cloth before winding tape on the reel.

Contamination also can come from the tape transport. To avoid this, thoroughly clean the recorder before tape is loaded. It's a good practice to clean the recorder again after use.

Reducing tension

Contamination is tape's worst enemy, but tension is a close second. Before a tape is used, relieve variations in tape stress by fast forwarding through the entire tape and rewinding it. This wind/rewind operation is as important with unused tape, straight from the manufacturer, as it is with previously recorded material.

Bulk erasure quickly removes previously recorded information. However, do not depend on the erase system of the recorder to delete all the previous signals. Double check the status of the material on a reel before using the bulk eraser. Is it really OK to lose it forever?

When recording, never start precisely at the beginning of a tape. Wind several feet onto the take-up reel, record a minute or two of color bars and tone, then begin the recording. This procedure prevents the contamination and physical damage that often occur near the beginning of the tape. From time to time, clip off the damaged, wrinkled end.

When the recording session is over, check the recording by rewinding and spot checking. Before storing the tape in the library, fast forward to the end, and rewind without stopping. This process reduces physical distortion caused by long-term storage. Take time to secure the loose end with an approved hold-down tab. Do not use masking tape or other adhesives that leave a sticky residue.

Storage

The tape library should have convenient access from production and editing areas. The room should be windowless, dust-free and fire-resistant. As mentioned previously, the floor should be easy to clean or be protected with anti-static carpet. Just as in the recording area, temperature and relative humidity control are important. The relative humidity in the storage area should remain at 35% to 45%, as in the recording area. The temperature requirements for the storage area are somewhat more stringent, however. Tape should be stored at 60°F to 65°F (16°C to 18°C).

For archiving, backcoated tape is recommended. The end-to-end rewinding procedure before storage prevents potential pack tension distortion. Reels for storage should have rigid hubs. Hubs with rubber sleeves can compress, causing tension distortion over time.

Tape often is shipped in cardboard containers, but plastic containers are preferable for storage. As extra protection against contamination, seal the reel in a plastic bag inside the container.

Shipping

When transporting tapes out of house, do not rely on a cardboard box sealed with masking or filament tape. Impact- and water-resistant shipping containers with locking covers are available.

Concern has been expressed about airport security X-ray systems as a potential hazard to recorded tape. Walk-through security systems do not present any hazard, but hand-held metal detectors should be avoided.

Although these guidelines are simple, common-sense suggestions, they often are overlooked. Experience shows that strict adherence to these rules has proved valuable in getting the best performance from videotape, not just today, but for years to come. |:-)))|

Wilke is marketing manager, videotape products, Ampex Magnetic Tape Division, Redwood City, CA. This article was adapted from an Ampex publication, "Guidelines to Better Tape Handling," authored by Wilke.

TRUTH... OR CONSEQUENCES.

If you haven't heard JBL's new generation of Studio Monitors, you haven't heard the "truth" about your sound.

TRUTH: A lot of monitors "color" their sound. They don't deliver truly flat response. Their technology is full of compromises. Their components are from a variety of sources, and not designed to precisely integrate with each other.
CONSEQUENCES: Bad mixes. Re-mixes. Having to "trash" an entire session. Or worst of all, no mixes because clients simply don't come back.

TRUTH: JBL eliminates these consequences by achieving a new "truth" in sound: JBL's remarkable new 4400 Series. The design, size, and materials have been specifically tailored to each monitor's function. For example, the 2-way 4406 6" Monitor is ideally designed for console or close-in listening. While the 2-way 8" 4408 is ideal for broadcast applications. The 3-way 10" 4410 Monitor captures maximum spatial detail at greater listening distances. And the 3-way 12" 4412 Monitor is mounted with a tight-cluster arrangement for close-in monitoring.
CONSEQUENCES: "Universal" monitors, those not specifically designed for a precise application or environment, invariably compromise technology, with inferior sound the result.

TRUTH: JBL's 4400 Series Studio Monitors achieve a new "truth" in sound with an extended high frequency response that remains effortlessly smooth through the critical 3,000 to 20,000 Hz range. And even extends beyond audibility to 27 kHz, reducing phase shift within the audible band for a more open and natural sound. The 4400 Series' incomparable high end clarity is the result of JBL's use of pure titanium for its unique ribbed-dome tweeter and diamond surround, capable of withstanding forces surpassing a phenomenal 1000 G's.
CONSEQUENCES: When pushed hard, most tweeters simply fail. Transient detail blurs, and the material itself deforms and breaks down. Other materials can't take the stress, and crack under pressure.

TRUTH: The Frequency Dividing Network in each 4400 Series monitor allows optimum transitions between drivers in both amplitude and phase. The precisely calibrated reference controls let you adjust for personal preferences, room variations, and specific equalization.
CONSEQUENCES: When the interaction between drivers is not carefully orchestrated, the results can be edgy, indistinctive, or simply "false" sound.

TRUTH: All 4400 Studio Monitors feature JBL's exclusive Symmetrical Field Geometry magnetic structure, which dramatically reduces second harmonic distortion, and is key in producing the 4400's deep, powerful, clean bass.
CONSEQUENCES: Conventional magnetic structures utilize non-symmetrical magnetic fields, which add significantly to distortion due to a nonlinear pull on the voice coil.

TRUTH: 4400 Series monitors also feature special-low diffraction grill frame designs, which reduce time delay distortion. Extra-large voice coils and ultra-rigid cast frames result in both mechanical and thermal stability under heavy professional use.
CONSEQUENCES: For reasons of economics, monitors will often use stamped rather than cast frames, resulting in both mechanical distortion and power compression.

TRUTH: The JBL 4400 Studio Monitor Series captures the full dynamic range, extended high frequency, and precise character of your sound as no other monitors in the business. Experience the 4400 Series Studio Monitors at your JBL dealer's today.
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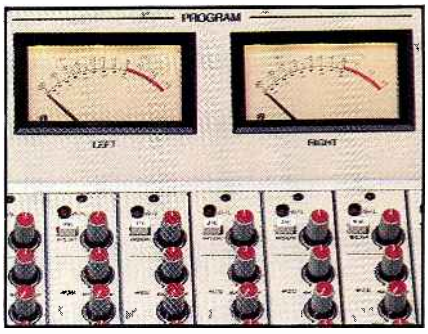
Measure performance of DA with rms, rss



By John Battison, P.E.

If you were examining directional antenna patterns, you'd find the terms *root-mean-square* (rms) and *root-sum-square* (rss) many times. In fact, if you were preparing the pattern for submission to the FCC, and these values were missing, the commission would not proceed with the application.

These terms are easily confused by engineers unfamiliar with DA patterns and their requirements, most likely because similar methods are used to obtain the data. On close observation, however, the differences between rms and rss become apparent. Let's examine these terms and how they apply to antenna patterns.

Most chief engineers are concerned with maintaining the rms value that appears with the DA pattern in the station's proof-of-performance. The pattern's rms value, a direct measurement of the system's efficiency, was determined when the proof was made, which may have been years ago.

The rms is a useful tool for measuring transmission system performance. It should remain constant within reasonable limits. However, as time passes, ground systems deteriorate, insulators become covered with soot and dirt, and the antenna's efficiency often decreases. If it has been quite some time since the proof, you may want to determine the antenna system's current rms value.

Check the performance

Making spot measurements on random radials is not a good method of checking antenna performance. Individual spot measurements tell only part of the story—the part that affects each measuring point. For an effective performance check, you must run a complete radial of at least 10 measurements. This applies to both DA and non-DA systems.

When you plot a radial on log-log paper and employ curve fitting, the inverse field for the whole radial appears at a glance. You can then read anticipated values at specified distances. Locations of the various coverage contours are determined in this manner. This procedure is useful when you are preparing the material for a proof-of-performance or if the general manager wants to know whether a given signal strength covers his house.

This material is invaluable when you're checking coverage for sales purposes. It is the only safe way of preparing coverage maps. Too often, the station sales staff creates an optimistic coverage map based on wishful thinking and vivid imagination. Competitors have challenged the use of such materials before the commission. Citations have been issued when it has been shown that false and misleading maps were being used.

Determining rms

Three basic methods can be used to develop rms values. Each method has its advantages, and you may want to become familiar with all three.

Method 1, most popular among consulting engineers, employs a polar planimeter to measure the area of the DA pattern as shown on the polar plot. This involves first determining the equivalent signal-strength value, in terms of millivolts per meter, for a single square unit of the area inside the antenna outline.

The planimeter is then placed on the antenna pattern, already plotted on graph paper. The securing spike and paper must not move during the measurement, or the results will be inaccurate. The planimeter dial (similar to a micrometer scale) is read, and the pattern is traced out carefully by the pointer.

The measurement begins at a marked starting point, continues all the way around the plotted pattern and goes back to the beginning. The dial is read again, and the first reading is subtracted from the last one. This procedure is normally performed several times in both directions, and the results are averaged.

The final value obtained is multiplied by the millivolt value for the single square. The result is the rms in millivolts per meter for the antenna pattern.

In *Method 2*, the antenna pattern is traced onto a piece of graph paper. The squares are counted and multiplied by the value for one square (as with the planimeter), producing the antenna rms value. This technique probably is not as accurate as the planimeter method, however, because it is easy to misread partial squares.

For *Method 3*, also popular, the inverse field is tabulated at one mile for every 5° or 10° around the pattern. Each value is squared and added to the next one, and the total is divided by the number of entries. Then, the square root of the total is found, and this is the rms of the measured pattern. The equation for calculating rms value by this method is shown in Figure 1.

$$E_0 = \sqrt{\frac{E_{10}^2 + E_{20}^2 + E_{30}^2 + \ldots + E_{360}^2}{36}}$$

where E_0 = rms field strength, mV/m
E_{10} = inverse field strength at azimuth angle of 10°, mV/m
E_{20} = inverse field strength at azimuth angle of 20°, mV/m, etc.

Figure 1. *This equation uses values obtained from a polar antenna plot to calculate the rms field strength in millivolts per meter.*

Modern techniques

Today, almost everyone uses a computer program to calculate the antenna patterns. Many of these programs also contain subroutines that calculate rms, rss, design parameters, anticipated operating parameters and a variety of things a designer needs to know. Unfortunately, these programs are complicated and not generally available.

Broadcast consultants may be able to provide you with computer programs. CompuServe and other bulletin board systems also may have programs that can help you better understand and maintain your directional and non-directional antenna systems.

A computer program is only as good as its developer and user. If you don't understand how directional antenna systems work, you might misinterpret some data provided by the program, or even worse, supply incorrect data to the commission. The bottom line is this: Don't rely on any computer program for all your information unless you are absolutely sure it's correct and that you aren't making a mistake. |:-)))|

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

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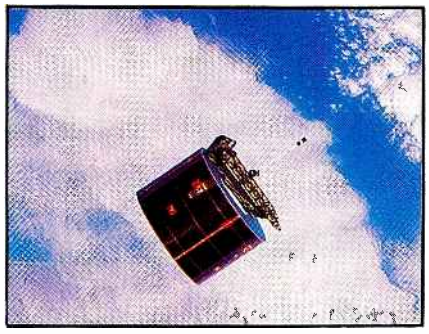

The rocket engine makes it all possible

By Elmer Smalling III

Communications satellites are sophisticated pieces of electronic equipment that have become the backbone of our TV, radio and print networks. For this reason, they receive a great deal of study and attention. Their lower-tech cousins, rocket engines (which make satellites and shuttles possible), don't get much press—until one explodes or an accident occurs during fabrication. The Nevada explosion of a rocket fuel plant in early May of this year is a reminder of how little is generally known about these modern propulsion systems. Let's explore the rocket engines, motors and fuels used to launch, propel and position communications satellites.

Propulsion systems

Rocket engines drive a spacecraft by rapidly ejecting matter away from the vehicle. This type of propulsion differs from the method used by prop or jet engines. They drive an aircraft by pulling or pushing fluid air with blades, which, of course, doesn't work in the vacuum of space! The two basic types of rocket engines are those powered by solid fuel and those that run on liquid fuel.

Solid fuel usually has a spongy consistency and, as it burns, forms hot gases that exhaust through the rocket nozzle to produce thrust. The mass of solid fuel within the combustion chamber of the rocket is called the *grain*. Some rockets have more than one grain. Solid-fuel rocket grains are shaped to burn efficiently, that is, to expend the fuel evenly over the entire grain as it burns. The igniter for a solid rocket is usually a small pyrotechnic primer charge wrapped around a hot wire. This small charge in turn ignites a large starter charge that ignites the motor.

Solid fuel consists of an oxidizing agent (a substance that promotes the loss of electrons because of its own tendency to gain them), a reducing agent or fuel (a substance that readily gives up electrons) and additives. These substances exist together at a normal temperature inside the rocket's combustion chamber. When heat is added, in the form of an ignition, a violent reaction takes place between the oxidizer and the fuel, generating the hot gas that propels the rocket.

The most common oxidizers are ammonium and potassium perchlorates, ammonium and potassium nitrates, and various organic nitrates, such as glycerol trinitrate (nitroglycerin). Common fuels are hydrocarbons, such as synthetic rubber, synthetic resins or cellulose derivatives.

Small amounts of additive substances serve a number of purposes. Catalysts or suppressors increase or decrease the rate of burning. Ballistic agents may be used to control the burn rate with changes in pressure. Stabilizers are added to prolong storage of the fuel.

Liquids and hybrids

Liquid fuels or propellants fall into three classes: *monopropellants*, *bipropellants* and *hybrid propellants*. Monopropellant fuels are single liquids. Bipropellants consist of fuel and oxidizer carried in separate containers, and hybrid propellants use a combination of liquid and solid fuel.

Some monopropellants are hydrazine (used to power the tiny thrusters on communications satellites), acetylene and hydrogen peroxide. Bipropellants consist of an oxidizer, such as liquid oxygen or fluorine, with gasoline, hydrazine or alcohol acting as the fuel. In the bipropellant engine, the fuel and oxidizer are brought together in the combustion chamber and are mixed and burned at high pressures, ejecting hot gases through the rocket nozzle at high velocities. Because the components of liquid-fuel rockets may explode when mixed or exposed to air, they are more difficult to handle than their solid-fuel counterparts.

Hybrid propellant rockets employ a liquid propellant and a solid propellant. The solid fuel in this type of rocket is not burned directly, but is heated to a point at which its gases are combined with the liquid oxidizer away from the surface of the solid grain. Many types of fuels (metallic, cryogenic, liquid and hydrocarbon) may be "burned" in the hybrid propellant rocket, making it a prime candidate for easy transport and rapid deployment.

Engine specs

The parameters of rocket engines differ greatly from those of prop or jet systems. Some of the common parameters are:

- specific impulse, in seconds.
- thrust, in pounds.
- combustion temperature, in degrees.
- combustion chamber pressure, in pounds/square inch.
- exhaust velocity, in feet/second.
- ratio of thrust to engine weight.
- flight speed, in feet/second.

Future propulsion systems

At least two types of propulsion will be used in the future for space travel: *ion* engines and *nuclear* engines.

Ion engines (electrostatic engines) propel a vehicle using the thrust obtained by emitting charged particles, or ions, that are accelerated in an electrostatic generator on the spacecraft. Ion engines have good sustaining thrust but low acceleration thrust.

Nuclear engines (nuclear pulse or NP engines) use energy released by nuclear fuel to turn a bulk fuel into plasma pulses. These plasma pulses are pointed at an impulse absorber on the vehicle that transfers them into forward acceleration of the vehicle.

Much remains to be done in perfecting large rocket engines before space transportation becomes routine. The increasing number of research positions in this field might make chemistry a popular subject in the near future.

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

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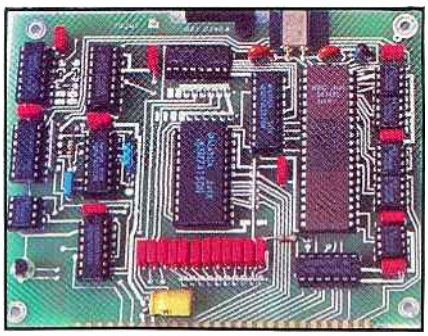

By Gerry Kaufhold II

It is the job of the digital-to-analog (D/A) converter to change the ones and zeros of the binary world into something that resembles the varying voltages of the "real" analog world. Unfortunately, the price of such conversion skyrockets as the need for accuracy increases.

One popular D/A circuit makes use of a weighted resistor ladder. Let's look at the R-2R ladder and uncover some of the reasons conversion is so expensive.

The R-2R ladder

This converter consists of a stable reference voltage source, a ladder network of precision resistors, a programmable analog switch and a buffer amp (see Figure 1). The ladder resistors are weighted in such a way that, by alternately opening and closing the switches associated with them, you can make the output voltage step incrementally.

The switch select logic closes some switches and leaves others open. This applies the desired portion of the reference voltage to the buffer amp inputs. Because the buffer amp quickly responds to the voltages applied, and could possibly pass random glitches that occur during the switching, its output is low-pass-filtered. The software that selects the switches also may use sequences that minimize glitching. The low-pass filter feeds another buffer stage that provides impedance matching to the load.

Kaufhold is an independent consultant based in Tempe, AZ.

An 8-bit R-2R D/A converter can generate only 256 voltage levels, an accuracy of one part in 256, or about 0.5%, across its full range. Accuracy is further limited by resistor tolerances, internal switch resistances and the stability of the reference voltage.

More accuracy

Sometimes, accuracy greater than half a percent is required. A 12-bit D/A converter can resolve one part in 4,096 (0.02%). To obtain more bits of accuracy, the converter must be designed to handle more than eight switches simultaneously. Most analog switch integrated circuits provide only four or eight discrete connections. This means that a 12- or 16-bit D/A converter must have a complicated combination of latches and software to handle the switch-selection information.

Another factor limiting the accuracy of D/A converters is the dc offset voltage of the semiconductor op-amp chip itself. Typically, the input of an op-amp is a differential "current mirror." Current flowing in the input transistor is mirrored by a second transistor that feeds a voltage into the amplifying circuitry. Although these two transistors are closely matched and built on the same dye, small mismatches exist. These "offsets" contribute to the error of an operational amplifier.

A 16-bit R-2R ladder D/A using a 10V reference could, in theory, produce a voltage as small as 150μV. This is substantially smaller than the offset voltages specified for most operational amplifiers. In other words, the smallest step that can be created is less than the error inherent in the circuitry.

Also, the stable reference must hold tight tolerances. If the 10V reference is off by 0.01%, a 1mV error, this is equal to seven 150μV steps, or three bit places. In essence, the 16-bit D/A is reduced to 13-bit performance.

This is not to say that high-accuracy converters are not available. However, they are expensive. Because of the difficulty of creating a workable 16-bit system, usually they are found only in laboratories.

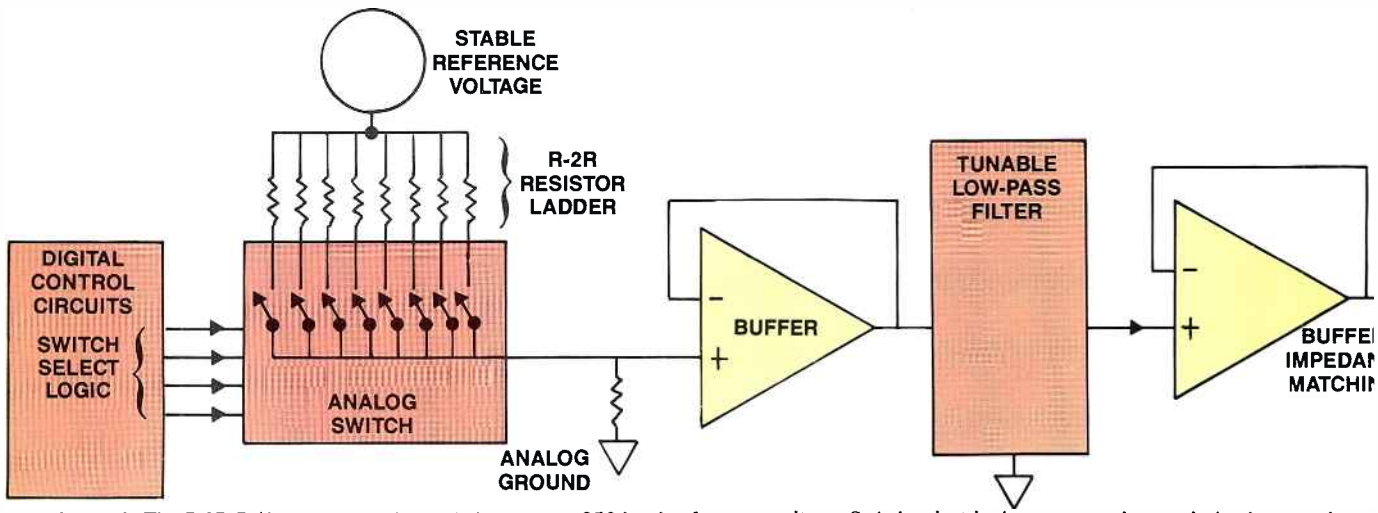

Figure 1. The R-2R D/A uses an analog switch to create 256 levels of output voltage. Switch select logic opens or closes relative legs on the ladder to make voltage. The low-pass filter removes transients that might occur as the switch settles.

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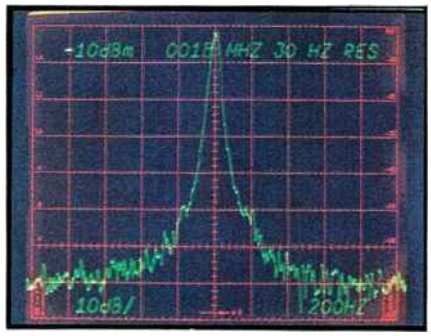
Part 4

Troubleshooting



CD player repair requires skill

By Brad Dick, radio technical editor

Although CDs have been touted as providing near-perfect audio, the quality level comes at a price: the complexity of the CD player. In the first three parts of this series, we've examined the four CD servo systems that control the mechanical performance of the player. These servos—spindle, tracking, radial/traverse and focus—must perform properly if the player is to be able to recover the data from the CD surface.

Data recovery

The data recovery process often is called *eight-to-fourteen-bit-modulation* (EFM) detection. As the laser beam is reflected back to the photodiode array, an RF signal, composed of sine waves varying in frequency from approximately 196kHz to 720kHz, is generated. This RF signal represents the EFM data encoded on the disc. The data contains the audio, control, sync and parity information.

Several physical limitations affect the player's ability to recover this data. Although the CD may look flat, any warping will affect both the focus and radial tracking requirements. Dust or dirt on the disc also limits the effectiveness of the laser in detecting the pits and flats. The servo response time is a factor, especially given the tight tolerances under which the device must operate.

Even the shape of the pits can affect the accuracy of the recovered data. Because the pits recorded on the disc do not have perfectly vertical sides, clean transitions between the flats and the pits are not produced. Instead, smooth, rounded pits cause a corresponding rounding of the edges (transitions) of the data signal.

All these factors combine to produce a sinusoidal waveform from the detector diodes. This RF signal contains nine discrete sine-wave frequencies. Nine discrete frequencies can be reproduced because a single pit/flat sequence can exist only between 3T (three clock cycles) and 11T (11 clock cycles). Consequently, the highest sine-wave frequency is: 4.321MHz ÷ (3×2) = 720kHz. The lowest sine-wave frequency is: 4.321MHz ÷ (11×2) = 196kHz. Note that the clock cycle terms must be multiplied by two because two successive 3T or 11T periods are needed to form a full sine wave.

Once the RF signal is recovered by the photodiodes, it is processed by an amplifier, which outputs a frame-structured datastream in the EFM format. The amplifier also supplies signals to the clock regeneration and synchronization circuits. These circuits recover the required bit-clock and sync patterns for system timing.

Eye adjustment

The key to successfully processing the EFM signal lies in recovering it with sufficient amplitude to drive the proper decoding circuits. Although manufacturers sometimes specify special test fixtures to make this adjustment, it is often possible to do so with only an oscilloscope and music CD.

The EFM signal, often referred to as the *eye pattern*, is composed of the sine waves recovered from the optical disc surface. Although sine waves are displayed, they are really digital signals with severely rounded corners, as previously mentioned.

To make the adjustment, connect a scope to the RF (EFM) test point. You should see a waveform approximately 500mV to 950mV in amplitude. Check the service literature for the exact level required. While monitoring the EFM signal, adjust the *tracking servo offset* for maximum EFM amplitude. In effect, this adjusts the offset of the tracking-error signal (TER). This signal is applied to the tracking-actuator coil in the pickup assembly, helping to center the laser beam on the optical tracks.

Continue monitoring the EFM test point, and adjust the *focus servo offset*. This adjustment more closely focuses the laser beam onto the optical tracks by changing the offset of the focus-error signal (FER). See Figure 1.

At this point, the signal should be of sufficient amplitude to drive the decoding circuits. Also, enough headroom should be available to allow warped or dirty discs to be played without errors.

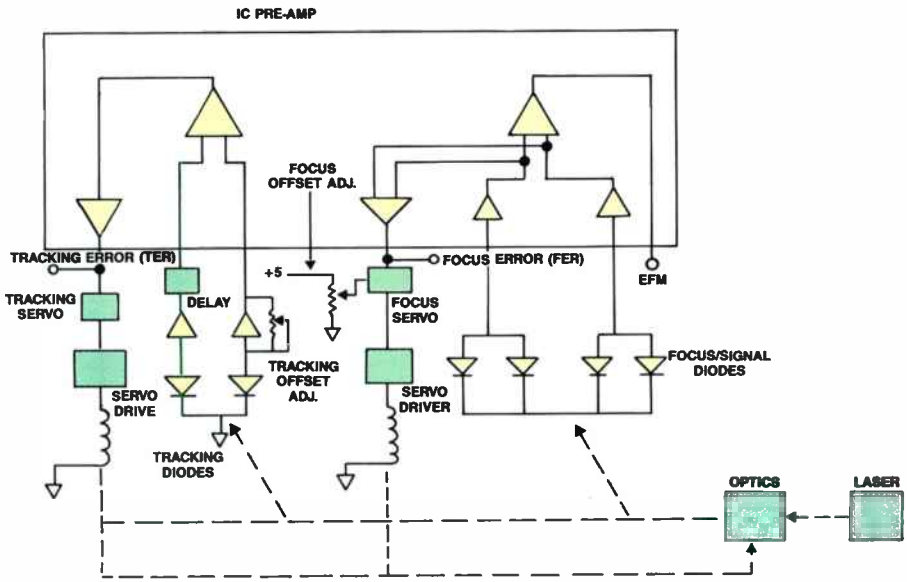


Figure 1. Alignment of the focus and tracking servos typically requires monitoring the EFM signal. Connect a scope to this test point, and adjust the focus and servo offset controls as required for a peak amplitude.

Acknowledgment: Background information on this topic was obtained from "Compact Disc Troubleshooting & Repair," by Neil Heller and Thomas Bentz, Howard W. Sams and Company.

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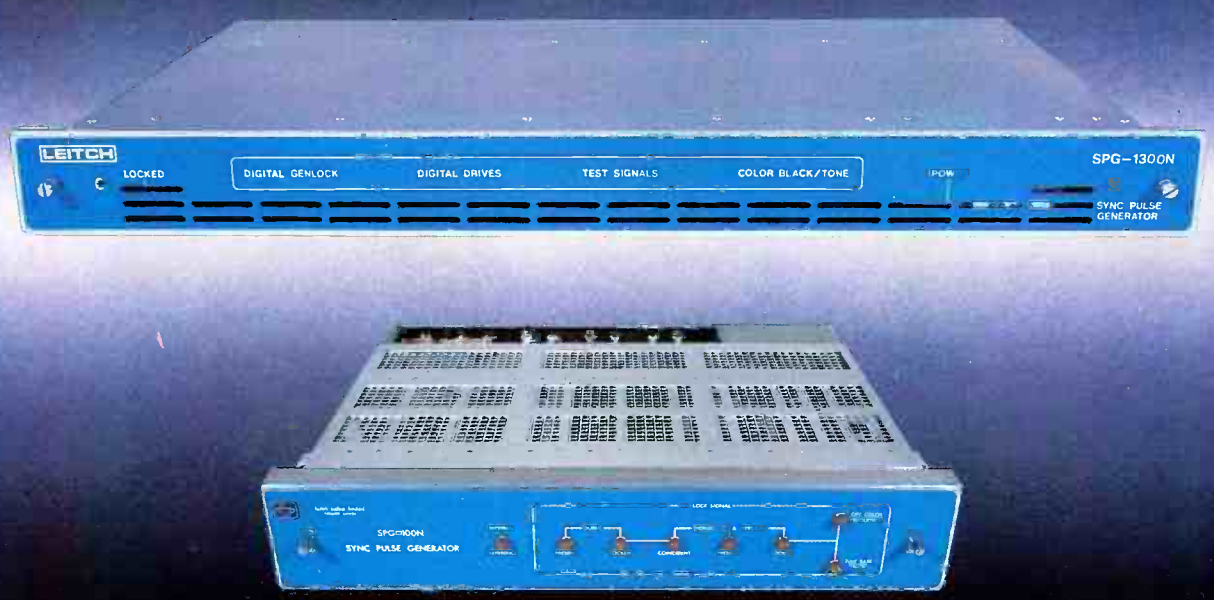

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Part 1

Management for engineers

Planning for success

By Brad Dick,
radio technical editor

You might believe that if you work hard and do well at your job, your company will reward you with money and position. Forget it. You may as well believe in the tooth fairy. One of the most common career mistakes you can make is trusting that the organization will take care of you.

Working hard is your reward for working hard. Companies are organizations in which people are allowed to exist for the good of the company. It's a fact of life.

Don't believe it? Think about this: Before leaving a job, you're expected to provide two weeks of notice. Yet if you're fired, you might get 30 minutes on a Friday afternoon to clean out your desk. In any workplace you are a hired hand, and so is everyone else—from the mail clerk to the president. The bottom line is that if you do good work, they might let you stay.

The ax could fall

Remember Frank, the TV engineer who was promoted to chief at a large TV station? He was a great guy, a hard worker and was liked by many at the station. Unfortunately, these factors did little to save him from the ax only six months after he took the job.

Frank was canned after his new crew and the union complained about his inadequate managerial ability. Yet, the skills and tactics Frank used in the new job were the same ones that had brought him success in his previous position. Unfortunately, they weren't appropriate in his new environment, and he lost his job. Frank now faces the prospect of not only finding another job, but doing so without the safety net of current employment.

If you do good work, they may let you stay.

Even if you are not fired, you could be laid off if the company changes ownership. It used to be that only top-level management people lost their jobs when a new company took over. Today, however, the head-chopping can extend all the way down to the VTR operator. Remember, if you don't look out for yourself, no one else will.

Despite these corporate "facts of life," you don't have to live in fear for your future. Armed with a career plan, you will be prepared to seize opportunities, as well as to protect yourself, if the ax falls on your head.

You probably spent more time planning your summer vacation than you did on how to get that promotion or new job.

Chance dictates career

Career planning is everyone's job, but few seem to be doing it. A lot of people simply wait for something positive to happen. Unfortunately, that seldom occurs. One study shows that as much as 60% of all career changes are simply a matter of chance. In other words, most employees who are promoted or moved to another position are simply in the right (or wrong) place at the right time. Wouldn't you rather call the shots with regard to your future?

A survey of executives showed that fewer than one-half spent any time on career planning. People typically spend more time thinking about the selection of a new car than they do about the future of their careers. In fact, you probably spent more time planning your summer vacation than you did on how to get that promotion or new job. If so, then you put more effort into something that may last two weeks than you did on something that could last 30 years.

About one-half of all managers say they are unhappy with their work. Even if you aren't one of them, you probably know a few. Despite their unhappiness, many of them do nothing about their situations. They complain, and they dream, creating a cycle of wasted effort that only instills in them a greater sense of hopelessness.

Develop a plan

That doesn't have to be the case. Instead of biding your time and waiting for something positive to happen, you can take charge of your career and increase the pleasure you receive from your job. The choice is yours.

The advantage to planning is a sense of control—you plan your career rather than allow your career to plan you. The old adage "If you fail to plan, you are planning to fail" is certainly true with respect to your career.

