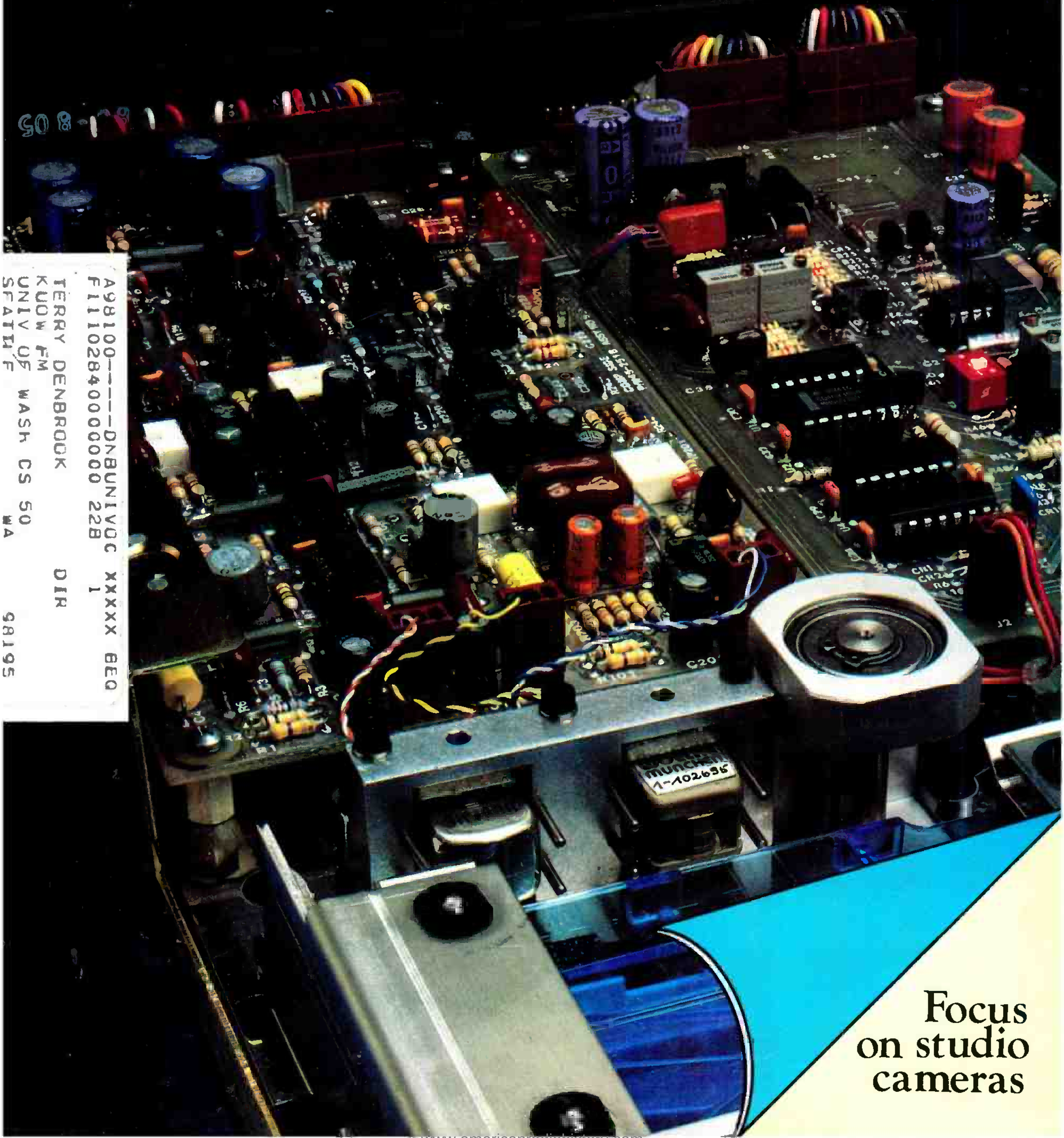
BROADCAST engineering

August 1985/$3

Dimensions in audio



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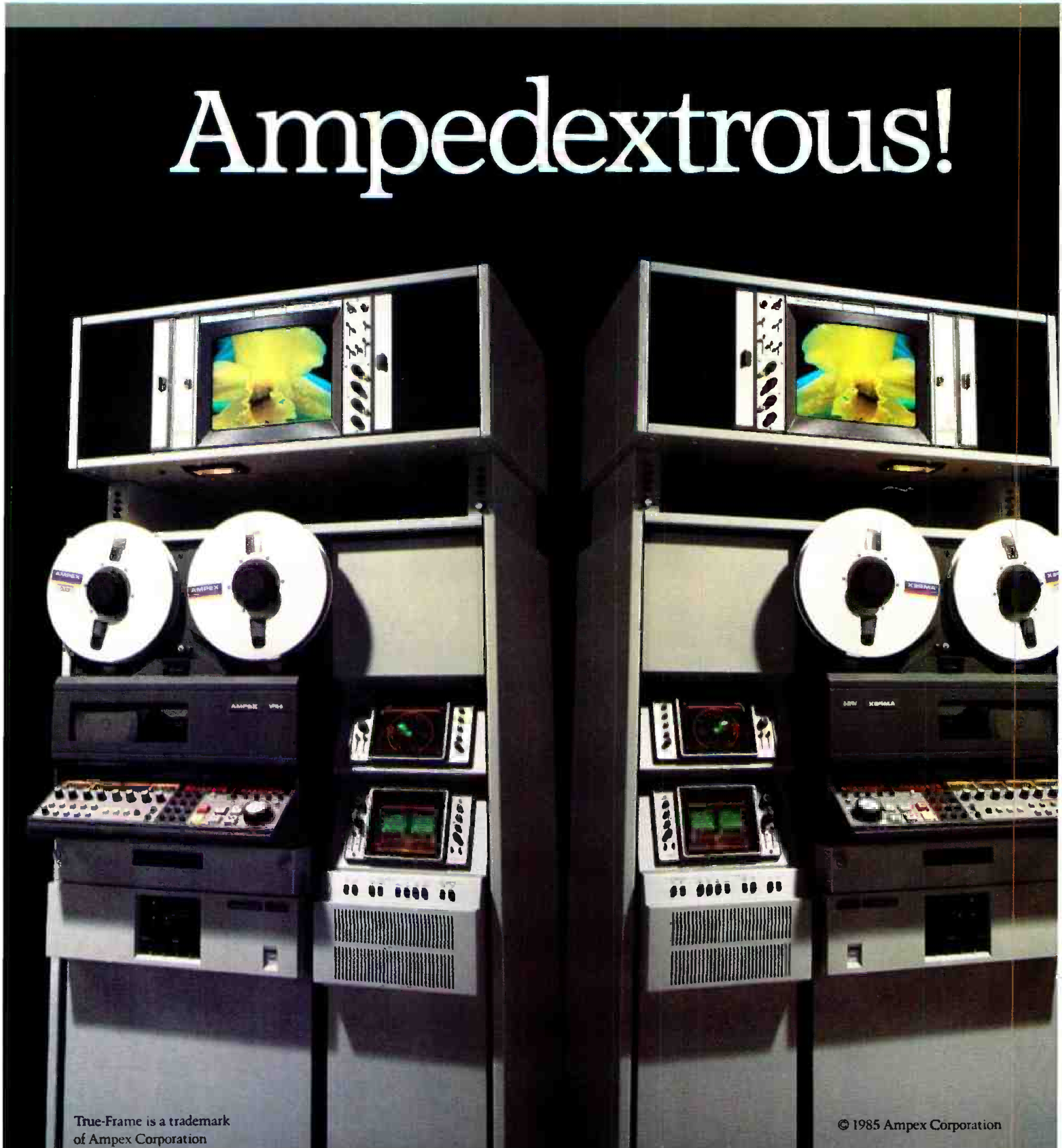

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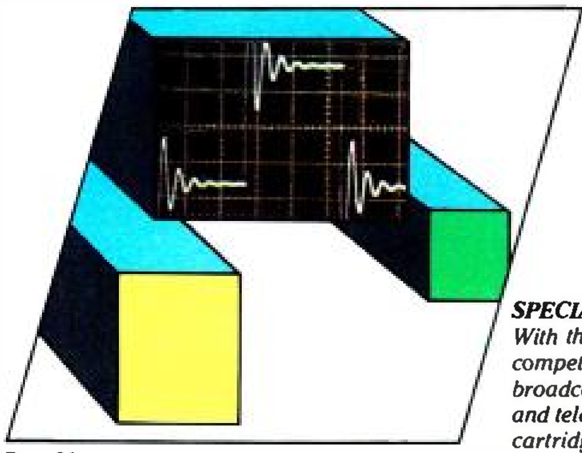

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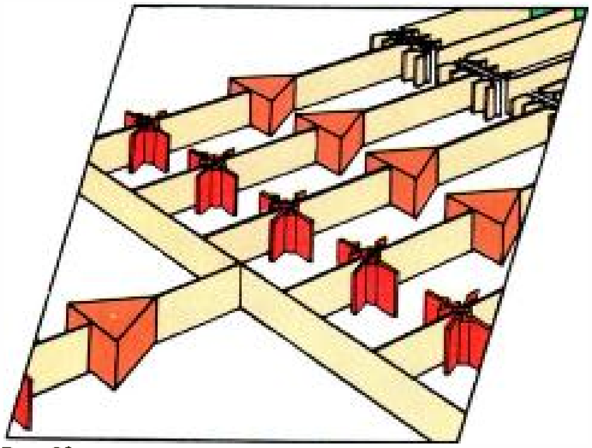
BROADCAST ENGINEERING

SPECIAL AUDIO ISSUE

With the advent of stereo TV, AM stereo and tougher-than-ever competition on FM, audio quality is of prime importance to broadcasters. Our special report on audio technology for radio and television focuses on audio processing, distribution systems, cartridge machine maintenance and monitoring audio waveforms.



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OTHER FEATURES

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ON THE COVER

The quality of broadcast audio is becoming increasingly important in today's competitive marketplace. Faced with stiff competition from both broadcast and non-broadcast sources, radio and TV stations are taking a hard look at their entire audio chains. *Our cover this month shows an* inside view of the Micromax audio cartridge reproducer. (Photo courtesy of Pacific Recorders and Engineering. The photographer was Rodney Jones, of Rodney Jones, San Diego and Los Angeles.)

DEPARTMENTS

www.americanradiohistory.com

News

Plans for Radio '85 under way

The Radio '85 management and programming convention, the second joint meeting of the NRBA and the NAB, has been set for Sept. 11-14, at Loews Anatole, Dallas. Plans include more than 60 sessions on management, programming, sales and others, and 20,000+ square feet of exhibit space.

Radio '85 sessions scheduled for managers are: station computer usage; planning and budgeting; effective management communications; market warfare; personnel management; managing cash flow; and common traits of successful managers.

Sessions for programmers are: morning radio success stories; training session for new program directors; grooming PDs to be GMs; AM success stories; news in a music format; a programmer's look at the rating services; and small market radio PDs.

Sales management sessions are: rates and revenues—how to maximize inventory; how to sell promotions without giving away the store; sales research—become a marketing partner with your client; how to recruit and to train effective sales people; sales forecasting and budgeting; specialized sales—co-op, telephone, jingles; selling for and against combos; and how the competition sells against you.

And scheduled general sessions are: buying that first station; competitive audio processing; brainstorming; a look at cable, LPTV, MTV; effective direct mail campaigns; living with the new FCC deregulation; new financing for buying/selling stations; and controlling legal costs.

Technical conference set

The 127th technical conference and equipment exhibit of the SMPTE has been set for Oct. 27 through Nov. 1 at the Los Angeles Convention Center in downtown Los Angeles. "New Directions in Technology—Difficult Decisions" is the theme for this year's conference. The last SMPTE Los Angeles conference, also held at the convention center, was the largest and best-attended conference in SMPTE's 69-year history. This year, there is more exhibit space available than two years ago, when the society met in a convention center for the first time.

Donald C. McCroskey, ABC, has been named program chairman by SMPTE editorial vice president Howard T. La Zare, Deluxe Laboratories. McCroskey, SMPTE's editorial director for television, will work with Edward J. Blasko, Eastman Kodak, who was appointed program vice chairman. Blasko also serves as SMPTE's editorial director for motion pictures.

Also appointed to positions on the program committee were T. Russell McMurtry, Eastman Kodak, as co-chairman, film), and Jerry L. Isenhower, NBC, as co-chairman television. Michael Chewey, Systems Unlimited, has been appointed general arrangements chairman by conference vice president French. Chewey was facilities chairman at the 125th SMPTE conference held in Los Angeles in 1983.

BROADCAST ENGINEERING

Editorial and advertising correspondence should be addressed to: P.O. Box 12901, Overland Park, KS 66212-9981 (a suburb of Kansas City, MO); (913) 888-4664. Telex: 42-4156 Intertec OLPK. Circulation correspondence should be sent to the above address, under P.O. Box 12937.

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BROADCAST ENGINEERING is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities and government agencies. Qualified persons include consulting engineers and dealer/distributors of broadcast equipment.

SUBSCRIPTIONS: BROADCAST ENGINEERING is mailed free to qualified persons within the United States and Canada in occupations described above. 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, except for the September Buyers' Guide/Spec Book, which is $20. Rates include postage. Adjustments necessitated by subscription termination at single copy rate. Allow 6-8 weeks for new subscriptions or for change of address. Second class postage paid at Shawnee Mission, KS.

BROADCAST ENGINEERING (USPS 338-130) is published monthly (except in December, when two issues are published) by Intertec Publishing Corporation, 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212-9981. Postmaster, return form 3579 to P.O. Box 12938 at the above address.

Editorial

Decision without debate?

A guest editorial

The Society of Motion Picture and Television Engineers has long been recognized for its significant role in standardization for the motion picture and TV industries. Because of this role, it was presented an Oscar by the Motion Picture Academy and has been honored by the Television Academy, which awarded citations for the universally adopted SMPTE time code and an Emmy for the society's role in developing the standard for the Type C 1-inch helical VTR format.

Since its founding in 1916, SMPTE has successfully developed more than 200 standards. To me, that's an enviable record, one that all of us associated with the organization look upon with pride.

Despite these achievements, SMPTE has been the recent target of criticism because standardization has not yet been accomplished in some areas. I believe this criticism is undeserved.

Though SMPTE is a recognized standardizing body for the motion picture and TV industries, it does not *create* standards. Instead, SMPTE is an administrative body, providing an environment for standardization and the apparatus for accomplishing it. SMPTE is neutral. It is not an advocate. Its only role is to provide the means for standardization to occur.

For almost 70 years, SMPTE has encouraged the adoption of voluntary and viable industry standards without imposing constraints on emerging technology or applying unseemly coercion during the process. Considering the rapid influx of new technology into the film and TV industry, a factor that greatly complicates any standardization effort, SMPTE has done a remarkable job of maintaining a comprehensive level of applicable standards and recommended operating practices, without which these industries could hardly function as well as they do.

The society is not authorized to, and is prohibited from, choosing and enforcing standards. Rather, it is a forum for conciliation and consensus among diverse groups of talented individuals that gather for technical and scientific discussions. SMPTE's goal is to seek voluntary standardization through in-depth examination and intelligent agreement among committee members, and it strives to mesh the standards and practices of technical excellence with commercial viability. Toward this end, compromise is the preferred path, and is encouraged by the society.

Standardization happens via the committee system. Five hundred specialists, representing competing manufacturers and users, serve on eight technical committees and 55 subgroups. It is in these subgroups, concerned only with specific segments of technology, that the standardization process usually begins.

The committees follow established procedures to ensure that due process is maintained. They work within defined legal constraints and self-imposed ethical guidelines, such as limiting the number of voting representatives from any one interest. Also, comparative studies or ratings of competitive products are prohibited. One system cannot be chosen over another when both are technically adequate; both can only be documented. This means that one recording format, for example, cannot be chosen over another. The ethical guidelines prohibit dissemination of committee information without clearance by the chairman, and this often leads to some misunderstandings with outside parties.

The standardization procedure is democratically structured, with the inherent merits and limitations of such a process. An American National Standard or SMPTE recommendation, however, does not prevent the manufacture, marketing or sale of products that do not conform to the standard. It is the consumer's prerogative to regard or to disregard a standard. The U.S. American National Standards serve to aid, not to compel, the manufacturer, the consumer or the general public. In the past decade, we have seen that, very often, the marketplace sets the de facto standard.

If there is a failure, the failure is not SMPTE's. We have brought the differing factions together. We provide them with a place to meet. We offer them a forum to present their ideas and their points of view. And we give them the time and administrative support to accomplish their tasks. SMPTE cannot force a standard, and that is its value. The society exists to serve the industry. Providing the standardizing mechanism, not the standards themselves, is the organization's role.

Those of you who are disappointed and frustrated by the absence of a standard in a specific area are encouraged to participate in the standardizing process. Our doors are open. Rather than censure SMPTE, you would do better to join it; with your input, agreement might be accomplished. As it has been said, one who does not author a standard will be its slave.

Prepared by Harold J. Eady, president of the Society of Motion Picture and Television Engineers.

The ban lifts for rebroadcast

By Harry C. Martin

The FCC has amended its rules pertaining to the rebroadcast of non-broadcast communications by radio and TV stations. CB and amateur radio communications now may be rebroadcast without prior authorization of the originating station. Also, the prohibition on rebroadcasts of personal radio service communications and rules requiring prior approval by the commission for rebroadcasts of non-broadcast transmissions have been eliminated.

Until recently, Section 705 of the Communications Act banned unauthorized interception and divulgence of amateur and CB transmissions. In view of recent revisions by Congress to Section 705, the commission believes it is no longer necessary to obtain rebroadcast consent from CB and amateur radio stations or to prohibit rebroadcasts of personal radio service messages, because secondary or receive-only rebroadcast use of such communications does not conflict with the purposes of these services.

One of the reasons for the rule change was concern, generated during the 1983 U.S. military action in Grenada, as to whether the commission's rules permitted the rebroadcast of amateur radio communications. Ham communications were the principal source of information regarding events in Grenada.

FCC clarifies citizenship requirements

The FCC has ruled that limited partnership interests are cognizable under the citizenship requirements of Section 310(b) of the Communications Act. Section 310(b) generally prohibits aliens from holding interests aggregating more than 20% of the ownership of a broadcast licensee or more than 25% of an entity directly or indirectly controlling a licensee.

The ruling was issued in response to a petition that contended that limited partnership interests are distinguishable from corporate and general partnership interests because limited partners, unlike other principals, are unable to exercise control over business affairs. The petitioner argued that the interests of limited partners are analogous to those of creditors and, like creditors, their ownership interests should be disregarded in determining citizenship compliance.

These arguments were rejected by the commission. Section 310(b) of the act was derived from the Radio Act of 1927, which applied to "*any* company, corporation or *association.*" The commission pointed out that precluding aliens from exercising actual control over broadcast facilities is only one of the objectives of Section 310(b). Safeguarding the United States from foreign influence in the broadcast field (including financial influence), reflects a broader purpose. In light of the legislative history and explicit language of Section 310(b), the commission said, it is not empowered to waive the provision or interpret it liberally in cases involving passive investors.

The commission ruled that Section 310(b) makes it unlawful for a limited partnership to be a broadcast licensee if the voting interests *or* the equity contribution of alien limited partners, in the aggregate, exceeds 20%. This interpretation also applies to the 25% limitation that affects companies directly or indirectly controlling the licensee.

Measurement procedures for TV power relaxed

TV licensees are now permitted to determine aural transmitter power levels in any manner that will assure operation at authorized power levels. This change is a result of comments recently received by the commission from TV station operators regarding previous meter calibration requirements, which they said were burdensome and extremely difficult, if not impossible, to comply with.

The deregulation action in this area was accomplished without issuance of a notice of proposed rulemaking and is effective immediately.

More "metrication"

Subparts E through H of Part 73 and all of Part 74 of the commission's rules have been converted to the metric system, effective immediately. Subparts B and C of Part 73, dealing with FM stations, were converted to the metric system in 1983. The newly affected sections deal with the following areas:

- Subpart E . . TV broadcast stations
- Subpart F . . international broadcast stations
- Subpart G . . emergency broadcast systems
- Subpart H . . rules applicable to all broadcast stations
- Part 74 . . . . experimental, auxiliary, LPTV, ITFS and translator stations

The most important rule sections affected by the changes are those dealing with required spacings between TV stations (Section 73.698) and the HAAT/power reduction curves, also for TV stations (Figures 3 and 4 of Section 73.699).

FCC action sparks NAB interest

The NAB has asked the FCC to reconsider last month's action establishing a radio frequency radiation guide. The FCC selected the American National Standards Institute's protection guide as the standard for determining whether the grant of an application should be considered a major action under the National Environmental Policy Act. The NAB agrees with the selection, but called for some improvements in the report and order.

The association recommended that the reconsideration provide: an opportunity for adequate public and industry comment on the formulation of the forthcoming technical bulletin, including a review of the FCC's initial draft of such a document; issuance in the bulletin of guidance that will balance the need for certainty against unnecessary paperwork and expense; a revised effective date of June 1, 1986, for its new rules or one not less than 90 days after the publication of a final technical bulletin; and an effective and immediate response to efforts of non-federal authorities which are impairing broadcasters' ability to engage in commission-authorized activities.

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Circle (6) on Reply Card

Strictly TV

Lightning strikes again

By Carl Bentz, technical editor

As outlined in last month's "Strictly TV," a method of monitoring component signals has been suggested that shows promise for quality assurance applications. Called *Lightning*, the system allows three video components to be combined

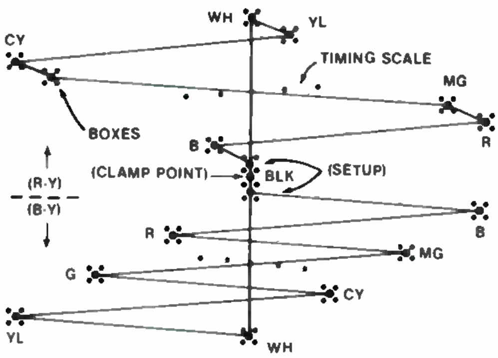


Figure 1. A display of 75% color bars indicates no delays.

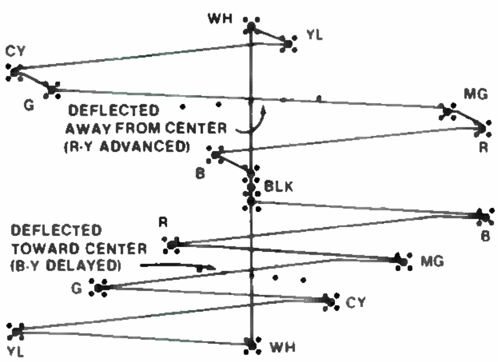
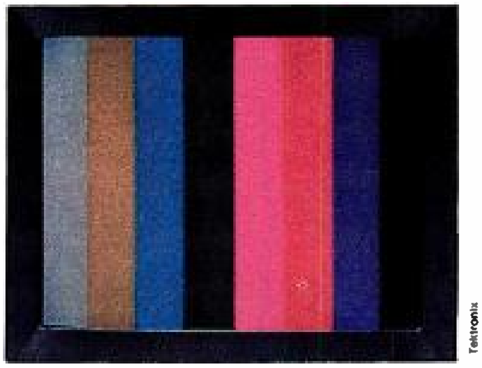


Figure 2. A display of 75% color bars with R-Y preceding Y and B-Y delayed from Y.

in a single display.

Clamping the component signals provides center-of-display reference points. Luminance is filtered, then displayed with vertical deflection alternately as a positive, then a negative waveform. R-Y and B-Y are also switched, so that R-Y corresponds to positive Y information. B-Y is displayed with inverted luminance.

If 75% color bars were applied to the Lightning display without delays or other degradations, the pattern shown in Figure 1 would result. Note that in the center, above and below the luminance clamp point, *black* setup for R-Y and B-Y appears. At the top and bottom, *white* appears. The trace passes through dots corresponding to the six points on a normal vector display. Right-to-left deviations of the trace roughly resemble R-Y and B-Y waveform displays, again clamped to a center screen location.



Note that timing scale dots are set at slight angles halfway above and below center screen. As you compare Figure 2 to Figure 1, note that the *green-to-magenta* line has moved upward, to show 75% bars with R-Y preceding Y, and B-Y delayed from Y. The lines connecting all of the color dots are no longer straight, which means that a color distortion would appear in the picture.

By using an electronically generated graticule, it is possible to precisely place the timing dots on the screen. It is practical to expand the deflections to allow easier reading of timing or delay errors.

The method is not restricted to Y, R-Y and B-Y signal inputs. RGB signals could be applied to the monitor through appropriate matrixing, with difference signals developed to drive the display. Delays in each of the RGB components will be displayed as shown in Figure 3. The trace indicates how the display might appear with a delayed red signal, or R-Y > B-Y. A blue delay would show in the lower part of the display. Green delay affects both color differences, because green is a part of R-Y and B-Y.

Measuring noise on the signals uses offsets for a multiple trace display. A precision square wave offset is introduced in both horizontal and vertical directions to form dot trios, as shown in Figure 4. The oval dots are not clearly defined, as the illustration suggests. They would appear fuzzy, with the size determined by the amount of noise involved. Additional gain required for the color signals introduces some noise, resulting in an oval shape in the horizontal deflection. Dot triples above the center involve the R-Y component, and those below show the B-Y signal.

When an offset control is adjusted to reduce the distance between the dots that appear in triple, a readout indicates the noise level. Precisely at the point where the space between two dots is eliminated, the readout shows the amount of noise. RMS noise readings for each of the three components are possible with one display.

Lightning is a suggested means to monitor a set of three analog com-

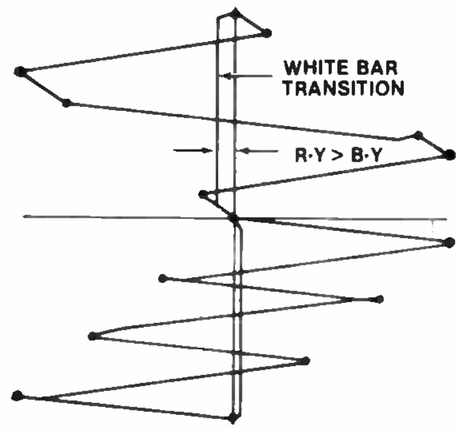


Figure 3. A delay in red is shown in the R-Y portion of the display.

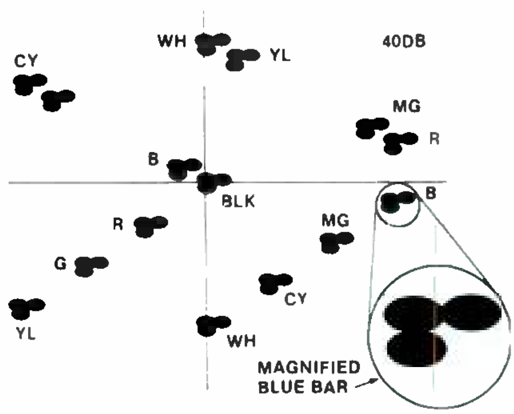


Figure 4. A tangential noise measurement of 40dB, using vertical and horizontal offsets.

ponents. Along with signal amplitude inequalities, delays in any component are also visible. No doubt other measurement methods will be offered, but this approach provides more information than has been available before, and requires only a minimum amount of user experience.

Editor's note: Our appreciation goes to Dan Baker and Tektronix for making this information available. Baker's paper titled, "New and Unique Method for Measuring Video Analogue Component Signal Parameters," presented at the SMPTE winter TV conference, is scheduled to be published in the SMPTE journal in the near future.

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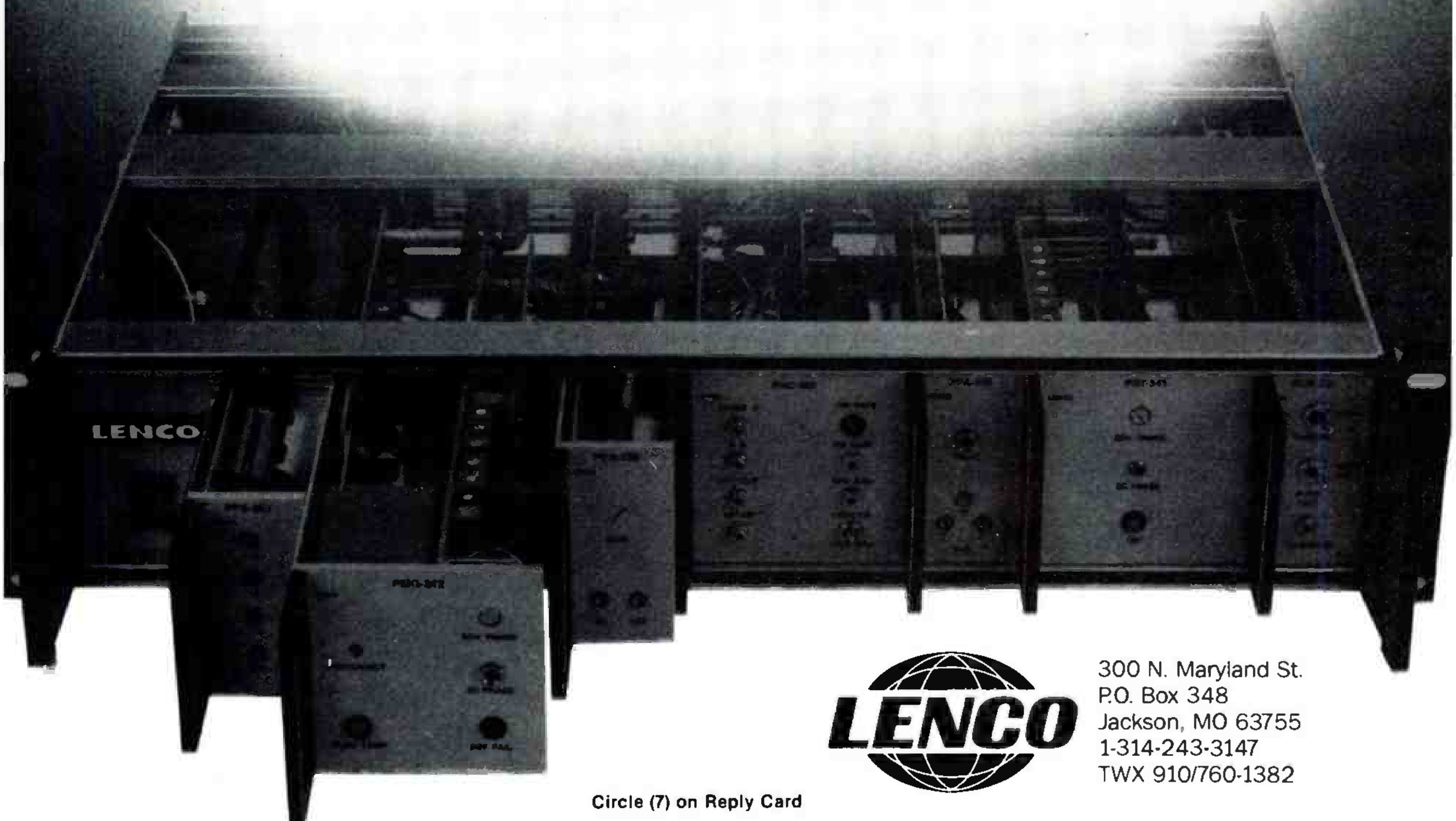

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Circle (7) on Reply Card

Making the move to AM stereo

By Ralph Chambers

An AM station planning to convert to stereo operation should make the move only after careful evaluation of the entire project, including a realistic assessment of the improvements required in each area of the facility for quality stereo programming. AM stations need to take into consideration the same quality standards used by their FM counterparts for years. Studios should be constructed and maintained for the highest performance possible. Quality control and monitoring facilities should be provided for each segment of the on-air product. In short, the basics of good engineering practice should be adhered to. The project can be a tremendous asset to the station, as well as a rewarding experience for everyone involved.

Investing in your station

Some owners and operators of monophonic stations that have not planned for eventual operation in stereo may ask, is it worth the price at this point in time? If you now program music of any kind (or plan to do so in the future), I'd say the answer is *yes*, especially in view of the number of major receiver manufacturers that are offering AM stereo receivers for sale to the public.

An AM stereo upgrading program brings added benefits to the station because it provides a good opportunity to thoroughly examine the performance of each link in the broadcast chain. This often results in the purchase of new audio source machines, mixing consoles and other equipment. Transmitter improvements and antenna system repairs also usually accompany an AM stereo updating project.

The more obvious benefits include an improved on-air sound in stereo, second-channel redundancy throughout the audio chain and a great promotional opportunity for the station.

Monitoring the signal

With a move to AM stereo, quality control becomes more important than ever. Appropriate monitoring facilities should be added to the production and control rooms. These monitors can be of various types, but I have found that a commonly available (and generally inexpensive) narrowband oscilloscope, plus stereo program and air monitor speakers, are all that is required. Increased operator awareness of the need to monitor each

Chambers is chief engineer of WCMQ-AM, Miami.

Pacific Recorders and Engineering

step in the station programming chain can be a great advantage to busy engineering and programming personnel who are continually looking for ways to streamline day-to-day quality control procedures. The addition of oscilloscopes (connected in the program chain where appropriate), along with the usual console VU meters, program audio monitors and air monitors, provides the station an efficient arrangement of four primary monitoring sources.

With adequate monitoring, on-air problems related to stereo operation—such as phase reversal or loss of one channel—are seen immediately by the operator, not just heard. A disc jockey may go for several minutes or longer without noticing a loss of stereo information, especially during busy drive-time periods when attention is on contests, phone calls and heavy commercial loads.

Besides the on-air control room, the most important location for an oscilloscope for monitoring stereo phasing is the production room. This is a critical link in the broadcast chain, where the commercial announcements and, in many cases, all the station's music programming are recorded.

Additional monitoring equipment at the transmitter site aids in testing, monitoring and maintaining the transmitter itself. The addition of an AM stereo monitor often simplifies the adjustment of transmitter tuning and neutralization controls.

Planning ahead

Conversion to stereo operation is usually best accomplished as a long-term project that encompasses the renovation of the entire broadcast facility, one step at a time. Not only is this approach the most cost-effective means of updating a plant, it is also the least disruptive to day-to-day operations. Many AM stations, recognizing the potential of stereo, designed their studios for eventual 2-channel operation. When the time finally came, these stations were able to make the changeover with a minimum of effort.

An AM stereo updating project should begin at the transmission plant, a critical link in the broadcast chain. A transmitter or antenna system that works poorly in mono will perform even worse in stereo. Most of the work involved in renovation of the facility can be performed by the station's full-time engineers or contract engineer. However, some portions of the project, such as the transmitter and antenna work, may require outside assistance from an experienced consulting engineer.

A total renovation is a major undertaking that requires commitment—financial and personal. Resist the temptation to cut corners. *Quick fixes* will come back to haunt you.

While the renovation work is under way, seize the opportunity to clean up any long-standing problems or to replace any unreliable equipment. A good argument can be made to management that it makes little sense to spend thousands of dollars to renovate the plant, only to leave a weak link in the system. Make the case that outdated equipment would have to be replaced anyway. Why not make the project complete now?

Test equipment

A state-of-the-art plant cannot be maintained with just a VOM and tool box. Therefore, the test equipment needs of the station should also be addressed as part of the renovation project. A high-quality oscilloscope, audio-frequency generator, THD and IMD distortion analyzer, logic probe, digital-frequency counter and digital multimeter are the minimum requirements for test equipment inventory at a radio station today. Accurate and cost-effective troubleshooting is possible only if the engineer has adequate test equipment.

Perhaps the most important piece of test equipment at the station is the modulation monitor. Make sure the monitor is accurately calibrated. An unreliable unit should be replaced. The monitor is both the reference instrument for measurement of modulation and the primary signal source for frequency response, distortion and noise tests. A new monitor is, of course, required for AM stereo operation and should automatically be in the station upgrade budget. Push for purchase of the monitor early in the renovation project, so you'll have the benefit of the added features of the new monitor during initial tests and adjustments of the system.

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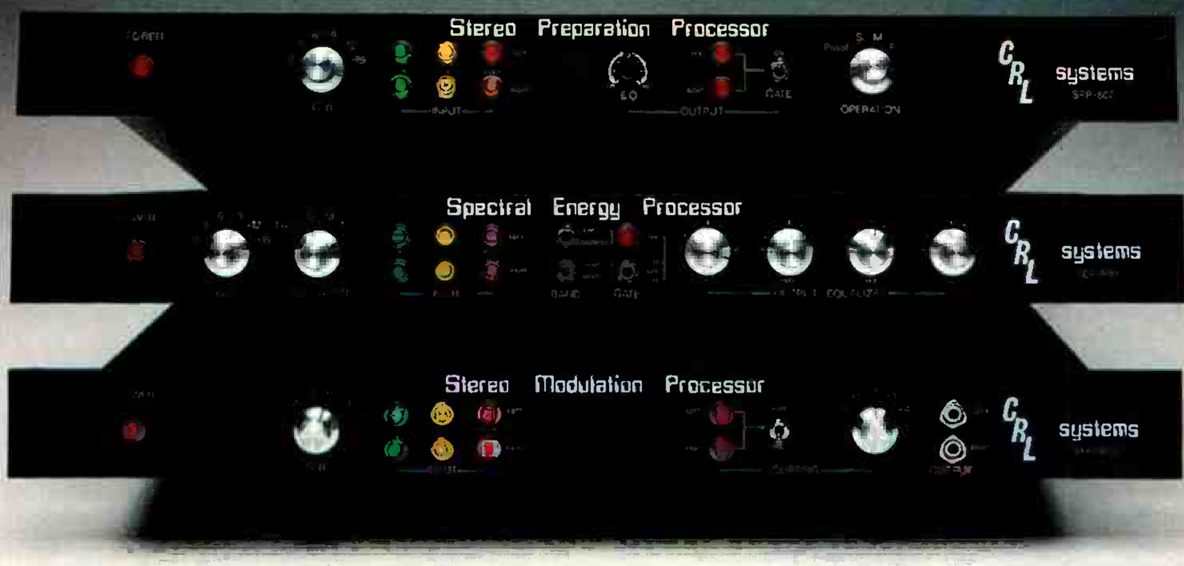

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Satellite technology

The trend is trends

By John Kinik

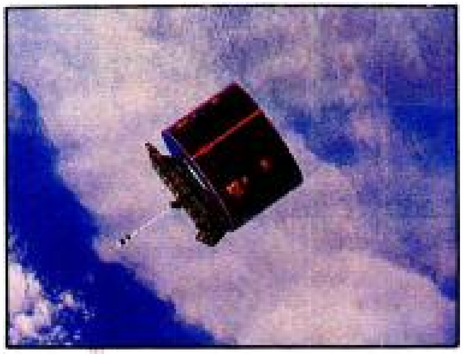
Major trends are occurring in satellite technology and other telecommunications technologies that will, if they continue, have far-reaching effects on the satellite industry and those who use satellites in the future. Most notable is the dramatic shift *away* from the use of satellites for telecommunications networks by the communications carriers (AT&T, MCI and others) in favor of fiber-optics technology.

The projections for fiber optics are so promising in terms of transmission quality and lower cost per circuit mile, that all network planning by these carriers is now dominated by fiber links. They are implementing an auxiliary role for satellites, of bringing off-network traffic onto the fiber network from smaller population centers, until economics justify installation of fiber. At the current planned rate of installation of fiber links by the common carriers and other new independent fiber companies, in 10 years, the transmission capacity to serve the country will be so great that some industry analysts are contemplating the possibility of completely eliminating the need for switching-voice circuits and low-rate data circuits in regional centers.

The general effect of this major shift back to terrestrial transmission will be a slowdown in the rate of satellite launches as compared to the projected launch rate two years ago. Because of this, it is possible that 2° spacing of satellite positions, decreed by the FCC when the demand for new orbital slots was so great, may be relaxed, either in terms of wider spacing or slower implementation.

Another major technology trend within the satellite industry is contributing to a decreased demand for orbital slots. New Ku-band satellite designs being proposed have a much higher communications capacity than existing satellites, due to the use of multibeam technology to increase the total throughput of the satellite. Just as the frequency reuse technique was employed on second generation C-band satellites and the newer Ku-band satellites to double the number of transponders by means of polarization-isolation and frequency-offsetting techniques, the new multibeam technology can increase a satellite's capacity even more by combining the previous techniques with spatial isolation (beams) over the geographical area covered.

Kinik, BE's satellite correspondent, is a senior systems engineer for a satellite carrier service.



NASA

As an example, a typical future Ku-band satellite launched for a specific private telecommunications network (such as the massive proposed Federal Express Zapmail network) might use three or four beams to cover the country instead of the single or dual beam coverage now used. This technique could be applied to both uplinks and downlinks and, in combination with polarization-isolation techniques on adjacent beams, could multiply the total capacity of the satellite by a factor of 3 or 4 over the 16-to-20-transponder capacity of current Ku-band satellites.

In addition to this method of increasing satellite capacity, it is also feasible to co-locate two satellites at the same orbital position to *double* the capacity. In short, it would be possible to create a total communications capacity from a given orbital position that is six to eight times the capacity of a typical current Ku-band satellite. This degree of capacity per orbital slot is a compelling argument for decreasing the total number of orbital positions needed for Ku-band satellites.

As the satellite industry's technology focuses on Ku-band, the number of C-band satellite launches could continue to decrease, perhaps easing the need for 2° spacing of these satellites.

Enter another trend—one that could create a new demand for C-band transmission capacity. The most successful new business communications application uses C-band satellites to deliver financial data on a 1-way basis to small (2-foot diameter) antennas that, because of their size, can be easily installed. The transmisson technique, called *spread spectrum*, uses large amounts of bandwidth for a relatively low throughput, and makes possible the use of such small antennas (otherwise impossible at C-band because of adjacent satellite interference and low signal level) through special digital coding methods. At the current rate of transponder usage, this type of data-distribution service may gobble up C-band transponders over the next few years, and create a need for additional C-band satellites.

Two other technological trends regarding the proposed new Ku-band satellites are: a much higher downlink EIRP and a wider variety of transponder frequency plans. Limits on downlink EIRP levels are imposed by interference considerations, in that an adjacent satellite may cause unacceptable interference because of relative signal levels. Because high EIRPs (in the range of 50dBW to 53dBW) are desirable to allow the use of small antennas (1m or less in diameter), there is a possibility that new high-power Ku-band satellites will be grouped in the same section of the orbital arc, to avoid adjacency of satellites with large differences in downlink EIRPs (such as 53dBW vs. 45dBW).