Finding success

Career planning helps you develop a feeling of success and promotes job satisfaction. Success means something different to everyone. To achieve it, however defined, you have to be able to identify the important things in your life. Maybe you are motivated by money. Perhaps the social interaction that takes place in your job is important to you. Others are driven by challenge.

As much as 60% of all career changes are simply a matter of chance.

It doesn't matter what particular job aspect motivates you and provides that feeling of accomplishment, only that you are able to identify it. Once you've done that, you can make further plans to nourish that need. It makes no sense to strive for things that will not fulfill your needs—including money.

We'll continue to examine ways to achieve career success. You'll learn not only how to plan your career more effectively, but also to identify what really matters in your life.

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New dimensions in broadcast audio

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To paraphrase Mark Twain, "Get your facts first. You can distort them later."

That seems to be how some broadcasters treat their audio. High-quality sources are common and inexpensive. It's only after the audio is recovered from the source and fed through the broadcast chain that it becomes distorted.

Never has it been so easy for the consumer to judge the quality of the audio transmitted by radio and TV stations. In the "old days" (back when we used tubes and transistors), broadcasters boasted of "broadcast quality" as the standard by which audio should be evaluated. No longer. Anyone who can part with a couple hundred dollars can obtain a receiver or amplifier capable of performance that often exceeds what's available from many broadcast stations.

If that isn't enough, consider the performance possible in a closed-loop (nonbroadcast) environment. Broadcasters are facing a real challenge. Products such as CDs, hi-fi and stereo videotapes and disks—and now, digital audiotapes (DAT)—are readily available. In addition, today's consumer is aware, more than ever before, of what good quality sounds like. The research tends to confirm that many consumers select audio sources that "sound good."

This means that broadcasters, in many cases, must play a catch-up game. They need to replace old equipment so that the air product more closely reflects the quality expected by today's audiences. Has your facility kept current with technology? If you conducted an A-B test between your air signal and a CD player, how would your station fare? Consider that your listeners, in effect, may be doing this as they switch sources. If your station is not producing a quality audio product, they'll know it, and they will react accordingly.

So what's holding you up? If you need a new audio console, read "New Approaches to Audio Console Design." The features available on modern consoles are numerous and exciting. Make sure you get one with all the options you need.

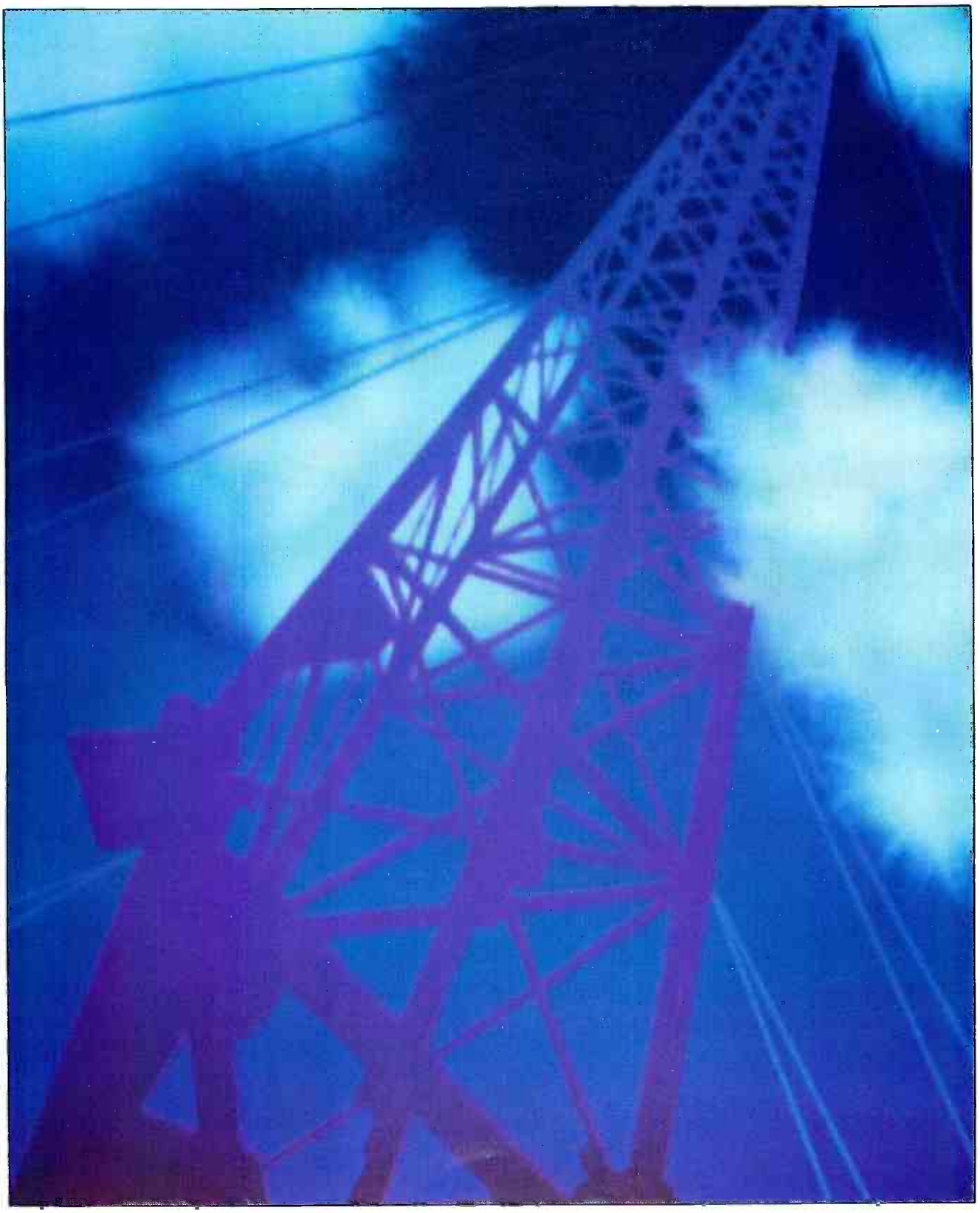
Maybe you need to adapt a piece of equipment to make it perform better. Richard Cabot, in "Active-Balanced Inputs and Outputs," looks at the advantages and disadvantages of the many kinds of circuits of this type.

Before you make any big decisions, however, really listen to your station. A trained ear is the most valuable tool of the audio engineer. "The Audibility of Electronics," by John Eargle, addresses the importance of listening to your audio chain. He also suggests ways to determine whether that $2,000 audio amplifier is twice as good as the one that costs $1,000.

Listen closely and critically to your station. Opening your ears might prove to be an eye-opening experience.

Brad Dick

Brad Dick,
issue editor



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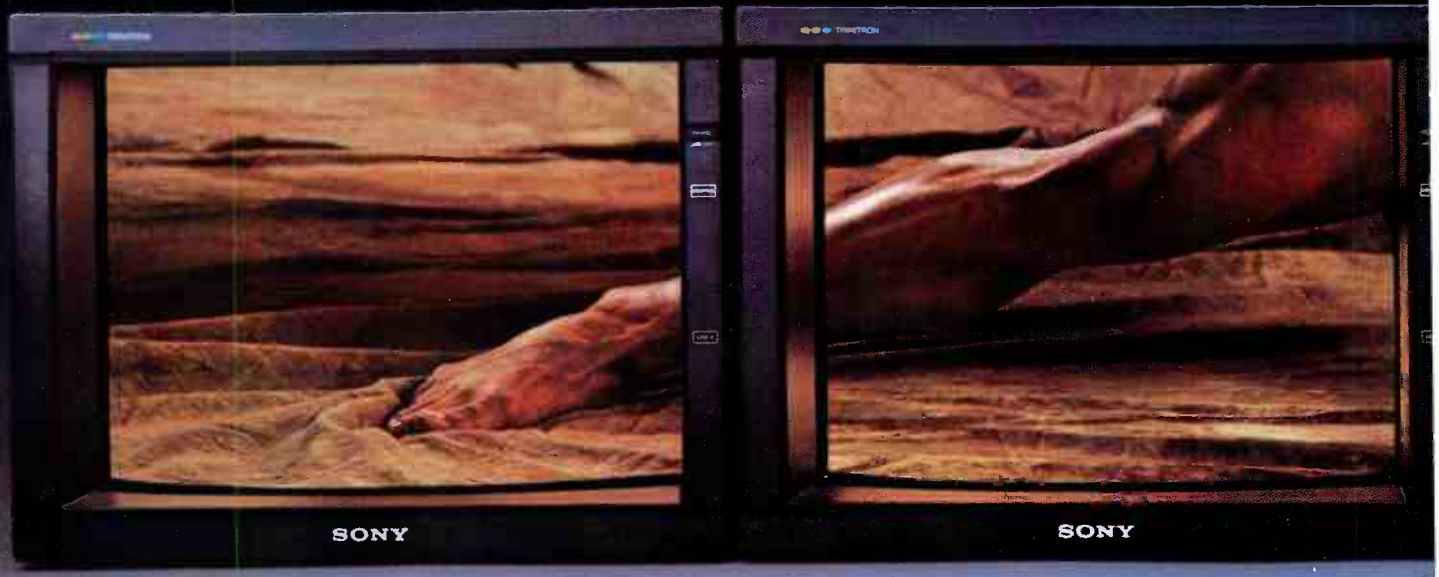

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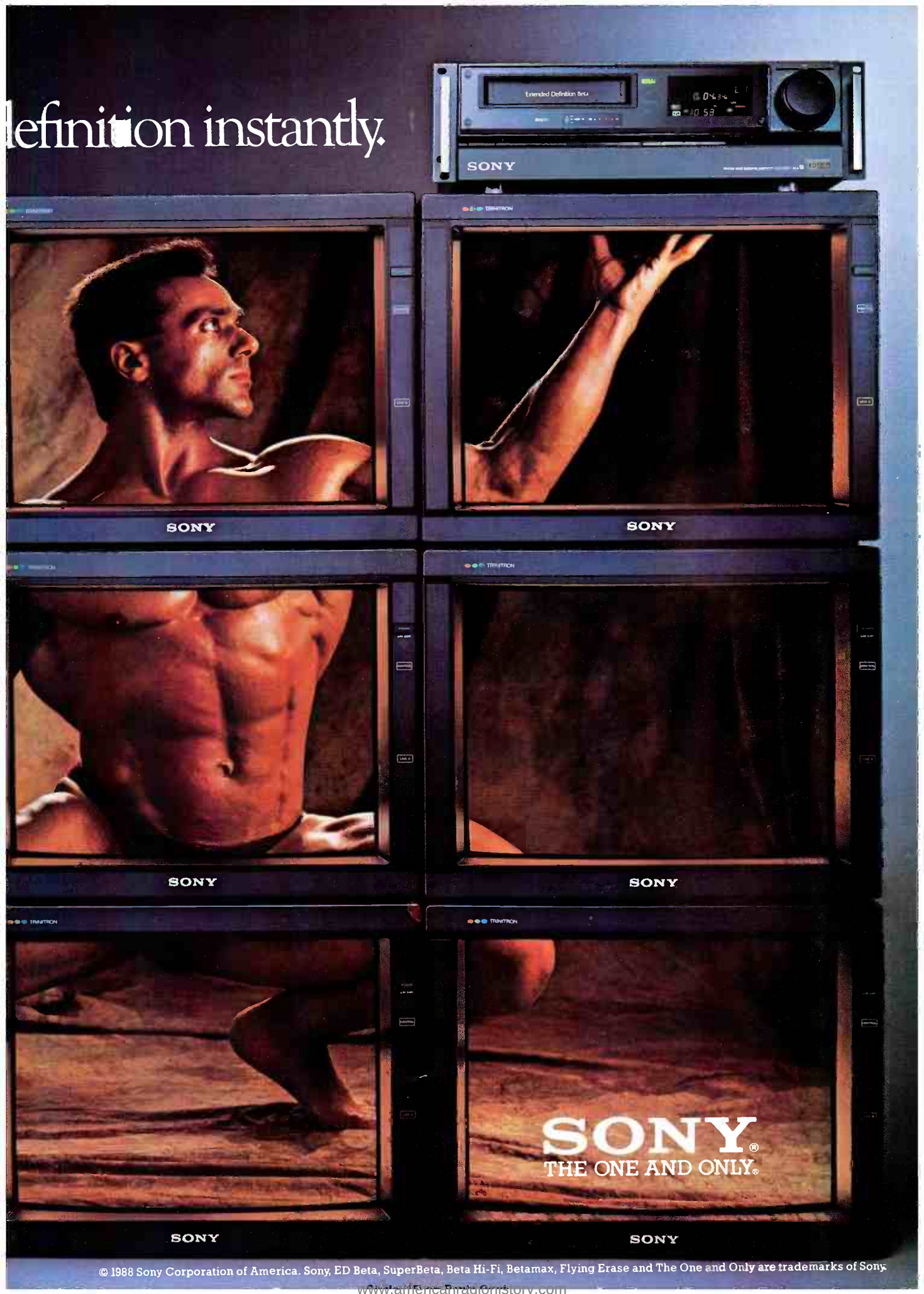

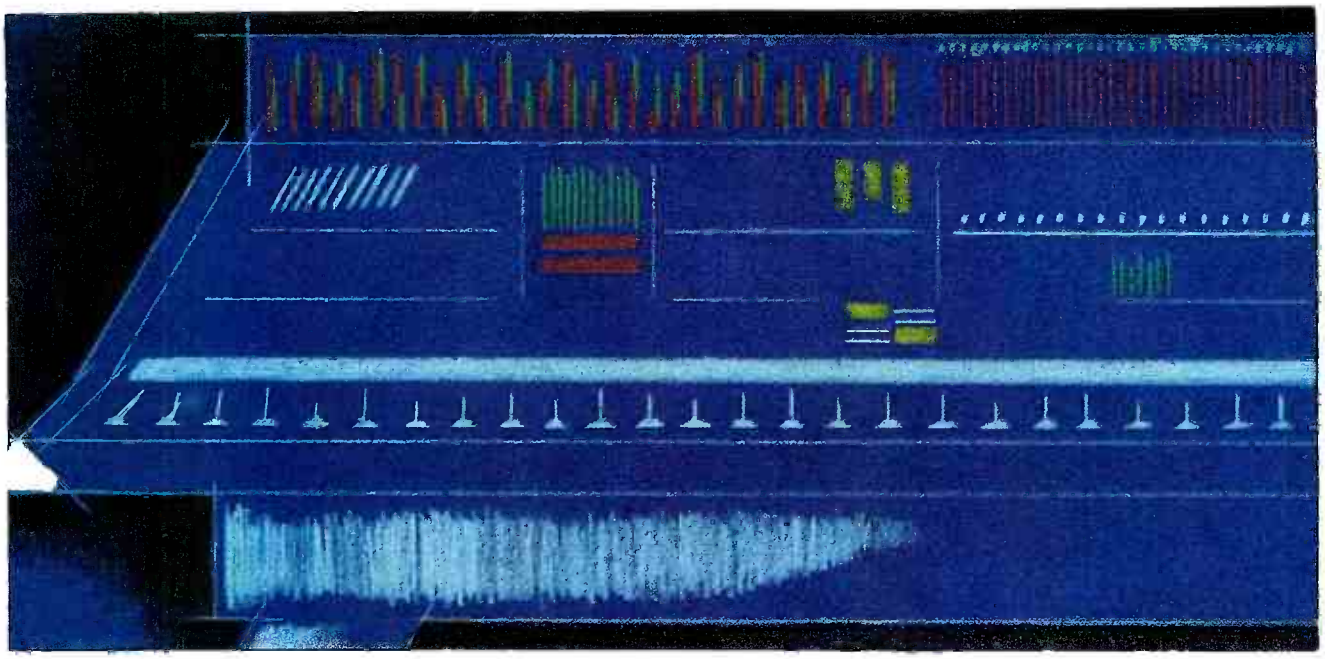

New approaches to audio console design

By Brad Dick, technical editor

The modern audio console is a testament to the changing demands and expanding applications in broadcast today.

The quality of broadcast audio has never been more important. For radio stations, audio is their only product. And the advent of MTS has forced TV stations to "get their audio act together." Broadcasters are scrutinizing the role of the audio console within the station.

In the "good old days," an audio console had only two output channels (audition and program), a maximum of eight to 12 rotary mixers and no more than two VU meters. The consoles were simple to operate because each mixer typically handled only two or four inputs, all of which were transformer-balanced. These consoles were designed for general applications, and stations often tried to use the same model in both the air and production studios. That way, the disc jockeys had to learn how to operate only one console. These consoles were expected to last almost forever. After all, there was no reason to replace one if it worked.

As many engineers can attest, the console of yesterday performed its task well and probably lasted longer than anyone had a right to expect. Things have changed, a lot. Broadcast consoles have evolved from limited-feature, fixed-application devices to full-feature, flexible designs.

Today's broadcast console may have more total outputs than yesterday's console had inputs. Modern consoles provide access to far more sources, often through more input faders. In fact, a single input channel may provide access to as many sources as the entire console of yesterday did. Both rotary and slider pots are used on modern consoles, providing a choice for engineers and operators. Highly effective active-balanced inputs have, in many cases, replaced the heavy and expensive transformers of the past.

Greater flexibility, improved performance and additional features all are available on today's products. In fact, a modern audio console may provide one of the best

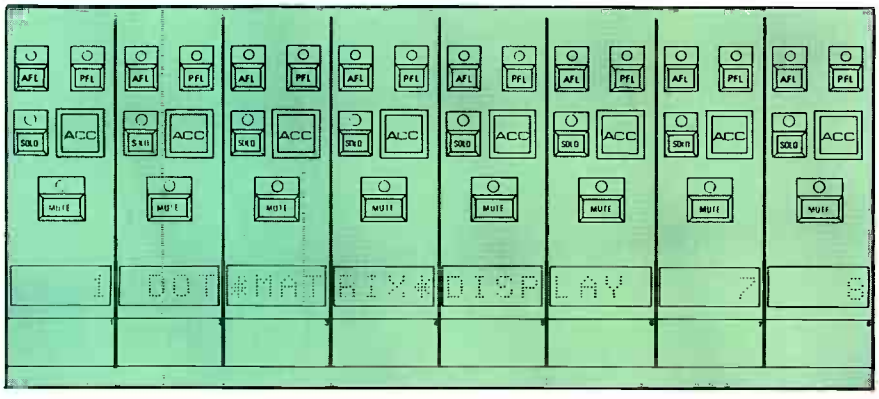

Figure 1. *An 8-input access panel with channel access, mono AFL, PFL, stereo solo, mute and auto-mute controls. Each module contains an alphanumeric display for channel status.*

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cost-performance ratios of any broadcast product.

Changing requirements

Despite the advantages of contemporary consoles, their changing applications are forcing console manufacturers to re-examine the design of their products. In the recording business, an important shift has been in the origin of the recorded sound. For instance, a large proportion of the sound recorded in studios today does not originate in the acoustical domain. Instead, these sounds come from electronic instruments, which can place different requirements on the mixing device than acoustical instruments would. When these sounds are reproduced from CDs, the broadcast console must be capable of equal performance.

In addition to the improvements in sonic performance, consoles also must meet new operational demands. An example is the increased complexity of today's TV productions, post-production work and audio-follow-video requirements. These applications require more inputs, additional control over each audio source with equalization and audio processing and, sometimes, automation. As stations search for more ways to be creative, they find that automation can provide that extra measure of performance.

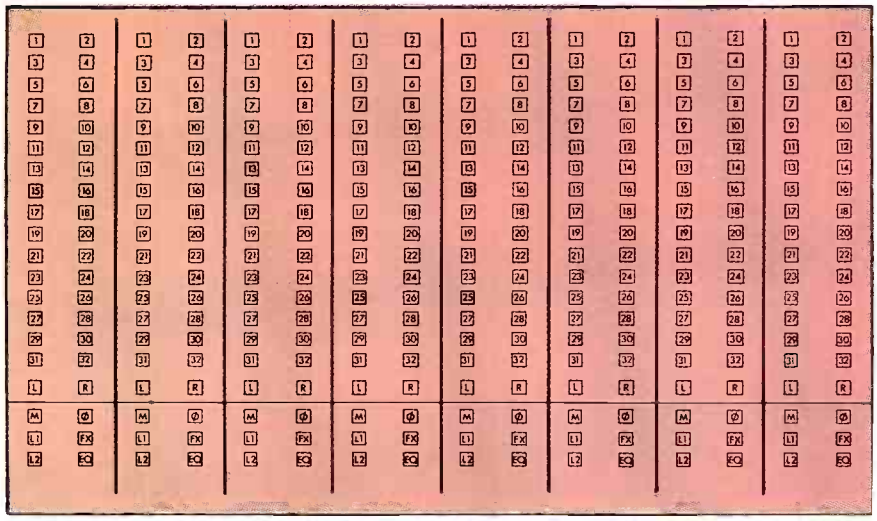

Figure 2. *The routing indicator panels display group assignments, input selection (mic/line), phase reverse, EQ and dynamics insert status.*

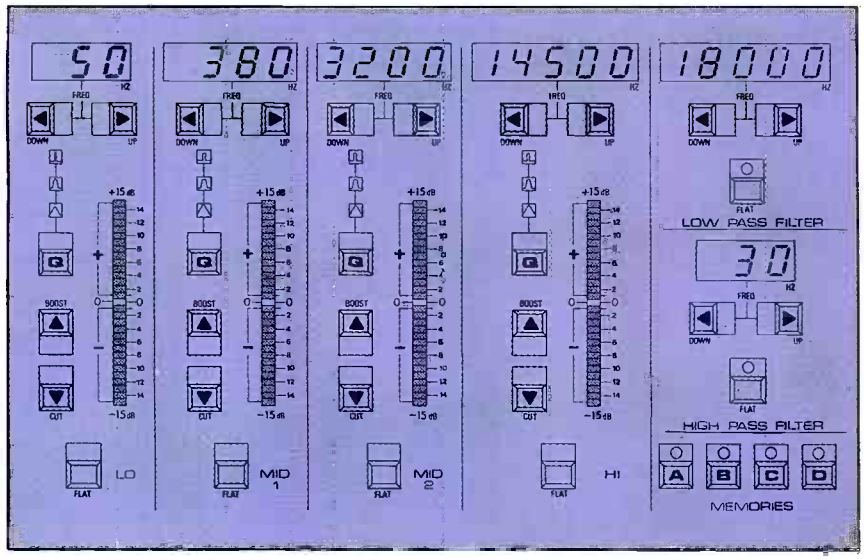

Figure 3. *A single assignable equalization module features four 16-frequency parametric EQ sections, plus sweep high- and low-pass filters.*

Big isn't always best

One of the most visible aspects of the console evolution has been the increase in size. Over the years, recording and production consoles have gone from 16- to 48- to 64-input designs. Obviously, as the number of inputs increases, so does the overall console size. As the width and depth increases, ergonomic and operational problems develop. Such a large console becomes user-hostile, requiring the operator to make long reaches in both front-to-back and side-to-side movements. Using these large consoles in broadcast applications may even require more than one operator, which is not a cost-effective idea.

Even if the ergonomic requirements could be met through a different front-panel layout, big consoles create acoustical problems in the control room in terms of volume and, more important, large reflective surfaces. When these surfaces reach certain proportions, it is no longer possible to ignore their effect on monitoring.

The acoustics aside, adding a 48- or 64-input console may require significant room reconstruction. Your station manager may not like tearing up a control room to accommodate a larger mixing desk, because it greatly increases the overall project cost. Besides, in many broadcast stations, such an option may not exist.

In many broadcast and post-production applications, space is at a premium, and audio facilities may come second in importance to video. It is a common requirement that a new console must be fitted into existing space, which was originally designed for less sophisticated (and often smaller) equipment.

Large consoles also create tremendous problems in remote-production applications. Although space is extremely limited in broadcast vans, mobile video production and recording trucks, these locations often require many inputs. An inverse relationship seems to exist between the required features and the available space. Audio console manufacturers have developed several solutions to these space and operator-control problems.

Assignable controls

Through digital-control techniques, consoles now can provide more features in a smaller amount of space. Even more important is the enhanced operational control available through *assignable controls.* To better understand how assignable controls work, you must understand how a large console is typically used.

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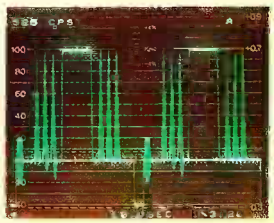

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Console operation can be broken down into several basic tasks: input selection, equalization adjustments, processing adjustments, output selection, level setting and monitoring. Historically, each of these tasks has required the use of separate knobs, switches and faders. However, digital technology has opened the door to a different approach.

One design approach that is receiving a lot of attention is the use of assignable controls. This technique allows one or more sets of controls to be assigned to many functions. With digital storage of commands and, perhaps, some digital processing, a fewer number of controls can perform a wide variety of tasks. The advantages are reduced console size and, according to some, easier operation.

Although large consoles are impressive-looking, realistically, an engineer can accurately set the controls of only one channel or module at a time. One study shows that on a conventional console equipped with 40 modules, an engineer is using only 2.5% of the controls at one time. This means that 97.5% of the console surface is wasted space.

The design philosophy of assignable controls can be extended to accompanying lights or displays that "echo back" the current state of a pot or switch so that the engineer can see the state of a particular circuit when a selection is made. Taking this a step further, it is possible to design a console that would sequentially control thousands of switch functions via a single button and sequentially display thousands of switch states via a single light.

The disadvantage of assignability is that it makes visual feedback a sequential accessing routine through the use of shared lights and displays, robbing the engineer of much vital, immediately available information.

Consider how easy it is to scan the controls on a typical console to find an improper setting. Locating a control that may be in the wrong position is both easy and relatively quick.

Now consider how many manual operations would be involved in interrogating a completely assignable 56-input console to determine the same data. And, if the input level for each channel were displayed in digital form, such as a numerical readout, how long would it take you to make sense of the information and to react?

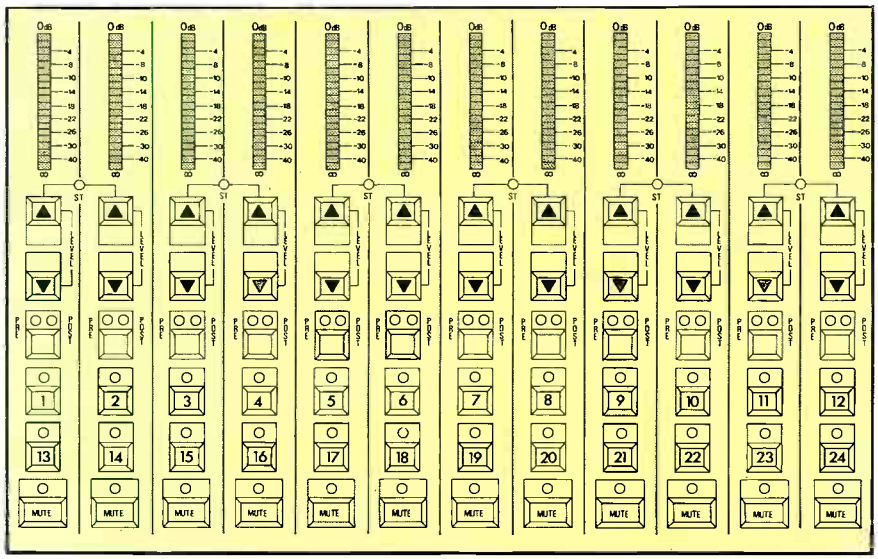

Figure 4. *The auxiliary send panel comprises 12 identical sections that can be ganged for 12 stereo pairs.*

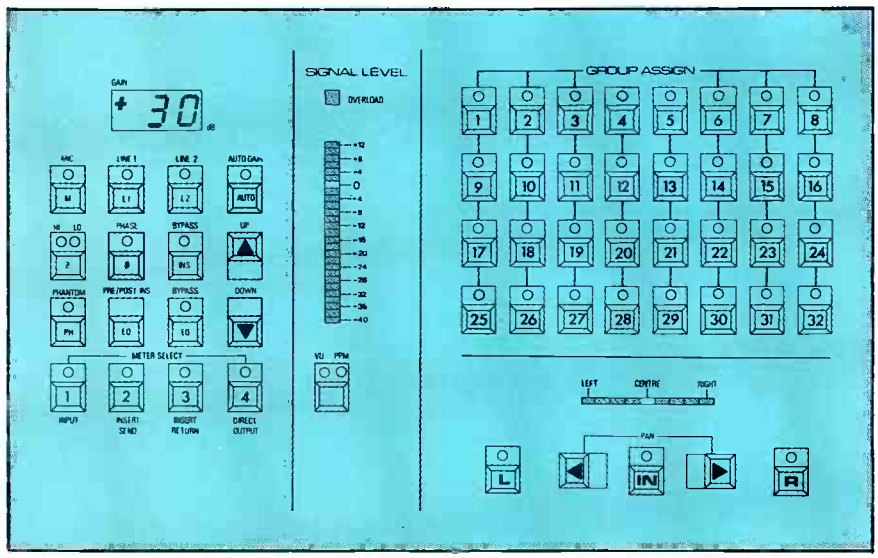

Figure 5. *The assignable mic/line routing section enables selection between mic and two line-level inputs, as well as assignment and pan to 32 output groups.*

Control surface

The degree to which a console design implements assignability is a matter of balance. A successful design incorporates the correct trade-offs for all design parameters, including which controls should be assignable and which should have dedicated controls and displays.

Such a design approach has its pitfalls. It is easy to get carried away with the concept of assignability and think that all functions can be assigned. If this idea were followed through, the engineer would be left with a control surface consisting of one set of controls and a fader, assignable to their appropriate functions. Such an approach is not usable in the real world.

A practical assignable console needs only carefully chosen controls with the remainder repeated, as on a conventional console. This may mean that the console still has the requisite number of faders (16, 32 or 64). If so, then the overall width of the console may be reduced only slightly, or not at all. Operator reach can be shortened significantly, however, because the equivalent of a conventional module contains only a few controls.

Programmability

As assignability functions are incorporated into a console design, it becomes easier to take that next step and provide *programmable features*—automation. Automated or programmed actions can be

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handled by a console operating under the control of a computer, but this feature involves a great deal of planning on the part of the designer. If every knob and switch must be programmable, then the design task (and resulting console) is far more complex (and expensive) than if some functions do not need to be automated.

Let's look at how a typical console is used. Once the equalization controls have been set, they seldom need to be changed during the broadcast mix. This means that *dynamic automation* (continual updating by the automation system) of EQ functions may not be required. Instead, a *static automation* through an instant reset function seems to be an ideal solution.

Such an approach allows the operator to set the EQ controls and later recall preset conditions as required. Static automation also can be applied to many other console functions. If properly used, the resulting console is simple to operate, is cost-effective and fulfills most operational criteria.

Faders, on the other hand, do require dynamic or real-time automation because the recording or production engineer is not only constantly readjusting levels, but may want to record (for later computer recall) the fader movement from one scene to the next.