Compatible satellite frequency plans may become a thing of the past, due to the growing tendency to design satellites for specific network applications, such as the previously mentioned Federal Express network. Whereas C-band satellites have evolved into standard frequency plans, making possible a standard receiver, the existing Ku-band satellites use several different frequency plans, including 43MHz, 54MHz and 72MHz transponder bandwidths. The proposed new Ku-band satellites might have transponder bandwidths ranging anywhere from 24MHz to more than 100MHz, depending on the application.

This lack of standardization lends complexity to the design of electronics as well as to the interference-coordination process. Primarily, these new frequency plans will affect telecommunications applications, but as the satellite operators offer some portion of transponders to other users, as is the case today, it will become much more difficult to talk in terms of standard nomenclature for frequency plans, transponder bandwidths, polarizations and EIRP levels.

The main impact of these trends on the broadcasting industry will be the complexity involved in using satellites and planning facilities for the use of satellites. A much wider range of options will be available to the satellite user, including technology based on C-band satellites, current Ku-band satellites, the new high-power complex Ku-band telecommunications satellites and the planned high-power DBS type of satellite which will eventually operate in a higher Ku-band frequency. How well the broadcasting industry uses these new tools will be directly related to its comprehension of the options available.

Tuning up for efficiency

By Jerry Whitaker, editor

There are probably as many ways to tune the PA stage of a transmitter as there are types of transmitters. Experience is the best teacher when it comes to adjusting a transmitter for peak efficiency and performance because of the many subtleties in tuning that require compromises between various operating parameters. Some engineers follow the tuning procedures contained in the transmitter instruction manual to the letter. Others never upen the manual, preferring to tune according to their own methods.

Spell it out

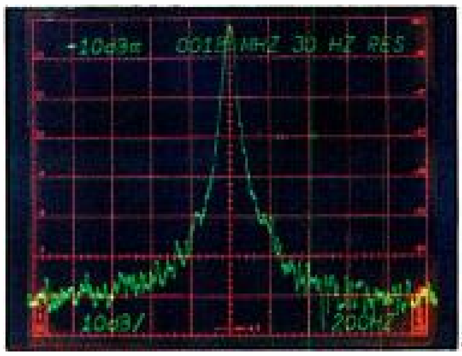
Whatever method you use, document the operating parameters and procedures for future reference—yours and your successor's. Do not rely on memory fur a listing of the typical operating limits of the transmitter. Write down the readings and post them at the transmitter building. If you are out of town one day and someone else has to service the transmitter, the list will be invaluable.

The factory service department can be an excellent source for information about tuning your particular transmitter. When presented with a problem that neither the instruction manual, nor your own previous experience covers, ask the field service engineers if they have run into a similar situation at another installation. Many times they can give you pointers on how to simplify the tuning process, or what interaction of adjustments may be expected. Whatever you learn from the factory, write it down. Again, a written record will help you and your successor.

Consider how much easier and faster the tuning process would be if you could consult written guidelines like the following tuning procedure for a common type of FM transmitter:

PA tuning adjustment:

- Unload the transmitter (switch the loading control to *lower)* to produce a PA screen current of 400mA to 600mA.
- Peak the PA screen current with the plate-tuning control.
- Maintain screen current at or below 600mA by adjusting the loading control (switch it to *raise).*
- Position the plate-tuning control in the center of travel by moving the coarse tune shorting plane up or down as needed. If the screen current peak is reached near the *raise* end of plate tune travel, raise the shorting plane slightly. If the peak is reached near the *lower* end of



travel, lower the plane slightly.
- After the screen current has been peaked, adjust the loading control for maximum power output.

When preparing the tuning procedure list, be specific and give full details of the direct and indirect effects of each adjustment. For example: *Driver tune inductor (L7) adjustment:*

- Set L7 so that C37 tunes up in the middle part of its range. (C37 is a 10-turn vacuum capacitor.)
- When the shorting bar on L7 is lowered (moved away from the PA tube socket), C37 must be turned clockwise to compensate.
- Peak the driver screen current with C37.
- The driver screen peak should coincide with PA screen peak and PA grid peak. Driver screen peak should also coincide with a dip in the left and right driver cathode currents.

The actual procedures will vary, of course, from transmitter to transmitter. But, if the particular tuning characteristics of the unit are documented in a detailed manner, future repair work is often simplified. This record can be of great value to an engineer who is fortunate enough to have a reliable transmitter that does not require regular service. Many of the tuning tips learned during the last service session may be forgotten by the time transmitter work must be performed again.

When to tune

Tuning can be affected by any number of changes in the PA stage. Replacing the final tube in an AM transmitter usually does not significantly change the stage tuning, although you should go through the tuning procedure just to be sure. Replacing a tube in an FM or TV transmitter, on the other hand, can significantly alter stage tuning. At higher frequencies, normal tolerances and variations in tube construction result in changes in element capacitance and inductance. Likewise, replacing a component in the PA stage may cause tuning changes due to normal device tolerances. Whenever you replace a component in a transmitter RF stage, run through the complete tuning procedure.

One of the primary objectives of transmitter tuning is stability. Avoid tuning positions that do not provide stable operation. Adjust for broad peaks or dips, as required. The transmitter should be stable from a cold startup to normal operating temperature. Readings should not vary after the first few minutes of operation.

Adjust tuning not only for peak efficiency, but also for peak performance. These two elements of transmitter operation, unfortunately, do not always coincide. Trade-offs must sometimes be made in order to ensure proper operation of the system. For example, FM transmitter loading can be critical to wide system bandwidth and low synchronous AM. Loading beyond the point required for peak efficiency must often be used to broaden the cavity bandwidth. Heavy loading lowers the PA plate impedance and cavity Q. A lower Q also reduces the RF circulating currents in the cavity.

Because of the interdependence of transmitter tuning and system performance, the tuning procedures outlined in the instruction manual should be carefully considered. There's nothing wrong with improving on the factory's recommended procedures—just as long as you don't create any new problems. |:(:-))))|

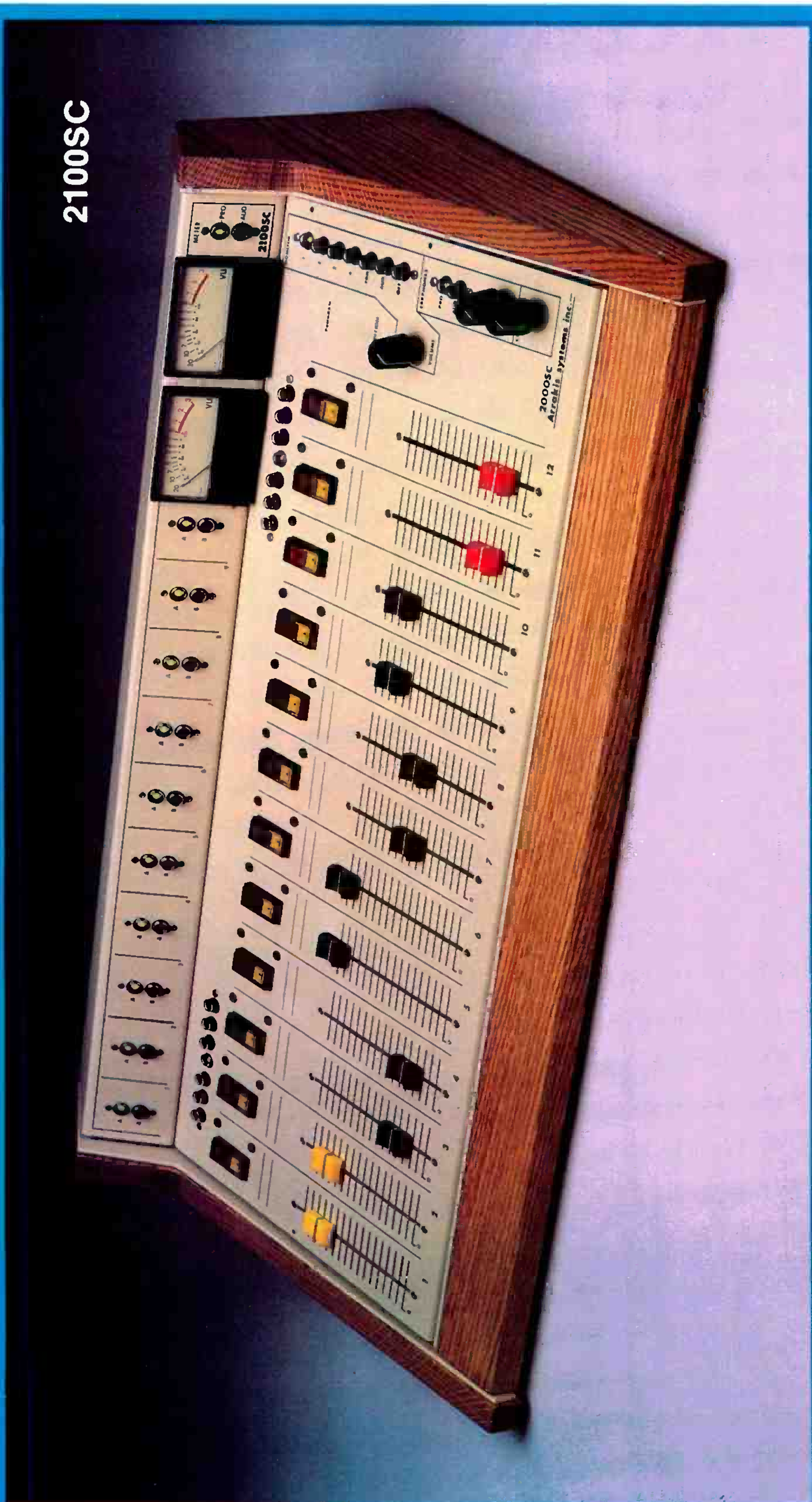
Safety considerations

Any troubleshooting work on a transmitter should be approached with extreme caution. High voltages that exist in a transmitter can be lethal. Such work should be performed only when a second engineer is in the room.

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

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

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



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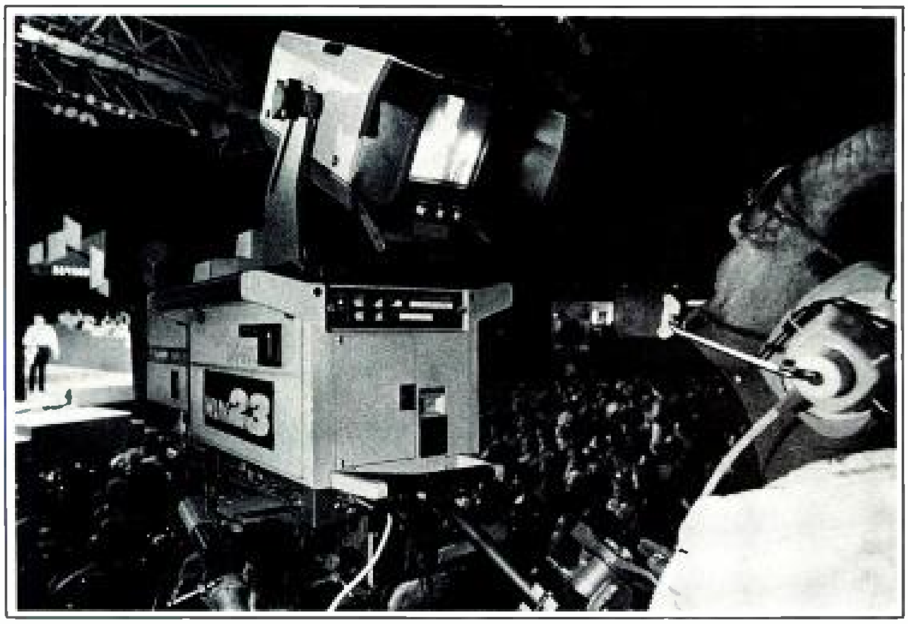
"Since each SK-97 and SK-970 has its own on-board computer, I can set everything up at the same time automatically."

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

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

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



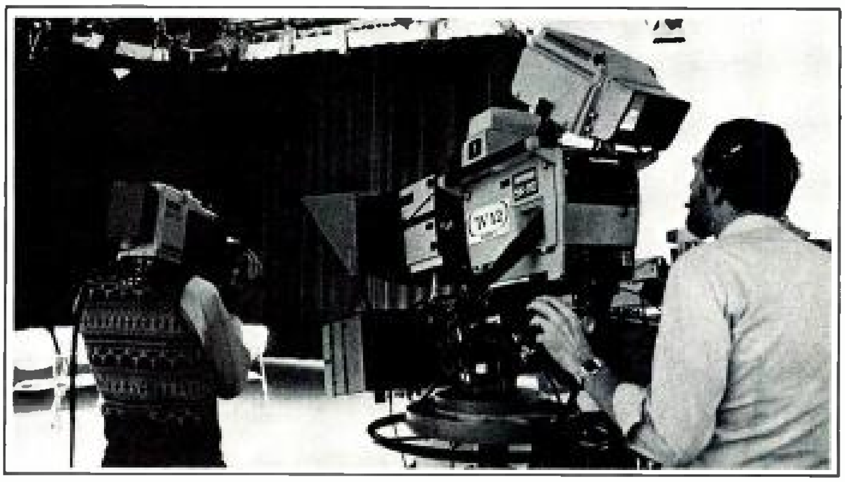
The SK-97 and SK-970 also perform superbly under low-light conditions. As a result, notes Chief Engineer Dennis Lusk, both can use very large lenses. And with real-time registration compensation automatically correcting for any changes throughout the travel of zoom lenses, the cameras are ideal for the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

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

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

Bill Weber
Vice President for Engineering
WHYY Television
Philadelphia, PA

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



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

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

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

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

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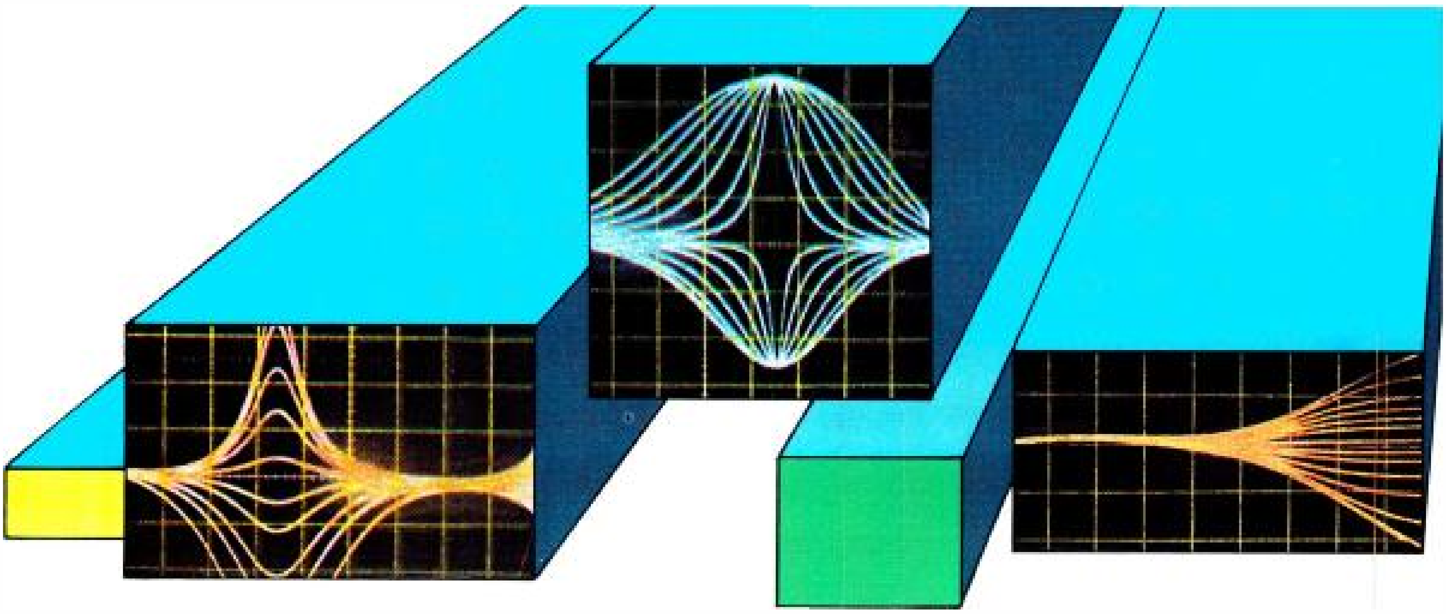


Dimensions in equalization

By Richard Cabot, Ph.D.

Increased emphasis on top quality audio for television and radio lends a growing importance to equalization and other forms of processing.

For more than 25 years, broadcast audio systems have used some form of equalizer technology. From the earliest days of the tube-based Lang and Pultec filters to today's multiband graphic and parametric systems, the equalizer has been relied upon to correct and to enhance sound. It has also formed the basis for many of the sophisticated automatic audio-processing systems in use today. Perhaps because of this popularity, equalizers are some of the most overused and misunderstood devices in the field of sound. They come in a wide variety of types, with more feature combinations than a Chinese dinner menu.

The frequency response curves of three simple equalizer circuits are shown in Figures 1, 2 and 3. These curves represent the gain of each filter with respect to frequency. Figure 1 shows the response of a boost circuit, with the important characteristics labeled. The *center-frequency* is the frequency of maximum boost, so called because it marks the center of the response peak.

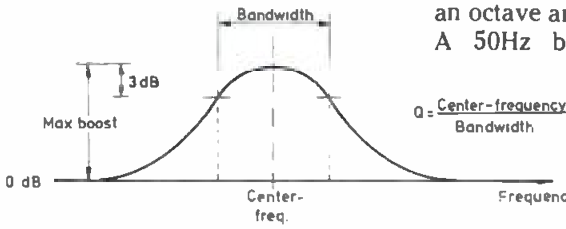


Figure 1. Basic boost filter response.

On each side of the center-frequency is a point at which the amplitude is 3dB lower than the maximum level. The range in frequency from the first point to the second is the *bandwidth*, an indicator of the sharpness of the filter. The smaller the bandwidth, the smaller the range of frequencies that will be affected by the actions of the filter. Because the ear hears changes in frequency on a percentage or *octave* scale, a filter of given bandwidth will have substantially greater effect with a low center-frequency than with a high center-frequency.

For example, a 50Hz bandwidth filter centered at 10kHz affects less than 1% of an octave and will be virtually inaudible. A 50Hz bandwidth filter at 100Hz, however, will affect almost an entire octave, radically altering the sound.

$$Q = \frac{\text{Center-frequency}}{\text{Bandwidth}}$$

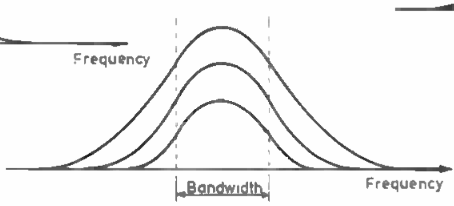


Figure 2. Constant Q boost filter response.

The filter sharpness can be defined by dividing the center-frequency by the bandwidth. The resulting number is called the *Q* of the filter. For the 50Hz bandwidth filter at 100Hz, the O is 2. For the 10kHz center-frequency filter, the Q is 200. Typical boost filters have Qs between one and 10.

Virtually all equalizers give the user control over the amount of boost or cut. The maximum boost on most equalizers ranges from 10dB to 15dB. At small values of boost, the concept of bandwidth or Q becomes hard to define. If the maximum boost is 2dB, how do you define the 3dB (down) frequencies? Most manufacturers, therefore, only specify the Q at full boost.

The filter response curve shown in Figure 2 maintains constant Q as the gain varies. This causes the frequency range that the filter affects to decrease as the maximum boost is reduced. The Q of the filter shown in Figure 3 decreases as the maximum boost is decreased, although the shape of the filter remains the same. This filter affects all frequencies around the center-frequency by the same relative amount as the degree of boost is varied. Both characteristics are used in commercially available equipment, although the manufacturer does not usually specify which type of circuit is used. In practice, there are situations in

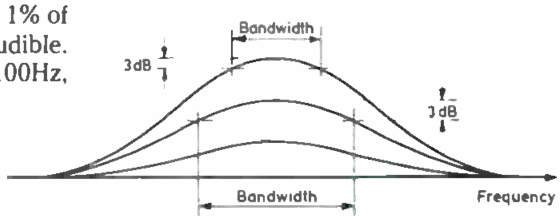
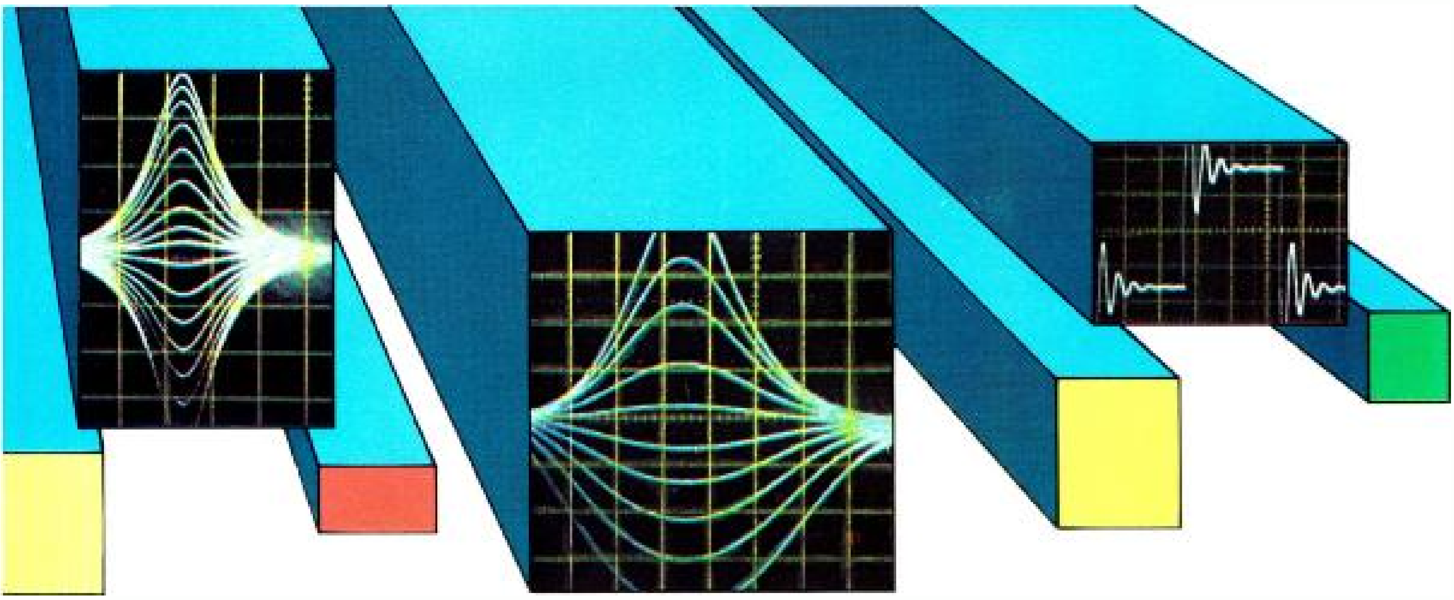


Figure 3. Constant shape boost filter response.