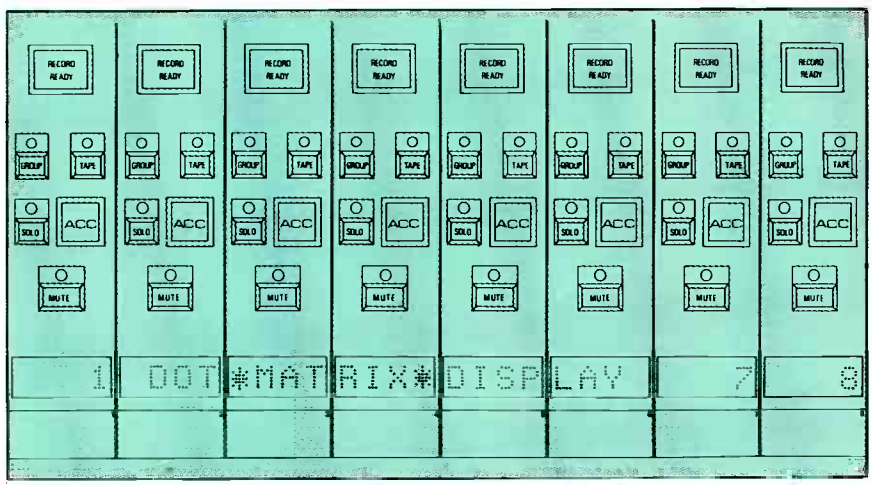

Figure 6. *Individual access panels are provided for each monitor channel with stereo solo, mute, group, tape switching and record/ready selection.*

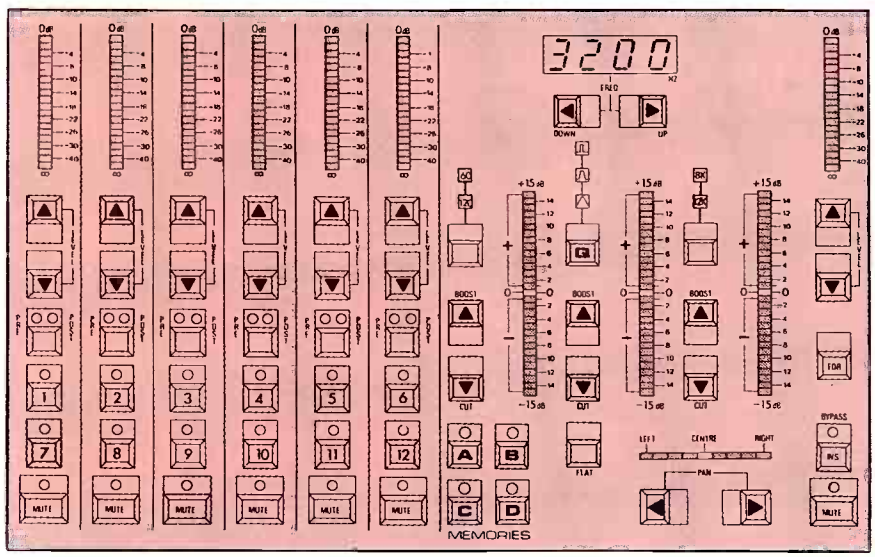

Figure 7. *A master monitor panel features controls for six auxiliary sends including 3-band EQ controls.*

Practical realization

The assignable approach requires the use of digital-control techniques. Although the audio still can be retained in the analog domain, level setting and other adjustments must be carried out through digital control of analog devices such as voltage-controlled amplifiers, motor-driven potentiometers or multiplying digital-to-analog converters (MDACs).

An alternative to the analog-signal, digital-control approach is the full-digital console. In this approach, the audio is converted to digital at the input stage and digitally processed throughout the console. Unfortunately, based on present microprocessor technology, a fully digital console may cost three times that of its analog counterpart. Furthermore, all-digital signal processing in consoles is still in its infancy. Let's pursue the analog console approach.

Apart from the channel, group and monitor faders, a digitally controlled, assignable console could provide static memory of all levels, routing, equalization, auxiliary sends, panning, mutes and solos. An on-board random-access memory could be used to allow all settings to be stored and archived to a floppy disk. A static memory system, linked to SMPTE time code, would allow the console settings to be reset within one video time frame (33ms).

Remote processing

Engineers usually think of consoles in terms of the front panel or control surface with an array of knobs, switches, lights and displays. Historically, each of these devices was linked mechanically to the circuitry located beneath the console. The knob was simply a physical extension of the potentiometer or switch to which it was connected. Recent advances in technology have made it possible to physically separate the knobs and buttons from the circuit elements they control. Now, the knobs and switches communicate electrically, rather than by more direct mechanical techniques. The result is an audio control surface without audio passing through the control knob or switch.

This approach is relatively new to audio engineers. Video engineers, on the other hand, are familiar with such remote-processing techniques. Video switchers and similar devices seldom route the video through the control panel. Instead, the video signal remains within a rack-mounted assembly that is directed by a control surface located elsewhere.

Remote-processing techniques offer many advantages to console designers. The first is size reduction, which was discussed previously. The second is that the design lends itself to an attractive *parallel-control* operation. The engineer manually operates the remote controls

Continued on page 36

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Circle (20) on Reply Card

Continued from page 32

while a computer shares connections to the wiring system making the adjustments as directed by the operator.

This technique also makes it easy to automate functions or to add programmability to the console. For applications that require programmability, remote processing is a requirement. Otherwise, the console would be unacceptably large.

Digital vs. analog

Let's look more closely at how digital processing fits into broadcast applications. A current debate centers on whether an analog or digital console is better. A first glance at console specifications reveals little useful information. The difference between the two approaches is subtle, but it becomes obvious upon careful reflection.

When an analog console is overmodulated, its performance tends to degrade gradually and progressively. Engineers who are aware of this know just how far to push analog circuits to take advantage of the available dynamic range.

A digital system reacts much differently. When using digital signal processing, engineers tend to back off modulation levels until they are absolutely sure that even random peaks will not exceed the system's peak limitation and create audible distortion. This aspect is important in broadcast applications, especially for live situations in which the events being carried are less controlled than they might be in a studio setting.

The bottom line is that an engineer must leave a generous amount of headroom inside the digital device, such as a tape recorder or console, just to cope with overshoots. Because of this, the dynamic range available for practical use may be more restricted than what is listed on a specification sheet.

Trade-offs

Reducing the modulation level on an analog system means that noise may become a problem. Similar level reductions in digital systems create an entirely different type of problem—increased distortion at low levels. A full-modulation level uses the entire range of quantizing levels/bits available on the A/D converter. However, when the audio level is low, fewer quantizing levels/bits exist, and the conversion becomes relatively crude. The result is a gritty, non-musical form of distortion.

These examples are not meant to suggest that digital systems are inherently inferior to analog; in fact, digital techniques will bring new standards of quality and freedom that are inconceivable in analog designs. However, the people who are designing digital systems must create products that will bring real benefit to the audio control room, rather than produce something that merely mimics or betters on paper the specification of an existing analog system.

Variety of choices

The comparison between analog and digital processing systems is complex. Whether one technology is superior to the other is not the issue. Rather, the concern is how these technologies can be best applied to solving the problems faced by broadcasters.

It is not so much a matter of the number of inputs and outputs as it is a question of application. Some tasks can be handled easily by hardware-based consoles, where computer-assisted features are not needed. For other applications, programmability, assignability and other digital-control features may be required. So when you purchase your next console, think analog. And think digital.

(See related article, page 38.)

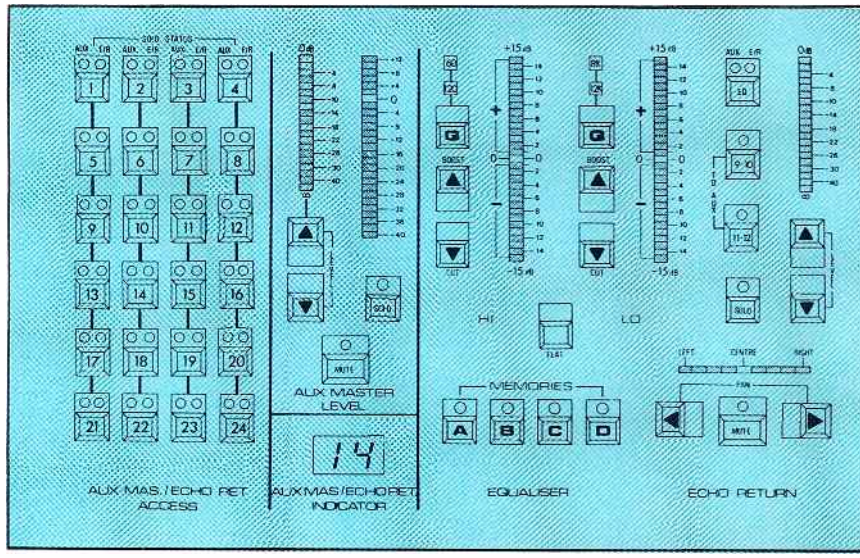

Figure 8. *A single panel provides selection and assignment of auxiliary sends and echo returns with a dedicated EQ section.*

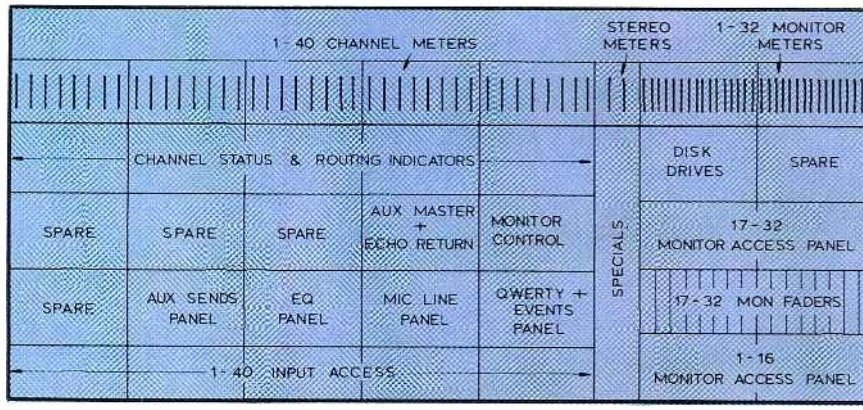

Figure 9. *Front-panel layout of a 40-input, 32-output assignable console, showing location of relevant control panels and overall dimensions.*

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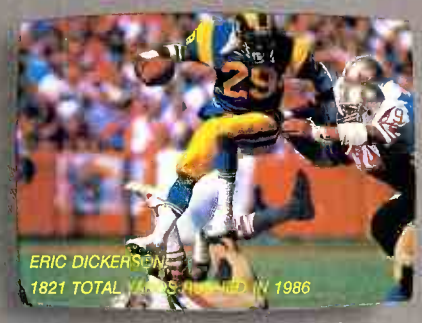
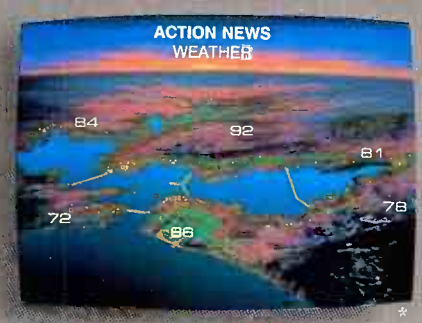




*Photos courtesy of San Francisco Production Group.

Circle (21) on Reply Card

Digital editing technology

The high-quality audio available from CDs and their widespread use has raised audience expectations. Listeners have come to expect quality sound from other types of audio reproduction, too. Broadcast and video-production facilities are re-examining how audio is handled within their studios. Nowhere is this more evident than in the area of audio editing.

Required performance

The foremost requirement for any digital editing system is quality. The accompanying audio-storage system also must be able to provide accurate storage and retrieval of the audio signal. Any degradation encountered in this phase of the process will be compounded every time the audio is placed on, and removed from, the medium.

Another important aspect of an audio-storage system, especially critical for editing purposes, is random access. The audio signal must be quickly accessible. Any delays will reduce the effectiveness of the entire editing system.

For a random-access system to be useful in the production room, it must provide unrestricted manipulation of the encoded audio. The editing/storage system should combine the enhanced audio quality of audio storage with the flexibility and creative freedom provided by modern analog systems.

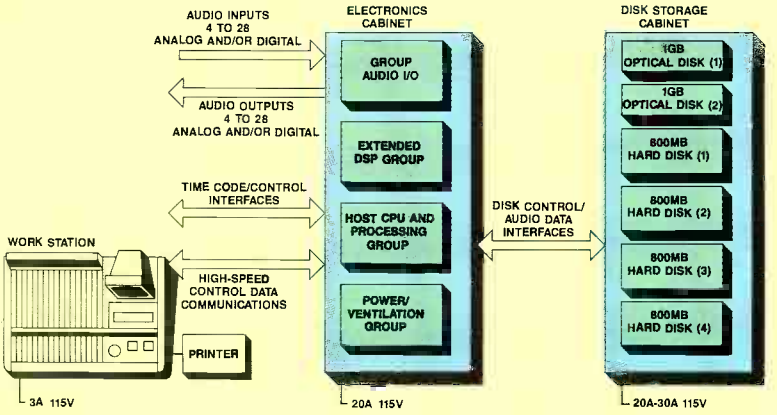
Random access allows digitally recorded audio to be organized in discrete segments that are defined by beginning and end time-code points. Each segment can be assigned a name by the user. A segment then can be assembled from other segments, or one segment can be split into several smaller ones.

This technique also provides the added flexibility to define a reel as a group consisting of any number of segments. With this method, material can be moved between reels or even between jobs. An advantage of such an organization scheme is that it parallels closely what is in current use in the analog domain.

Non-destructive editing

A key difference between a digital system and an analog system is how the edits are performed. In the analog domain, the tape is often physically cut and pasted together, forming a longer program segment. With digital applications, the original audio signal does not need to be changed in any way. Instead, the edit can be implemented by a series of pointers and instructions to replay specified segments. The integrity of the original material is preserved during the random-access editing process.

This technique allows multiple edits to be performed on the original data without changing the data in any way. Instead of physically moving the data around on the disk in the correct order, edit decision lists (EDLs) are used to command the system to perform the electronic edits. The result is a complete segment or even an entire program.



Modern digital editing systems often incorporate unique control surfaces to take better advantage of the system's features. Major system components include audio I/O, CPU, control surface and storage systems.

Human interface

Digital editing and storage systems have opened the door for new and different control surfaces and human interfaces. Although familiar manual controls such as faders, buttons and knobs are used in some systems, they operate only as remote commands for processing computers. An additional advantage of these controls is that no audio appears on the control surface. Instead, the audio is restricted to the equipment racks with the rest of the storage/editing system.

Commonly known motion controls such as play, stop, fast forward and rewind can be replicated on the control surface. The operator doesn't care whether these buttons control a tape machine or a hard disk. The advantage is that software within the system forces the storage medium to "act" like a tape recorder, thereby making the system more familiar to the operator.

Storage medium

The benefits of random-access capabilities depend heavily on an appropriate storage medium. Magnetic hard disks can provide 120 minutes or more of audio storage. *Write once read many* (WORM) disks provide even higher levels of storage, but the drawback is that previously recorded material cannot be erased. These disks are, however, particularly useful in storing completed programs or segments that may be needed later.

As hard-disk storage technology improves and erasable optical disks become available, you can expect to see more audio applications. At this point, perhaps only those of you who have used digital editing systems or worked through the evolution of computer storage from cassette to hard disk can appreciate the advantages digital editing offers.

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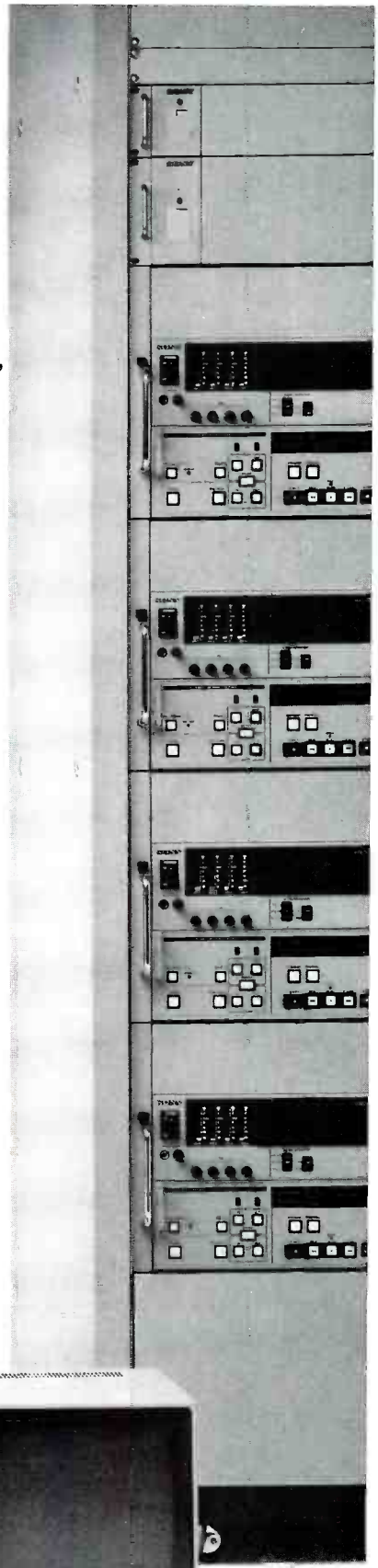

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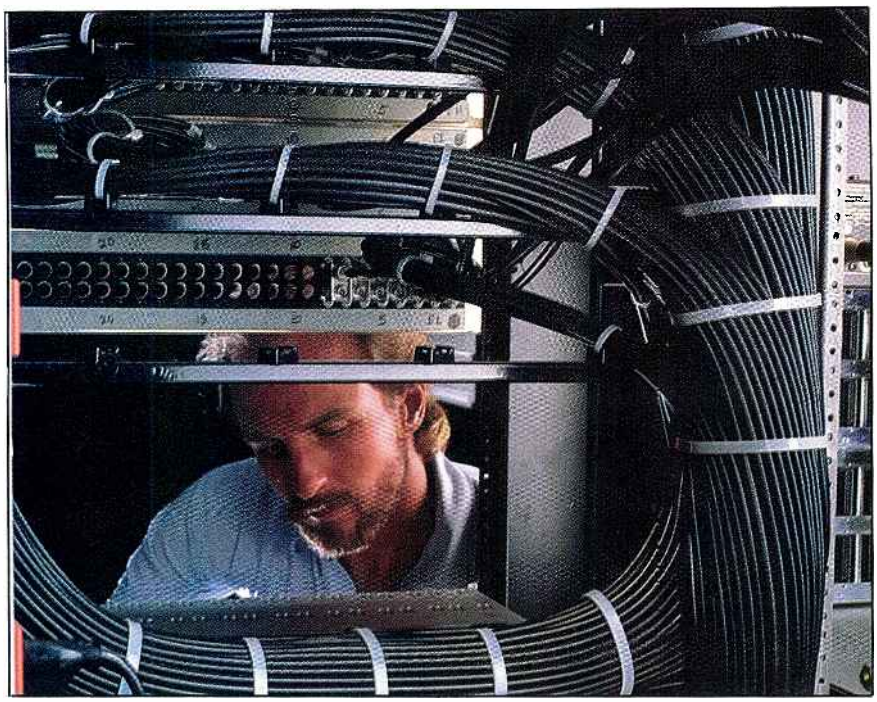

Active balanced inputs and outputs

By Richard Cabot

Don't become unbalanced over hum and noise.

System interfacing problems have existed since the first audio engineer tried to wire two pieces of equipment together. Equipment that works flawlessly alone can fail miserably when wired together. One of the first problems encountered was ground loops.

Early audio workers used transformers to solve differences in ground potentials between equipment or signals picked up in cabling. These transformers helped to usher in the age of balanced and floating interfacing. However, they also added significant cost, weight and distortion to the equipment.

As the performance of the electronic equipment improved, these shortcomings became more noticeable. The large size of the transformers also made them inconvenient for use in the ever-shrinking chassis of transistorized equipment. As solid-state technology became more common, designers began to look for ways to eliminate the use of transformers. The result was electronically balanced inputs and outputs (I/O).

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

Let's first examine what a *balanced line* is and what problems it solves. Figure 1 shows a basic source and load connection. No grounds are present, and both the source and load float. This is the optimum condition for equipment interconnection.

Either the source or the load may be tied to ground with no problems, provided only one ground connection exists. Unbalanced systems are created when each piece of equipment has one of its connections tied to ground, as shown in Figure 2. An example of this is if the source is an amplifier output whose power supply is tied to the chassis. The difference in ground potential causes current to flow in the ground wire and develop a voltage across the wire resistance. The ground-noise voltage adds directly to the signal itself. Because this ground current is usually from leakage in power transformers and line filters, the current is 60Hz ac and gives rise to hum. Reducing the wire resistance through heavier ground wire helps, and

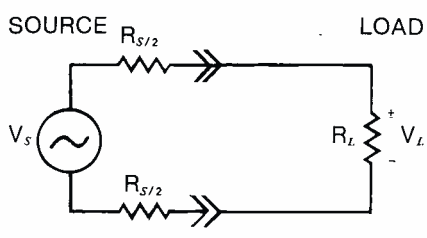

Figure 1. *A basic source and load connection. No grounds are indicated, and both source and load float.*

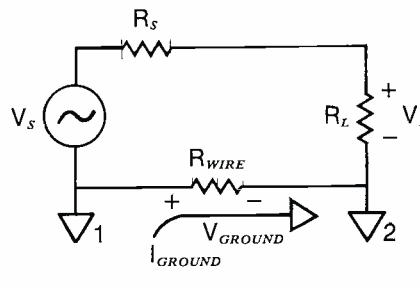

Figure 2. *An unbalanced system in which each piece of equipment has one of its connections tied to the ground.*

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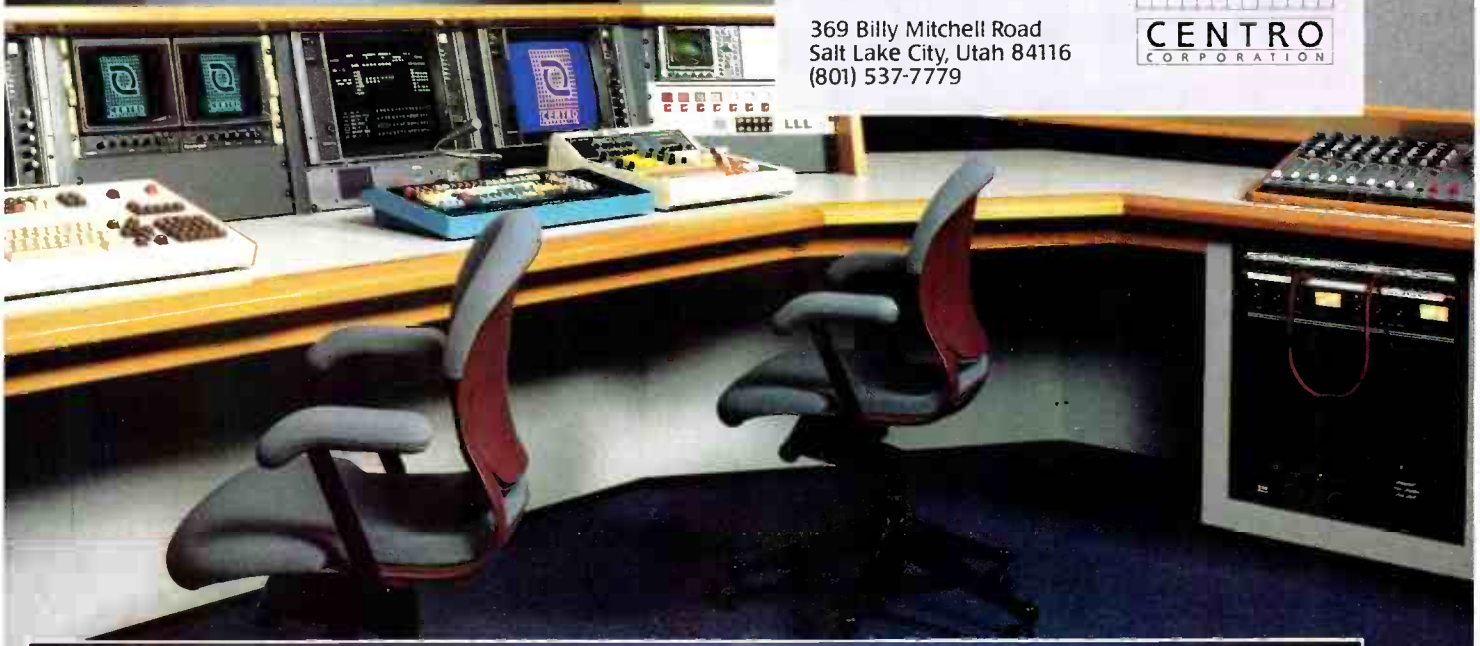
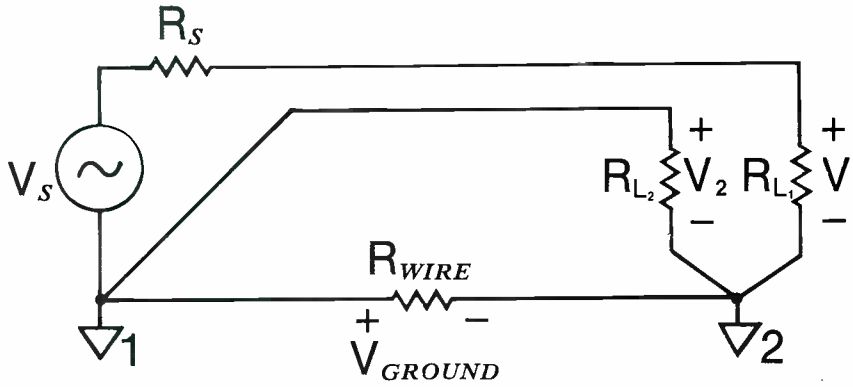


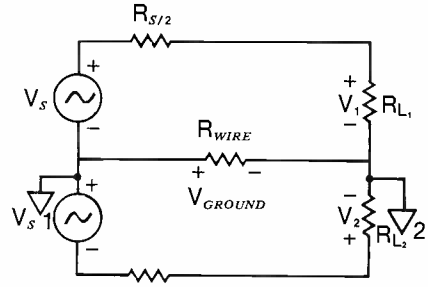


$$V_1 = V_S + V_{GROUND}$$
$$V_2 = V_{GROUND}$$
$$V_1 - V_2 = V_S$$

Figure 3. *The ground-loop noise can be canceled by amplifying both the high side and ground side of the source and subtracting the two.*

the hum will be reduced, but it is difficult to get an adequately low resistance.

By amplifying both the high side and the ground side of the source and subtracting the two, it is possible to cancel the ground loop noise (see Figure 3). This is the basis of a *differential input* circuit. Unfortunately, the cancellation runs into trouble when the source impedance of the unbalanced source is taken into account.



$V_1 - V_2 = 2V_S$

Figure 4. *A balanced source where the amplitude error is eliminated.*

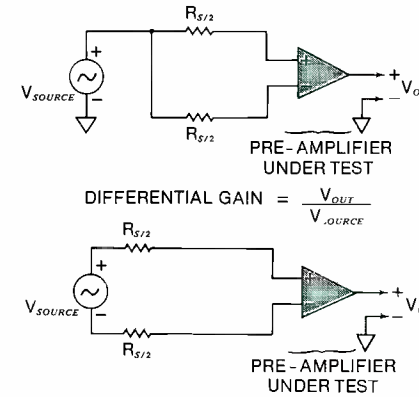


Figure 5. *Illustration of common-mode rejection ratio (CMRR).*

One side of the line will have a slightly lower amplitude because of the attenuation of the source impedance.

By creating a signal that is out of phase with the original, you can make the source balanced and eliminate this error, as shown in Figure 4. An added benefit is

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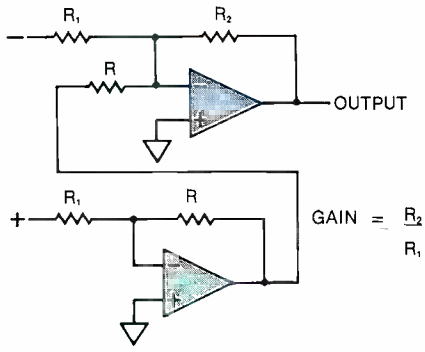

Figure 6. Without adjustments, this circuit will provide about 50dB of CMRR.

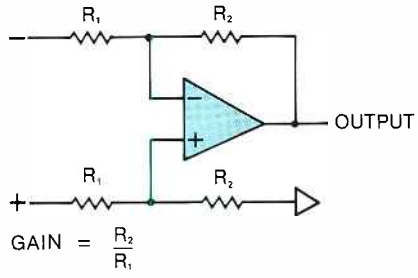

Figure 7. The simplest and least expensive active-balanced single op-amp circuit. Performance depends on resistor-matching and the balance of the source impedance.

that for a given maximum output voltage from the source, the signal voltage is doubled over the unbalanced case.

CMRR

The measure of how well an input rejects ground noise is called the *common-mode rejection ratio* (CMRR). (See Figure 5.) If a differential input is used to reject noise, the desired signal is applied between the plus and minus amplifier inputs. The amplifier will have a certain gain for this signal condition, called the *differential gain*. Because the ground-noise voltage appears on both plus and minus inputs simultaneously, it is common to both inputs.

The amplifier subtracts the two inputs, giving only the difference between the voltage at the two terminals at the output. The gain under this condition should be zero, in practice, but it is not. CMRR is the ratio of these two gains in decibels. The larger the number, the better. For example, a 60dB CMRR means that a ground signal common to the two inputs will have 60dB less gain than the differential signal. If the ground noise is 40dB below the desired signal level, the differential input will make it 100dB below (the desired signal level). However, if the noise is already part of the differential signal, the CMRR will do nothing to improve that signal.

Common-mode range is a specification of the largest common-mode signal that can be handled at the input without clipping or other malfunction. Virtually all active input stages are adequate in this parameter, being able to handle several volts of common-mode signal. If the common-mode signal is higher than this, the system grounding is grossly inadequate. However, with 1V of common-mode signal, the CMRR of a typical active input (about 60dB) will not provide adequate signal-to-noise ratio. In this situation, it's time for a transformer.

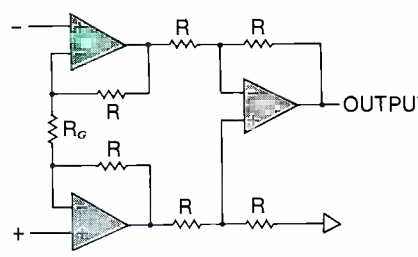

Figure 8. The two additional op-amps create an instrumentation-grade input circuit.

Active-balanced input circuits

One approach to active-balanced inputs is shown in Figure 6. The positive input is buffered and inverted by an inverting op-amp stage. This signal is then added to the signal from the negative input in a second inverting amplifier stage. Any common-mode signal on the positive input has been inverted and will cancel when it is added to the negative input signal. Both inputs have the same impedance and can be easily protected from overloads because of the large input resistor. The matching of resistors limits the CMRR to about 50dB without adding adjustments. With the addition of an adjustment, it is possible to achieve 80dB CMRR, but component aging will degrade this substantially over time.

The most simple and least expensive active-balanced input is the single op-amp circuit. (See Figure 7.) For a unity gain stage, all of the resistors are made the same value. This circuit presents an input impedance to the line that is different for the two sides. The positive input impedance will be twice that of the negative input. This does not cause a problem except in applications in which many of these inputs are paralleled. The CMRR is dependent on the matching of the four resistors and the balance of the source impedance. The noise performance of this circuit, which is usually limited by the resistors, is a trade-off between low loading of the line and low noise.

Adding a pair of buffer amplifiers before this circuit results in an *instrumentation* grade input, as shown in Figure 8. The input impedance is increased greatly, and source-impedance effects are eliminated. Additional noise is introduced by the two added op-amps, but the resistor noise usually can be reduced by dropping impedances, causing a net improvement in noise. Adding resistors to the input stage makes it possible to add gain while maintaining the low-noise performance. This gain also increases the CMRR by the same amount of the gain in decibels. However, the amount of gain that can be used is limited by the line level and the clipping point of the op-amp.

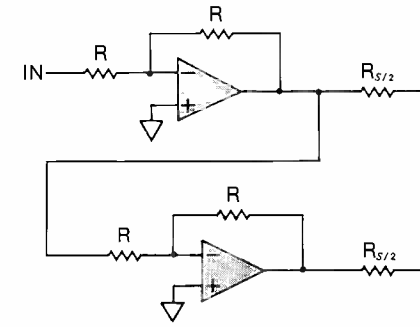

Figure 9. This simple balanced output can produce about 20V, double that of an unbalanced output.

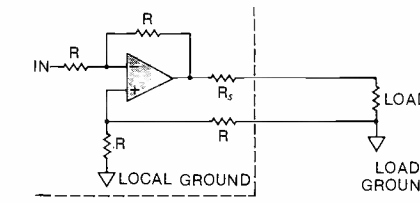

Figure 10. The remote ground-sensing output should not be used when driving long lines or parallel loads.

Active-balanced outputs

Early equipment with active-balanced output stages used the approach shown in Figure 9. The signal was buffered to provide one phase of the balanced output signal. This signal was then inverted with an op-amp inverter to provide the other phase of the output. The outputs were taken through two resistors, which are half of the desired source impedance. Because the load is driven from between the outputs of two op-amps, the maximum output voltage is about 20V, double that of an unbalanced output. This circuit works reasonably well if the load is always balanced, but it suffers from two problems.

The first problem arises when unbalanced loads are being driven or when one side of the signal is inadvertently shorted to ground. If the negative output is shorted to ground by an unbalanced load connection, the first op-amp is likely to distort. This produces a distorted signal at the input to the other op-amp. Even if the circuit is arranged so that the second op-amp is grounded by unbalanced loads, the distorted output current probably will show up in the output from coupling through

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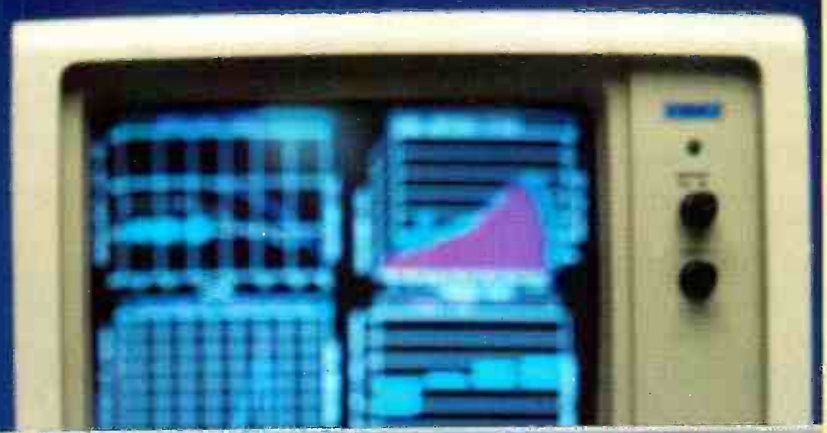

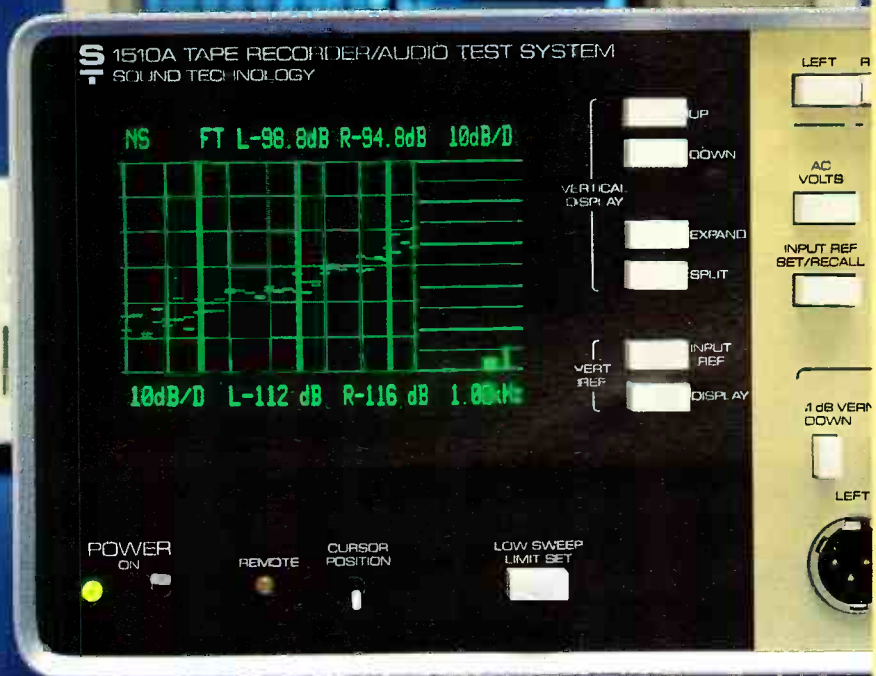

THE SOUND TECH 1510A AUDIO TEST SYSTEM

Until recently, most Audio Test Systems have been either manual stand-alone systems or external-computer driven automated systems.

Engineers have long enjoyed the portability, ease of operation and cost effectiveness associated with manual stand-alone systems. Unfortunately, these systems have always lacked speed and documentation capabilities.

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grounds or circuit board traces. Equipment that uses this type of balanced output often provides a second set of output jacks, which are wired to only one amplifier for unbalanced applications.

The second problem is that the output *does not float*. If any voltage difference (power-line hum) exists between the local ground and the ground of the device receiving the signal, it will appear as an addition to the signal. The only ground-noise rejection will be from the CMRR of the input stage at the receive end.

A few companies offer unbalanced outputs that sense ground at the load and attempt to reject hum voltage. A schematic of such an arrangement is shown in Figure 10. This type of circuit often encounters problems when driving long lines. However, in short interconnect situations the circuit can work well.

These circuits do not lend themselves to driving several loads in parallel, because there is no longer a single remote ground to sense. They also have a problem patching into other devices because the load must be unbalanced, and the ground must be isolated from the patchbay or system.

Several manufacturers now are offering electronically balanced and floating outputs on their products. The basis of these designs is shown in Figure 11. The circuit consists of two operational amplifiers, which are cross-coupled with positive and negative feedback. The output of each amplifier is dependent on the input signal and the signal present at the output of the other amplifier. These designs may have gain or loss depending on the selection of resistor values. Also, the output impedance may be set via appropriate selection of resistor values. Some resistance is needed from the output to ground to keep the output voltage from floating to one of the power-supply rails.

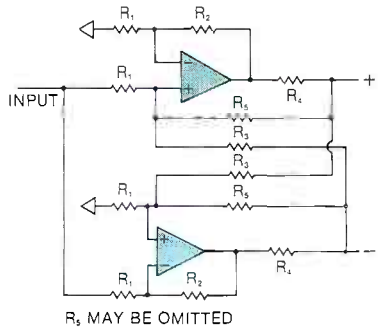

Figure 11. *An electronically balanced and floating output can exhibit bandwidth performance superior to that of a transformer.*

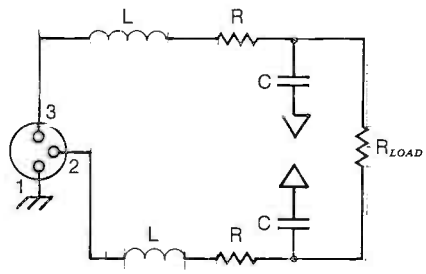

Figure 12. *A typical input RFI-rejection filter. Note that the inductors are sometimes eliminated because of cost or susceptibility to noise pickup.*

Because of the added resistors to ground and any output ac coupling, the impedance from the output to ground is not infinite. This reduces, but does not eliminate, the coupling of ground noise. If care is not taken with device compensation, stability problems also may result.

Designing the output stage with a gain of two allows the signal to drive balanced loads to approximately 20V from standard op-amp supplies, as with the previous circuit. However, when unbalanced loads are used, the voltage swing is limited to one-half this value before clipping occurs.

If the circuit is designed for unity gain, it will not clip until the circuits driving it clip, but the output voltage is halved.

Main story continues on page 54

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Zeus processor (left), TBC-7 (front)

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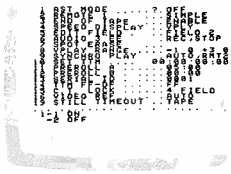

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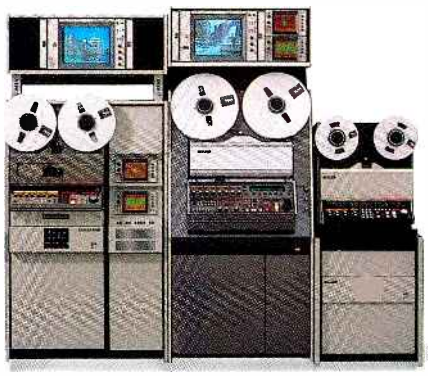

(left to right) VPR-6, VPR-3, VPR-80

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System noise

By Terry Pennington

In electronic circuits, noise is being generated in all conductive elements regardless of whether a purposeful signal is applied to the system. Consider the hiss you hear on an input channel when the gain is raised to a normal operating level. This noise is an amplified version of the random electron activity, *thermal noise* taking place in the components at the input of the channel and all successive gain stages.

These components include anything in the dc portion of the circuit such as resistors, transistors, wire, vacuum tubes or whatever else has been included in the paths of inputs. Usually, ac components (capacitors) are not included in the noise equation unless they are operating as something other than a pure capacitance, which sometimes happens with capacitors that are improperly applied.

Once the thermal noise at the input stages of the amplifiers is established, it is amplified (multiplied) by the gain of all succeeding amplification stages. In a normal microphone to line-level situation, as much as 80dB of gain may be present. As a result, the noise developed at the input could increase by 10,000 times.

In practice, the input noise of a good amplifier may be as low as 3nV to 4nV (10^{-9}V) times the square root of the bandwidth (usually 20kHz), which yields a noise level of about 0.5μV (10^{-6}V) over the audio range. Multiplying this number by 10,000 (the gain of the pre-amp) yields a noise level of 5mV (10^{-3}V). This level, by any standard, represents a lot of noise and is unavoidable.

Pennington is director of technical marketing and product development at Rane Corporation, Mountlake Terrace, WA.

Active noise

The two types of noise, passive and active, are both important in terms of equipment design. For this application, however, the noise that causes the most concern almost always lies in the active components or even in the device's basic design philosophy.

The most common gain block used in modern processing equipment, the operational amplifier, has an *equivalent input noise* specification that supplies the required information to indicate how much noise will be applied at its input. The amount of noise present is a function of the conductive density of the input stage, just as it is with the density of a passive component.

In resistors, the higher the conductive density, the lower the noise that follows with a lower resistance. High densities create less noise than low densities. An operational amplifier may be designed in such a way that the physical area of the transistors is larger and operated at relatively high current to reduce the amount of noise generated.

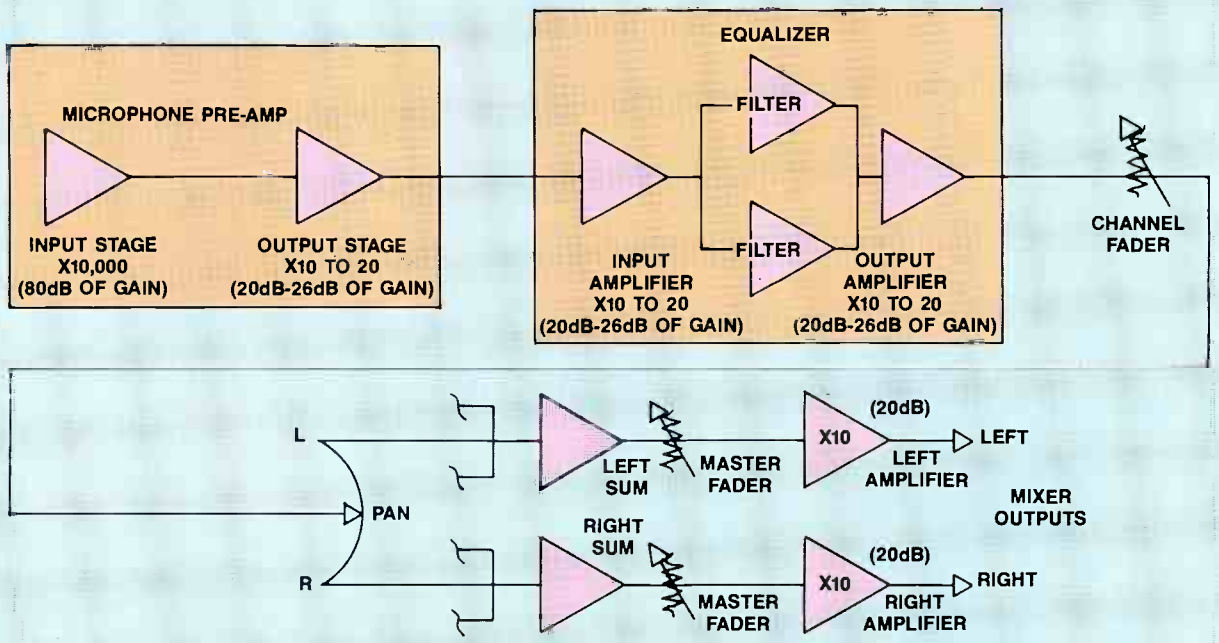
The same sort of trick has been used in discrete amplifiers for special applications, such as instrumentation pre-amps and moving-coil phonograph cartridge amplifiers. In these cases, many small-geometry transistors are connected in parallel to effectively increase the area and, therefore, the density of the active elements. This has the same effect as one large transistor.

Noise in practice

The net impedance (resistance) at the input of a microphone pre-amplifier has a great deal to do with the ultimate noise performance of the amplification process. The microphone's impedance ends up paralleling the input impedance of the pre-amplifier, thereby reducing the overall impedance to a level that is low enough to guarantee satisfactory noise performance.

Let's look at an example microphone pre-amp with an unloaded input impedance of 10kΩ. With nothing connected to this input, and the gain raised to its maximum, a great deal of noise probably would be present.

One reason for this is the inherent noise of the elements in the input stage as they rub their electrons together. The second noise source is the hum fields and radio signals that enter the system through this unterminated high impedance. This noise is amplified to an audible level by the time it reaches the out-



Simplified block diagram of an audio mixer, showing points in the signal flow where noise is amplified.

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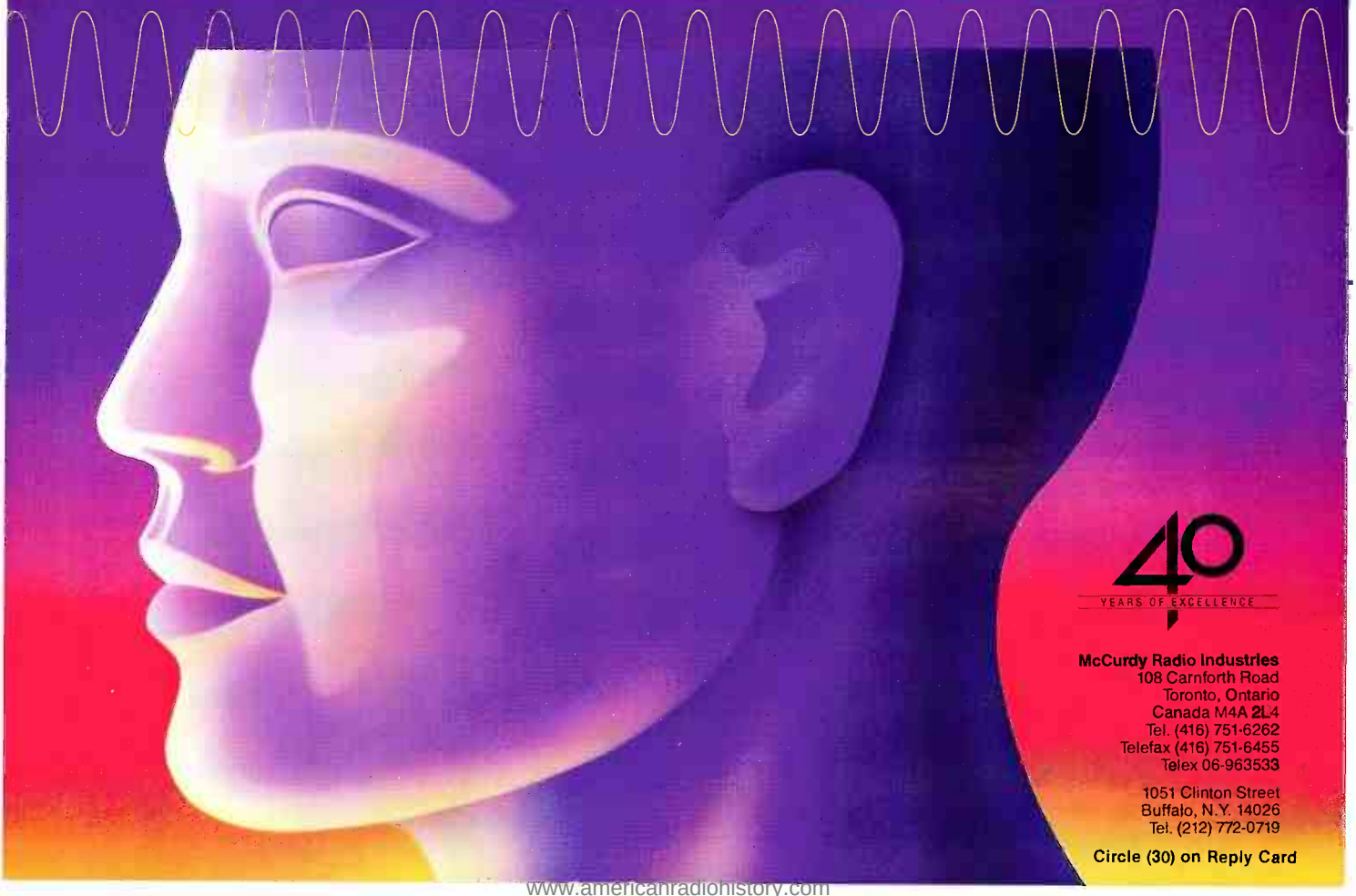

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put. High impedances make great antennas for all manner of undesirable background noises.

To prevent these problems, avoid high impedances at all costs. It is safe, however, to allow high impedances to exist if they will be reduced by external means when the circuit is in actual use.

Most amplifier inputs have fairly high impedance when open, and for a good reason. It is assumed that a low-impedance source will be connected to the input, which will lower the net result and improve the noise performance. If the input impedance were low to begin with, the input would load the source and reduce the level at that point. This is not a good idea because the loss incurred must then be compensated with extra gain, which, in turn, raises the noise.

Example case

Let's consider the example of a 600Ω source driving a 600Ω input. When this occurs, exactly one-half the signal voltage will appear across the source and the other half across the input. Because the signal across the input is all the amplifier can see, half of the signal is effectively lost.

If the input impedance is 10kΩ, the vast majority of the signal will appear across the 10kΩ, with only 5% of the original signal remaining across the 600Ω source. This equates to a loss of only −0.5dB, as opposed to −6dB with the input impedance set at 600Ω.

All the concepts that can be applied to microphone inputs can be expanded to include line-level inputs and gain structures. The most basic rule is to provide all outputs with as low an impedance as possible and, conversely, to ensure that all inputs are at as high an impedance as possible. Doing so will ensure minimum signal loss (requiring less make-up gain and, therefore, less noise). It also will ensure that the net input impedance of each gain stage will be as low as possible to minimize thermal noise and induced pickup of extraneous signals.

Main story continued from page 48

Aside from these minor problems, the circuit works well and can exhibit bandwidth superior to that of a transformer output stage at significantly lower cost.

Interfacing problems

Susceptibility to radio-frequency interference (RFI) is a common problem with active-balanced inputs. Strong radio signals often can be rectified by non-linearities in the input operational amplifiers or transistors. Although wideband, low-distortion circuits will be less prone to this problem, they are not immune to it. Therefore, any signals that are outside the range of the active circuits must be filtered out before they are inadvertently demodulated. To reduce the problem, most manufacturers add small series resistors and capacitors to ground at the input terminals.

Inductors also may be added, but they are susceptible to external magnetic fields. If package shielding is inadequate, the inductors may pick up as much garbage as they are supposed to filter out.

Toroidal inductors usually will reduce substantially the pickup of external signals. A schematic of a typical input RFI-rejection filter is shown in Figure 12. For the reasons just cited, and because of cost, the inductors often are omitted.

Consider the application

The clipping point of active-balanced inputs and outputs is not always what you might expect. The active-balanced output stages discussed previously can deliver as much as 20V into a high-impedance balanced load. However, when the stages are unbalanced, the maximum output is cut in half. The maximum output specifications of any product you intend to use should include the conditions under which the level must be reduced and the amount of reduction for unbalanced operation.

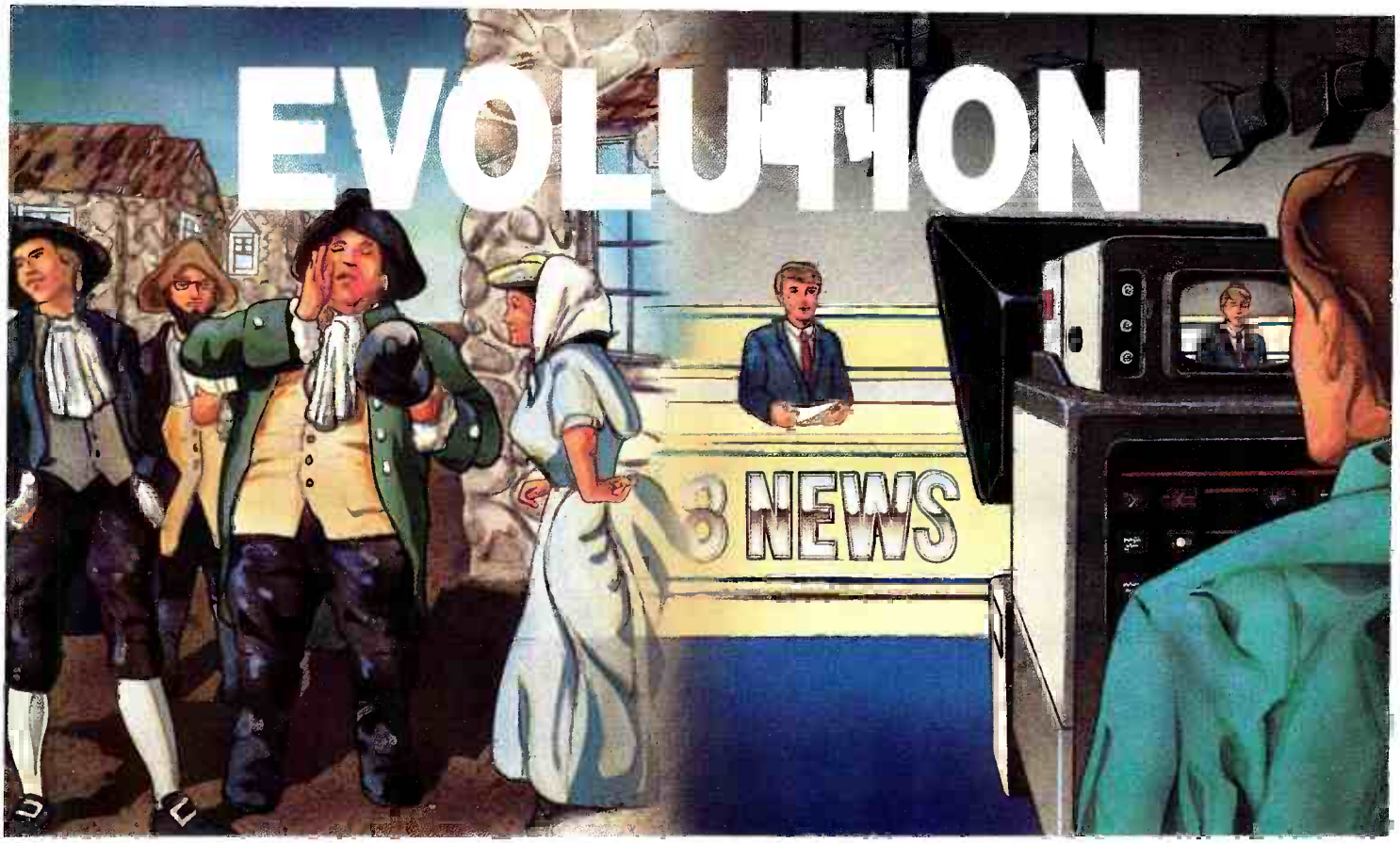
Output floatability often is unspecified in actively balanced and floating outputs. When a remote power amplifier is being driven, such as in a large studio complex or for a remote broadcast, a large potential difference may exist between the equipment chassis. This problem often is the result of the equipment being on different phases of the power line.

A transformer floating output will have a small capacitance from the center tap of the balanced line to ground and will induce a little 60Hz common mode onto the line. An active-balanced and floating output, on the other hand, has an impedance from each output to ground, typically several tens of thousands of ohms. This induces a common-mode potential between the chassis, which must then be rejected by the CMRR of the balanced differential input.

Mixing balanced and unbalanced outputs and inputs can be done if care is taken in planning where signals go and how wiring is to be performed. It's important to remember that the ground of one device is not quite the same as the ground of another.

The biggest problems will arise with patchbays because all outputs and inputs can be thrown together in potentially random order. In this situation, it is best if all inputs are of one type and all outputs are of another type. Otherwise, one repatching of an effects device can destroy the S/N of the entire system.

Although active-balanced I/O circuits are not as good as transformers for rejecting ground noise and RFI, they usually are adequate if well-designed. Because of their advantages in cost, weight and low distortion, they are generally the best choice for a circuit in all but the most difficult situations. |:-)))|



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The audibility of electronics

By John Eargle

Does a $6,000 stereo amplifier necessarily sound better than a $600 model?

It's not always easy to separate myth from reality, but it's a must when you're making sonic judgments of electronic hardware. Controlled listening tests generally lead to the conclusion that differences are minimal between devices with similar specifications—as long as all equipment is operated below its clipping points. However, "human factors" can greatly affect the evaluation of electronic hardware. This article will help you sort through these factors and will include test setups to help you accurately determine your audio equipment needs.

Eargle is president of JME Consulting Corporation, Los Angeles.

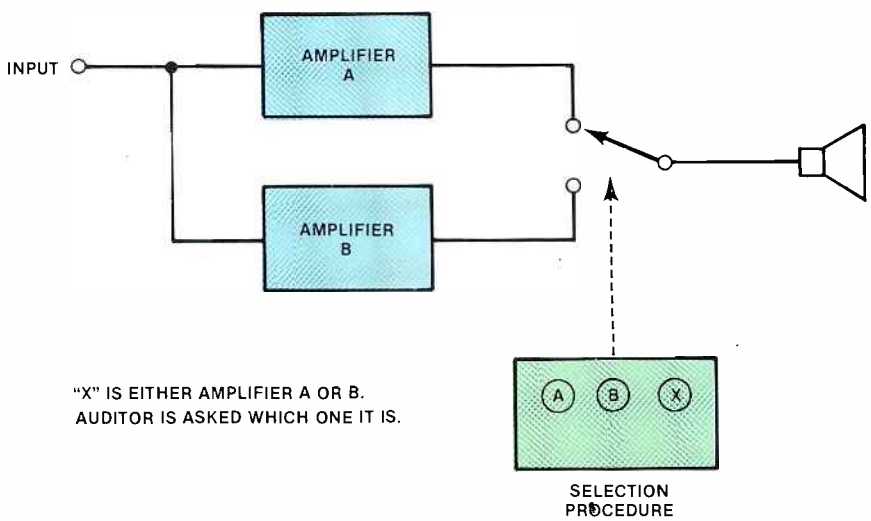

Figure 1. Double-blind testing allows station engineers to select audio components based on perceived quality without the bias introduced by packaging or "peer pressure." Setup here is for amplifier selection.

Do the ears have it?

The listening experiences that take place in a professional audio dealer's demo room are usually quite different from those that occur in a high-end hi-fi store. The pro audio demo room is visited by recording and production engineers who are concerned with a large palette of sound differences, from microphones to equalizers, limiters, compressors and, of course, consoles. And, although engineers are certainly concerned with the sound of a new piece of equipment, they may be just as interested in its ease of operation, maintainability, reliability and stability during a long recording or editing session.

When evaluating power amplifiers, for instance, engineers may be inclined to take the matter of sonic characteristics on faith, believing that the unit's specifications more or less tell it all. Also, they may consider any sonic differences between amplifiers to be a good order of magnitude less than those that result from microphone choice, microphone placement and signal processing.

On the other hand, the hi-fi store deals with a simple transmission chain, consisting basically of source, pre-amp and power

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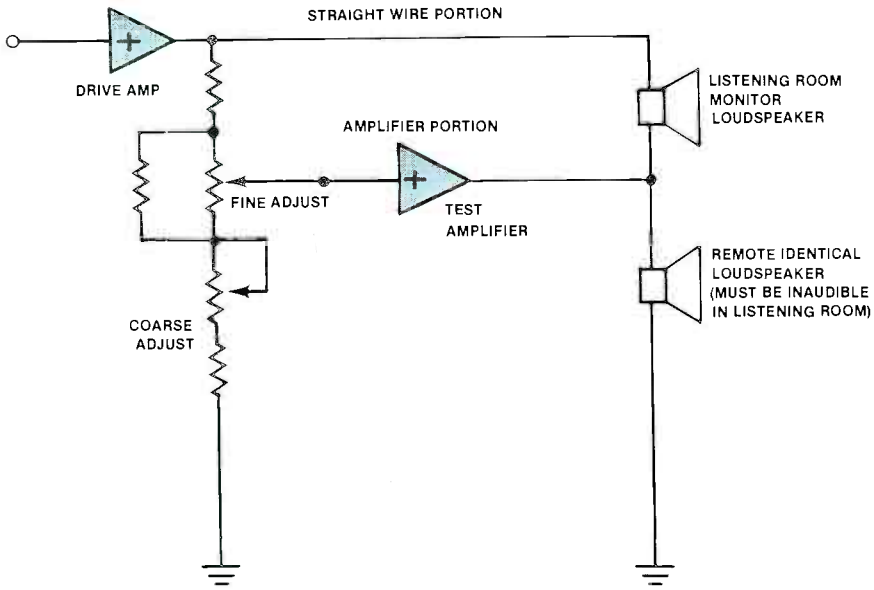

Figure 2. *The "Hafler straight-wire differential test" audibly tests for distortion by nulling out common signals between the two amplifiers. Residual signal to speaker is error or distortion.*

amplifier. It is worth noting, however, that many of the developments taking place in high-end consumer audio have found their way into pro audio systems. Many studios routinely specify exotic consumer amplifiers to power monitor loudspeakers, and the current interest in high-grade cabling and hookups had its origins in the hi-fi world. High-grade consumer loudspeaker systems have had a noticeable impact on classical recording.

Going beyond power amplifiers, what sonic differences might exist between different microphone pre-amps, or between straight-through, line-level input/output paths through consoles of similar architecture but different manufacture? Where measurable differences exist, you would expect some listeners to hear them some of the time. But it is surprising how much distortion goes undetected by many listeners.

A proper test environment

Too often, power amplifiers are compared under informal, subjective conditions. In a typical dealer showroom, whether professional or consumer, an amplifier may be auditioned for 15 minutes. It is then removed and replaced by another amplifier. The listeners usually know which amplifier is which, and they are often unanimous in judging sonic characteristics. It is a rare listener who admits to hearing no differences.

The problem is that the listeners have expectations that a certain model will sound better, so it does. Even the tactile aspects of an amplifier can heighten that expectation. Extra heft, finely turned metal knobs, big handles and meters may produce this reaction.

What's more, even if none of the listeners have any particular expectations, the

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The critical loudspeaker-amplifier interface

Even after you have selected the right amplifier for your control room, your job may not be over. In the double-blind amplifier tests mentioned in the main story, the loudspeakers used presented a fairly smooth resistive load to the amplifiers. However, conventional studio monitors may be quite different. Because of the relatively high efficiency of the monitors, the motional impedance curve may show the effect of considerable load reactance.

At the AES convention in November 1986, Stanley P. Lipschitz and John Vanderkooy presented a paper entitled "Computing Peak Currents Into Loudspeakers." What they and others have noted is that under certain transient-drive conditions, a loudspeaker may actually present an effective *resistive* load to an amplifier that may be less than *one-half* its steady-state impedance minimum value.

In particular, they measured a theater loudspeaker system with a rated impedance of 4Ω. From their tests, they discovered that the LF section had an actual minimum of 1.48Ω, and the HF section had an actual minimum of 2.4Ω. This is the type of information that an engineer laying out a sound system should have access to, but it's not included in any manufacturer's specification sheet.

The impact of this information is that a system that sounds good on paper may not perform up to expectations. Aside from the egg on the designer's face, expensive hardware could be damaged.

first person to comment on sonic differences tends to sway the whole group.

The testing dilemma can be solved through "double-blind" procedures. With this method, neither auditors nor testers know which of the two amplifiers is playing at the time of the trial. Auditors are asked to identify only differences, not preferences. For example, each auditor may be given an A-B switch and asked to switch back and forth between the two amplifiers, noting any differences between them.

When the auditors are ready for the actual trial, they press a button labeled "X." Amplifier X may be either A or B, and the auditors are asked to determine which it is. After they make their judgments, they go on to the next trial. X is randomly varied between A and B, providing the listeners a fresh approach to each trial. The basic test setup is shown in Figure 1.