Cabot is vice president/principal engineer of Audio Precision, Beaverton, OR.



which one has advantages over the other, but it is difficult to say that one or the other is superior.

So far, we have considered the case of boost circuits. The situation changes, however, when the filter is set to produce a cut or reduction in gain over some frequency band. Figure 4 shows the response of a simple filter circuit when the boost/cut control is adjusted for a 10dB cut (−10dB). The center-frequency of the filter is defined as the frequency of minimum gain, the opposite of a boost filter. The bandwidth, and therefore the Q, is defined by the frequencies at which the gain is 3dB less than maximum.

Figure 5 shows the response curves of a constant Q filter section when adjusted for varying values of boost and cut. The curves of boost and cut are not mirror images of each other. This type of filter produces sharp nulls in the response curve at the center-frequency. There are applications, however, in which this characteristic is not desirable, and the inverse of the boost curve would be more appropriate. Such a response characteristic is shown in Figure 6. The Q of this filter is not constant in the cut mode. It is

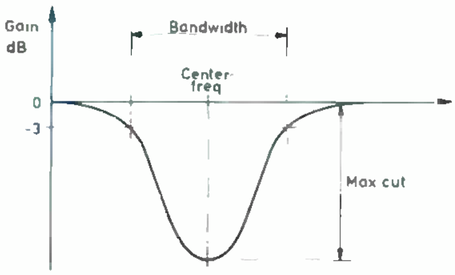


Figure 4. *Basic cut filter.*

much lower than the corresponding boost position. This characteristic is called a *reciprocal peaking filter.* Most graphic equalizers use reciprocal peaking filters, while most parametrics offer constant Q filters.

Shelving equalizers

The need often arises in radio and TV broadcasting to boost or cut all frequencies above or below some selected frequency. A unit that performs this function is called a *shelving filter.* Frequency response curves for a low-frequency shelving filter are shown in Figure 7, and Figure 8 shows the curves for a high-frequency shelving filter. These filters are effective in correcting frequency roll-off at the extremes of the audio band.

The boost or cut amplitude of a shelving equalizer is defined as the maximum deviation from the nominal (flat) gain of the filter. For a high-frequency shelving equalizer, it is the high-frequency gain minus the low-frequency gain. A low-frequency shelving equalizer is the reverse. The frequency characteristics of a shelving filter are described by the *turnover frequency*, the *stop frequency* and *transition ratio.*

The turnover frequency is the point at which gain changes from the nominal value by 3dB. In a shelving equalizer adjusted for a boost, the turnover frequency is the frequency at which the gain is 3dB above the midband value. The stop frequency is the point at which gain stops increasing or decreasing. This is taken as the frequency at which the gain is within 3dB of maximum or minimum, for boost and cut settings respectively. When small boost or cut values are selected, these definitions can become unclear. It is common to approximate the shelving equalizer curve with

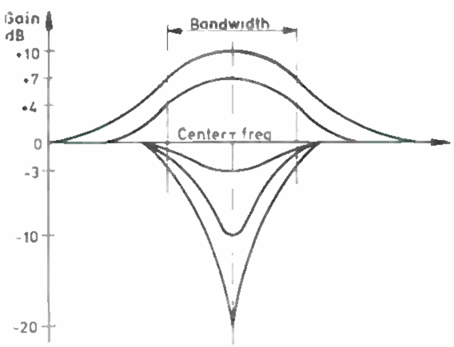


Figure 5. *Constant Q boost/cut filter.*

straight lines and use the points where they intersect as the appropriate frequencies, as shown in Figure 9. The ratio of the higher to the lower of these two frequencies is often termed the transition ratio. It is analogous to the Q of the peaking filter.

Shelving filters have one significant drawback when used without audio band limiting. A high-frequency shelving filter boosts all frequencies above the turnover point. This boost usually extends past the audio band, increasing ultrasonic signals along with the desired program material. This problem can be reduced or avoided by inserting a low-pass filter into the signal path after equalization at the audio band edge (20kHz).

Comparing equalizer types

We have concentrated on the basic equalizer circuits, but only briefly mentioned how these circuits are used in complete studio equalizers. The most flexible equalizers on the market provide independent control over all parameters of the basic filter sections. These are called *parametric equalizers.* Most units on the market provide three to five filter sections in one package. Each section is usually independently adjustable. Often, the frequency ranges of these sections

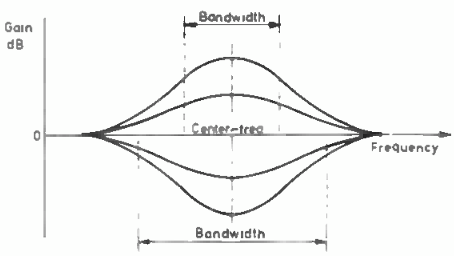


Figure 6. *Reciprocal peaking filter.*

are not the same, and there is considerable overlap between sections. For example, the first filter might be adjustable from 20Hz to 2kHz, and the second adjustable from 50Hz to 5kHz. By staggering the sections this way, the entire audio band may be covered without requiring excessive operating range from any one filter stage.

Most of the parametrics on the market

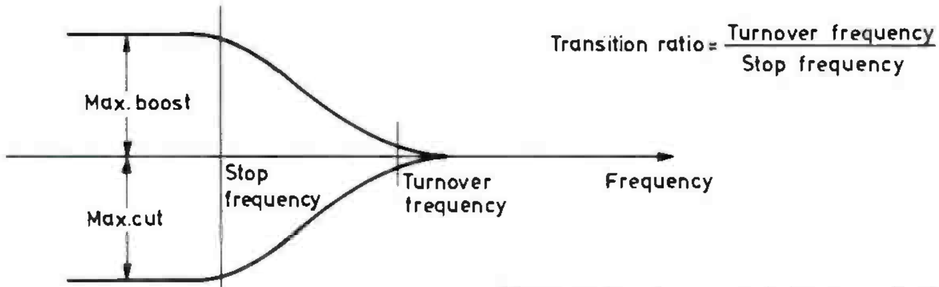


Figure 7. Low-frequency shelving equalizer.

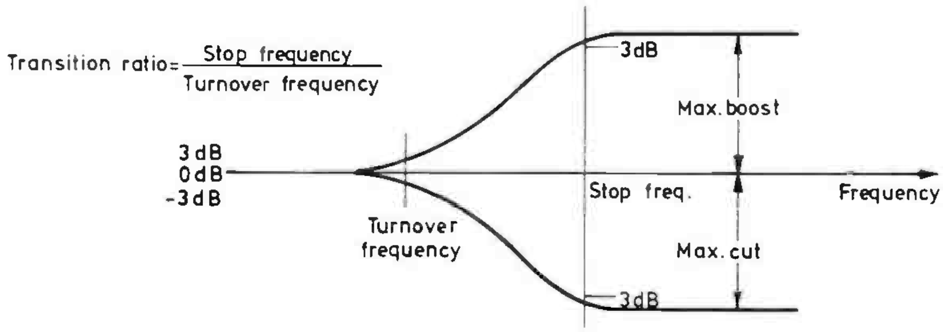


Figure 8. High-frequency shelving equalizer.

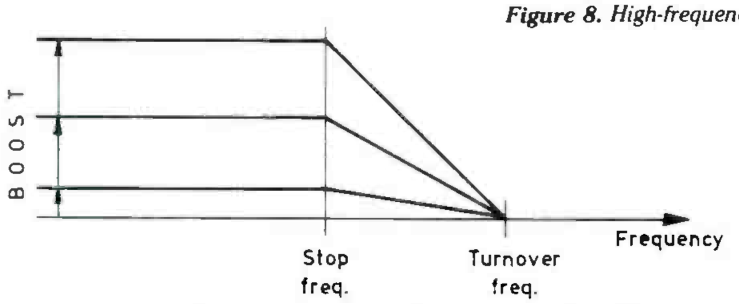


Figure 9. A straight line approximation of the shelving equalizer response.

break their frequency adjustment ranges on each filter into two or three bands. The filter is made tunable within these bands via a multiturn potentiometer. To simplify tracking requirements, the range is generally limited to about 10:1. Selecting between bands (almost always in factors of 10) is done with a switch that changes capacitors in the filter. This approach provides fine resolution on frequency setting and allows approximate calibrations to be written on the equipment front panel.

Some parametrics provide switch-selected modes such as constant Q/reciprocal response or peaking/shelving. These features can significantly enhance the flexibility of the unit, eliminating the need to select between response types in advance of the purchase. Constant Q cut capability is rarely needed except in sound system feedback reduction.

Flexibility and freedom from predefined frequencies and Qs make the parametric equalizer a powerful tool. This flexibility also makes the parametric equalizer a complicated tool. However, with experience, the operator can achieve precise equalization that can match the desired characteristics quite closely. Because the unit is really several simple filter sections in cascade, the effect of using two sections simultaneously is equal to the sum of their individual responses. This lack of interaction between

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controls makes the adjustment task easier. By using the sections one at a time, you can remove aberrations in system response in order of their significance. Complex response adjustments can be made by connecting two equalizers in series.

Graphic equalizers

Graphic equalizers are so named because they contain a bank of filters on octave or fractional-octave center-frequencies whose gain controls are arranged to create a graph of the resulting frequency response on the front panel of the unit. The row of linear sliders provides a simple operator interface, enabling instant recognition of the gain in each frequency band.

Graphic equalizers are commonly available with frequency resolutions from one octave (nine or 10 sliders covering the audio band) to one-third octave (27 to 31 sliders). Graphic equalizers are almost always fixed-frequency, fixed-Q devices. These limitations are imposed primarily by cost and panel space considerations.

Unlike those in a parametric equalizer, the filters in a graphic equalizer are wired in parallel. As a result, the response with two sliders boosted or cut is not the same as the sum of the responses with each slider advanced individually. The Q of each filter is designed based on the spacing between center-frequencies. There is, however, some latitude allowed. The actual Q, and some subtleties concerning the way in which the filters are connected, affect how well the filter responses combine.

Graphic equalizers are generally reciprocal filter devices. The response obtained with any control settings may be undone with a complementary setting of the controls.

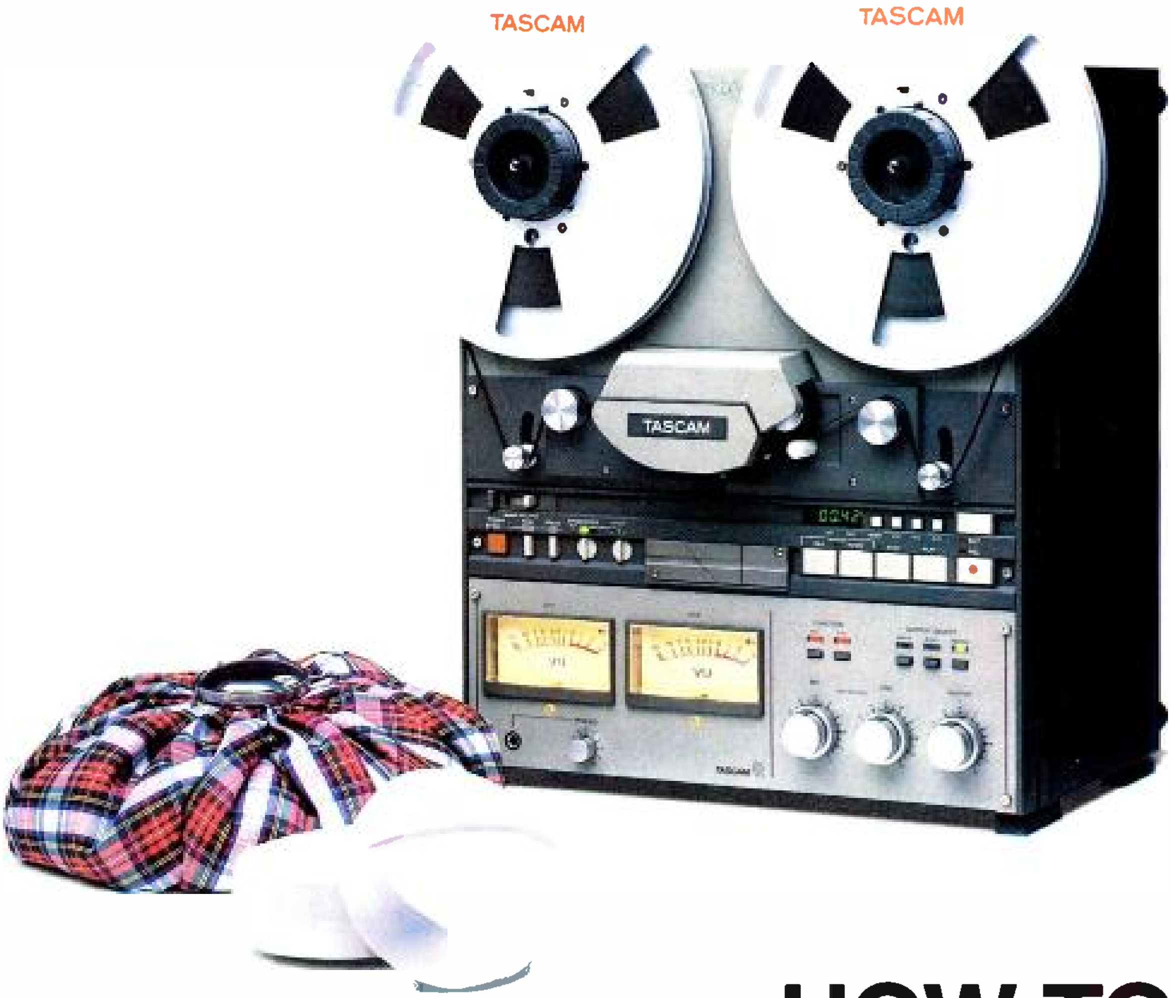
Hybrid systems

Several hybrid approaches to equalization are available, along with products of some newly emerging technologies. In the hybrid category, there are several commercial units that seek to provide the advantages of parametric and graphic equalizers in one package. One company has developed a graphic equalizer that has a fine frequency-adjustment control under each linear fader. This allows the user to trim the center-frequency of the filter to exactly match the frequency of the desired response peak or dip. Another manufacturer has introduced a graphic equalizer that includes several tunable notch filters.

To help users adapt to a parametric equalizer, yet allow them to easily visualize the resulting response, an equalizer is available in which the boost/cut controls are linear faders arranged in a manner similar to a graphic unit. The positions of the boost/cut controls help convey the resulting response curve to the user.

There are several programmable equalizers on the market that use analog filters controlled by a microprocessor. With a programmable equalizer, the user can set the desired frequency, Q and boost or cut on a digital display. Accuracy is assured, but this system does not always enable the user to easily understand what the resulting response curve will look like, or how to set up the unit for the desired sound. There is at least one equalizer on the market, however, that overcomes this problem by using a CRT to display the response curve. By using a light pen or some simple controls, the response may be adjusted to any desired shape within the capabilities of the system. The advantage that almost all programmable units offer is the capability of storing several equalizer settings in memory and recalling them when needed.

Digital audio can be expected to make significant changes in equalization and other forms of audio processing in the next few years. It has already revolutionized artificial reverberation, and several companies have demonstrated research prototypes of digital equalizers. The technology exists today to duplicate the functions of most commercial parametric or graphic equalizers.



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Ultimately, the cost of digital systems will be competitive with top quality analog-based approaches when implementing full-function equalizers.

Interfacing

Often, the suitability of an equalizer for a specific application is more important than its available features. If you can't get the signals in and out, it doesn't much matter how well the unit *would* equalize. The most important attribute in this regard is the presence of balanced inputs and outputs. Some manufacturers try to save a few dollars by using unbalanced I/O reminiscent of home hi-fi gear. Using that kind of unit in a broadcast studio system is an invitation to ground loops and noise problems that will ultimately cost you a lot more than you initially saved.

Transformer-based I/O is heavily dependent on the quality of the transformers used in the circuit. An inexpensive transformer can significantly degrade signal quality, affecting frequency response and causing distortion. Therefore, many manufacturers have designed active input and output circuits for their products that achieve balance with multiple op-amps. The best of these provide excellent common mode rejection ratio (CMRR) performance.

The function of a balanced input is to reject signals that appear in-phase on the two input wires and to amplify the signals that appear differentially. This allows the balanced signal from the source device to be received, and the noise that is usually injected equally into both wires to be rejected. The measure of how well this is performed is called the common mode rejection ratio (CMRR). It is the ratio of the differential gain to the common mode gain, expressed in decibels.

If an active input circuit is used, the CMRR will sometimes degrade with various input gain control settings. Active inputs are often limited in maximum input voltage before clipping. A good equalizer should, however, be capable of accepting +28dBm input levels. Transformers will often distort on high-level bass frequencies, but their distortion is fairly mild in comparison to active input clipping.

Active outputs, in their simplest form, merely invert the normal output of the equalizer and feed both the original and inverted signals to the load. If either of these outputs is shorted to ground, the op-amp will current limit and badly distort. Improved active output circuit designs cross-couple two op-amps to create a circuit that is insensitive to load imbalance. Unfortunately, some of these circuits oscillate when driving long cables. They are also somewhat limited in output voltage capability (typically about +22dB).

Comparing responses

After setting up an equalizer, it is often necessary to compare the flat response with the equalized response. An in/out switch is helpful for this, permitting instant *before* and *after* comparison. Graphic equalizers generally offer one overall in/out switch for the entire unit. Many parametrics, however, feature not only a master in/out switch, but also one on each filter section. This permits comparison at each stage of the equalization procedure. It also allows two filters to be set up with, for example, the equalization for two different vocalists. The operator can then switch between the responses by simply pressing the appropriate button.

Care should always be exercised in the use of equalization for both production and on-air applications. There is no point in boosting high frequencies beyond 10kHz at an AM station, or beyond 15kHz at an FM or TV station. The energy simply will not reach the listener or viewer. Also, consider the effects on headroom that selective frequency boost can have on audio chains and recording machines. As with most forms of audio processing, equalization *in moderation* provides the best results.

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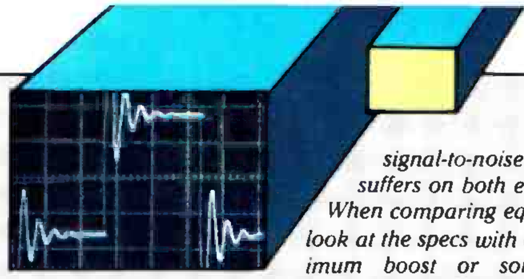

What the specs don't tell you

Often, a product is specified with impressive numbers, all the current buzz words and glowing verbiage, but still doesn't seem to work right. Even though an equalizer may be specified for a noise figure of –90dB, it might sound like the ocean in a storm. There is an abundance of products that don't deliver as expected.

Noise specifications can be the most confusing of all equalizer specs. Most manufacturers give you one number for noise, usually with the controls flat. Some even specify noise with the EQ in bypass or the in/out switch out. Not surprisingly, when the unit is adjusted to typical settings, that stormy ocean can become a tidal wave of problems.

Table 1 shows the results of noise measurements on five commercial 27-band equalizers. Everything looks fine when the controls are flat. Unit A appears to be the best, based solely on the published noise performance. When only a few decibels of boost are introduced, however, things change drastically. Unit A is now fairly poor, especially in comparison to the others. When full boost is applied, the S/N ratio goes from bad to worse. This comparison is not contrived, and the performance of unit A is not unique.

Also, note that noise increases significantly even when frequency cut is used. Normally, this would not be expected, and does not occur in a purely passive equalizer. When cut is used, the noise problem worsens because the maximum input level to the unit is limited by the presence of all components in the original signal. When any portion of the spectrum is cut, the overall signal level is reduced. The signal-to-noise ratio, therefore, suffers on both ends.

When comparing equalizers, always look at the specs with controls at maximum boost or some known intermediate setting. The master gain control can also have an effect on noise performance, although not usually as significant as the filter controls. It is advisable to check the noise performance at both ends of the gain range.