The key is that the auditors are listening for differences, *not* preferences. When levels are matched carefully between amplifiers, and when the amplifiers are operated within their linear power limits, then most auditors—skilled or unskilled—fail to reliably detect differences.

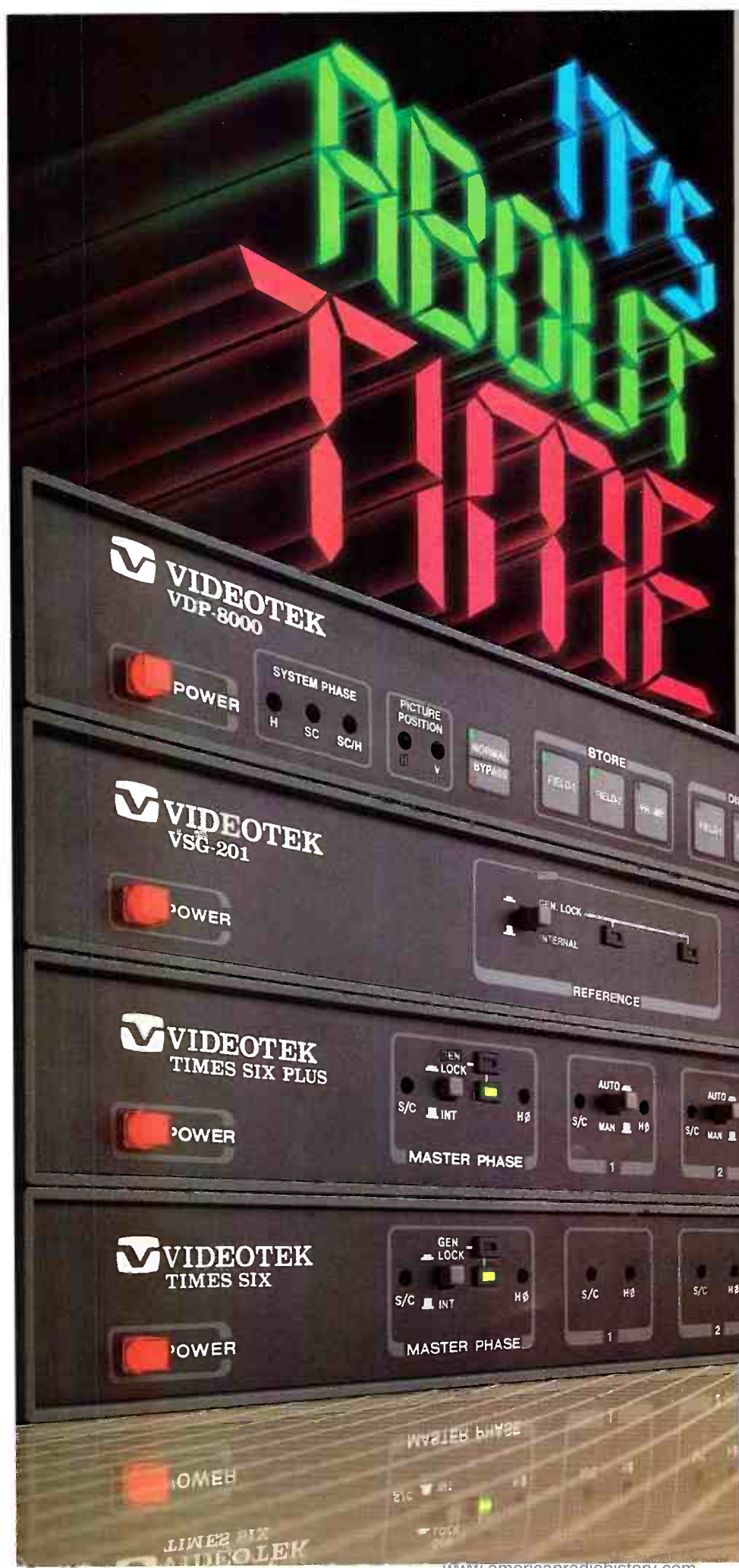
In this type of listening test, conducted by David Clark and Ian Masters, five amplifiers were used, ranging from a low-cost receiver to a pair of highly regarded, expensive mono-tube amplifiers. Between these extremes was at least one amplifier widely used in driving control-room monitor loudspeakers. A total of 25 auditors, on an overall statistical basis, failed to detect differences among the amplifiers. The amplifiers were operated carefully within linear limits so that amplifier overload and recovery were not apparent.

Although no single test is definitive enough to prove that nobody can reliably hear differences, ever, the evaluations made in this listening test are in accord with those from other double-blind tests.

What differences can be heard?

Any slight difference in gain setting between amplifiers A and B in a double-blind test can be spotted easily by skilled audi-

Continued on page 89



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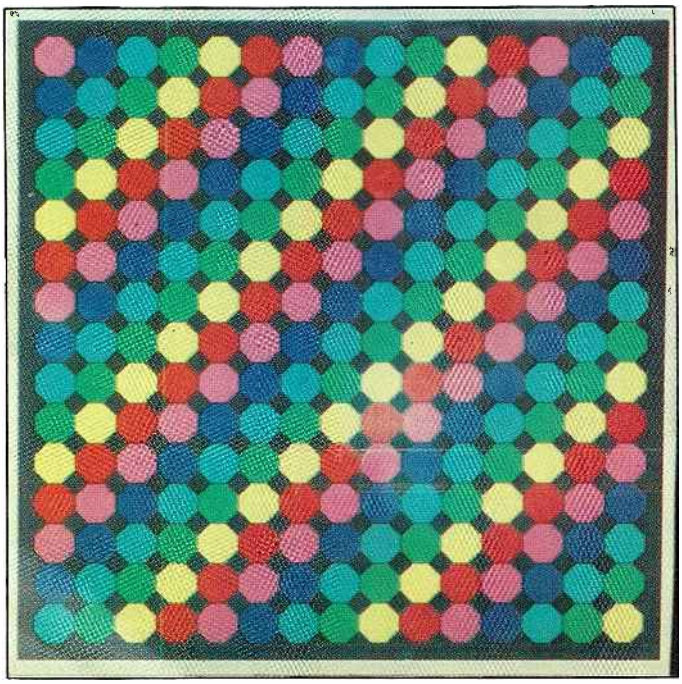

Display technology update

By Rick Lehtinen, TV technical editor

New approaches to CRT and LCD design and construction promise a variety of broadcast applications.

We can see good now. Real good.

The current generation of display devices for broadcast and other video is the best ever. Compared with Farnsworth's home-brewed iconoscopes, Fernseh's real-time telecine at the 1936 Berlin Olympics and the whirling disks of the early color systems, this is truly remarkable display hardware.

Current methods of picture creation and transmission, not the medium of picture display, limit the top side of video technology. As good as the images are, the best screens are now better. Computer-aided design (CAD) work stations, for instance, require incredibly precise monitors. Drafters, who must make lines meet, can't introduce errors because of ambiguity in the display. Whereas video's venerable cathode-ray tube (CRT) was the basis for these advanced display systems, the spin-offs from these high-tech variants are coming home again, making even better monitors available to broadcasters.

The progress is not limited to CRTs. Liquid-crystal technology and video-projection systems are getting better as well. Soon, you might be able to choose from several options to present the pictures you produce. If the last link in the chain—the display device—is not a strong one, then all else is for naught. Let's take a journey to the cutting edge of video display technology.

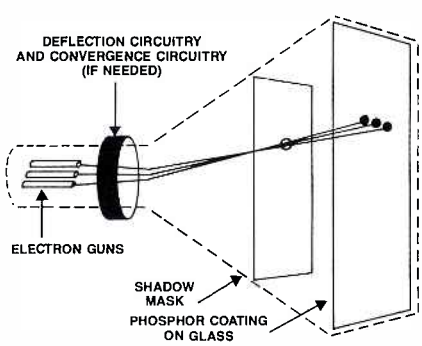

Figure 1. *The basic functions of CRT elements. Electron guns give off electrons that eventually will strike the phosphorus screen, producing light on the tube face. Deflection circuitry directs the beam sweep, and convergence circuitry corrects the beam path, so the dots align. The shadow mask "eclipses" the beam from all but the desired phosphor portion.*

What's new with CRTs?

The CRT works by shooting a stream of electrons through the fields produced by a series of magnets and electromagnets. These fields steer the beam until it splats against the faceplate, causing an array of phosphors to glow with the image to be produced. The electron stream is proven technology, and steering it is tricky, but the manufacturers have become adept at it. The big news in CRTs is in the last few inches before the beam hits the phosphors. Advances in shadow masks and the proliferation of the flat-square tube face are elevating the performance of CRTs.

The shadow mask is a slotted or drilled shield placed just behind the CRT's phosphor-coated faceplate, on the electron gun side. Its purpose is to ensure that the beams produced by each of the electron guns strike only the proper phosphor dots.

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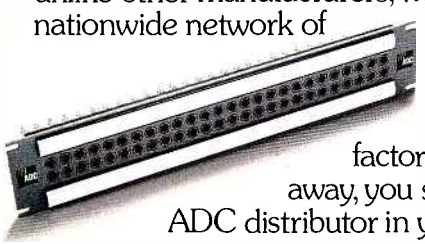

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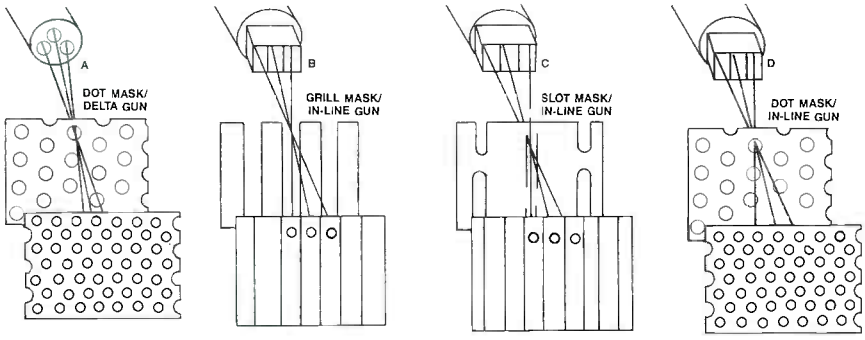

Figure 2. *The four basic CRT configurations. The dot mask/delta gun (a) was pre-eminent in high-end monitors until recently. In the grill mask/in-line gun, known as Trinitron (b), the guns are arranged in a row in the neck of the tube. The slot mask/in-line gun (c) is popular in TVs and lower-end monitors. The dot mask/in-line gun (d) is the current standard in high-end monitors for video and computer graphics.*

The manufacture of such a screen is a precise operation, and over the years, it has become more so as the *pitch* of CRTs (the space between dots on the screen or holes in the mask) gradually has tightened, allowing more dots per screen.

The shape of the mask and screen has evolved too. The flat-square tube face is now available. Previous tube designs had a gentle curve to them, a compromise between the needs of the electrons to have a constant radius arc from the guns to where they converge on the tube face, and the needs of the viewer to be able to see a complete image from one position. Advances in convergence circuitry gradually have allowed the screen to be unwrapped, and convergence circuitry now is available that compensates for a flat faceplate.

As the tube pitch increases, and the faceplate flattens, it becomes necessary to adjust the shadow mask as well. The shadow mask must be suspended precisely in front of the phosphored faceplate. If the mask changes shape when the CRT heats, the hardware that suspends it must compensate to prevent a phenomenon known as "thermal doming," in which the mask deforms because of temperature and misaligns itself. A new method of CRT construction known as *corner suspension* provides such compensation while delivering significantly better microphony characteristics and lighter construction. This not only reduces the weight of the picture tube, but also allows the mask assembly to be manufactured economically with better materials. Several other manufacturers are beginning to produce corner-suspension CRTs.

The right gun for the job

As the quality and construction of the CRT evolves, it becomes important to know the advantages of each type available. In this way, you can optimize your equipment purchases, matching the CRT to the application. Ask yourself these questions:

- What screen size is needed?
- What inputs are needed? (One, two or three NTSC inputs? Is an RGB input necessary? What about remote input switching?)
- What are the monitor's sync and termination requirements?

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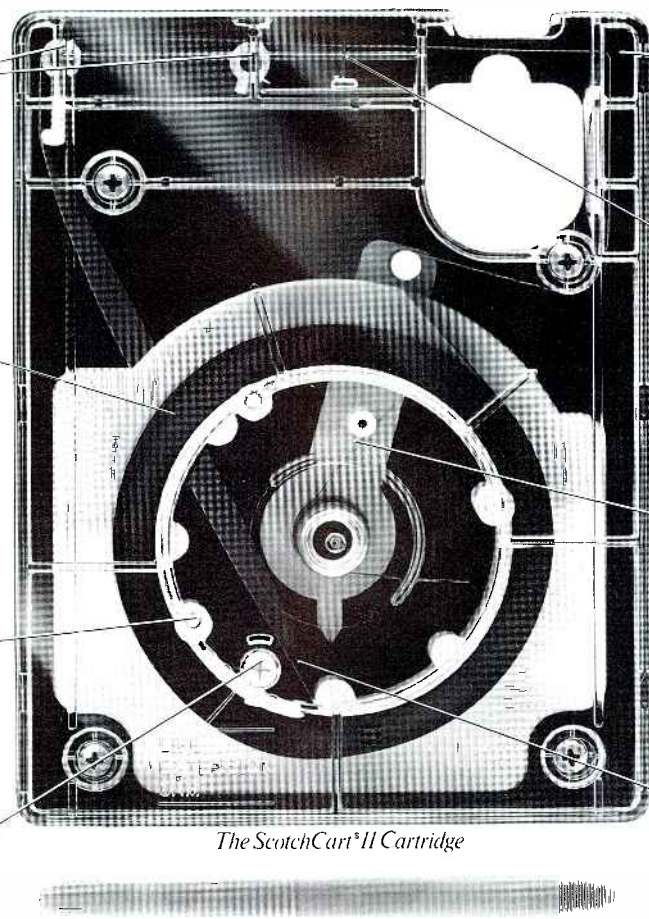

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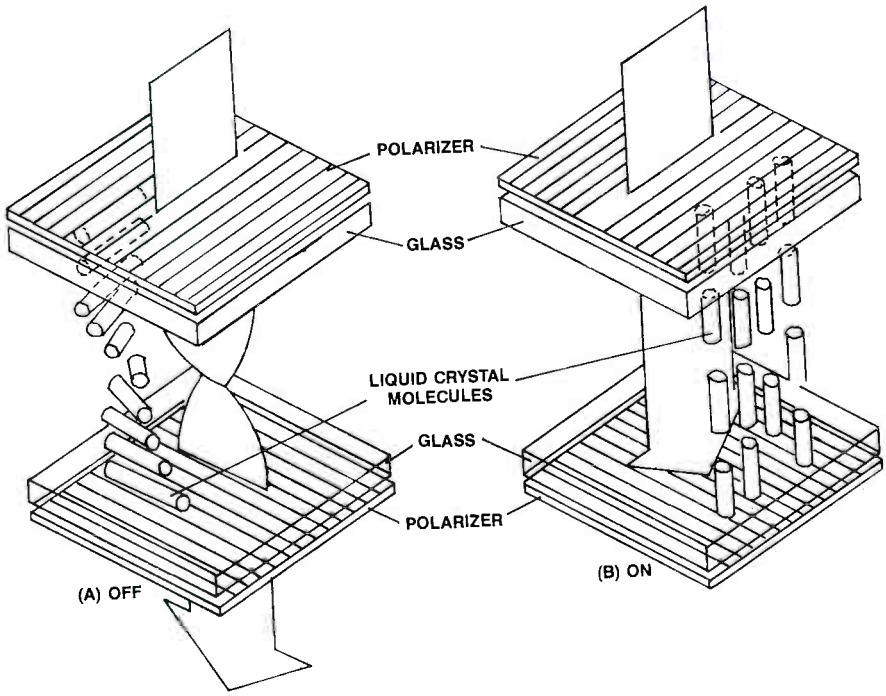

Figure 3. *In a twisted nematic display, incoming light is first passed through a polarizer. The liquid-crystal material, sandwiched between glass, rotates the polarized light 90°. Light then passes through a second polarizer and out to the viewer. If the cell is turned on, however, the liquid-crystal molecules align themselves in a perpendicular orientation. This allows light to pass without rotation, so it is blocked by the second polarizer.*

•Are pulse-cross display, individual color-channel selection or underscan capabilities needed?
•What resolution is required?
•What CRT structure would be most appropriate?

CRT performance

The architecture of the tube determines CRT performance. Two principle factors are the placement of the electron guns and the structure of the shadow mask. (See Figure 1.) Following are descriptions of the four major CRT configurations. Each of these architectures is shown in Figure 2.

•*The dot mask/delta gun*

A mature technology, it is being discontinued this year. In a delta-gun CRT, the three electron guns are placed like the three points of an equilateral triangle (resembling the Greek letter Delta). Unfortunately, this triad arrangement causes each gun to have a different parallax error on the screen, requiring complex dynamic convergence circuitry to get all three beams to land together on the tube face. Manufacturers frequently install active convergence circuitry to allow fine adjustment. Because of the popularity of this

Continued on page 72

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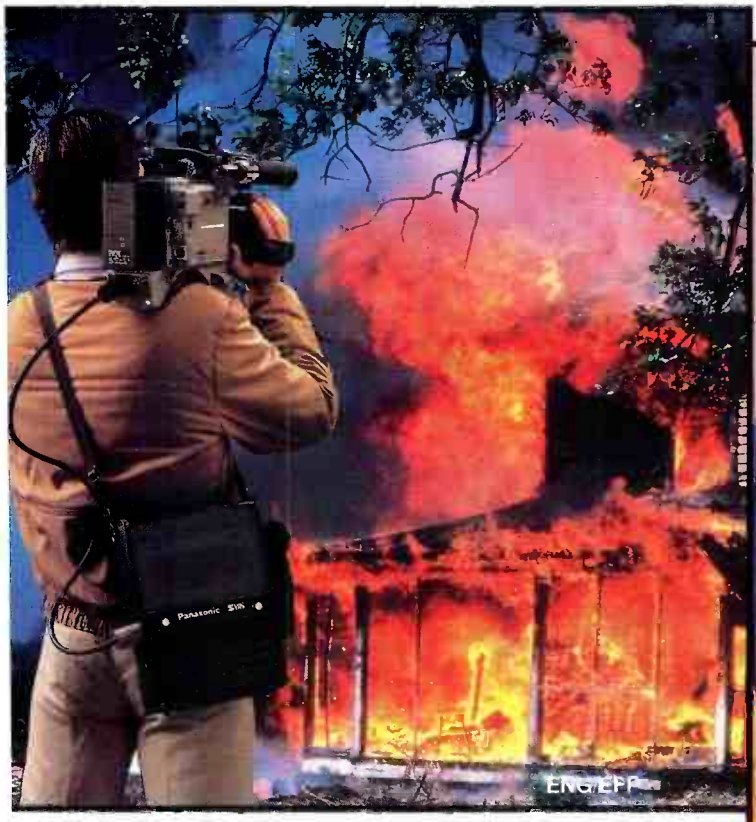

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Continued from page 68
type of CRT, monitor alignment is a familiar activity in many engineering departments.

•The grill mask/in-line gun

In this popular system (Trinitron), the guns are arranged in a row in the tube neck. These tubes produce an extremely bright picture with good contrast. However, some engineers think that, although the picture may be eye-pleasing, this type of CRT has a tendency to mask noise. Some also say that it is difficult to make technical judgments because the saturated colors it can produce are visually deceiving.

•Slot mask/in-line gun

This CRT is used in consumer TVs or lower-end monitors, where broader pitch (distance between pixels) can be tolerated. The CRT's yoke and fixed convergence ring are adjusted by the manufacturer for best performance, then sealed. This tube is quite bright because the mask has slots instead of dots, allowing more electrons to land on the phosphors.

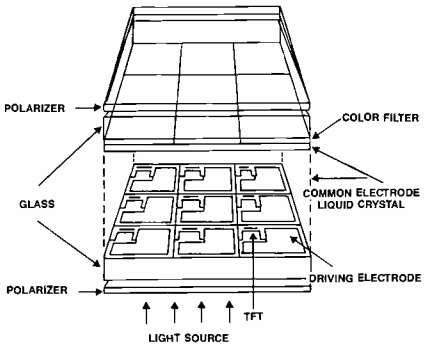

Figure 4. *In a color LCD display, shown here using thin-film transistors, a semiconductor device printed onto the glass substrate holds a charge on the driving electrode for the duration of the refresh cycle. Light passes through a cell, then through a colored gel that determines its output color.*

•Dot mask/in-line gun

This is the most popular CRT architecture in the professional video and computer graphics market. The dot mask gives better resolution than the slot mask. Although this configuration has the delta gun/dot mask resolution capabilities, no dynamic convergence is needed. Improved performance of deflection yoke technology allows convergence accuracy within 0.3mm-0.5mm tolerance levels. The CRT's yoke and convergence ring are factory-set, then sealed.

Although the CRT is an important factor in monitor selection, it certainly is not the only one. The monitor's price and reliability, ease of service and the availability of replacement parts, as well as the reputation of the manufacturer, all must be considered.

Will LCDs displace CRTs in video and HDTV?

Concurrent with advancements in CRTs, liquid-crystal displays (LCDs) also have been going through a series of refinements. The most recent devices use thin-film transistor (TFT) technologies to make full-color pictures with at least twice the effective resolution of standard video monitors. The impetus for LCD displays are obvious: A flat package display needs a smaller box, and the highest voltage needed in a liquid-crystal system runs a light bulb.

A bit of background

Liquid-crystal material is an organic liquid with some of the optical properties of a crystal. When a voltage is applied to liquid-crystal material, the alignment of its molecules is affected. Different alignments affect light in different ways. Electrically controlling the phase of liquid-crystal material can control the flow of light

through it.

Most of today's LCD devices are of two types: *guest host* (GH) and *twisted nematic* (TN). In GH displays, a dye is dissolved in the liquid-crystal material. This dye blocks and passes light, depending on the orientation of its molecules. Electrically controlling the liquid crystal controls the alignment of the dye molecules as well. GH displays have wide viewing angles, high brightness and good color brightness. They often are used in automotive applications.

Twisted-nematic displays are now the most widely used type of LCD (see Figure 3). They have low operating voltage requirements and consume little power (as low as 0.1W per pixel). A twisted-nematic LCD is so called because the liquid-crystal agent inside is layered in such a fashion that it gently twists rays of light 90° as they pass through, when the current is off. When voltage is applied, the molecules realign themselves, and there is no rotation.

Light enters a TN cell through a polarizer. It leaves through another polarizer set at right angles to the first. If the current is off, the polarized incoming light is rotated by the crystal so it can pass through the second polarizer with little attenuation. When the crystal is energized, it provides no rotation, and the light is blocked by the second polarizer. Most LCD displays suitable for video are of the TN type.

Video LCDs

In a typical CRT, such as the ones used in TV receivers, about one-quarter of a million pixels are addressed with color and gray-scale information 30 times each second. Illuminating any given pixel is primarily a matter of timing. In a flat-panel display, each pixel has a row-column address. A matrix of 480 rows by 500 columns—about equal to a TV set—requires 250,000 individual addresses. A system of direct addressing, using an individual wire for each pixel, would be virtually impossible unless the display was the size of a billboard. Clearly, a system of matrixing is required.

Because of crosstalk and other problems, however, adjacent pixels are likely to receive a fraction of the control voltage and become slightly energized. Partially turning on undesired pixels in this manner adversely affects the contrast ratio of the display. Time-division schemes are used to limit this effect, but they lower the duty cycle of the cells, causing other contrast problems.

The best solution to date involves implanting a thin-film transistor on the substrate near each cell. As the address lines activate a given cell, the TFT holds the charge, stretching out the duty cycle. The charge finally decays, and the cell dims just as the address cycle comes

around again. If the cell is not needed, it remains inactive. If it is needed again, it takes on the charge required to last it through the next cycle. A high-resolution version of such a device was introduced recently. With a little more than six inches to a side, it has more than a million pixels and can provide twice the resolution of current TV screens.

About LCD color

So how does an LCD provide color? The answer is simple: the same way as a lighting director on a studio set. (See Figure 4.)

Laid out in rows and columns, the individual LCD pixels are addressed individually by the addressing matrix. In a color system, one-third of the pixels are covered by a gel that passes red light, one third are gelled for green, and a third for blue. Colors are formed by mixing each of the primaries in a desired proportion for each group of three pixels.

Of course, a good white light is needed behind the liquid-crystal screen. Most systems use a fluorescent light source. It may be operated in a starterless configuration to increase reliability, and it may be RF-driven, operating at about 20kHz.

Future trends

LCD technology is advancing. Expect to see greater density, hence higher resolution. In fact, new systems already have been demonstrated in which the liquid-crystal medium is ferromagnetic. Called "smectic C" crystals, the molecules are aligned by a pulse of current, and they stay aligned until they receive a new pulse. This promises greater densities, because no device is required to hold the cell in a given state. Furthermore, the cells do not need to be refreshed because internal forces lock their molecules in position.

Will LCDs ever bump off the venerable CRT as the display medium of choice? The answer is a resounding maybe. CRT advances portend better performance in the future, and for applications in which the power and size requirements of CRTs don't prohibit their use, they will probably be fixtures for a long time to come. For applications requiring a cool and thin-packaged monitor, look to LCDs as an emerging force.

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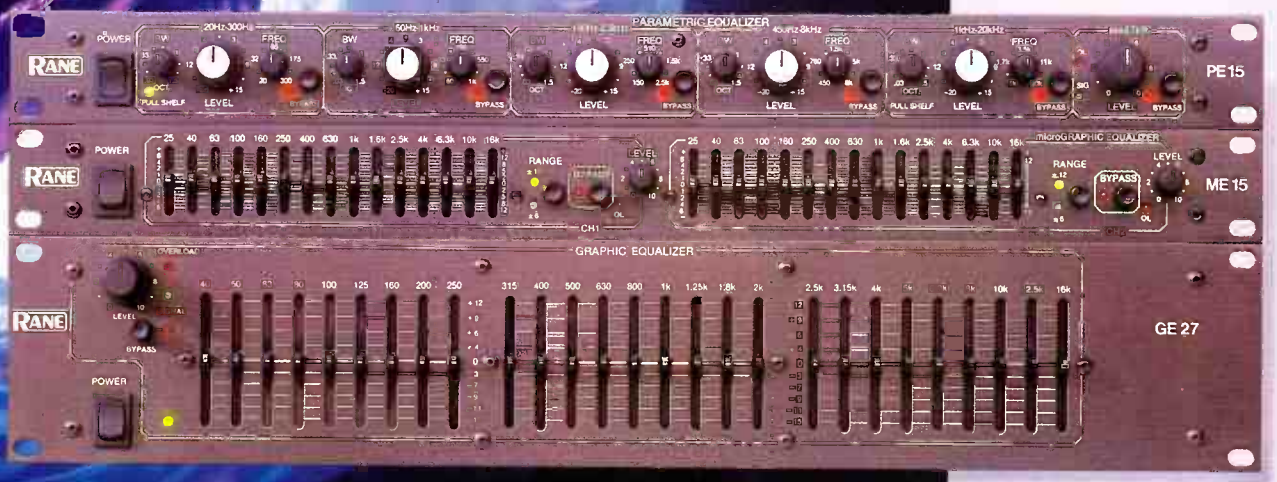

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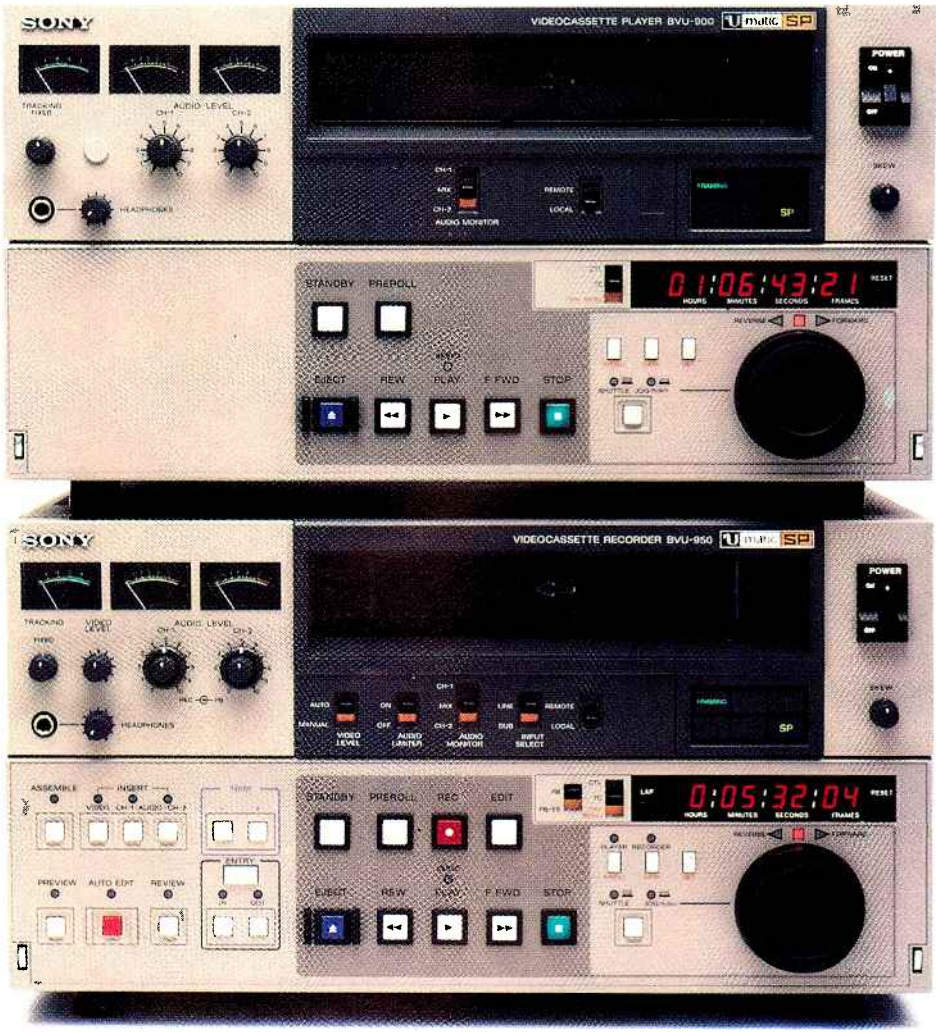

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Ampex ESS-2 still-store system

By Mike Berry

The relatively recent introduction of electronic still-stores has brought dramatic changes in the way TV stations treat stored images. The long-time staples of TV art and film departments, such as slide mounts, trays, carousels, processing equipment (the "chem") and even slide film, are obsolete. Today, electronic graphics are in.

Many of you are familiar with a still-store's capability to store images. However, the Ampex ESS-3 still-store and composition graphics storage system does this and a lot more. It incorporates features and capabilities usually associated with other equipment.

The system provides luminance, chroma-keys, grids and color backgrounds and also performs wipes and dissolves (like a production switcher). It can be used for titling, including changing the image size, shape, location, shadow and border. Like a digital video manipulator, the device can scan in custom fonts, squeeze and move video. It can mix or pick any color off the screen, store palettes, cut, paste and compose graphics like a paint system. It also can compile a list of stills and play them back like a slide chain.

Hardware/software

The hardware consists of the central controller, the signal system, a menu monitor, a viewing monitor, compose-access stations (CAS), remote-access stations (RAS) and the storage media (up to 25 fixed or removable disk drives). The CAS is comprised of a full keyboard and is equipped with a trackball and eight soft keys. The RAS is made up of the same soft keys including preview/program keys, numerical entry keys and an LED-type readout of catalogued titles of graphics. On-air effects, such as position, border and transition between stills, require the switcher/keyer option. Also, stills that must be smaller than full-screen size require size-reducer options.

The eight soft keys on each access station control the 24 major menu selections. Essentially, the three major areas of operation are *catalogue*, *list* and *compose*.

Berry is a broadcast designer for Dallas-Post Productions, Dallas. He was a broadcast designer at WHAS-TV, Louisville, KY, when he prepared this report.