Distortion

Distortion is a close runner-up for the title of most confusing equalizer specification. Again, a common technique is to specify total harmonic distortion with the equalizer adjusted for flat response. As with noise, however, there will be variation with boost and cut of each filter band. The worst case will usually occur when the filter is set to cut the test sine wave. This is a slightly unfair test, but it usually produces some interesting results.

When the filter is set to boost one of the harmonics of the input signal or the signal itself, some strange results can occur. One revealing measurement is a twin-tone intermodulation test at the center-frequency of a boosted filter. This excites the filter and partially simulates actual use. Many commercial equalizers use slow-speed op-amps for filters that have mediocre slew rate performance. This can create transient intermodulation (TIM) distortion.

Susceptibility to radio frequency interference (RFI) is a common problem in all audio equipment. As designers learn the techniques of controlling RFI, however, it is becoming less of a concern. If the unit is to be mounted in an enclosed rack with short, shielded cables connected to other equipment in the rack, the equalizer should be all right. Long cable runs or applications in which the equalizer is not shielded can cause RFI problems that may be difficult to resolve.

There is no foolproof method for specifying RFI performance. Only the acid test of field experience will tell. Fortunately, filters are available that can be inserted in the signal lines and ac line cord to help solve an existing RFI problem.

EQ	FLAT	+3dB	+6dB	+9dB	+12dB	–3dB	–6dB	–9dB	–12dB	Typical EQ Curve	Approx. Price
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B	–92	–79	–70	–66	–66	–86	–81	–79	–79	–66	$ 550
C	–91	–87	–81	–74	–62	–92	–91	–91	–90	–76	$ 650
D	–89	–68	–82	–80	–76	–92	–92	–93	–93	–81	$1200
E	–86	–77	–71	–67	–59	–85	–85	–84	–83	–66	$ 600

Table 1. Output noise for five well-known ⅓-octave equalizers expressed in decibels referred to one milliwatt.

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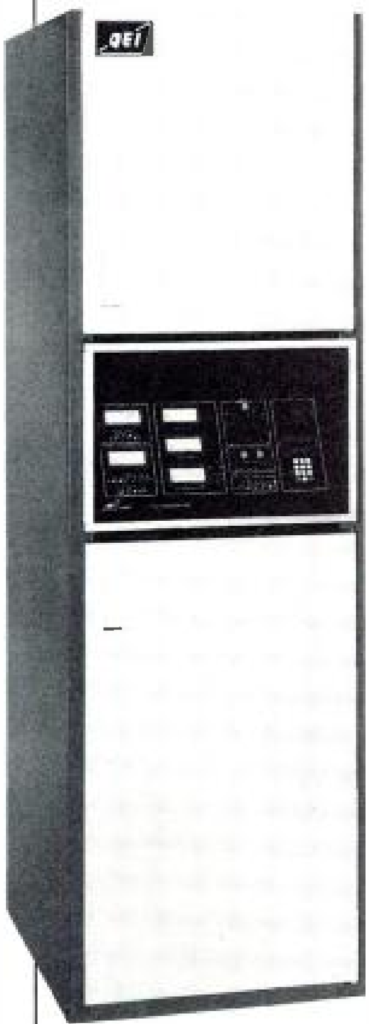

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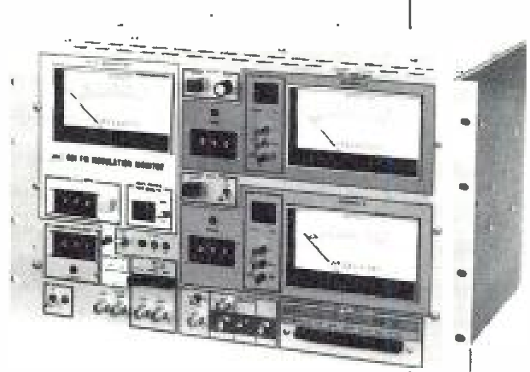

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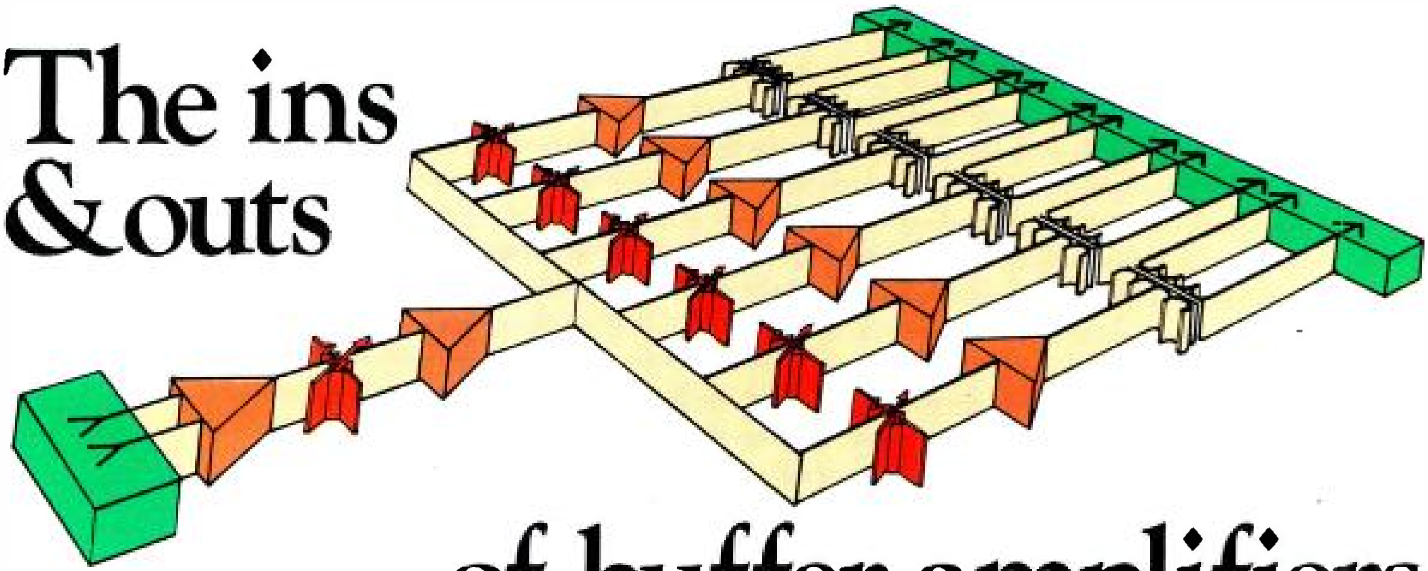
The ins & outs of buffer amplifiers



By William Isenberg

As you plan an audio distribution system, be aware that the seemingly small details warrant just as much consideration as the more obvious requirements

There it is on the schematic diagram: the familiar triangle that represents an audio distribution amplifier. Pretty simple, you think, with the station signal flow diagram spread out before you. The simplest aspects of audio distribution, however, have a nasty habit of evolving into annoying problems if proper care isn't given to initial design and construction of the system. There's more to installing a distribution amplifier than just connecting the input and output wires.

The architecture of a typical distribution amplifier (DA) is shown in Figure 1. An input buffer accepts the incoming signal and routes it to several output level controls that individually drive output line amplifiers. The circuit uses a differential input buffer stage and transformer-isolated output amplifiers. Most DAs currently produced have at least six output channels per unit.

The first important parameters to establish in the design of a DA system are the input signal origination point, level and format. You need to know if the source is balanced or unbalanced, local or remote. In a production studio, for example, where sound quality is vital and all cable runs are usually short, a differential input stage is ideal. A DA used to distribute a remote line (Telco) feed, on the other hand, is better suited to a transformer balanced input stage.

Isenberg is a circuit design consultant affiliated with Marshall Long Acoustics, Santa Monica, CA.

Differential input

A differential input buffer stage is shown in Figure 2. All circuit values are for reference only. The inputs labeled + and − are non-inverting and inverting, respectively. The 2.2kΩ resistors (R1 and R2) and 100pF capacitors (C1 and C2) act as a passive filter to suppress radio frequency interference (RFI) and other types of interference outside the desired bandwidth of the operational amplifier (op-amp). The two 10μF capacitors (C3 and C4) remove any dc present on the input lines. Resistors R3 through R6 form the differential input, with common mode rejection determined by resistor matching. Some circuit designs use 1% resistors or a matched resistor network for this function. Capacitors C5 and C6 control the rise time of the op-amp and help cancel stray capacitance in the circuit board layout. At a radio station where high RF fields are common, there may be RF pickup; therefore, ferrite bead inductors are sometimes used in addition to the R/C networks shown.

Transformer inputs

A transformer input buffer stage design is shown in Figure 3. The most important element of an audio input transformer is the metal shield placed between the primary and secondary windings to eliminate electrostatic and capacitive coupling. An R/C network across the secondary may be used to control transient distortion in the windings. This distortion usually shows up as ringing on a square wave. (There should be no more than 3% overshoot.) The two 5kΩ resistors (R1 and R2) terminate the winding so that a 10kΩ load is reflected back to the source. The amplifier runs at a gain of 2.

Two important characteristics to look for in selection of a transformer are the frequency range over which the input common mode spec applies and the maximum voltage that can be tolerated. If you have doubts about a particular transformer, call the factory and ask the customer service or engineering department just what the spec means and how it was measured.

After you know that the incoming line will not destroy the DA, the next consideration is the kind of loading the system will tolerate. Should the line be bridged or terminated? If the line is bridged elsewhere in the system, avoid any loading that would cause line levels to change when a patchcord is inserted at another point in the plant. Also consider adding terminating resistors to the input side of any high-impedance input. If the DA input stage is balanced, forcing one side of the line to common (ground) will usually increase the system noise substantially.

Figure 4 shows a typical unbalanced input circuit. The RF rejection network is followed immediately by a coupling capacitor and input reference resistor. The scary part of this design is the inverting input of the stage, connected directly to common, a probable source of noise.

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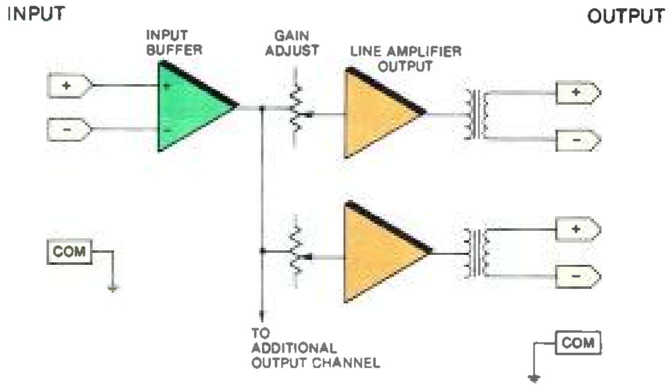


Figure 1. The architecture of a typical audio distribution amplifier.

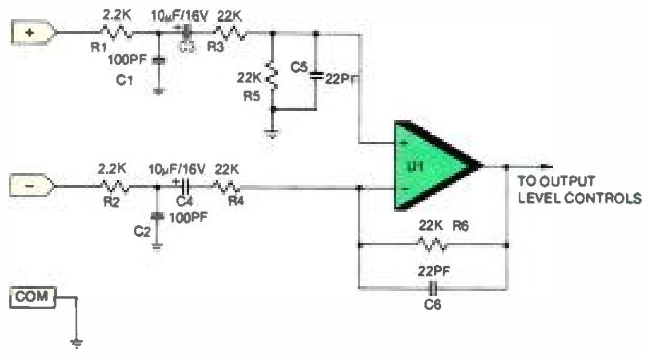


Figure 2. A common differential input amplifier stage design.

Planning checklist

Now that the signal is in the door, what next? The DA gain should be adjustable to match the system line level without degrading the S/N figure. At this point, overall system performance can often be improved by adding a bandpass filter. (Transformers can make good bandpass filters.)

If surplus gain is one of your requirements for the DA, make sure you have enough to do the job. It is more than a little annoying to find during shakedown tests that the system is shy a decibel.

Next, check the output source impedance and the exact format of the output circuitry. Where does the output have to go? How long are the lines? What is the configuration of the load at the other end? The answers determine what kind of output circuit you will need.

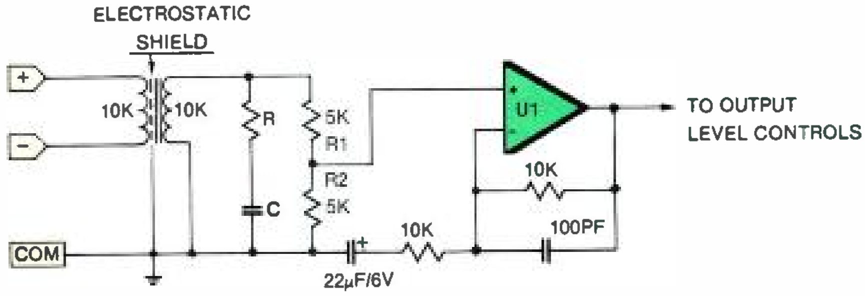


Figure 3. A typical transformer-isolated input channel.

An unbalanced output stage is usually acceptable if the load includes a differential input stage. For such an application, 2-conductor shielded wire should be used with the DA common as the low side. At the load, the differential input receives the DA output, plus whatever power line noise and RFI was picked up in the interconnecting cable, and a sample of the noise from the common wire. The dif-

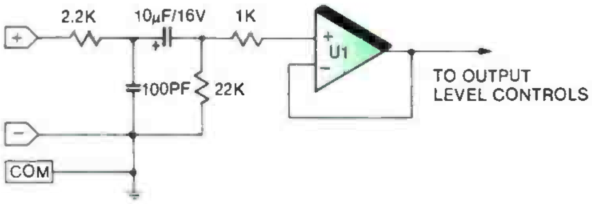


Figure 4. An unbalanced input amplifier stage.

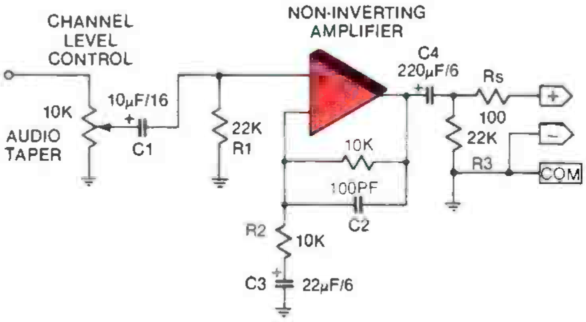


Figure 5. An unbalanced DA output channel.

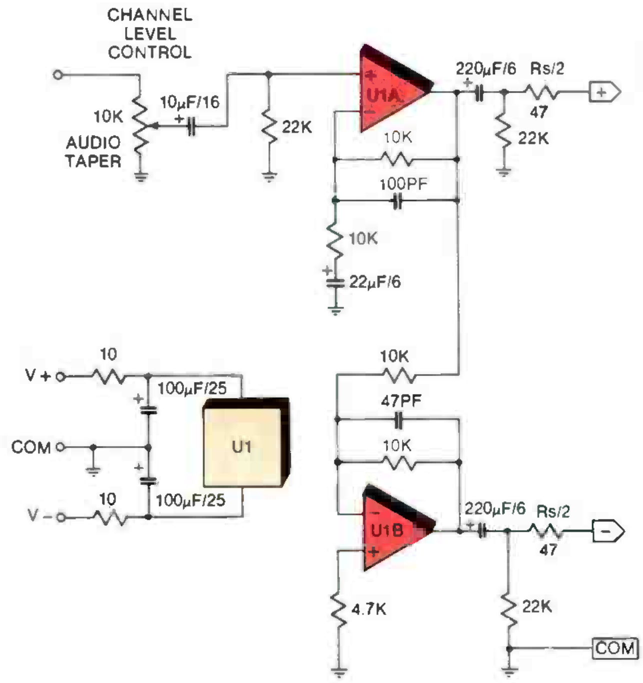
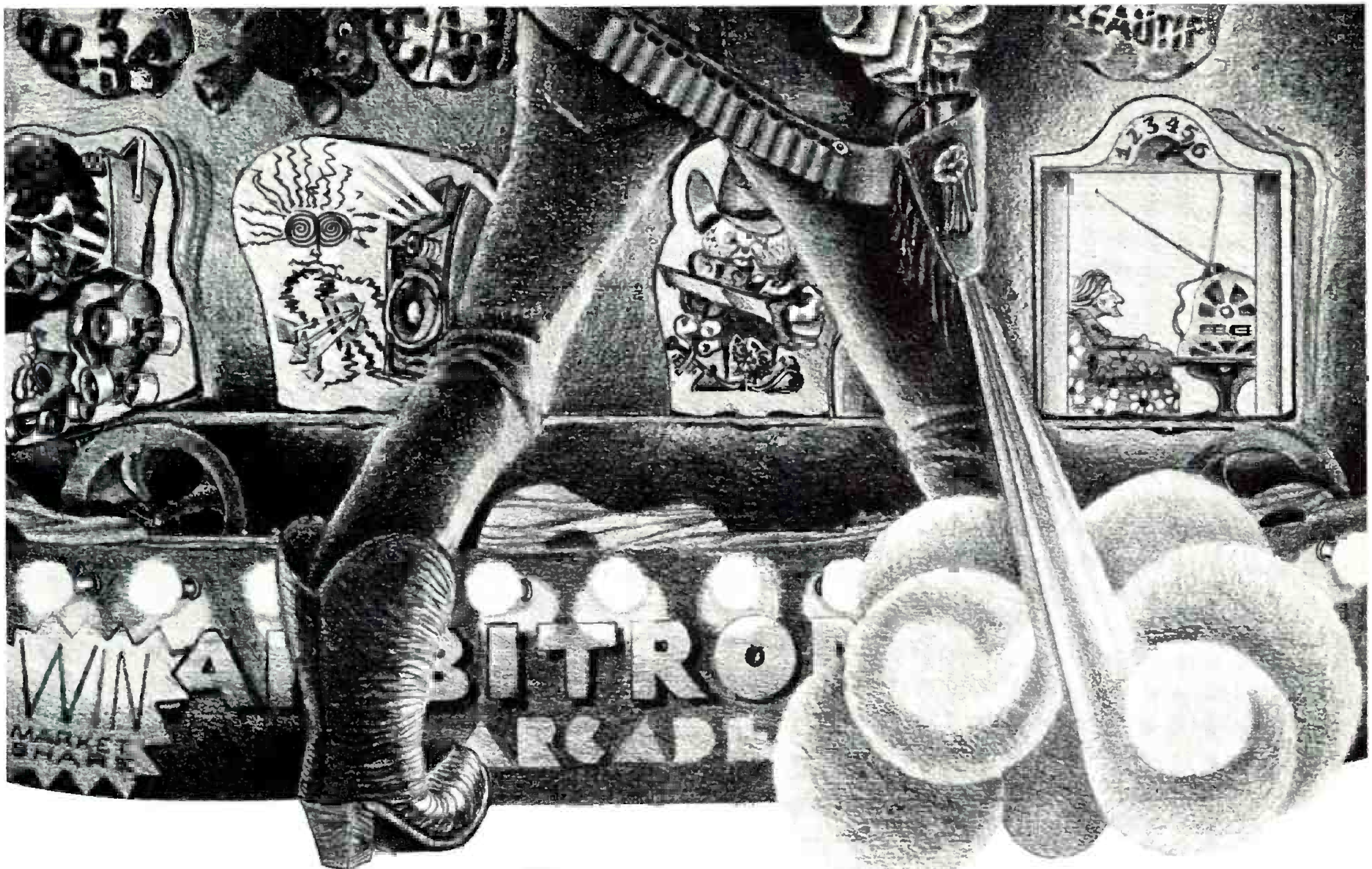


Figure 6. An active balanced output channel.

ferential input stage subtracts the common signal from the input signal and delivers a clean output.

Unbalanced output

A typical unbalanced output channel is shown in Figure 5. A blocking capacitor located after the stage level control (C1) prevents any swishing noise because of rotation of the gain control. A reference resistor (R1) is connected between the op-amp non-inverting input and common. The op-amp runs at a gain of 2, so the input control has some operating reserve. Capacitor C2 controls op-amp rise time and establishes the amplifier's upper 3dB point at somewhere between 60kHz and 100kHz. Low end response is rolled off by the relationship between R2 and C3 (the 10kΩ shunt resistor and 22μF capacitor to common). Capacitor C4 removes any dc from the output and resistor R3 restores the amplifier reference to common. Build-out resistor Rs protects the output stage and preserves amplifier bandwidth by isolating any capacitive loading so that it



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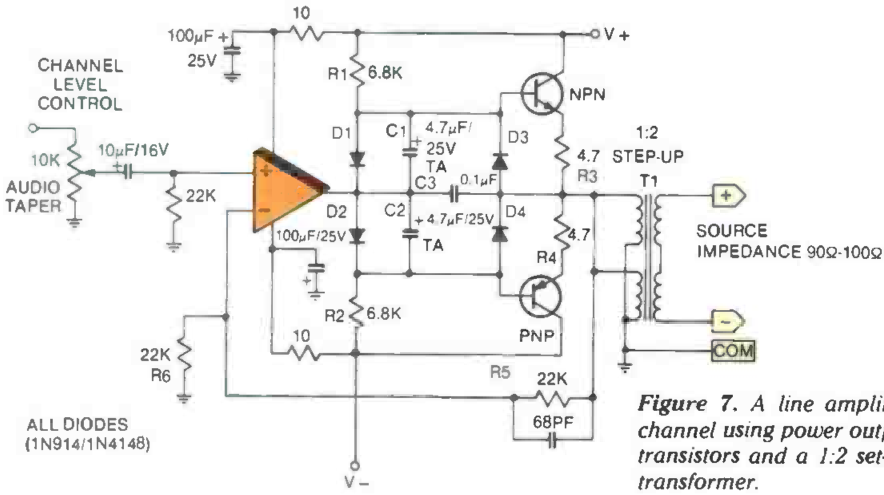


Figure 7. A line amplifier channel using power output transistors and a 1:2 set-up transformer.

will not interfere with frequency compensation of the op-amp.

Balanced output

The performance of an unbalanced output stage can be improved by generating an out-of-phase signal for the low side. This provides two outputs, each referenced to common. Either side can be used to drive the load. When this type of output signal is connected to a differential input stage, the S/N ratio improves by 6dB because the differential is twice as large.

Figure 6 shows a balanced output stage of this type. Note that the only addition here over Figure 5 is an inverting amplifier and another build-out resistor. The output source impedance is the sum of both build-out resistors.

Problems will occur with this design, however, when the low side is connected to common at the load end, instead of going to a differential or transformer input. The low side of the differential output stage will shut down or try to deliver a large amount of current to the line, usually resulting in severe distortion of the audio material or destruction of the op-amp.

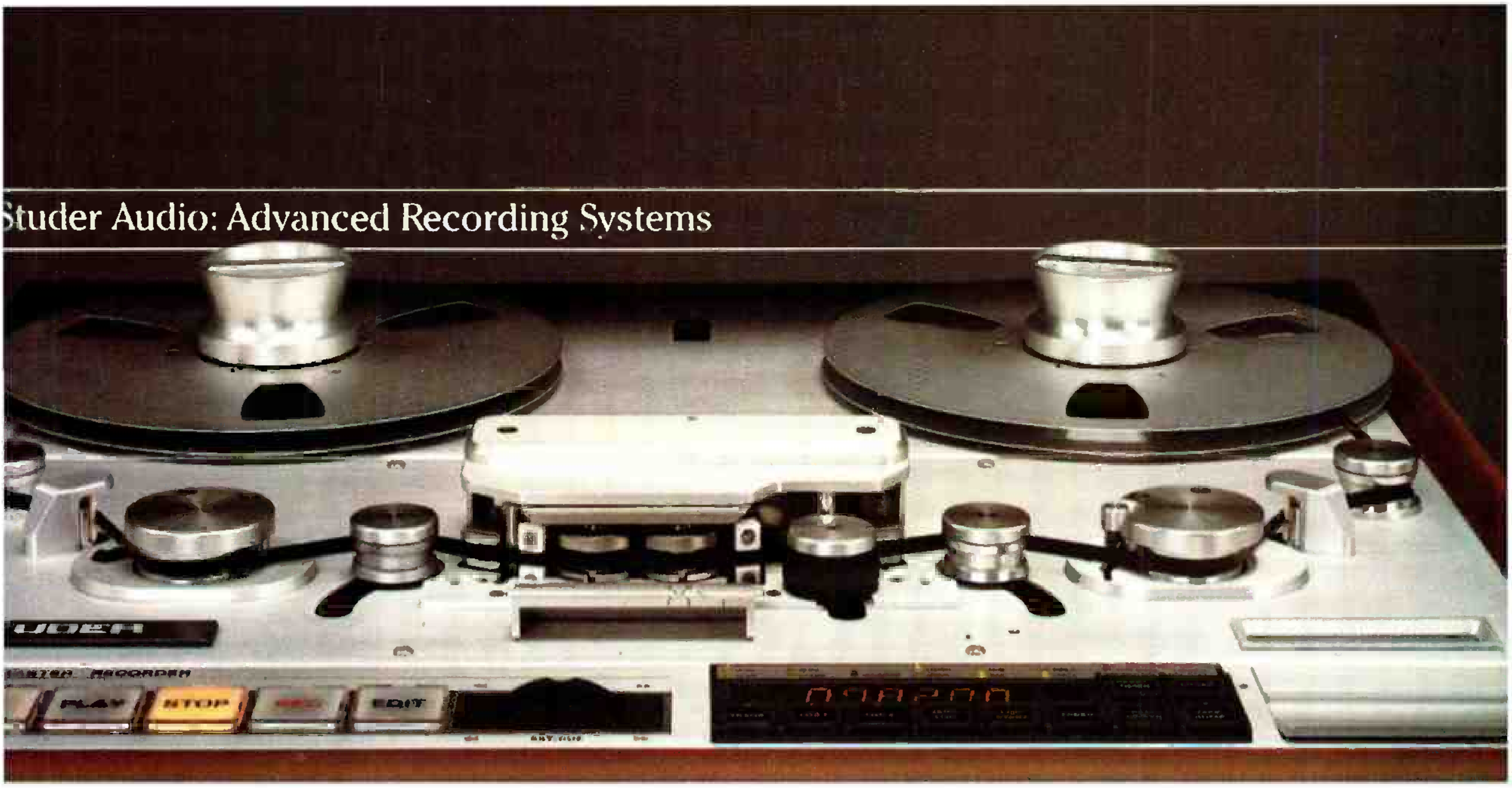
For most DAs with this type of output design, caution statements in the instruction manual warn users of this potential hazard. If the output of the unit does not go to a patch point, it is generally acceptable to use this type of design. However, when the signal goes to a patch panel, a transformer output is always the safest arrangement.

Balanced and floating

If the DA output leaves the premises or has a run of more than 100 feet or so, an output transformer will allow either side of the line to be connected to common with no ill effects, even if the common in question is electrically different from the local common. The code words for this capability on the DA spec sheet are *balanced* and *floating*. DAs with this option usually cost (and weigh) more per channel and may not come in a space-saving, 1-rack-unit package.

Line amplifiers

Figure 7 shows a premium design line amplifier with a 1:2 step-up output transformer. With all the parts shown, it is easy to see why this approach costs more than other designs. Also, a power supply with some muscle is required when several stages are running at full output. The output transformers add weight to the unit and cannot be located directly adjacent to the power transformer



The hardware is typically Studer. The software is simply astounding.

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For more information on the new A820 Analog Master Recorder, please contact: Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210; (615) 254-5651.

STUDER REVOX

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without running the risk of hum pickup. The circuit shown is essentially a small power amplifier that delivers about 24dBm or ½W output.

Diodes D1 and D2 (the two diodes just to the right of the op-amp) bias the output transistors into class AB operation, and resistors R1 and R2 provide a current source for driving the output devices. When the output level approaches clipping, the current from R1 and R2 decreases, and the two 4.7μF capacitors in parallel with the bias diodes (C1 and C2) maintain bias during clipping excursions. Capacitor C3 helps the op-amp remain stable as the high-frequency characteristics of the output devices change in proportion with the current delivered. Diodes D3 and D4 act to remove drive from the output stage when a current—determined by the voltage drop across resistors R3 and R4—is reached. As in the other examples, the gain of the entire circuit is set by the 22kΩ feedback and shunt resistors (R5 and R6).

Typically, a transformer is connected in a 1:2 step-up arrangement to increase the output voltage. This is harmless in itself, but the output source impedance goes up in the process. In most cases, the resulting transformer impedance is approximately 100Ω. This shows up as a 1dB drop when the output is terminated with 600Ω.

The termination loss alone is not so bad. However, if the cable run is hundreds of feet long, the capacitive loading will reduce high-frequency response as well. It is quite possible that the output wiring itself will be more difficult to drive than the load at the other end. For such situations, a 1:1 connection at the output transformer may help. (See Figure 8.) A 150Ω to 150Ω strap results in a source impedance of about 20Ω. If the cable run is extremely long or the amplifier directly feeds a telephone company line, forget trying to hold the source impedance low, and bridge the other end. In this case, classic source impedance-matching and termination-loading techniques must be used.

The outside world

When feeding a telephone line, it is important to increase the source impedance to match the line, as shown in Figure 9. This is normally done with build-out resistors. Subtract the source

Evaluating your DA

Below is a checklist of questions to ask yourself as you evaluate audio distribution units. The points are listed more or less according to the amount of trouble that an oversight could cause.

- *Does the DA have a safety agency approval?*
- *How reliable is it? Does it run hot?*
- *What kind of input/output connections does it have?*
- *Will it load or unbalance the source?*
- *If the output is shorted, will the unit recover by itself?*
- *What are the frequency response, distortion and noise specifications?*
- *How much gain does the unit have?*
- *How many outputs does it provide?*
- *How much headroom does it have?*
- *Does the system sound good?*
- *How much will it cost—now and later?*
- *Is there a turn-on/turn-off transient?*
- *Are there provisions for standby power?*
- *Is the unit easy to service?*

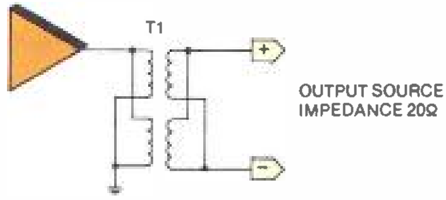

Figure 8. The winding configuration for output transformer strapping of 150Ω to 150Ω (1:1).

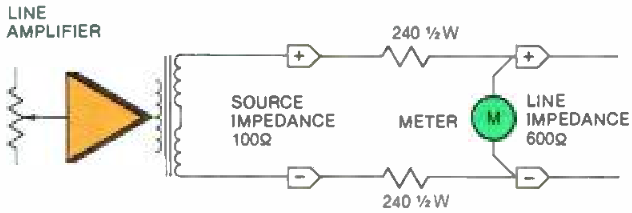

Figure 9. Using a pair of build-out resistors to increase amplifier output impedance to match the load.

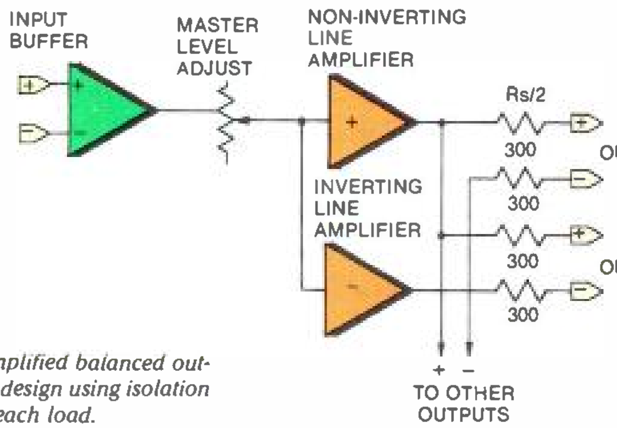

Figure 10. A simplified balanced output amplifier DA design using isolation resistors to feed each load.

impedance of the unit from the desired line impedance and divide by two. Place one resistor on each side of the line. A broadcast loop is generally 600Ω. A subscriber loop is about 900Ω. When adding build-out resistors, be aware that the circuit will suffer an insertion loss of 6dB.

Line levels should be measured across the line and not at the DA. Do not leave a standard VU meter with internal copper oxide rectifiers connected to the line when program material is applied. The rectifier typically adds about 0.25% distortion to the line.

DA headroom is also a concern in Telco applications, so check the clip level into a dummy load. Try to avoid levels of more than +8dBm on the line itself, because this may cause crosstalk in the Telco network.

An important consideration for selection of a DA is isolation between output channels. Drive one of the outputs to rated power and observe how much signal shows up on the other output channels. Check from 20Hz to 20kHz. Output separation should be at least 40dB across the band.

Another way to check output channel

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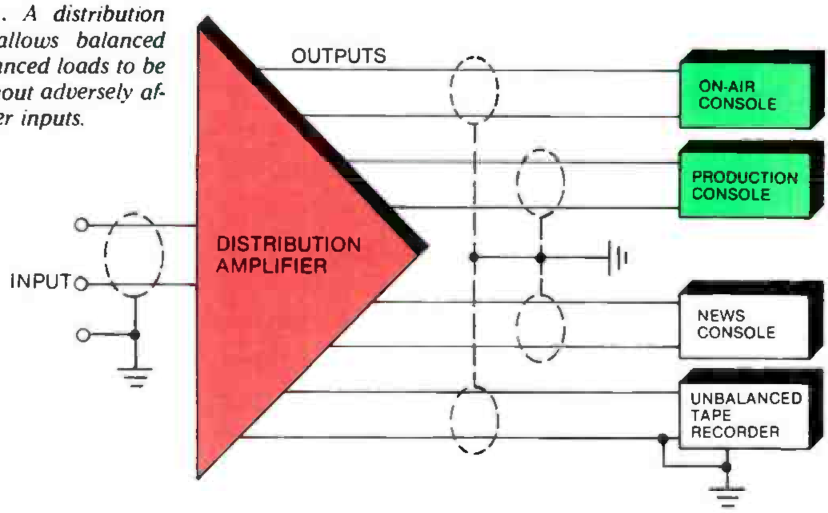


***Figure 11.** A distribution amplifier allows balanced and unbalanced loads to be driven without adversely affecting other inputs.*

isolation is to see what happens when one channel is shorted when being driven at maximum output level. One shorted output channel should not change the output level or distortion on any other channel.

Some DA designs are built around a variation of the differential output circuit discussed previously. Instead of using individual line amplifiers with individual build-out resistors, a master output stage is connected to the various loads through multiple sets of build-outs (see Figure 10). This is acceptable in some situations, but the design will not provide isolation of any dc that may come in on an output line, nor will it ensure a substantial amount of signal isolation between outputs. When driving telephone loops with the Figure 10 design, make sure that the telephone company has installed repeat coils at the transmission point.

Other considerations in the selection of a DA system include the types of input/output connections provided. Common I/O hardware includes barrier strips, XLR connectors and insulation displacement devices. Avoid purchasing a unit with an offbeat mechanism that makes temporary connections for checkout and testing difficult.

The next thing to consider is power—or the lack thereof. Does the application require backup or battery power? What kind of power is needed, and for how long? Is there any way to connect standby power to the unit without voiding the warranty?

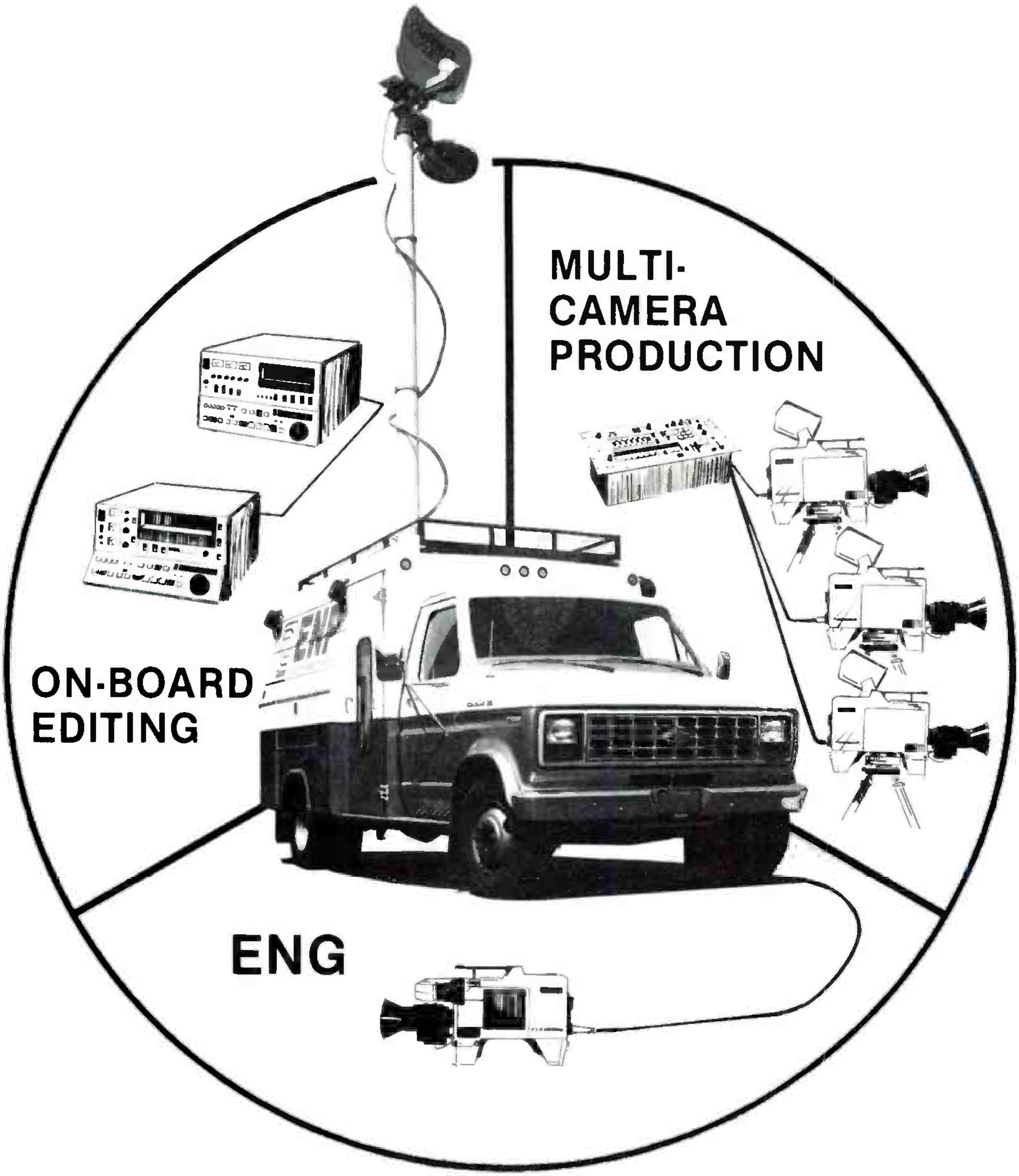
Most situations do not call for backup power; the unit just plugs into the rack. Stop! Take a look at the back panel for a sticker that says the unit is certified by Underwriters Laboratories or Los Angeles City Labs for direct connection to the power line. Can't find it? Time to find another unit.

Other common warnings tell users not to attempt repairs and to keep the equipment away from rain or moisture. Absence of these seemingly trivial disclaimers means that, legally, you could be at fault for installing unsafe equipment. If the unit is going to Canada, it must be approved by CSA.

As with most facility design projects, careful planning and installation of DA equipment will pay handsome dividends for years to come. Money and time invested in detailed system planning is never wasted.

Acknowledgement

The author wishes to thank Ken Fause of Smith, Fause & Associates, Century City, CA, and Lynn McCroskey of Sonics Associates, Birmingham, AL, for their assistance in the preparation of this article.



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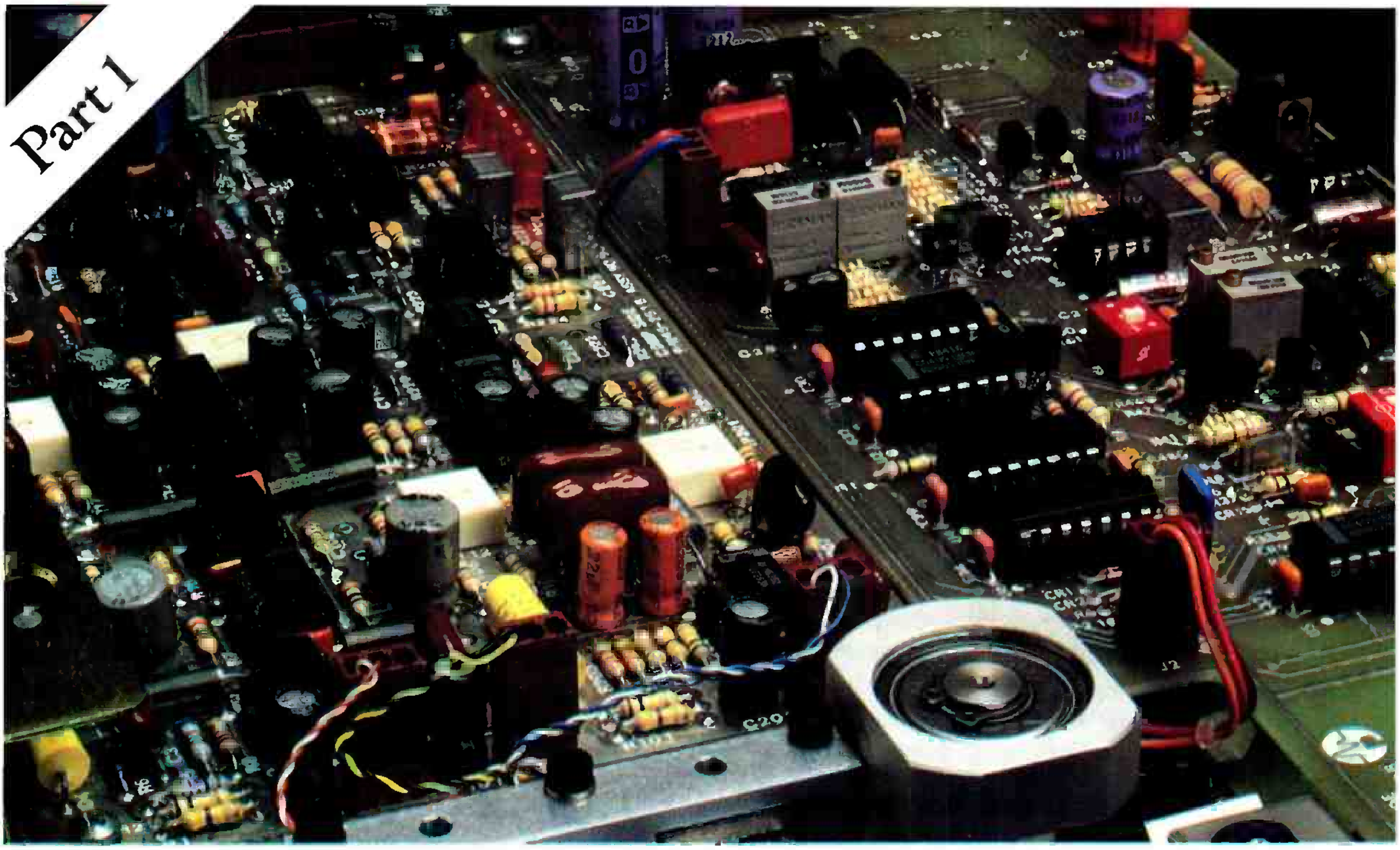

Courtesy of Pacific Recorders and Engineering

Maintaining cartridge systems

By Douglas Fearn

In order to get top performance out of your cartridge tape system, every link in the chain must be examined.