Performance at a glance

- *Graphics remain totally digital without quality loss from successive updates or saves*
- *Artist-friendly with menu-driven commands*
- *Frame and field grab*
- *Programmable cuts, dissolves and wipes*
- *4:2:2, 13.5MHz component coding*
- *Composite and RGB inputs and outputs*
- *Up to 10 simultaneous users*
- *Fixed or removable media storage*
- *Digital video transfer between signal systems*
- *Up to 1,000 stills available on one hard-disk drive*

Catalogue

Through the *catalogue* menu, you can create, delete or list a previously recorded still's title or an entire category. It also is possible to renumber a still and do a title search by name, category or ID number. An optional printer can provide a hard copy of the catalogue whenever needed.

Lists

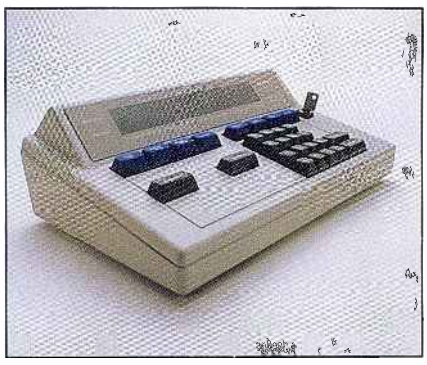
The *list manager* allows the operator to compile any number of lists of stills for playback at a later time. Ten presets allow the variables of a still in a list (such as a graphic's size, position on the screen, border size and color, type and transition duration) to be individually set. These settings never affect the originally saved still, only the manner in which it is played back in a given list and displayed on line (whether it is full screen or compressed).

Transitions between stills include takes, dissolves and wipes up, down, left, right, in and out. The transition duration can be assigned from one to 600 fields.

A collection of stills can be accessed through the list feature. Before a newscast, for example, the director can simply browse or run a title search to locate the required graphic's ID number, then compile a list. This compilation can be made or reviewed in either a text or video mode. And, unlike film slides, a still's existence in a previously compiled list will not prevent its use in another new list.

You can use the still-store for limited animation by compiling a list of similar stills and playing them back. Bar charts displayed with the list feature and the

The 825 fixed-media drive can store up to 1,000 stills. Up to 100 stills can be stored on removable disk packs.



Various record and playback functions can be controlled from the remote-access station.

Courtesy of WHAS-TV

Colors can be chosen from the screen or mixed as desired.

GET IT IN STEREO

In the field or on the run, the AKG C 522 ENG, mics it just like you hear it — in stereo. Wherever you are, whatever you're recording, from courthouse interview, press conference, rock concert, to forest fire, the C 522's clarity, rugged performance, and convenience are exactly what you need to add a true-life dimension.

Inside its sturdy housing are two matched cardioid condenser capsules, elastic-mounted for low noise and pre-configured to give you a smooth, one-handed XY-stereo field. It's a workhorse mic, with the little extras a working pro needs, like a built-in rechargeable battery, low-power warning LED, integrated on/off switch and boom mount shock suspension.

Get it live in stereo with the AKG C 522.

AKG acoustics

77 Selleck Street
Stamford, CT 06902

Reporter: Denise O'Brien.
With permission of Colony Communications, Inc

wipe-up transition are good examples of how the system's features can be combined to create effects similar to animation.

Stills can be transferred digitally to another ESS-3 or to the Ampex AVA-3 art system through an internal networking system. This allows the sharing of images between devices. The ESS-3 also can store stills to disk in 4:2:2 component digital form.

Compose

The *compose* mode operates with two framestores. Input video can be accessed by field or frame grabs or by recalling a still already recorded within the system. For positioning, compose offers a mix feature, a live (electronic-to-electronic) half-dissolve between two video sources for reference and comparison.

One compose framestore contains the base picture to be modified, and the other contains the replacement picture from which the modifying information is derived. For example, if a name were to be keyed over a freeze of a person, the still in base would be the person's picture, and "replace" would hold the text information.

The *luminance key* then would be selected and various choices made: positive or negative polarity, hard or soft key gain, the key's clip, transparency, color, border, drop shadow, position and color. The same basic setup and procedure apply to chroma-key and scissors. When using the chroma-key feature, you can select any screen color to key out.

Scissors is a unique mode. It allows an operator to use a backlit copy stand and camera to form a silhouette, describing the cutting edge or key signal between base and replace video.

Cut and paste allows any portion of replace (or source) to be cut, reduced in size, moved and pasted onto the base or target picture. The cut is a geometric shape such as a square, rectangle, circle, ellipse or diamond. The horizontal and vertical dimensions of the cut-and-paste shape can be controlled independently.

Colors can be chosen from the screen or mixed using the three independent inputs of hue, saturation and luminance. They can be saved in the palette indefinitely.

Storage

For safety's sake, each storage pack contains two dedicated picture locations to save the contents of the two compose framestores. Saving stills in these temporary areas is quicker than the standard method of recording a still. Storage also can be done manually at any time during compose. In most cases, storage automatically takes place when a picture is modified. The temporary storage areas have proved to be of value in preserving the previous version of a graphic, particularly when multiple layers are involved.

As with almost all user-definable variables in the still-store (such as gain, level, hue and transparency), selections can be made in two ways: The operator can enter a number known to give the desired results or use the CAS trackball (and a discriminating eye) to decide visually on the best solution. Both methods are valid and useful and are often used in tandem.

Some operators prefer to first enter a number that will provide the approximate desired results. Then, using the CAS trackball, they fine-tune the selection. Because numbers are assigned to all possible settings, elements such as a format's color can be matched repeatedly and identically.

Grid lines of varying width, height and number can be made with ease, then moved to any position on the screen. Base or replace video, or both, can be *fuzzed* (defocused) for interesting, creative results.

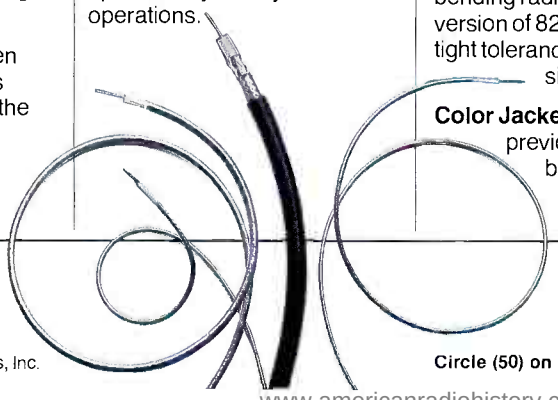
A BELDEN® BROADCAST CABLE MEANS NEVER HAVING TO SAY YOU'RE SORRY

Signal disruption during a live broadcast is a major and costly embarrassment.

With close to 30 million seconds of air time in a year, it only takes a few seconds to realize why you need Belden quality.

That's why the broadcast industry depends on Belden cable to cover large events such as the Olympics and the Indy 500. Events where a cable has to keep working while being subjected to extremes of weather, terrain and traffic. Events where there is no second chance.

And, because broadcasters need a cable they can install permanently without worry of failure, Belden is also relied upon for day-to-day studio operations.



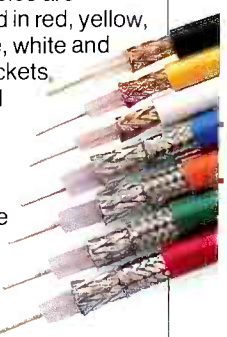
The broadcast industry knows that Belden is accepted worldwide as the standard for reliable, top-quality cable. More importantly, broadcasters know Belden has earned this reputation by designing durability into cables, so users won't have reason to be sorry.

New ways to avoid apologizing.

Dependable Belden performance is now available in six new broadcast cables:

Conformable™ and Flexible Coax—9307, 9308 and 1168A are innovative conformable replacements for semi-rigid coax in applications calling for improved flexibility, high temperature rating or tight bending radii. 1163A, a flexible version of 8281, is designed to tight tolerances for excellent signal return loss.

Color Jacketed Coax—previously available in black only, Belden's 8241, 8281 and 1163A video cables are also now offered in red, yellow, green, light blue, white and orange outer jackets, making channel coding much easier.



If you've ever had to apologize for inferior cable performance, find out why *There is no equal* to Belden. For ordering information call your local Belden distributor. Or contact:

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Circle (50) on Reply Card

Custom fonts or images can be scanned into the system and recalled for use with any graphic.

The cut-and-paste features allow any portion of an image to be reduced and moved as desired within the frame.

Because all the images are stored in the digital domain, there is no loss of quality as layer after layer of images are used to create the final product.

Custom fonts can be scanned in, stored and recalled to add text to a still. The kerning, however, still requires a deft touch and patience to achieve acceptable results.

The still-store's *browse* mode is a quick, frequently used method to review up to 12 slides at a time. Each still's unique ID number also is displayed, allowing rapid recall to a full-screen-sized image.

The ESS-3 is the useful means by which we create, store and access graphics for three daily newscasts, numerous live cut-ins and promos, programming and commercial production. At our station, it has proved to be a logical first step into the world of computer graphics. In its three years of operation, no one has yet to call for a return to the "good old days" of camera cards and slide film.

Ampex recently introduced the ESS-5 and the ESS-5G, which are single-user, streamlined versions of the ESS-3.

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 support is limited to providing loan equipment and to aiding the author if assistance is requested in some area.

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

CLASSIC

THE COMPREHENSIVE PRODUCTION CONSOLE WITH MULTITRACK & GML OPTIONS

The Classic is Amek's answer to the needs of the contemporary production audio engineer.

It's "no compromise" approach to build quality fulfils today's high technical standards, incorporating proven manufacturing methods with the latest in modern circuit design.

The Classic is more than a mixing console—it is a console system with a variety of frame sizes, module choices and automation options. These elements are combined to produce a console to suit many individual requirements including radio, TV, film and video post production.

The Classic can be automated with either conventional VCA fader automation, or the world famous GML (George Massenburg Laboratories) moving fader system. This features ¼ frame accuracy and is hard disc based, allowing complex routines to be set up which are unavailable with any other system.

With versions ranging from small non-automated consoles to 64 input automated "supermixers", shouldn't you be finding out more about what the Classic can do for you?

Initial customers include: Television New Zealand (3 consoles); H.T.V. Ltd, Wales; R.P.S. Ltd, Nottingham; Kratky Film, Czechoslovakia; TV2, Denmark (3 consoles); Molinare Ltd, London; Rond Du Point Film Studio, Paris; Municipality of Athens; Great Hall of the People, Beijing.

AMEK

EMPHASIS ON ENGINEERING

Head Office, Factory and Sales: Amek Systems and Controls Limited, New Islington Mill, Regent Trading Estate, Oldfield Road, Salford M5 4SX, England. Telephone: 061-834 6747. Telex: 668127 AMEK G. Fax: 061-834-0593.

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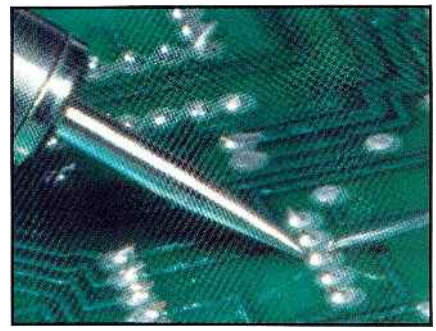

Testing BTSC stereo system parameters

By Eric Small

As strange as it may seem, the most accurate way to measure the modulation of a BTSC TV stereo system is by measuring its separation, not the modulation. Typically, separation measurements yield modulation data that is 30 to 50 times more accurate than the information you get by measuring modulation directly.

The reason for this paradox lies in the nature of the BTSC stereo system. In any stereo system that transmits its signals as sum-and-difference channels, each channel must be treated identically. Otherwise, the result will be serious degradation of the stereo separation. BTSC stereo challenges this by processing its L−R channel through a complex noise-reduction system while treating the L+R channel linearly.

Tracking error

If the output of the noise-reduction decoder in the receiver is identical in amplitude and phase to the signal that went into the noise-reduction encoder at the transmitter, everything will work out. However, if the decoder and encoder fail to track one another, the stereo separation will be reduced seriously.

Correct tracking depends on the reference level of the encoder in the stereo generator being set to exactly the same modulation level of the aural transmitter—usually 25kHz deviation. In setting the deviation to match the reference level, even an error as small as a few tenths of a decibel would greatly reduce stereo separation. This effect is so dramatic that it can be observed with program material, as opposed to test tones.

Test procedure

The test procedure for making these measurements is simple. Measure the maximum level of one channel, left or right, using an ac voltmeter with approximately VU ballistics. This could be a voltmeter connected to an accurate stereo decoder, or it might be a modulation-monitor indicator that has VU-like, rather than peak-indicating, characteristics.

Observe some wideband program material, such as music or crowd noise, and determine the maximum level. Then remove the program material from that channel wherever it is convenient in the air chain. Determine the maximum level of the residual program material in the now dead channel. Subtract the value of this level from that of the level measured when the channel was driven. This is the dynamic separation.

The separation value is not as important as any sudden decrease in previously measured values. Typically, for a system having 35dB to 45dB of separation in the BTSC mode across the audio midband, the dynamic separation should be 30dB to 40dB.

Test material

It is suggested that these measurements be made at the same time every day, using the same program material if possible. If it doesn't offend your sense of patriotism to use it, the National Anthem, aired every day at the same time, is a good piece of program material for this purpose.

Try alternating channels, maybe using the left channel on even-numbered days and the right channel on odd-numbered days. It should be possible to do the whole test in a few seconds. Of course, log the data so that it is easy to scan across many measurements at a time.

This test, despite its simplicity, provides you with a sensitive test of a critical and easily distributed parameter of a BTSC stereo system. By merely monitoring peak modulation, you cannot detect the extremely small gain errors that will disturb separation.

Small is president of Modulation Sciences, Brooklyn, NY.

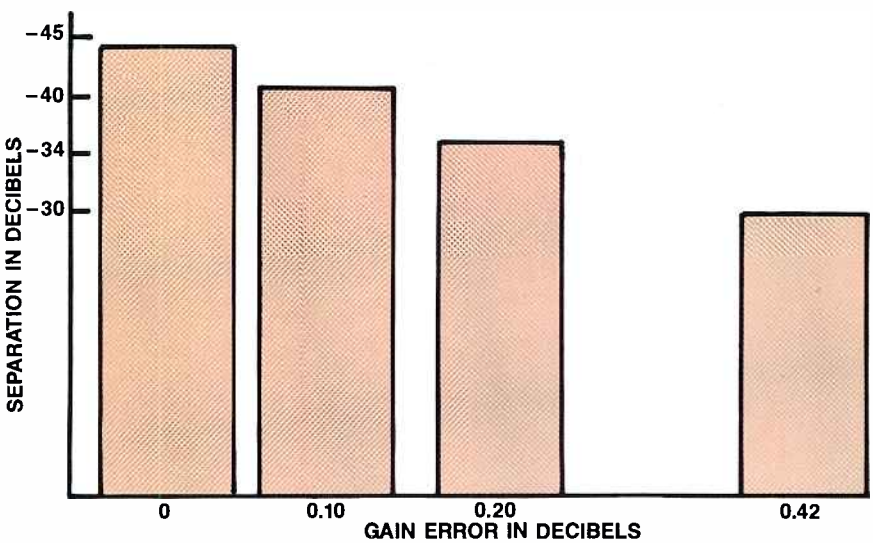

Figure 1. The graph shows how even small changes in gain can greatly affect the dynamic separation of a BTSC stereo system.

Continued from page 4

medium-power satellite technology is making this alternative even more viable.

The lack of agreement on the D2-MAC transmission standard is a thorn in everyone's side. The failure of TV-SAT 1, which was to be a testing ground for this transmission standard, has put added pressure on manufacturers of the D2-MAC packet and the Bundespost, which has financed the project with public funds.

End to Ireland's radio monopoly

The Irish government, after a long tug of war, has resolved to commercialize radio broadcasting. The new legislation calls for an end to the monopoly of Radio Telefis Eireann (RTE) and signals the go-ahead for a network of 24 regional, and hundreds of local, private radio stations to broadcast directly to Irish listeners.

Comark's Klystrode-equipped transmitter on the air

On June 5, Comark placed the first Klystrode-equipped UHF-TV transmitter on the air, in full-time broadcast service, at WCES-TV 20, a PBS affiliate. The station serves the Augusta-Wrens market for the Georgia Public Telecommunications Commission, Augusta, GA.

FCC proof-of-performance testing of the 120kW transmitter was witnessed and confirmed by the commission's engineering staff.

Based on actual measured electrical power consumption, WCES-TV has achieved up to a 50% savings in annual energy costs using this transmitter, compared to pulsed klystron-equipped transmitters. The measurements confirmed that the Comark Klystrode transmitter met or exceeded all specifications, and consumed less total energy than the 25-year old, 30kW, G.E. transmitter it replaced.

Philips pursues manufacturing venture

Philips and the Province of Jiangsu, the People's Republic of China, have entered a joint venture to manufacture color picture tubes. Partners in the venture include the Chinese National Huadong Electronics, with a 45% share; Philips, with a 30% share; and the Hong Kong-based Novel Investment and Trade Company.

Total investment amounted to $180 million, of which Philips contributed $100 million for modernizing the production facilities.

The new plant is expected to produce approximately 1.6 million picture tubes annually. Production is based on Philips' technology for "flat-square" color picture tubes.

THE FIRST INTELLIGENT BROADCAST COLOR MONITOR

BARCO INDUSTRIES' new CVS professional broadcast monitor is microprocessor-based to make it intelligent in operation and easy to use.

It has both a digital and an analog bus for maximum flexibility. Plus four "open" slots that let you plug in today's options and those yet to come. As new features do come along, you'll be able to add them through software - no hardware changes !

All CVS functions are controlled from the front of the monitor or from a remote keyboard. An optional master remote permits control of a series of monitors.

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You can also store, and automatically call up, either calibrated presets or your own preferred presets.

Like our best master control monitors, the CVS has Automatic Kinescope Biasing (AKB) to maintain color and black level stability.

The CVS also generates more internal test patterns than any other monitor. They include white field, cross hatch and color bars.

The CVS is available in both 14 inch and 20 inch versions, and provides outstanding picture quality in any TV standard.

For complete specifications, contact your local BARCO INDUSTRIES Dealer or BARCO INDUSTRIES, 170 Knowles Drive, Suite 212, Los Gatos, CA 95030. Phone : (408) 370-3721

BARCO INDUSTRIES is a member of the ACEC-group.

IMS / 729

Back to Brighton

By Jerry Whitaker, editorial director

The "who's who" of broadcasting worldwide will gather in Brighton, England, this fall for the 12th International Broadcasting Convention (Sept. 23-27). The NAB convention captures attention around the world because of its size. Brighton's claim to fame is its long tradition, international flavor and scenic location.

The show will offer attendees a record number of exhibitors from around the world—more than 180—displaying and demonstrating the latest in broadcast equipment. Altogether, the convention will occupy more than 21,000 square meters (that's 225,750 square feet to the rest of us). The exhibition area will encompass the Brighton Metropole Conference Center, the Brighton Centre some 150 meters away, and the Grand Hotel (located between the two). As at previous IBC shows, the exhibition sites will be fronted by an area along the esplanade where outside broadcast vehicles, equipment and mobile units (including satellite earth stations) will be on display.

Technical sessions

The IBC exhibition will complement the 4-day program of technical sessions in which papers dealing with the latest developments in audio/video broadcasting and allied fields will be discussed. The wide-ranging program reflects advances in broadcasting and related technologies. The number of seminar papers—about 100—are evidence of worldwide interest in the technical sessions.

Leading experts from 11 countries will deliver presentations on a wide variety of issues, including:

- High-definition television (spread over two days).
- Direct broadcast satellite and cable systems.
- Recording formats and hardware.
- Studio and outside broadcast equipment.
- Developments in camera technology.
- Transmission system advancements.
- Radio and TV receiver designs.
- RF/TV and audio measurement techniques.
- New broadcast services.

The tone for the conference will be set at the opening session as invited speakers outline the impact of evolving technology on future broadcast activity.

IBC Award

A key event during the convention will be the announcement of the 1988 recipient of the IBC Award. The award was instituted in 1984 to recognize a significant contribution by a person or group of persons to all aspects of broadcasting technology. It is a tribute to outstanding work in research, design, development, manufacture, operational practice or management, without regard to nationality or country of residence. The award is made to individuals, not to companies or organizations.

A specially commissioned sculpture in glass, along with a cash award, will be presented during the convention. Previous IBC Award recipients are:

- In 1984: Dr. Geoffrey Phillips (head of the BBC research department radio frequency group), in recognition of his internationally acclaimed work spanning more than 30 years in fostering the efficient use of the RF spectrum for broadcasting.
- In 1986: Aleksandar Todorovic (assistant general manager, JRT Televizija Beograd, Yugoslavia), for his leadership in worldwide standardization of the 4:2:2 digital component videotape format.

A "really big show"

IBC is sponsored by the Institution of Electrical Engineers, IEEE, Institution of Electronic and Radio Engineers, International Association of Broadcasting Manufacturers, Royal Television Society and SMPTE.

Information on attendance can be obtained by writing to the following address:

IBC Secretariat
Institution of Electrical Engineers
Savoy Place
London, United Kingdom
WC2R 0BL

Telephone 01-240-1871 (United Kingdom) or telex 261176 IEE LDN G.

If you plan to attend IBC and have not made hotel reservations, do so immediately. Brighton has a limited number of hotel rooms within walking distance of the exhibition and seminar sites.

Travel to Brighton from Gatwick Airport is approximately 30 minutes by train or 24 miles (38km) by car. From Heathrow Airport, an air shuttle is available to Gatwick. You also may take the bus or underground from Heathrow into London and board the train to Brighton.

The social program during the convention will include a civic reception, the IBC champagne buffet and special events for spouses.

Continued from page 62

tors. The gain difference may not be commented on for what it is; instead, the louder amplifier may be judged as being brighter or having more detail.

In double-blind tests of phono pre-amplifiers, it is common to use an inverse RIAA filter so that the response of the phono section can be tested with an external program source (not a vinyl disc). Under these conditions, it may be possible to identify slight variations in the RIAA responses of different pre-amps. Typically, gain is matched at 1kHz, and if a pre-amp phono section exhibits a slight rise in its low-frequency boost (which is not uncommon), then many auditors will judge it as sounding warmer.

A microphone pre-amplifier sometimes can be identified by the spectral characteristics of its noise floor, often near a subliminal level, or by its susceptibility to clipping at high mic-input levels. (Both of these aspects were important in the tube-vs.-transistor comparisons made a few years ago.) These factors lend credence to the belief that consoles can sound quite different from one another.

Many engineers routinely switch out, or patch around, any part of the console architecture not actually in use. Is the result audibly better? Double-blind testing certainly would determine the answer. (It is the author's opinion that on general principles, and in the absence of more compelling reasons, it is always a good idea to bypass the unnecessary.)

Double-blind testing can go a long way toward helping you select the "best" equipment, which is not necessarily the prettiest or the most popular.

Amplifier distortion

In a different approach to testing the audibility of amplifiers, David Hafler (in the February 1987 issue of "Audio") describes a method for "nulling out amp distortion." Again, this is a type of A-B test and is based on the premise that if A and B are presented together and subtracted, what remains is the difference between the two. In this particular test, a comparison is made between an amplifier and a straight-wire bypass around it.

Figure 2 shows the basic setup for such a procedure. The main loudspeaker is located between the output of the driving amplifier (the straight-wire portion of the setup) and the output of the amplifier under test. Because the output of the driving amplifier is common to both, its action, good or bad, is effectively eliminated. What you hear out of the main loudspeaker after the null setting has been made is simply the residual distortion and phase-amplitude anomalies produced by the amplifier under test.

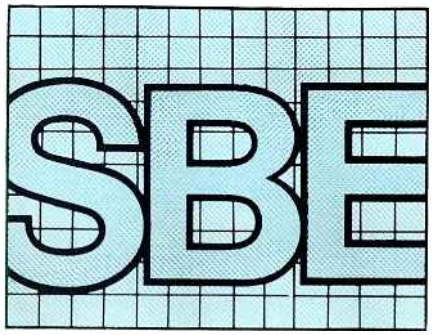
Obviously, the better the amplifier, the less sound you will hear out of the main loudspeaker. Hafler states that because of phase and amplitude deviations in the test amplifier, the residual output from the loudspeaker varies from sheer distortion (with bad amplifiers) to clean artifacts.

Honesty is the best policy

Although these tests are critical and demand careful setup, they can help eliminate errors in evaluation that are caused by non-auditory factors. Also, they isolate the actual distortion products that may be generated by an amplifier. This kind of testing can isolate amplifier differences that are well below the acuity of even the most trained listeners.

Many aspects of electronics design, from the subtle to the bold, relate to audibility. An aspect of human design, however, is the tendency to "go with the crowd" and hear things that are not really there. Regardless of the methods used for testing, and no matter whether you're an old hand or new to it, the best advice you can follow is to be unremittingly honest in all listening tests.

SBE Update



Goza takes Wulliman board position

By Bob Van Buhler

Jim Wulliman has resigned from the SBE board of directors to accept duties with the Ennes Foundation. He recently retired as engineering manager of the WTMJ stations in Milwaukee and has taken up residence in Green Valley, AZ. Wulliman served the society for many years. In addition to his position as a board member, he held the offices of president, secretary and chairman of the certification committee. He plans to continue to chair the certification committee.

In accordance with the bylaws, the board voted on a replacement for Wulliman. By unanimous vote, the vacancy was filled by Bob Goza of the St. Louis chapter. Goza has been a member of the national SBE convention committee and now serves as a member of the convention core committee.

SBE committees

Past columns have described the activities behind the SBE executive committee, the convention exhibitor committee, the convention core committee and the public relations and chapter liaison committees. However, many other important committees function at the national level.

The frequency coordination committee has been one of the most visible in recent years, actually shaping federal policy on Part 74 regulatory matters. Chaired by past president Richard Rudman, the committee includes members Gerry Dalton, Bob Van Buhler and SBE counsel, Chris Imlay. The four also are regular members of the all-industry national frequency coordination council. The council speaks for the broadcasting and cable industry consensus with regard to Broadcast Auxiliary Service (BAS) and Cable Television Relay Service (CARS) frequency usage.

Closely related is the FCC filings committee, which files SBE comments on regulatory matters before the FCC, EPA and other federal agencies. The national frequency coordinating council does not file comments, but expects its constituents to have their own viewpoints on regulatory matters and to make their concerns known to the federal government. Also chaired by Rudman, this committee includes Chris Imlay, Gerry Dalton and new board member Dane Erickson, whose federal service experience is helpful to the committee.

The industry and professional society relations committee helps SBE interface with other important groups such as SMPTE, IEEE, NAB and NCTA. This committee consists of co-chairmen David Harry and Tom Weems and member Chuck Kelly.

The sustaining membership committee's work is an important source of support to the society. Chairman Joe Manning will continue to manage this committee with the help of members Chuck Kelly, Tom Weems and Jesse Maxenchs.

Membership committees

The fellowship committee, composed of chairman Nile Hunt and past president Ron Arendal, studies the history and activities of the members to identify outstanding contributors to the society. The committee makes periodic reports and, as appropriate, suggests members to the board for election to the position of SBE Fellow.

The awards committee is charged with developing incentives for excellence in the local chapters. The committee is co-chaired by board members Tom Weems and Phil Aaland. Brad Dick, Richard Farquhar and Robert Parkhurst are members.

The nominating committee for 1987-88 is chaired by Tom Weems. Committee members include Bill Harris, Nile Hunt, Brad Dick and Joe Snelson. This group monitors the membership for qualified candidates to fill vacancies on the board of directors and to serve as officers.

Each of the committees reports periodically to the national office. Summaries of their work will be reported in "SBE Update."

Golder scholarship awarded

Chapter 9, Phoenix, AZ, awarded the James F. Golder scholarship for 1988 to David Cantrel of Mesa, AZ. Cantrel will attend Arizona State University.

A project of Chapter 9, the Golder Scholarship is awarded regularly in memory of James F. Golder, who died in a tower-climbing accident on Feb. 12, 1983. Golder, a technician at KPNX-TV, Phoenix, was a third-generation broadcast engineer. Contributions to the James F. Golder Foundation are welcome. For more information, please contact Bill Strube, KPHO-TV, Phoenix, at 602-264-1000.

Convention committee survey

The SBE exhibitors advisory committee recently conducted a survey of 1987 SBE convention exhibitors. A total of 98% of the exhibitors classified themselves as manufacturers, 14% as distributors and 10% as service companies. As expected, most were marketing to TV (90%) and radio broadcasters (71%).

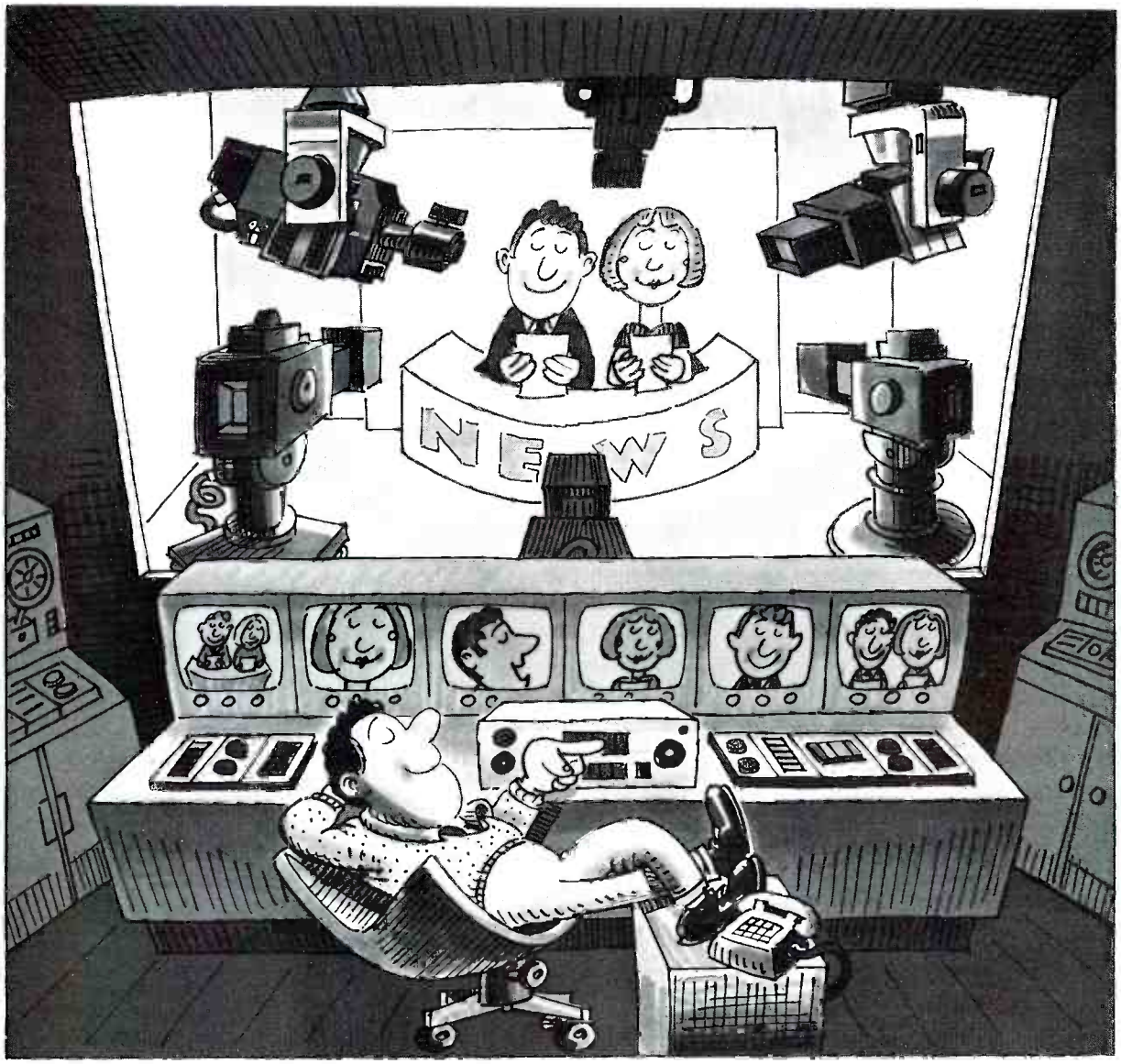
The remaining exhibitors targeted video or film post-production, recording studios and industrial television as prospective clients. Most exhibitors attended the convention in search of sales and sales leads. However, 67% viewed their presence, in part, as a public relations tool. The convention was used for company marketing research by 49%. Of the people staffing the booths, 53% were listed under sales and marketing, 24% were managers and 23% were listed as engineers and technicians. Virtually all the exhibitors also participate in the NAB convention, and 56% show their products at SBE regional conventions.