Like many stations, WKSZ-FM plays virtually all its music from tape cartridges. With a background that includes both recording and broadcasting, I drew on techniques of the recording studio when I was faced with the tasks of selecting and operating cartridge tape equipment. After several years of striving for the best possible performance, I now feel confident that excellent audio quality can be obtained and maintained using cartridges. The secret, as in the recording studio, is meticulous attention to detail.

Inside the cartridge

All brands of tape cartridges are capable of high quality performance. Each engineer probably has a favorite, for whatever reason. Most of us tend to be loyal consumers when it comes to carts, relying on previous experience with a particular type. The two most important attributes of a cartridge should be ruggedness and dependability. The type of tape used in the cart, however, is a factor that is often overlooked by engineers. There is a significant variation in the performance of different types of tape.

Several years ago, a major tape manufacturer staged a demonstration of its reel-to-reel audiotape in a recording studio. The three most popular tapes available at that time were used, and the same selection from a master tape was recorded on each of the sample tapes after careful bias optimization and record equalization. According to standard test measurements, the three tapes were not very different. But in *listening tests*, there were significant differences in the *sound* of the three tapes.

Because I was somewhat skeptical of this demonstration, I decided to repeat the experiment at my own studio. I used the same three brands of tape and carefully recorded three versions of the same music selection, making certain that nothing changed except the bias and record equalization. After splicing the three tapes together, I listened to the results. There really was a difference! I invited three other engineers and several studio musicians to listen to the tapes, carefully screening the playback machine so there would be no clues as to which tape was being played. Everyone could hear the differences, and all agreed that one tape sounded better than the others.

There are additional factors to consider when choosing cartridge tape, such as: Will it hold up for a long time? Does the oxide shed excessively? Will it stretch as the lubricant wears off?

The tape supplied in the carts we used for years seemed fine, and I was pleased with the results. But when the tape was discontinued by the manufacturer, I began evaluating every tape I could get samples of.

One problem in evaluating different brands of tape is the need to have all of the tape loaded into the same type of car-

Fearn is chief engineer, WKSZ-FM, Media, PA.

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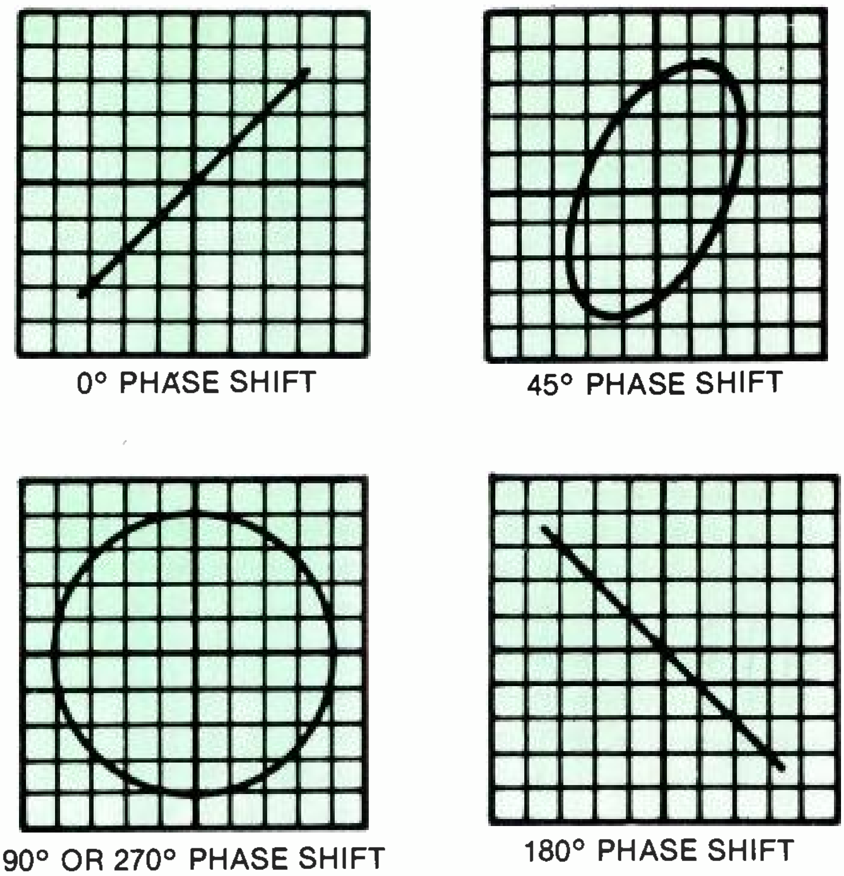

Figure 1. *Oscilloscope photo displays for various phasing conditions. The same displays will occur at multiples of 360°.*

tridge shell you intend to use on the air. Fortunately, most reloading companies are willing to supply various tape samples loaded into specific cart shells.

Before checking each new sample, you should put the primary music-recording cartridge machine on the bench and completely align the system. (I use industry-standard test tapes, recorded on lubricated tape and loaded into our favorite type of cartridge shell.)

Checking the machine

At WKSZ, we have developed a standard procedure for cartridge-machine alignment that I use to check each unit. Any problems encountered in the sequence (see Table 1, page 48) are corrected before taking the next step. The use of a standard machine-alignment procedure speeds the maintenance process and ensures that all units are adjusted to the same parameters.

After the playback section has been checked, a sample cart is used for the record-alignment procedure. For the bias adjustment, I follow a routine that is somewhat different from that recommended by most machine manufacturers. Instead of peaking the bias at 1kHz (basically a crude method), or *overbiasing* by 1dB to 3dB at 10kHz (a better, but still not very accurate method), I adjust the bias for minimum 50Hz modulation noise. This procedure is quick and

gives superior results. Bias adjustment on a 2-channel cart machine can be completed in minutes.

Record a 50Hz sine wave at 0VU (the level is not critical) with the playback routed to a distortion analyzer. After adjusting the meter to the oscillator frequency, adjust the bias for minimum THD. Actually, I do this by ear, listening to the amplified output of the distortion analyzer. As the bias is adjusted, there will be a definite increase in "graveled" noise in the monitor on either side of the optimum setting. With most tapes, there is a difference in the sound on either side of optimum. I've found that the best point does not always correspond to the minimum distortion reading, because some characteristics of distortion products are subjectively more irritating than others. I adjust the bias until it *sounds* the *least offensive*.

This procedure does not seem to work as well with some machines as with others, and you may find that certain units require the manufacturer's recommended procedure. Usually, however, the proper point is quite distinct and easy to determine.

Be careful not to adjust the bias completely out of range. If the tape being tested is significantly different from the tape previously used in the machine, adjust for peak output at 10kHz to first get into the ball park.

After the bias is correctly set, check to see how much 10kHz overbias has occurred. Generally, the bias is close to the 1dB to 3dB overbias usually recommended, but not always. Note the overbias amount and then readjust for minimum 50Hz modulation noise. This step is not strictly necessary, but I find the results interesting.

The record-head azimuth should next be checked using a signal generator and oscilloscope or tape recorder test set. If your recorder has an automatic record-head azimuth adjustment feature, skip this step in the procedure. Careful adjustment of record-head azimuth is critical to the overall performance of the machine.

Record equalization is set so that 500Hz and 10kHz are equal in amplitude when recording a −10VU sine wave. This results in flat response on most popular machines, but a different technique may be necessary in some instances. Some engineers like to use a *sweep tone* test tape and oscilloscope to set EQ, but I have trouble getting consistent results with this method.

The machine record level is set by recording a 500Hz sine wave and adjusting the oscillator to give the same output as the playback alignment tape. The record meters are then adjusted to read 0VU.

A complete frequency-response test series should next be run using the ANSI

____ 1. Clean out machine
____ 2. Clean relay contacts, sockets, edge connectors, etc.
____ 3. Adjust tape guides
____ 4. Adjust cartridge guides
____ 5. Check head position
____ 6. Demagnetize heads (and capstan on machines with a steel capstan shaft)
____ 7. Check pressure roller solenoid adjustment
____ 8. Clean heads, capstan, pressure roller
____ 9. Adjust capstan servo motor duty cycle (ITC Series 99 only)
____ 10. Replace all shields removed for above maintenance work
____ 11. Align playback head
____ 12. Adjust playback EQ
____ 13. Measure playback frequency response
____ 14. Adjust output with standard level cart
____ 15. Measure wow and flutter
____ 16. Measure S/N
____ 17. Measure muted noise level
____ 18. Calibrate playback meter(s)

Table 1. Cartridge machine playback alignment procedure.

standard frequencies from 31.5Hz to 20kHz (plus the non-standard 10kHz). Note the results in a maintenance log.

The overall S/N ratio is measured by switching the test oscillator off and reading the residual noise level while recording. This procedure should give a reading of about −55dB with most tapes. This test does not use the *peak* level specified by many tape and machine manufacturers, nor does it account for bias leakage into the output of the machine, but it will be consistent from test to test and it is quick.

I have not yet standardized my distortion-measurement procedure because I'm not certain what is really meaningful. I've listened to tapes with superior distortion performance that didn't sound as good as tapes with less impressive THD figures. Distortion measurements should at least tell you if you've made a radical error in the alignment procedure.

One worthwhile distortion test involves recording several spot frequencies (such as 50Hz, 500Hz and 5kHz) and measuring THD while increasing the record level. Note the oscillator level required to produce 3% THD at each frequency.

There's no point in making THD measurements above 7.5kHz because the second harmonic will not be heard

Continued on page 52

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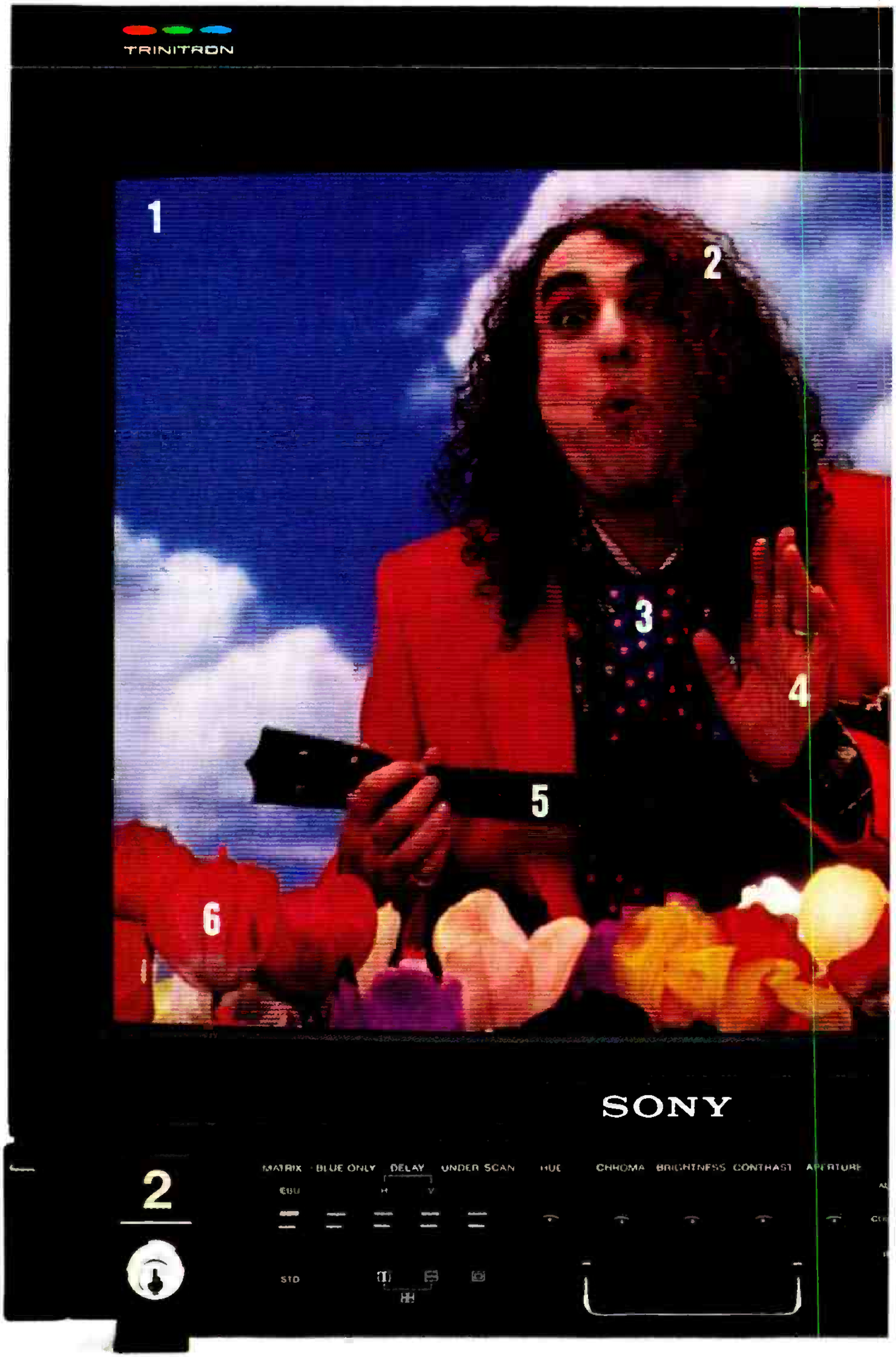

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SONY Broadcast

Continued from page 48

- ____ 1. Align record head (if necessary)
- ____ 2. Check phase error
- ____ 3. Adjust record bias
- ____ 4. Adjust record EQ
- ____ 5. Measure frequency response
- ____ 6. Measure THD
- ____ 7. Measure IMD
- ____ 8. Measure crosstalk
- ____ 9. Measure record/play wow and flutter
- ____ 10. Measure overall S/N
- ____ 11. Calibrate record meter(s)

Table 2. *Cartridge machine record alignment procedure.*

(or broadcast), but the interaction between the bias and the recording frequency can be a useful indication of performance. Record a 10kHz signal while listening to the machine playback. Increase the oscillator output until a beat note is heard and note the level. This test is more dependent on the machine than the tape, but alignment has an effect.

Measure SMPTE intermodulation distortion at 0VU and +10VU and note the results. There are usually significant measurement differences between various tapes. These differences, however, do not appear to be reflected in subjective listening tests.

A complete listing of the record-section alignment procedure is shown in Table 2.

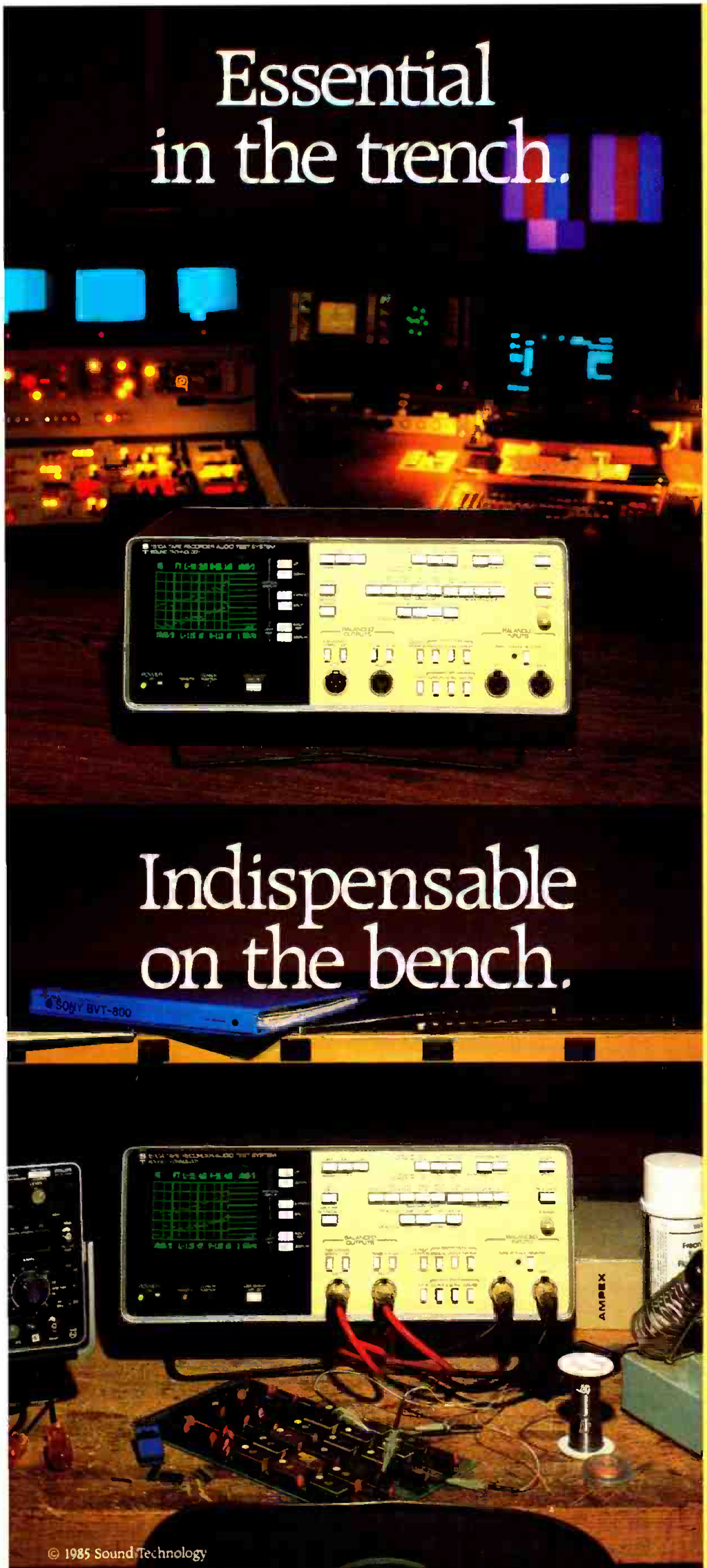
Comparing tape types

After completing the cart-machine playback and record-alignment procedures, return the unit to the production studio and record a standardized musical selection on each test cartridge. I recommend the use of a master reel-to-reel tape that has a 0VU 1kHz tone at the beginning to ensure that all carts record at exactly the same level. You can make such a tape from a record merely by recording a tone at the head of the tape and then recording the music. Record the program material at 15ips (or 30ips if your machine will run at this speed). Use this master reel-to-reel tape for all of your cartridge tape tests. Assemble a collection of sample carts loaded with different types of tape for use in making decisions about tape selection.

Because listening tests are subjective, opinions of various listeners should be considered with caution. You may not hear any difference at all, or you may notice subtle differences that you wouldn't necessarily classify as sounding "better" or "worse." This does not mean that your hearing is deficient, because the recording cart machine may be contributing more problems than the tape. In any case, the previous procedure should help to determine which tape sounds best.

Other factors, such as tape life and oxide shedding, are not easy to determine. The manufacturer's reputation can be a clue, but be aware of the effects that cart machines may have in these areas of performance.

In the next installment of this series, we will examine proper cartridge-recording procedures.



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Audio program analysis

By David G. Harry

Adjustment of an audio processor can best be made when the means are available to accurately measure complex audio waveforms.

Deregulation by the FCC of many technical standards for broadcasting has expanded the freedom of stations to transmit program audio. For a number of years, the commission has allowed radio stations a nearly unlimited range of equalization and audio processing, while maintaining technical performance minimums on the basic transmitting equipment. But now, requirements to measure and to record frequency response and total harmonic distortion at various modulation levels have been eliminated. Broadcasters have total freedom to transmit any quality of signal they wish, provided they remain within RF spectrum and power allocations. They now also assume full responsibility for the quality of their products. They will benefit from, or suffer the consequences of, their quality control.

In this setting, the so-called marketplace will provide feedback to broadcasters, presumably rewarding the desirable signals with audience shares and rejecting undesirable signals. Of course, radio station programming is a major variable in audience attraction, but technical aspects carry considerable weight.

Adjustment and control of the technical elements of the audio signal are often left to the subjective judgments of station personnel, who typically listen to their station and to competitive stations on several selected radios. Changes are then made in equipment and operations to suit personal preferences.

Although human evaluation probably will continue to be the ultimate measurement of audio program quality, recent developments in instrumentation have made it possible to provide new quantitative technical information, derived from program material, that should significantly augment listening judgments. The idea of quantifying and providing a visual indication of audio program level is not new. Because the sensitivity of the human ear varies simultaneously with both frequency and amplitude, various instruments have been developed that provide visual indications of the complex signal characteristics typified by broadcast programming. This technique is called *audio program analysis.*

Harry is vice president and director of marketing at Potomac Instruments, Silver Spring, MD. This article was adapted from a technical paper presented by Harry at the 1985 NAB Engineering Conference.