Most exhibitors showed a preference for a St. Louis location, but many also like Denver, Atlanta and Nashville, TN, along with Phoenix, AZ and Kansas City, MO.

Comments on the 1987 convention were mostly favorable and included suggestions on scheduling to avoid time conflicts with technical sessions and exhibit hours. The convention also took a couple of jabs on food service and last-minute changes, as well as the readability of name badges. All these issues have been addressed by the new show management, Eddie Barker Associates.

The 1988 SBE Convention and **Broadcast Engineering** Conference will be Sept. 22-25 at the Currigan Convention Center in Denver. Attractive hotel room rates are available for the convention, so make your reservations early. Additional details are available in the convention flyer.

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



MULTIPLE CAMERAS. ONE OPERATOR.

Impossible? Not if your cameras are mounted on EPO Servo-Controlled pan and tilt heads. These extraordinary, labor-saving devices, which first found favor in legislatures where remote-controlled, unobtrusive coverage was a key factor, are now the basis for complete remote-controlled news studios.

Just look at these outstanding features:

- Up to 500 preprogrammed positions per camera, including control of iris and black levels
- Programmable fade modes that provide smooth transition from preprogrammed shots
- Ability to zoom and focus
- Unobtrusive
- Can be operated via telephone lines or microwave in a remote studio away from the main studio location
- Wide range of pan and tilt heads, for full studio cameras with teleprompters to ENG type cameras
- Wide range of control options, from panels with multiple-shot memories to simple joy stick remote controls.

It's flexible, affordable—and it's sold and serviced exclusively in the U.S.A. by A.F. Associates.

THE RADAMEC EPO REMOTE CAMERA CONTROL SYSTEMS

Your news show's bottom line will never look so good.

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Circle (56) on Reply Card

New products

Color computer graphics system

Accu-Weather has announced the Amiga color computer weather graphics system. Available graphics include national and regional satellite images, national and regional radar and precipitation displays, current and forecast weather maps, jet stream patterns, long-range outlooks, custom-drawn portrayals of major events in weather history and illustrations of key weather concepts.

Circle (350) on Reply Card

Integrated cable organization network

ADC Telecommunications has introduced the I.C.O.N. (Integrated Cable Organization Network), its family of products for terminating and cross-connecting audio cabling. The I.C.O.N. uses QCP insulation displacement (punchdown) contact for cable termination. The products are available in rack-mount and wall-mount versions.

Circle (351) on Reply Card

MIDI line mixer and equalizer

Akai Professional has introduced the following products:

- The MB76 programmable mix bay combines the power of a 7-in/6-out audio routing switcher or programmable patchbay along with a fully programmable 7-in/6-out audio signal mixer in a 1-unit rack-mount package. The systems can route any audio signal to any output and can combine signals from all seven inputs to each output. The input level of each channel can be programmed individually from −28dB to +3dB, or off. Each level and routing configuration is stored as one of 32 banks, which can be recalled by MIDI or by footswitch.
- The PEQ6 programmable equalizer features six independently programmable 7-band equalizers in a single rack unit. Each center band can be adjusted in 1dB steps from −10dB to +10dB. The internal memory stores 32 banks, and each bank contains the settings of the six EQ channels. The banks can be recalled by MIDI program changes or via footswitch. The low noise and distortion specs make it possible to stack channels in a cascade configuration to attain up to 36dB of boost/cut.

Circle (352) on Reply Card

Simulsat satellite antenna

Antenna Technology has introduced a 70° capture angle Simulsat satellite antenna. It can receive a total of 35 C-band and Ku-band satellites, simultaneously, from Spacenet 2 (69°) to Satcom 1R (139°). A retrofit 70° feed box is available for existing Simulsat customers. The antenna is available in 3-, 5- and 7- meter sizes.

Circle (353) on Reply Card

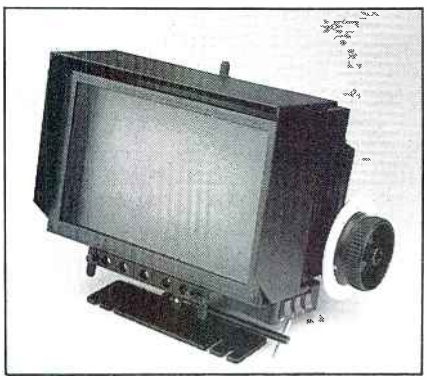
Multi-effects unit

Applied Research & Technology has announced the MultiVerb digital audio signal processor. Up to four simultaneous effects are available from one single rack. Reverberation, arpeggio effects, reverse gates, pitch shift, doubling, imaged doubling, dig-

ital delay, chorusing and EQ multi-effects all can be programmed into the unit's 200 memory locations, or alternatively, selected from the unit's 100 on-board presets and subsequently stacked. These multi-effects may then be randomly accessed later, in groups of four, if required. The unit also features battery backup for full memory protection, remote footswitch jack with preset increment, a level selector, 16-bit digital processing and MIDI compatibility, random-access keypad and 32-character LCD display.

Circle (354) on Reply Card

Variable light source



Arriflex has introduced the ARRI Obie One light, a variable light source to be used as an on-camera Obie light or a regular fill light. It is designed for maximum light output and complete control of the output without affecting the light's beam angle or color temperature. This is a 3-bulb light source whose direct light output (not reflected) provides a broad, even pattern continuously adjustable within a 2.5 stop range. Its basic intensity ranges are selected with the high, medium or low bulb settings, then fine-tuned within each setting by moving the bulbs and their compound reflector in and out with a focus knob. The kit includes hood, filter frame, camera-mounting bracket, gel filter frame and a set of one each blue 3216, 3208, 3206, 3204 and 3202 gels.

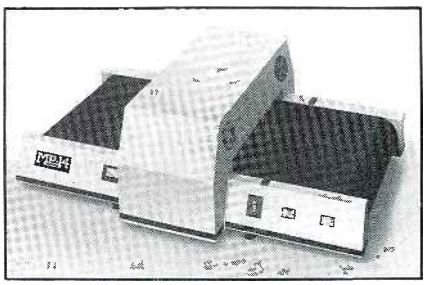
Circle (355) on Reply Card

Video wipe

Audio Kinetics has announced the WIPER, a video wipe or countdown inserter that provides a visual cue facility. A time-code inserter option also is available.

Circle (356) on Reply Card

Bulk tape degausser

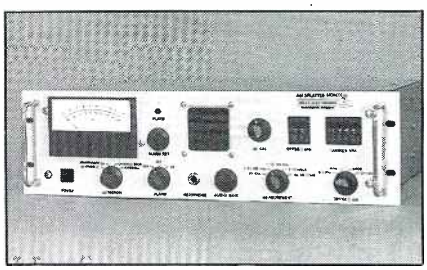


Data Security has introduced the following products:

- The MP-14 bulk tape degausser completely erases 1,500 Oe metal-particle tape cassettes and 1-inch C-format reels. The company also developed *autogauss*, which works like a metal detector. The tape degausser generates strong magnetic fields to erase the metal-particle tape cassettes. When an aluminum reel is placed on the conveyor, the tape degausser senses it and drops the field strength to a power level appropriate for C format. The MP-14 also features a manual override of autogauss and a media sensor to optimize its duty cycle without requiring the operator to activate erase and reset controls. Both strengths and modes are indicated by lamps and an ammeter.
- The MP-7 bulk tape degausser completely erases 1,500 Oe metal-particle tape used with Betacam SP, M-II and D-2. It features dual diagonal coils that erase cassettes in a single pass along a conveyor belt. Dual ammeters monitor the field strength in each coil.
- The TC-14 bulk tape degausser has been re-engineered with field strengths that completely erase tape through 900 Oe, such as S-VHS and D-1. It operates on standard 20A, 120V circuits.

Circle (357) on Reply Card

AM splatter monitor



Delta Electronics has introduced the SM-1 AM splatter monitor. It is frequency-agile and measures both in-phase and incidental-phase modulation. Its portable active antenna and dc power input allow the monitor to be used for field testing. It operates from an automobile cigarette lighter.

Circle (358) on Reply Card

Pro stereophones

Audio-Technica has introduced the 900 series of professional studiophones. The models ATH909 and ATH911 are open-back designs that allow the user to hear outside sounds while monitoring program material. When isolation from ambient sound is required, the ATH910 responds with a closed-back design that allows "on-mic" operation at high monitor levels without feedback. Features of the studiophones include soft foam pivot-action earpads and adjustable padded headbands, 96dB sensitivity, 4Ω to 24Ω matching impedance, 30Ω actual impedance and 20Hz to 20,000Hz frequency response. All three models feature a 3-meter straight cord with ¼-inch phone plug.

Circle (359) on Reply Card

Tape cartridge machine

Broadcast Electronics has introduced the Phase Trak 90 record/playback stereo (the PT-90 RPS). Features include automatic tape analysis with a learn mode, a built-in splice finder and test oscillator, optional high/low level-sensing, LED metering of left and right channels and four record cue circuits, including an FSK encoder.

Circle (360) on Reply Card

Heavy-duty digital multimeters

Beckman Industrial Instrumentation Products Division has introduced the HD150 series of 3½-digit, heavy-duty, autoranging, digital multimeters (models HD151, HD152 and HD153). A "Skyhook" and tilt stand are supplied with the HD153. The Skyhook can be flipped out from the back so the meter can be hung just about anywhere. After function selection, the proper range is set automatically by a microprocessor, so the user does not need to hold the meter. The DMM technology features CMOS dual metal gate, A/D converter that incorporates a fast voltage-to-frequency converter for range selection. Amplifying this signal and connecting it to a speaker produces a tone proportional to the magnitude of the reading. The meters all come with battery and fuses installed, and with a spare 250mA/600V fuse inside. Test leads and an operator's manual are included.

Circle (361) on Reply Card

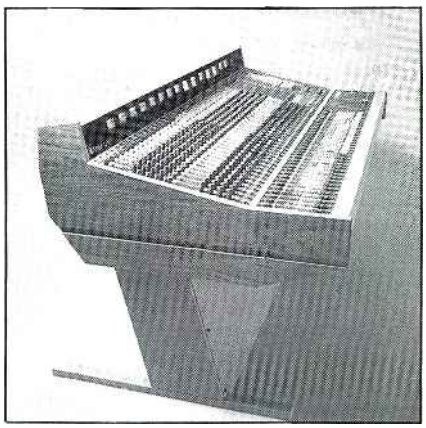
Hand-held portable test bench

B&K-Precision has introduced the Test Bench, a hand-held test instrument with the capabilities of five separate instru-

ments. The model 388-HD is a 41-range voltmeter/ammeter/ohmmeter/ frequency counter/capacitance tester/logic tester/transistor tester/diode tester/continuity tester. All of these capabilities are contained in a case the size of a conventional hand-held digital multimeter. The test bench is packaged in a drop-resistant safety yellow case. It features an oversized LCD display for high readability under all operating conditions. The test bench also features the triple protection of reverse polarity protection, overload protection and high-energy fusing.

Circle (395) on Reply Card

Master control console



Wheatstone has introduced the TV-500 MTS master control console. It includes four stereo subgroup buses, two separate stereo master buses, a mono bus for SAP, as well as mono sum outputs. Also included are four fully stereo auxiliary buses for foldback, mix-minus and special effects. Each control comes with a pre/post fader switch and an on/off switch. The mono input modules include source selection between two mic inputs and a third line input. The stereo line inputs can select any one of four stereo sources, as well as full mode and balance control. Input modules include semi-parametric equalization, stereo solo/cue functions and insert point bypass switch.

Circle (396) on Reply Card

Test instrument and field retrofit kit

Broadcast Video Systems has announced the following products:

- The DIGIVIEW, an instrument for measuring and checking parallel digital signals sampled according to CCIR recommendation 601. The unit ensures accurate setup of analog-to-digital conversion equipment and for checking the transparency of digital processing systems. The unit is a printed circuit card that fits an expansion slot of any IBM-compatible personal computer with a suitable graphics adapter. A comprehensive software package allows component waveforms corresponding to a selected line of the digital signal to be displayed on the computer screen and measurements of the numerical information to be made. Additional facilities include the detection of erroneous data and the ability to numerically compare the output of a system with the input that was stored earlier.
- A field retrofit kit for COX model 203 and 204 NTSC encoders. The update provides 75Ω outputs of Y and C at the specified level for the Y/C input of S-VHS recorders. The normal NTSC outputs of the encoder are not affected.

Circle (397) on Reply Card

Rack-mount cabinets

Winsted has announced three models of shallow-depth rack-mount cabinets. They are available with 10½-, 14- or 19¼-inch rack space. The cabinets are designed to EIA standards. The cabinets can be combined with the System/85 consoles. Side panels lift off easily for maintenance.

Circle (398) on Reply Card

Batteries

Cine 60 has introduced the KFC battery. Made specifically for ENG crews, the battery is equipped with its own built-in 2-rate charging system that fully charges it in four hours, then keeps it ready for use indefinitely by maintaining it fully charged while preventing dangerous heat build-up and deterioration through overcharging. The batteries have built-in visual indicators and sensing circuits that provide continual monitoring of charge status.

Circle (399) on Reply Card

Additional board features

CMX has introduced the following board additions and new products:

- Additional features for the CMX 3600 include separate audio and video cross-

Audio Transformers

Choose from a wide variety of types and packages

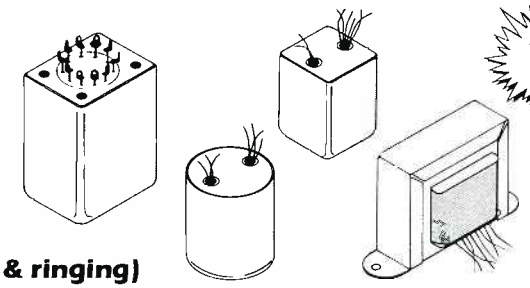
Computer optimized design

100% tested – consistent quality

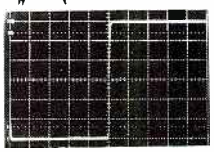
Low distortion

Wide bandwidth

Minimum transient distortion (overshoot & ringing)



REVISED JUNE 1988



JE-16A
2 kHz Square Wave

INPUT TRANSFORMERS AND SPECIAL TYPES

Model	Application	Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20Hz Max Input Level[1]	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width[2] –3 dB @(kHz)	20 kHz Phase[6] (degrees)	Over-Shoot (%)	Noise Figure (dB)	Magnetic Shield[4] (dB)	Number of Faraday[4] Shields	Package[5]	PRICES 1-19	100-249	1000
MICROPHONE INPUT																
JE-16-A JE-16-B	Mic in for 990 opamp	150-600	1:2	+8	0.036 / 0.003	–0.08 / –0.05	230	<1	<1	1.7	–30	1	A = 1 B = 2	79.19 87.04	52.36 57.55	36.12 39.70
JE-13K7-A	Mic in for 990 or I.C.	150-3750	1:5	+8	0.036 / 0.003	–0.09 / –0.21	85	<1	<2	2.3	–30	1	1	79.19	52.36	36.12
JE-115K-E (Improved)	Mic in for I.C. opamp	150-15 K	1:10	–2.5	0.125 / 0.010	–0.25 / –0.06	95	<1	<1	1.5	–30	1	3	57.55	38.05	29.81
LINE INPUT																
JE-11P-9	Line in	15 K-15 K	1:1	+26	0.025 / 0.003	–0.03 / –0.30	52	<1	<3		–30	1	1	128.33	84.86	58.54
JE-11P-1	Line in	15 K-15 K	1:1	+17	0.045 / 0.003	–0.03 / –0.25	85	<1	<1		–30	1	3	54.93	36.32	28.46
JE-6110K-B	Line in bridging	36 K-2200 (10 K-600)	4:1	+24	0.005 / 0.002	–0.02 / –0.09	125	<1	<1		–30	1	1	77.65	51.34	37.68
JE-10KB-C	Line in bridging	30 K-1800 (10 K-600)	4:1	+19	0.033 / 0.003	–0.11 / –0.08	160	<1	<2		–30	1	3	55.83	36.91	25.76
JE-11SSP-8M	Line in / repeat coil	600 / 150-600 / 150	1:1 split	+22	0.035 / 0.003	–0.03 / –0.00	120	<1	<3.5		–30	1	4	204.36	135.12	93.22
JE-11SSP-6M	Line in / repeat coil	600 / 150-600 / 150	1:1 split	+17	0.035 / 0.003	–0.25 / –0.00	160	<1	<3		–30	1	5	103.31	68.31	47.13
SPECIAL TYPES																
JE-MB-C	2-way[3] mic split	150-150	1:1	+1	0.050 / 0.003	–0.16 / –0.13	100	<1	<1		–30	2	3	47.09	31.14	24.41
JE-MB-D	3-way[3] mic split	150-150-150	1:1:1	+2	0.044 / 0.003	–0.14 / –0.16	100	<1	<1		–30	3	3	79.99	52.89	41.39
JE-MB-E	4-way[3] mic split	150-150-150-150	1:1:1:1	+10	0.050 / 0.002	–0.10 / –1.00	40	<1	<1		–30	4	1	120.12	79.42	54.79
JE-DB-E	Direct box for guitar	20 K-150	12:1	+19	0.096 / 0.005	–0.20 / –0.20	80	<1	<1		–30	2	6	57.29	37.88	29.64

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

PACKAGE DIMENSIONS:

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

NICKEL CORE OUTPUT TRANSFORMERS[7]

Model	Construction	Nominal Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20 Hz Max Output Level[8] (dBu)	across (n) windings	600 Ω Load Loss (dB)	DC Resistance per Winding	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width –3 dB @ (kHz)	20 kHz Phase[6] (degrees)	Over-Shoot (%)	Package[11]	PRICES 1-19	100-249	1000
JE-11-BMCF	Bifilar 80% nickel	600-600	1:1	+26	1	–1.1	40 Ω	0.002 / 0.002	–0.02 / –0.00	>10MHz	<0.5	<1[10]	7	85.62	56.62	39.65
JE-11-DMCF	Bifilar 80% nickel	600-600	1:1	+21	1	–1.0	38 Ω	0.004 / 0.002	–0.02 / –0.00	>10MHz	<0.5	<1[10]	8	59.13	39.10	26.97
JE-123-BLCF	Quadfilar	600-600 150-600	1:1 1:2	+32	2	–1.1	20 Ω	0.041 / 0.003	–0.02 / –0.01	>450 170	<0.5 <1	<1[9]	7	77.55	45.29	31.25
JE-11SS-DLCF	Bifilar split/split	600-600 150-600	1:1 1:2	+27	2	–1.0	19 Ω	0.065 / 0.003	–0.02 / –0.01	>10MHz 245	<0.5 <0.5	<1[9]	8	56.30	37.22	25.68
JE-11-ELCF	Bifilar	600-600	1:1	+23.5	1	–1.1	40 Ω	0.088 / 0.003	–0.03 / –0.00	>10MHz	<0.5	<1[10]	9	38.18	25.24	17.41
JE-11-FLCF	Bifilar	600-600	1:1	+20.4	1	–1.6	58 Ω	0.114 / 0.003	–0.03 / –0.00	>10MHz	<0.5	<1[10]	10	28.72	18.99	13.10
JE-112-LCF	Quadfilar	600-600 150-600	1:1 1 2	+20.4	2	–1.6	29 Ω	0.114 / 0.003	–0.03 / –0.01	>450 205	<0.5 <1	<1[9]	10	34.44	22.77	15.71
JE-123-ALCF	Quadfilar	66.7-600	1:3	+26.5	3	–1.3	8 Ω	0.125 / 0.003	–0.04 / +0.06	190	<1	<6[9]	8	70.01	35.38	24.41
JE-11S-LCF	Bifilar w/ split pri.	600-600 150-600	1:1 1:2	+30	1 (sec)	–1.7	63 Ω	0.058 / 0.002	–0.02 / +0.01 –0.02 / –0.05	>10MHz 155	<0.5 <1	<1[9]	8	70.01	35.38	24.41

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

PACKAGE DIMENSIONS:

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

These charts include the most popular types which are usually available from stock. Many other types are available from stock or custom designs for OEM orders of 100 pieces or more can be made to order. Certified computer testing is available for OEM orders. Call or write for applications assistance and/or detailed data sheets on individual models.

Prices shown are effective 1/1/88 and are subject to change without notice. Packing, shipping, and applicable sales taxes additional.

jensen transformers
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Circle (63) on Reply Card

points; expanded save system with GPI configurations and switcher memory configurations; keyboard assignments of separate audio and video switcher cross points; keyboard selection of time code, tape timer or user bits for each machine; and expanded learn keys with eight character titles, keystroke display count and deletion of one or all learn keys.

• CMX Version 300 software includes advanced switcher control, which includes switcher breakaway modes and upload/download of the switcher memory contents with GVG, Ampex, Abekas, Ross, Bosch and other switchers; pre-cue auto assembly; text editing; mark files; and fetch EDL time codes.

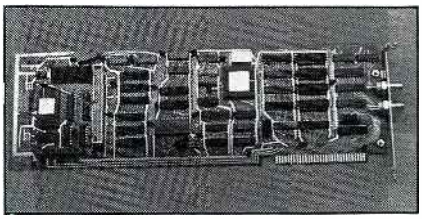
• Features for the CMX 100 include *match cut calculate* expanded to allow any event in the list; *trigger mark* facilities edit through marking of triggers on either record or source tape; *match-back* automatically back times tape from its current position; and the *printer port* allows use of a printer with RS-232 serial interface.

• An audio/video switcher is designed to work with all CMX large-scale editing systems. It provides cuts, dissolves and fade to black for A, B and C source machines, as well as auxiliary and black inputs. A non-time base corrector mode allows cuts and fade to black in the absence of TBCs.

• A patented software technique called MC^2 (matched computer cut) generates a negative cutter's list and a CMX edit decision list. The film cut and the videotape master generated from each list will be frame accurate and match each other. The two lists guarantee maximum error of one video field over the entire show duration.

Circle (362) on Reply Card

Digital signal processor



Dalanco Spry has introduced the model 25 digital signal processor for the PC/XT/AT, designed for real-time digital signal processing, algorithm development and data acquisition. It features the 40MHz Texas Instruments' TMS320C25 digital signal processor and is offered with on-board 12-bit, 110kHz A/D and D/A converters. Software includes a debugger, assembler and disassembler, signal and spectrum display, FFT and filter applications examples, utilities for the software developer, record and playback programs, and a program for viewing captured data.

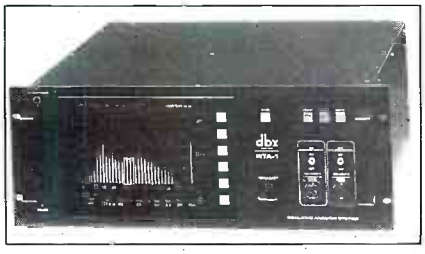
Circle (363) on Reply Card

Full-duplex intercom system

DILESS has introduced the ProCom full-duplex intercom system, which features push-button dialing. Each station is equipped with a push-button unit that enables the user to make the required connection at the touch of a single button. Any station may be used as a beltpack or be table-mounted. Stations are connected with standard 3-core microphone cables. The automatic central unit can handle 11 simultaneous connections. Several stations may be series connected on the same line.

Circle (364) on Reply Card

Software enhancements



dbx has announced software enhancements for the RTA-1 professional real-time analysis system. They include enhanced room-response curve capabilities, improved microphone-calibration capabilities and customized print-out. Model number RTA-1 V.1.5 will designate the new units.

Circle (365) on Reply Card

Low-pass filter line

Eagle has announced the addition of a 1kW filter line to the HLC700 series of filters. There are separate part numbers for HF (HLC721LXXX), VHF (HLC722LXXX) and UHF (HLC723LXXX). The design cut-off frequency replaces the X's in the part number. The models cover from 3MHz to 500MHz. The filter will handle 1kW for an unlimited time period into a 1.5:1 VSWR. Up to 150W may appear in the stopband. An 0.050-inch nickel-plated brass enclosure ensures durability and protection from large electromagnetic fields.

Circle (366) on Reply Card

Delayed sweep oscilloscope

John Fluke Manufacturing has introduced the Philips PM 3070 100MHz delayed sweep oscilloscope with full cursor measurement capabilities in both the time and amplitude axes. It features an *autoset* function for automatic display setups at the touch of a button.

Circle (367) on Reply Card

Time base corrector

For-A has introduced the FA-300, an S-VHS time base corrector. It corrects time

base errors from S-VHS VTRs that interface Y/C358 component signals as well as composite signals from ¾-inch and ½-inch heterodyne VTRs. The TBC provides a means of correcting color problems inherent in S-VHS VTR systems. The *Chromacor* Y/C delay adjustment corrects horizontal color displacement in S-VHS systems. The TBC provides Y/R–Y/B–Y outputs. Additional features include component processing, dropout compensation, wideband CCD comb filter, full-frame memory with freezes and strobes and black stretch.

Circle (368) on Reply Card

Microcomputer-controlled charger

Frezzi/PAG has introduced the MC2 microcomputer-controlled, 4-channel charger. It is portable and charges any battery or mix of batteries in the 1.5Ah to 12Ah, 6V to 15.6V range. Both ac- and 12Vdc-powered models are available. The charger is automatic, with auto ac line select/auto cell balancing/auto maintenance charge/self test program/fail-safe shutdown/auto fault detection. Battery voltage also is selected automatically.

Circle (369) on Reply Card

Digital test signal generator, waveform monitor/vectorscope and oscilloscope

Leader Instruments has announced the following products:

- The model 411 NTSC test signal generator synthesizes 18 test signals with 10-bit D/A precision. It provides precision test signals free of the effects of drift and aging. Full gen-lock operation is provided, or the internal reference yields ±2Hz subcarrier accuracy. Test signals include SMPTE, full-field and split/reverse bars; window pulse/bar; dot/crosshatch; white, red and blue rasters; multiburst; 100IRE chroma signal; modulated and unmodulated staircase or ramp; and switchable APL with bounce function. Output feeds are composite, blackburst, composite

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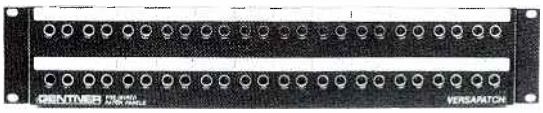

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Solutions like the VRC-1000 Remote Control which has allowed countless engineers to monitor and operate their transmitters through any Touch-Tone™ phone. A preprogrammed synthesized voice gives you the parameters, you make the adjustments with the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

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Circle (71) on Reply Card

sync, composite blanking, H and V drive, burst flag, color field reference and subcarrier.

• The model 5870 combination waveform monitor/vectorscope incorporates an SCH phase meter, a waveform monitor and a vectorscope in one half-rack unit. The waveform and vector displays can be superimposed for hands-free monitoring. Remote-control capability of all front-panel functions and dc operation are standard. The case, feet and handle are supplied.

• The model 3060D digital storage oscilloscope is equipped with a 4K word memory, 40 megasamples per second maximum sampling rate and 60MHz real-time bandwidth. The unit offers CRT cursor read-outs of voltage, time, frequency, phase and voltage and time difference ratios. The GPIB interface is standard and allows the oscilloscope to be used in remotely controlled test systems conforming to IEEE 488 standard. Also included is a plotter interface that can be used to create a hard copy of stored waveforms on the HP-GL type plotter. Up to four waveforms can be stored into memory. Other features include roll mode, pretrigger view, view time, memory protect and sine and pulse interpolation. The oscilloscope also has a dual time base with calibrated delayed sweep plus alternate sweep and triggering.

Circle (370) on Reply Card

Standby power battery

GNB has introduced the Watchman II deep cycle standby power battery with Absolyte-sealed lead acid technology. It is maintenance-free and delivers more than 300 cycles. The battery has a sealed lead acid configuration of highly absorbent, binder-free separators made from Manville Tempstran glass microfibers. The battery can be used in any position.

Circle (371) on Reply Card

Software for graphics systems

Microtime has released the Version 4.4 system software. It includes advanced 3-D sculpting, including the capability to sculpt individual cross sections of a model, deform complete models or pull individual vertices on a model. Individual cross sections may be moved, rotated, warped and turned into a circle or a beveled rectangle. The second addition is local/pin lights. The user can select multiple local lights in addition to multiple infinite lights to illuminate the models within a scene. In addition, the local lights can move along trajectories during an animation to create effects. The colors of the local lights also are selectable.

Circle (372) on Reply Card

VLSI-based system, dual-channel option and still store

Pinnacle Systems has introduced the following products:

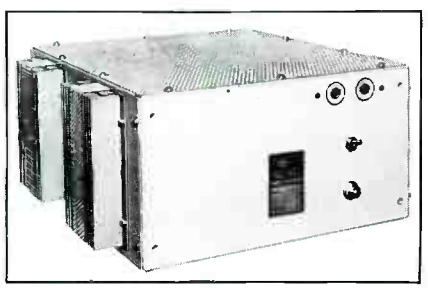
• PRIZM is a VLSI-based system that offers Z-axis image manipulation of live video images with multiple layering of 3-D still images, including perspective and rotation. It is an option on the 2000 and 3000 series video work stations.

• The DC-2000 dual-channel option can create five simultaneous layers of video in a 2-channel system. It is designed for the 2000 and 3000 series video work stations. The option allows users to simultaneously manipulate images with input from two separate video work stations, using one control panel. The option is compatible with PRIZM.

• Still storage and retrieval has been added to the 1000 series video work stations. Users can freeze, store and retrieve more than 100 images on an internal disk, with fast recall.

Circle (374) on Reply Card

Sine-wave inverter



Nova Electric has introduced the model 2560-12, a solid-state 250kVA sine-wave inverter. It employs pulse-width modulation and operates from a battery or generator over an input range of 11Vdc-16Vdc. It produces 120Vac output at 60Hz, with a low-distortion sine-wave output.

Circle (375) on Reply Card

Cart work station

Odetics Broadcast Division has introduced the CWS500 cart work station, a remote, on-line cart record system that com-

Once again, S
the art of cuttin

Leave it to Sony to keep the simplicity of a childhood art form in the sophisticated art of video editing.

For the fact is, we've made technological advances that have added both precision and speed to editing, without adding complexity. And that holds true for all our editing control units.

The Sony RM-450, BVE-600 and BVE-900 clearly demonstrate this approach. They all share Sony's operating feel and philosophy. For one thing, they all share key common features. Such as Auto Detect, which automatically identifies the type of Sony VTR being used, and automatically sets the appropriate control parameters through its RS-422 serial control port.

In addition, they also share the ability to read Control Track and Time Code. As well as the ability to perform video/audio split edits. Yet they also offer a range of other features to accommodate every budget.

For two machine editing, you don't have to think twice. It's the Sony RM-450.

Two-machine editing has never been as smooth, effortless and flexible. The RM-450 comes equipped with both 33-pin and 9-pin RS-422 remote control interface connectors, for comparably equipped VTRs.

What's more, mixed operation is possible using any combination of 33-pin and 9-pin VTRs.

The RM-450 can work with Time Code based editing (with 9-pin VTR connections) as well as CTL editing. It will also do split audio/video edits.

In fact, every aspect of the RM-450 has been designed for stress-free operation. This includes a keyboard layout which allows for a minimum of key strokes, a JOG/SHUTTLE dial on both the player *and* recorder side for convenient search, and dynamic tracking operation, and more.

Indeed, it is difficult to think of a dual-VTR editing task for which the RM-450 wouldn't be perfectly suited.

RM-450

The BVE-600.
A/B Editing from A to Z.

The BVE-600 goes beyond the capabilities of the RM-450 to offer three VTR control (two players and one recorder). This makes A/B roll editing possible, when used with the optional plug-in video switcher boards and an external MXP-29 Audio Mixer. With either composite or component/composite boards in place, you have dissolve, wipe, superimposition at your fingertips...with no

ony elevates g and pasting

BVE-600

need for an external video switcher.

In short, there is simply no more adaptable, efficient tool for use with U-matic® and Betacam® VTRs than the BVE-600.

The BVE-900. Created to be at home in any post-production house.

The BVE-900 was created with a clear strategy in mind: design the most expandable, easy-to-use, economically sound editing system possible. And make it meet Sony's rigorously high standards, and your high demands.

This editing control unit controls up to four VTRs in any A/B roll edit, enabling you to perform sophisticated editing chores like sync roll, sync play, and more.

The BVE-900 gives you sweeping control of video switchers; and of audio mixers, including fader selection and VCA control, for automated split audio/video edits.

And all this control is easily controllable, through a simple-to-master keyboard and easy-to-read menu driven display. It's technology that fosters creativity, rather than thwarting it.

Beyond any individual feature, all Sony editing control units are built with a full recognition of your post production demands. That's why all our units, when connected to Sony VTRs, switcher, audio mixer and video monitors, form a *system* which is capable of satisfying the most difficult editing needs. Yet if you need help or service, you only have to remember one name, Sony. What could be more convenient and efficient than that?

For more information about Sony's entire line of editors, write to Sony Information Center, P.O. Box 6185, Union, NJ 07083. There's a lot more to learn about the editing control units that bring new technological innovation and performance to cutting and pasting.

Circle (75) on Reply Card

SONY®

Professional Video

BVE-900

plements the TCP1000 play-only cart system. The work station can be operated in a remote location. The self-contained stations include an AT-type computer and keyboard, a sequence controller, a 10-XTM switcher with audio and video monitoring.

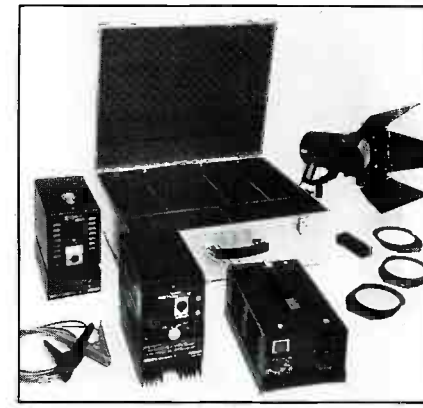
Circle (376) on Reply Card

Parametric equalizer/notch filter

Orban has announced the model 642B parametric equalizer/notch filter. It features dual 4-band or mono 8-band configurations, selectable by a front-panel cascade switch. Each band can be tuned over a 20:1 frequency range; tuning ranges of the individual bands overlap to maximize versatility. The "constant-Q" design of the filters provides +16dB boost and −45dB cut in each band, resulting in full notch-filtering capability with no interaction between parameters when one is adjusted. A vernier on the frequency control of each band facilitates precise tuning of sharp notches. Continuously tunable 18dB/octave high-pass filters and 12dB/octave automatic sliding Besselworth low-pass filters provide complete flexibility to limit bandwidth.

Circle (377) on Reply Card

Studio light system



Osram has introduced the HMI 270 studio light system. It is a modular system that consists of a lamp capable of producing five times the light of a comparable tungsten-halogen lamp. It includes two electronic ballasts (one for 110V/220V, 50Hz or 60Hz, and one for 30Vdc operation off a belt or the company's rechargeable NiCad block batteries), and an auto 12Vdc-30Vdc car battery adapter. The core of the system features an HMI 250 W/SE metal halide lamp. Its single-ended design and short arc produce high luminance at a color temperature of 5,600°K when run at full power. The lamp is mounted axially in the reflector, and focusing can be done either electronically or manually. The lamp produces 4,000 lumens and comes to full output in less than one minute. It also has a high optical output ratio of 80% light to 20% heat. The light does not require a conversion filter for daylight.

Circle (378) on Reply Card

Tape degaussers

Quantum has announced the expansion of the Weircliffe 1900 series bulk tape degaussers:

- The 1905 accommodates M-II and mini Beta SP cassettes, and the BTE-1910 is designed for the Beta SP format.
- The BTE-1925 is a conveyor-type tape degausser. It erases up to 1,400 M-II or mini SP cassettes per hour, in their storage cases.
- The BTE-1915 is a bulk eraser to accommodate the D-1 and D-2 digital cassette formats.
- The BTE-1935 is a multipurpose degausser capable of erasing various tape formats including 1-inch C format, U-matic, VHS, S-VHS and Beta.

Circle (379) on Reply Card

Audio consoles

Radio Systems has introduced the RS series of audio consoles. They are available in 6-, 12- and 18-channel models and feature three output buses; full remote control and tally functions on all channels; two inputs per channel, selectable at microphone, line and consumer levels; dbx VCA circuitry; P&G faders; timer; and insert/patch points on all channels.

Circle (380) on Reply Card

Universal frequency counter

Simpson has introduced the model 714, a high-accuracy 1.3GHz universal frequency counter. It features three input ranges: dc to 100MHz, dc to 2.5MHz and 100MHz to 1.3GHz. All functions—frequency, period, frequency ratio, time interval and totalizer—are front-panel selectable. Other features include 1ppm time-base stability and aging, selectable time base, X1 and X10 attenuation, 150kHz low-pass filter, adjustable triggering on channels A and B, self-check and display of internal time-base oscillator.

Circle (381) on Reply Card

Electronic power conditioners

Sola has introduced a microprocessor-based electronic power conditioner. It offers 94% efficiency at full load, plus high-inrush overload capacity. It has output capacities of 500VA, 1,000VA and 2,000VA. The front panel is equipped with red, yellow and green solid-state lamps that indicate operating and fault conditions. The conditioner operates within specifications in an ambient operating temperature range of 0°C to 40°C. The unit is programmed for over-temperature protection, which allows for automatic shutoff when the ambient temperature exceeds the specified operating conditions.

Circle (382) on Reply Card

Hand-held digital storage oscilloscopes

Tektronix has announced the Tek T201 and T202 hand-held digital storage oscilloscopes (DSOs). They weigh less than two pounds each and come with battery pack, probes and carrying case. Both scopes offer two channels, dual time base, 5MHz bandwidth for repetitive signals, and a 20

Otari's compact EC-201 SMPTE/EBU time-code reader is a natural for field or studio operation, and it costs only $495. It offers 1/20 to 60X playspeed reading, 40 hour continuous use on battery power, and reshaping circuitry on the loop output.

This advanced reader features a full hexidecimal user bits display (with a hold-button for edit logging); a −10 to +10 dBV input range; balanced XLR inputs/outputs, and includes an AC adapter, belt clip and batteries. It measures 1.5″ x 4.2″ x 5″ and weighs 18 oz.

Contact Otari at (415) 341-5900 for your nearest dealer. From Otari: Technology You Can Trust. Otari Corporation, 378 Vintage Park Drive, Foster City, CA 94404.

OTARI

Circle (79) on Reply Card

megasamples per second sampling rate with 20ns resolution. The scopes feature preset parameters.

Circle (390) on Reply Card

Computer prompter upgrades

Tekskil Industries has improved its 909C computer prompter. It features larger type, almost double the original font, plus a lower-case prompt font. A 10A ac adapter permits the field power supply to be used in the studio with adequate power to operate the computer and three 12Vdc monitors. A 12V monitor conversion kit also is featured for the Ikegami 9-inch monochrome PM 930 monitor.

Circle (391) on Reply Card

Color sync generator

Video Accessory Corporation has announced the model 200 color sync generator. It provides RS-170A blackburst, sync, subcarrier, blanking, burst flag, horizontal drive and vertical drive signals. The unit ensures that all gen-lockable video equipment is synchronized, and can free run or gen-lock to other video sources. Outputs and loop-through input are located on the back panel. Power and genlock indicators, frequency trim, subcarrier phase and horizontal phase adjustments are located on the front panel.

Circle (392) on Reply Card

Circle (101) on Reply Card

Business

Zero acquires Anvil Cases

Zero Corporation, Rosemead, CA, has acquired Anvil Cases. It will become a part of the Zero Halliburton Division of Zero Corporation. Zero designs and manufactures enclosures and accessories for the electronics industry.

Hughes signs for Westar satellite fleet

Hughes Aircraft Company, a unit of GM Hughes Electronics, El Segundo, CA, has signed an agreement to purchase the Westar satellite system from Western Union. The Westar system includes three C-band communications satellites in orbit and a fourth on the ground that is scheduled to be launched in 1989. The Westar satellites will be operated jointly with three Hughes owned and operated C-band Galaxy satellites. The purchase does not include the Westar earth stations.

Otari moves to new headquarters

Otari has moved to new headquarters located in the Vintage Park Development. The address is 378 Vintage Park Drive, Foster City, CA 94404; telephone 415-341-5900. The 2-story facility houses 34,000 square feet of combined office and warehouse space. New additions include an acoustically designed listening room by RLS Acoustics, customer training facilities, and a special test room for the laser-based Thermal Magnetic Video Duplicator (TMD).

Rank Cintel expands Midwest offices

Rank Cintel, Valley Cottage, NY, has relocated its Midwest broadcast sales office to new, expanded premises. The address is 830 E. Higgins Road, Suite 103, Schaumburg, IL 60173; telephone 312-884-0770. The offices have been equipped with a fully digital graphics suite for demonstrations of the Gallery System still-image management/library.

Lexicon acquires Roscor sports video editor

Lexicon, Fort Lauderdale, FL, has purchased from Roscor all of the assets and the business of Roscor related to the Roscor sports video editor, an advanced computerized video editing and analysis system. The Roscor system is a major addition to Lexicon's PlayBASE sports analysis product line.

People

William G. Connolly, Richard K. Wheeler and **John Richardson** have been appointed to positions with Sony, Teaneck, NJ. Connolly is president of the Advanced Systems activity group, and will manage activities such as HDTV. Wheeler is president of Sony Communications Products Company and is responsible for sales and marketing of products for the professional video, broadcast and professional audio divisions. He also oversees the customer service support, product management and finance/administration. Richardson is sales director.

Eugene W. Hammerle has joined AF Associates, Northvale, NJ, as director of engineering. He assumes both line and administrative responsibilities. He manages the systems engineering department, which includes the design of TV systems—studios, control rooms, editing facilities and mobile units. He also helps identify and implement growth opportunities in broadcast engineering.

Margaret F. Coppenrath has been named regional distribution manager for the Atlanta Distribution office of Agfa-Gevaert,

Ridgefield Park, NJ. She is responsible for customer service for the Southern region of the country.

Simon Bohannon has been appointed CSD manager for Audio Kinetics, England. He is responsible for the service and training department. **Tim Harrison** is technical sales engineer.

Tom Creighton of THC Associates, has been appointed Washington consultant for Comark Communications, Colmar, PA. Creighton is responsible for establishing and maintaining technical liaison with the corps of Washington, DC, broadcast consultants in areas relating to the company's line of tetrode, klystron and Klystrode tube-equipped transmitters, as well as its comprehensive line of RF transmission systems and components.

Donald F. Bogue has been named acting president and chief executive officer for Cubicomp, Hayward, CA.

Randall Smith has been appointed Western regional sales manager for For-A Corporation of America. He is responsible for marketing and support of broadcast, video and industrial/CCTV products in the Western United States.

John Duty has joined Arriflex, Blauvelt, NY, as Midwest lighting sales manager. He is in charge of all sales and service of ARRI, HMI, Fresnel, kit and specialty lighting, and for the ARRI Grip line of lighting and grip products.

Harrison J. Klein has been elected to the board of directors for Hammett & Edison.

Thomas E. Yingst, Robert R. Weirather, Fred Brown, Scott Martin and **Kent Pendleton** have been appointed to positions with Harris, Quincy, IL. Yingst is vice president and general manager of the Broadcast Division. Weirather is director of strategic marketing for the Broadcast Division. He is responsible for marketing, including new production identification and development, marketing research and external communications. Brown is radio district sales manager for Iowa, Wisconsin, Minnesota, upper Michigan, Nebraska, South Dakota

and North Dakota. He represents the line of AM, FM and short-wave transmitters, FM antennas, audio equipment and service training programs. Martin is radio district sales manager for North Carolina and South Carolina. His territory has been expanded to include Florida and Georgia, where he represents the line of AM and FM transmitters, antennas and audio equipment. Pendleton is radio district sales manager for southern California, southern Nevada, Arizona, Colorado, Utah and Hawaii. He represents the line of AM, FM and short-wave transmitters, FM antennas, audio equipment and service training programs.

Hans P. Dettmar has been named president of Lightning Eliminators and Consultants, Santa Fe Springs, CA.

Dave Richardson, Rick Fisher and **Omar Fattah** have been appointed to positions with McCurdy Radio, Palatine, IL. Richardson is Western regional manager. He is responsible for developing additional sales for the audio-for-video line. Fisher is Midwest regional manager. He also is responsible for developing additional sales for the audio-for-video line. Fattah is marketing manager. He is responsible for international sales, new market development and coordination of the dealer network.

Peter C. Lowten has been appointed vice president of marketing for Quanta, Salt Lake City.

Stan Hubler and **Gene Behrend** have been appointed to positions with RTS Systems, Burbank, CA. Hubler has been promoted to vice president, director of engineering. Behrend is systems engineer.

Phil Guy has been appointed marketing manager for Soundtracs plc, Surrey, England. He is responsible for increasing the company's profile in respect to new products, and for organizing the day-to-day operation of the marketing department.

Leo Burnett has been named agency of record for the audio-video department of BASF Information Systems, Bedford, MA. He is responsible for the strategic advertising role for the company's consumer and professional audio and video products.

Peter Cornell and **Yoel Schwarcz** have been appointed to

positions with Klark-Teknik, England. Cornell is technical support manager. Schwarcz is product manager.

Quentin R. Nelson has been appointed Northeast regional sales manager for Magni, Beaverton, OR. He is responsible for sales in New York, the New England and Commonwealth states and Michigan.

Stephen H. Edmunds, David Bower, Peter Rainger and **David F. Craddock** have been appointed to positions with Dynamic Technology, London, England. Edmunds is managing director. Bower has taken over management of the sales department. Rainger is research consultant with responsibilities for coordinating and extending the research and development activities. Craddock has resigned from the company to form a consulting company. He will act as a consultant for Dynamic Technology.

Charles J. Motta, Jr. has been named vice president of marketing for Prime Image, Saratoga, CA. He will work with dealers in the Eastern United States and will establish off-shore dealers.

Tom Volpicella, Scott Petrozzini and **Keith Scott** have been appointed to positions with Fuji Photo Film U.S.A., Elmsford, NY. Volpicella has been promoted to professional district sales manager. He is responsible for managing the sales force and for network sales in the Northeast region. Petrozzini has been promoted to senior account representative. He is responsible for key account sales in the New York metropolitan area. He also works with and supervises the other New York account representatives. Scott is account representative, professional products. He is responsible for professional sales with post houses, duplicators and dealers in southern California.

John E. Fick has been appointed applications/sales engineer for Gentner RF Products, San Jose, CA. His duties include customer assistance and sales of the VRC-1000 remote-control unit and accessories, as well as all other products.

Frederick P. Collins has been appointed chairman of the board and chief executive officer for Microwave Radio Corporation, Lowell, MA. He will be leading the strategic direction of the company. Collins previously served as director, managing partner and chief technology officer.

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MAINTENANCE ENGINEER New Orleans Teleport looking for bright, creative, intelligent individual to fill position as Maintenance Engineer. Will be responsible for Maintenance, Repair and Installation of Equipment. Knowledge of Ku-Band, C-Band technology, as well as broadcast facility operations and Repair of Broadcast Equipment necessary. Uplink-Downlink experience also necessary. Resume and Salary history to: New Orleans Teleport, Inc., 1047 World Trade Center, New Orleans, LA 70130, Attn: Director of Engineering. 6-88-3t

TV MAINTENANCE ENGINEER. Ever thought about working in Alaska? We are seeking a studio/ENG maintenance engineer with strong background in U-Matic, 1" VTR's, studio, ENG cameras. Send resume, references, salary history to: KTVA, 1007 W. 32nd Ave., Anchorage, AK 99503, Attn: Chief Engineer. EOE. 6-88-2t

HANDS ON CHIEF ENGINEER needed for AM & FM in Tallahassee, FL. Prefer 5 years minimum experience, SBE certification and strong technical background. FM soon to upgrade to 1400' tower facility. Send resume to: Bruce Timm, P.O. Box 1874, Tallahassee, FL 32302. 6-88-2t

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ASSISTANT CHIEF ENGINEER: Top 15 Market ABC affiliate seeks qualified assistant Chief; 5 years experience on Broadcast Studio Equipment, Sony Beta Cart, U-matic and 1", Grass Valley switchers experience with RCA Transmitters and MA/cams and Harris microwave helpful. Send resume and salary history to: Ralph Lee, CE, KSTP-TV, 3415 University Ave. MPLS 55414. EOE. 7-88-1t

TELEVISION MAINTENANCE ENGINEER: Lifetime Cable TV seeks an experienced maintenance engineer for its new broadcast facility in Astoria, Queens N.Y. Knowledge of Sony 1", ¾", Beta SP and Betacart desired. Familiarity with GVG switchers, editors and FX a plus. Position will involve custom construction and routine maintenance. Available to work evenings. Salary commensurate with experience. Full benefits, 401K. EOE. Send resume to: Lifetime Cabletelevision, Attn: Personnel Department, 1211 Avenue of the Americas, New York, N.Y. 10036. Telephone inquiries accepted by contacting Director of Engineering at 212-719-7175. 7-88-1t

TV-HELP WANTED TECHNICAL: Chief Engineer for new satellite delivered cable service. Your input will be vital in construction of new facilities. Solid video systems background and good communications skills essential. Computer hardware/software experience desireable. S.B.E. Certification a plus. Please respond with resume and salary requirements to Ed Gordon, NuStar, 384 Technology Drive, Malvern, PA 19355. 7-88-1t

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TECHNICIAN: Major Pittsburgh entertainment firms seeks a full time technician. Responsibilities include operation and maintenance of television equipment. Requirements include associate degree in Electronic Technology; minimum five year's progressive experience in broadcasting; requires day, night and weekend shifts. Send resume and salary requirements to: WQED, Human Resources Department, 4802 Fifth Avenue, Ptttsburgh, PA 15213. EOE, M/F/V/H. 7-88-1t

ASSISTANT CHIEF ENGINEER needed for medium market sunbelt CBS affiliate. Good organizational and communicative skills a must. Applicants should have prior hands on maintenance experience with VHF transmitters, live ENG and general studio equipment. Knowledge of on-air operational procedures helpful. Send resume and salary requirements to Lee Davis, Chief Engineer, WRDW-TV, Drawer 1212, Augusta, GA 30913-1212. EOE. 7-88-1t

MAINTENANCE ENGINEER: for NBC affiliate. Need technician with experience in RCA VHF transmitters, Ampex Quads, VPR-2's, and Sony ENG equipment. Send resume, references and salary history to: KJAC, P.O. Box 3257, Port Arthur, TX 77643, Attention: Chief Engineer. EOE.12-87-8t

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THE CHRISTIAN SCIENCE PUBLISHING SOCIETY—BROADCAST ENGINEERING—RADIO, TELEVISION, SATELLITE: The Broadcast Engineering Department of The Christian Science Publishing Society is looking for experienced broadcast maintenance engineers. Individuals must have a strong background in the setup, repair and maintenance of state-of-the-art equipment and systems. The following openings exist: TV MAINTENANCE SUPERVISOR; RF SYSTEMS ENGINEER; RADIO MAINTENANCE ENGINEER. Send resumes to: Maria Parrott, The Christian Science Publishing Society, C-44, One Norway Street, Boston, MA 02115. 7-88-2t

REGIONAL SALES MANAGER—Growing manufacturer of broadcast video products seeks two regional sales managers. Positions based in California and Chicago area. Require aggressive self-starter capable of working with minimum supervision. We offer competitive salary, excellent benefits including profit sharing. Interested individuals should send resume with salary history and requirements to Dept. 699, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66212. 7-88-1t

STELLACOM, INC. provides Engineering, Maintenance and Operational support for video systems and services used at the NASA Johnson Space Center, Houston, Texas. To provide increased support to our customers, we are seeking the following professionals. **ENGINEERING MANAGER:** •BSEE or equivalent technical degree, MBA preferred, with a minimum of 12 years combined experience in design, development and management of electronics engineering projects. •Experience with both microprocessor-based telecommunication systems and television systems design required. •Excellent writing/presentation skills a must. •Responsible for managing a staff of Electronic design and Television System Engineers in all phases of engineering design origination and project implementation. •Reports directly to the Project Manager. •References required. **TELEVISION SYSTEMS DESIGN ENGINEERS:** •BSEE or equivalent technical degree preferred. Requires at least 5 years experience in the design and implementation of television systems and subsystems. •Disciplines should include production, graphics, post-production, teleconferencing, signal processing, transmission and reception, videotape recording techniques, analog and digital video processing, video/film interfaces and signal distribution. •Candidates should be familiar with the latest techniques and applications of current audio/video equipment and signal processing. •Excellent communications and writing skills required. •References required. If you meet the required qualifications, please call and/or address your resume to: Lucille Rhame, StellaCom, Inc., 16441 Space Center Blvd., Bldg. A, Houston, Texas 77058, (713) 480-3377. Excellent Benefits. We are an Equal Opportunity Employer. Principals Only Please. 7-88-1t

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TRANSMITTER SUPERVISOR: Experienced RF engineer needed to supervise and maintain a Harris BT 220 UHF Transmitter. Must have a minimum of 5 years RF experience and hold a valid FCC license. Salary $27,834. State benefit package. Send resume by July 29, 1988 to: Robert C. Hoerr, Maryland Public Television, 11767 Bonita Avenue, Owings Mills, MD 21117. EOE/AA. 7-88-1t

ASSISTANT DIRECTOR OF ENGINEERING. Minimum 5 years experience in TV. Good knowledge of RF, analog and digital theory. New facility, state of the art equipment. Send resume, salary history to Ken Preston, Director of Engineering, KSEE, PO Box 24000, Fresno, CA 93779. EOE M/F. 7-88-1t

VIDEO REPAIR TECHNICIAN: Anticipated opening for 9/88; Service ¾" & vhs VCR, TV, & a/v equipment; some operations necessary. AAS or trade school w/2 yrs' experience required. Hands-on VCR/TV service, production experience, & driver's license preferred. 12-month position, sal. $21k minimum, good benefits. Send resume & letter by 8/12/88 to Video Tech—Central AV, Suffolk Community College, 533 College Road, Selden, NY 11784. 7-88-1t

CONSULTING ENGINEER

Hammett & Edison, Inc., a leading consulting engineering firm specializing in engineering for the radio and television broadcasting industry, has an opening for a senior engineer. Our work involves broadcast systems design, FCC applications, and forensic engineering, including some field work and travel. A bachelor's degree is required; advanced degrees are desirable, as is broadcasting industry experience. Professional engineering registration is essential but can be obtained later. Our West Coast location is close to beautiful, exciting San Francisco and the technology center of Silicon Valley. If you are interested in this career opportunity in a challenging field with a firm known for 36 years of engineering excellence, please reply in writing with your resume to:

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MAINTENANCE ENGINEERS for top 10, full power, high-band, university owned, PBS affiliate. Minimum 5 years experience desired in the installation, operation, and maintenance of audio, video, microwave, satellite, high-power transmitting, and support equipment. FCC general class license required and SBE certification helpful. Submit resumes to: Al Leverick, Chief Engineer, KUHT, 4513 Cullen Boulevard, Houston, Texas 77004. Please—no phone calls. Equal Opportunity Employer. CLOSING DATE SEPTEMBER 1,1988. 7--88-2t

TRANSMITTER SUPERVISOR—WASHINGTON D.C. station needs supervisor to perform maintenance and supervise the technical operation of XMTR facility. Requires Bachelor's Degree in Electrical Engineering, Electronic Technology or a related field. Must possess General Radio/Telephone License, RF endorsement is desireable. Three years of progressively responsible TV maintenance experience with supervisory responsibilities. Experience in maintining VHF/UHF transmitters utilizing vapor-cooled klystron tubes. For prompt and confidential consideration, forward your resume with salary history to: Clarence Brodus, Director of Operations & Engineering, WHMM-TV, 2222 Fourth Street, N.W. Washington, D.C. 20059. We Are An Equal Opportunity Employer M/F/H. 7-88-1t

THE WASHINGTON DC BUREAU OF CONUS COMMUNICATIONS is seeking a full time Engineering Maintenance Supervisor. This person must be capable of supervising a small engineering maintenance department and must have experience in servicing Sony Betacam field equipment, and studio edit facilities. Candidates for this position should have experience in operating a wide variety of broadcast video and audio equipment, as well as, the use of a spectrum analyzer. Experience with satellite equipment or transmitters is desirable, but not required. Individuals seeking this position must be able to work in close quarters with an active news organization, and make decisions quickly, frequently while under pressure. Salary is open, depending on qualifications. Resumes should be sent to Scott Goodfellow, 1825 K Street, NW, Suite 601, Washington, DC 20006. 7-88-1t

RADIO-TV ENGINEERING MANAGER: The University of West Florida is seeking an experienced Radio/TV maintenance engineer. This position is an opportunity for a candidate with strong technical background and excellent people skills to move into a managerial position requiring hands-on maintenance. Qualifications: Bachelor's degree in electrical/electronics or related field, plus one year experience in the maintenance, design, operation or construction of technical broadcasting equipment or high school diploma and five years experience as described above. Engineering manager is responsible for ITV cable system, 3 TVRO systems, 2 production studios, audio and video editing suites. Salary $20,500-$30,000. Send resume with cover letter, names of three references and UWF application to Personnel, (904) 474-2694, UWF, 11000 University Pkwy., Pensacola, FL 32514 by August 8, 1988. UWF is an EOE/AA, M/F/V/H institution. 7-88-1t

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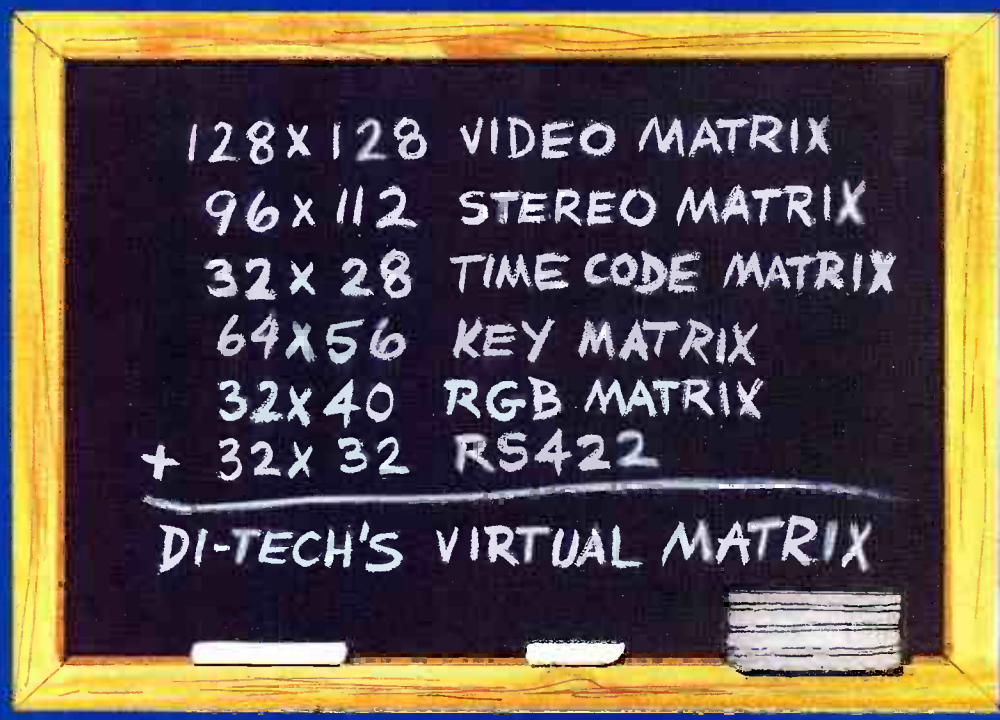

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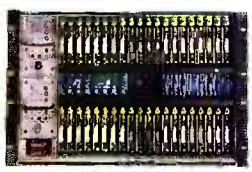
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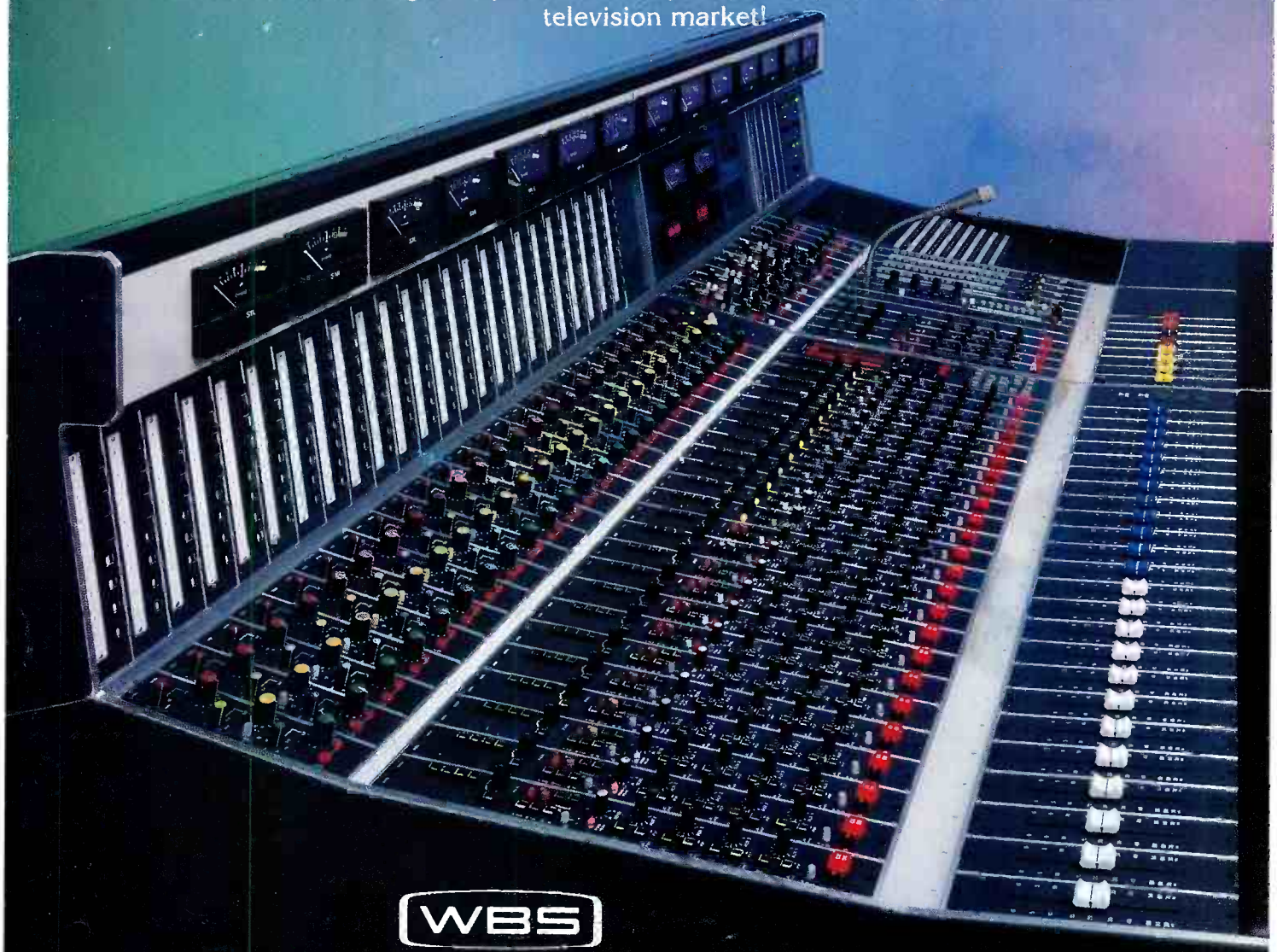

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