Conventional program indicators

Devices such as the VU meter, modulation monitor (and peak flasher) and peak program meter (PPM) are used by broadcasters to measure and to analyze program audio. Other devices, such as the CBS loudness meter and real time spectrum analyzer (RTA), have also been used to evaluate program audio. Each device has its own characteristics and applications.

It is difficult to quantify audio program material, which contains complex variations of amplitude and frequency with time. Furthermore, the human perception of audio is complex. We can begin the intricate task of quantification of program audio by reviewing its fundamental characteristics.

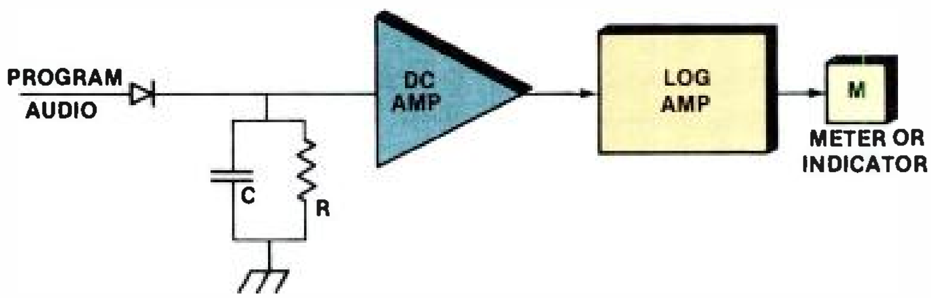

Figure 1. Block diagram of a typical audio peak indicator circuit.

Unprocessed audio

All audio transmission systems are limited by two constraints: the maximum undistorted peak-amplitude excursion and the noise floor. For the best transmission quality, the audio-signal level should be set for the highest value before clipping or substantial distortion occurs. This allows transmission with the least degradation in S/N while limiting distortion to within prescribed parameters.

To set the audio level within the transmission system amplitude window, the wideband (unweighted) peak value of the audio must be known, as well as the peak-amplitude capability of the transmission system. For instance, in a high-quality program channel using +30dBm sine wave amplifiers, a $\pm 34.6V$ swing is the limit before clipping, meaning that the peak-audio level in that circuit must be held below $\pm 34.6V$. Thus, the first and most fundamental value of program audio to be quantified is the wideband peak value of the audio waveform.

Measuring peak audio

Although an oscilloscope can be used to measure peak-audio voltages, this technique is impractical for daily operations because it is difficult for an operator to read the random waveforms typical in audio programming. A peak-reading panel meter or solid-state bargraph indicator seems to provide the most practical display. Figure 1 shows a simplified diagram of a peak-detecting circuit used to drive either type of indicator.

Basically, the audio waveform is rectified through a diode and the resulting single-polarity waveform is used to charge a capacitor. The capacitor is charged to the peak value of the rectified audio and the charge is held long enough so that the panel meter or other indicator has sufficient time to correctly indicate the stored value of the waveform. The resistor then discharges the capacitor, and the resulting time constant provides the fall time for the output indicator.

The peak detector can be designed to capture positive-going peaks, negative-going peaks or the larger of either peak.

Detectors can be designed to capture short audio peaks and store them so that any panel meter can function as a true peak-reading device.

Average value

Figure 2 shows the amplitude vs. time graph of two waveforms: unprocessed program audio and a sine wave. Each has a peak value set to ±34.6V, the peak value of a +30dBm sine wave.

Although the peak values are set to be the same, the average values of the two signals are very different. The average value of the sine wave is 64% of the peak value, or 3.92dB below peak. The unprocessed program signal, however, typically has an average value that is at least 20dB below the peak value. Compared to a continuous sine wave, unprocessed program material contains many peaks that have much shorter duty cycles and much higher crest factors. Figure 3 shows a typical detection circuit for an average responding voltmeter.

Audio processing for the purpose of

Origins of the VU meter

The VU meter was introduced in 1939 as a standard program level indicating device. Its purpose was to better standardize audio transmission levels among program suppliers, such as broadcasters and telephone companies. The VU meter is simply a combination of a bridge rectifier, resistor network and microammeter to produce an average responding voltmeter. The VU meter is calibrated so that 0VU is set at 0.744V RMS on a steady-state sine wave. This is equivalent to 1mW into 600Ω for 0dBm.

The definition of a standard VU meter goes beyond the continuous tone-reading characteristics. The dynamic characteristics of the meter are set so that it will read 99% of its ultimate value on a sine wave tone burst 300ms long and will fall to 5% of the reading in 300ms. The overshoot characteristics are tightly specified and the frequency response is flat across the audio band.

The VU meter is fundamentally an average responding device with a relatively long time constant. On unprocessed program material, it will not respond to short-duration program peaks. Program peaks can be 20dB higher than the VU indication. If no program clipping is desired, a transmission system with about 20dB of headroom following the VU meter is necessary.


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modulation peak control (or to increase loudness) changes the average and/or peak audio waveforms, reducing the separation between the peak and average values. Fast compression increases the average value of the audio, and fast peak-limiting and/or peak-clipping controls wide-amplitude excursions of the peak values. The net effect is a higher average-to-peak ratio. Although unprocessed program audio often has an average-to-peak ratio of −20dB, sophisticated audio-processing equipment can change that ratio to as high as −10dB, while maintaining a quality that, apparently, is acceptable to the radio listener.

Thus, the average value of the program audio waveform is a significant indication, and the effectiveness of audio processing can be fundamentally characterized by measuring the average-to-peak ratio. It is not necessary to know the absolute value of the peak-audio voltage in modulation percentage in order to analyze the effects of processing. Instead, the ratio of average-to-peak is the important factor.

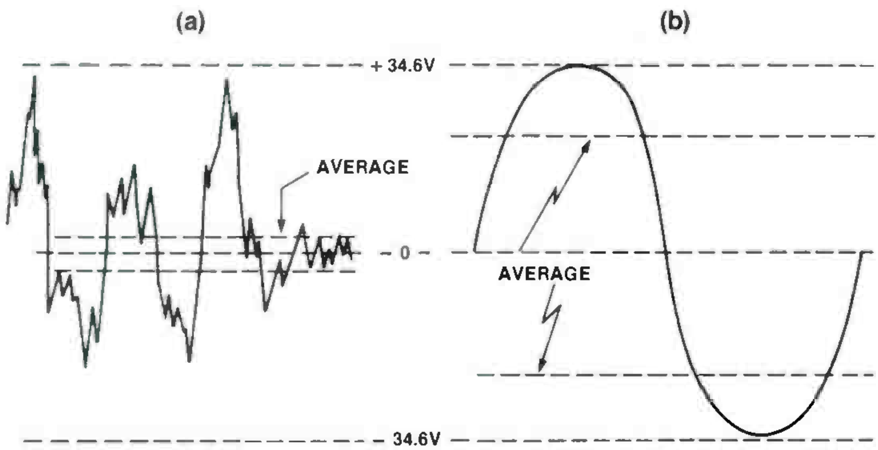

Figure 2. A typical waveform of (a) unprocessed program audio and (b) a sine wave signal.

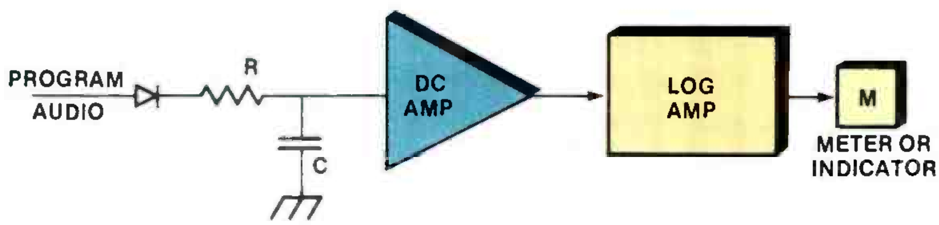

Figure 3. Block diagram of an average responding meter circuit.

Peak density

Peak control is an important part of audio processing. Many audio processors

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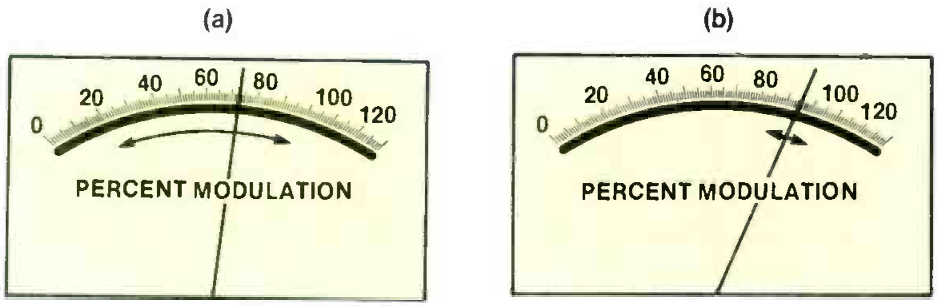


Figure 4. Modulation monitor meter dynamics for (a) a lightly processed station and (b) a highly processed station.

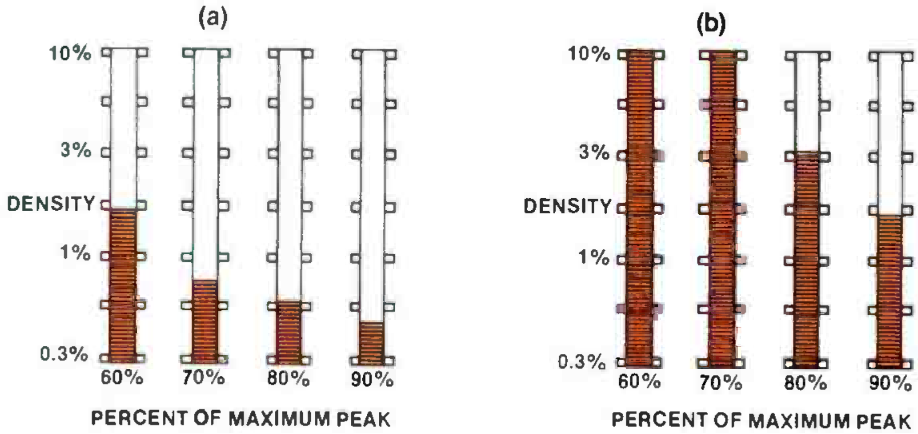


Figure 5. A density bar-graph display for a station with (a) light audio processing and (b) heavy processing.

use an automatic gain-control amplifier followed by a peak clipper to produce controlled-distortion peak clipping. Some stations use various combinations of equipment and a composite clipper to increase loudness.

When observing the modulation monitor at a radio station that uses this type of audio processing, the meter tends to stay at a high value, such as 95%. Figure 4 depicts the modulation-meter deflection for lightly processed and highly processed program material. If the peak flasher threshold of the modulation monitor is adjusted to between 60% and 90%, the observer will note that modulation peaks occur much more frequently than if the station audio were unprocessed. Higher values occur more often because the waveform has been modified for higher peak density.

Another way of describing the effects of processing is to say that the amplitude distribution has changed. Measurements on a number of radio stations have shown significant differences in peak-amplitude distribution which can be described as the station's *processing signature.* Measurements of the amount of time modulation peaks, which exceed 60%, 70%, 80% and 90% of the maximum peak value, provide an excellent

indication of the station's control of modulation. The percentage of time peaks, which exceed a certain modulation percentage, is referred to as *peak density*. A readout technique that graphically displays the amount of time certain specified peak values are exceeded is shown in Figure 5.

Four bar graphs are arranged so that each is reading the activity occurring at specific peak thresholds. For example, the left-hand portion of the bar graph shown in Figure 5(a) indicates the amount of time the audio waveform exceeds 60% of its maximum peak value. The scale is logarithmic, with 10% of the time set as the top of the bar graph and 0.3% established as the bottom of the bar graph. The other bar graphs operate similarly, representing the percentage of time the input waveform exceeds 70%, 80% and 90% of the maximum peak amplitude of the modulating waveform.

The display shown in Figure 5(A) indicates that peaks are exceeding 60% of the maximum peak value approximately 2% of the time, 70% of the maximum peak value 0.6% of the time, 80% of maximum peak value 0.5% of the time and 90% or greater peaks about 0.4% of the time.

When measuring a highly processed signal, the picture looks very different. In Figure 5(b), notice that 60%, as well as 70%, of peak value occurs more than 10% of the time, 80% of peak 3% of the time and 90% of peak threshold 2% of the time. This means the modulation waveform has been substantially processed and clipped, pushing the waveform up so that it occupies higher peak values more often.

In order to measure peak density accurately, a program analyzer must be capable of automatically calculating the ratio of the instantaneous peak value to the wideband peak value over time.

Audio spectrum

Many modern audio processors employ filters that divide the spectrum into a number of bands, process each band separately, then recombine the signals, adding other equalization and filtering. This approach enables the processor to use attack and decay time constants tailored for the individual frequency bands and permits heavier processing with less distortion than is possible on a wideband basis. The tonal characteristics of the program audio can be readily changed with this system by adjusting the gain of the summing network, which recombines the outputs of the individual bands.

Tonal enhancement is often used to make a radio station sound louder or *brighter* on consumer receivers. Adjust-

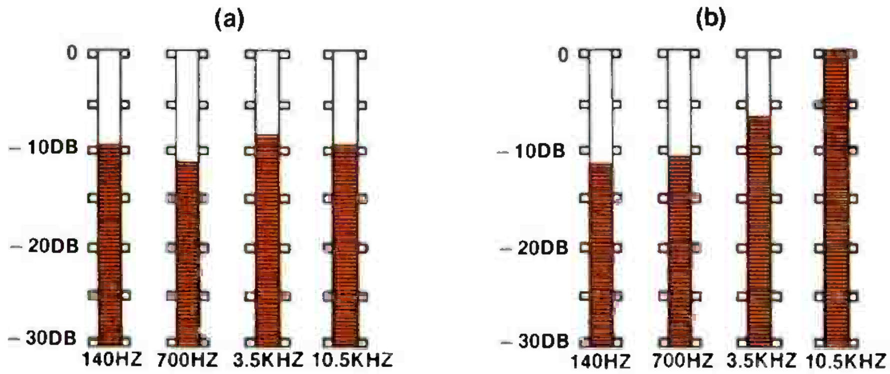


Figure 6. A 4-band spectrum bar-graph display for a station (a) without pre-emphasis and (b) with pre-emphasis.

ment of this equipment is usually done by the subjective method of making changes and then listening to the station (and its competition) on several radios to determine appropriate settings.

In the business of sound, tonal characteristics are often described by referring to the bass, midrange, presence frequencies and highs. These qualitative frequency bands have been taken to center at approximately 140Hz, 700Hz, 3.5kHz and 10.5kHz. Although many real time spectrum analyzers take a mathematical approach to dividing up the audio spectrum into octave or ⅓-octave bands, these four basic bands seem to represent how we describe sound.

Because any audio program evaluation should include spectrum information, comb filters may be used to define the four frequency bands of interest. By combining the outputs of the comb filters, quasi-peak detectors and appropriate switching networks, the bar graph can be used as a conventional real time analyzer with limited resolution.

When equalized program material is observed on the spectrum display, the deviation from a straight line becomes the approximate amount of equalization used. For instance, if 10dB of pre-emphasis are used, the 3.5kHz bar graph could read 5dB higher and the 10.5kHz bar graph 10dB higher. This approach can also be used to compare the processing techniques of various radio stations. Figure 6 compares the bar-graph frequency display of a normal spectrum and a pre-emphasized spectrum.

Stereo

Although stereo modulation monitors often provide peak modulation readings of left, right, L+R and L−R signals, this information is seldom available without access to a monitor. Much information can be derived, however, from observing these signals.

L+R is, of course, the monophonic compatible channel for both AM and FM stereo. If a station is interested in providing a loud processed signal to its monophonic audience, then the L+R channel is the one to study. Most FM and many AM stations are operating in stereo, and stereo information is contained in the L−R signal. For example, some beautiful-music stations desire a wide stereo image and the level of L−R can be as high as L+R. For FM stereo, this means the L+R must be reduced in amplitude to accommodate the higher L−R level. Many FM country-and-western stations want a dense L+R signal for mono loudness and are willing to sacrifice stereo levels. In that case, the L−R level can be up to 15dB below L+R.

By observing the L−R spectrum when a monaural tape cartridge is played on a stereo playback machine, any azimuth errors clearly show up as high-frequency L−R information. Monitoring this way can quickly identify bad carts, an imbalance in stereo processing or misaligned cart machines. The bar-graph display of this condition is depicted in Figure 7.

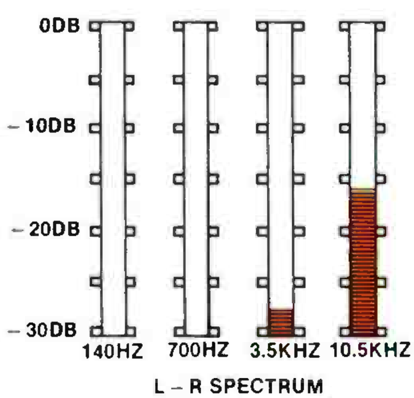


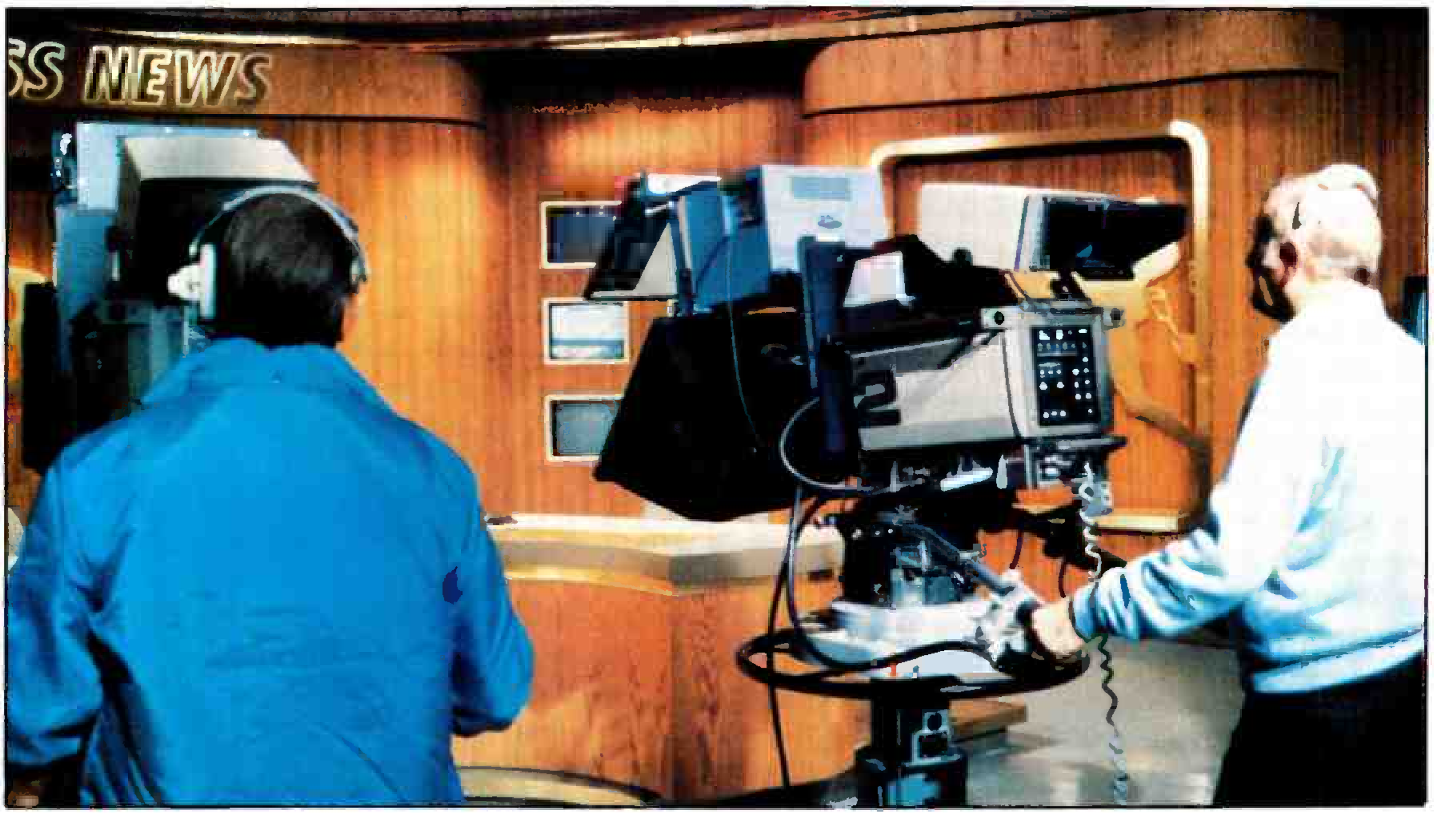
Figure 7. A spectrum bar-graph display of the L−R signal showing high-frequency channel imbalance.

Detailed audio program analysis can be extremely valuable to competitive, real world broadcasting. The additional information provided by such analysis should contribute to improvements in the quality of broadcast audio and a better understanding of the actual audio signal. [BE]

Selecting a studio camera

By Bob Ross

There's more to purchasing a new studio camera than matching the specs with your wish list.



Courtesy of WJZ-TV

When selecting a new studio camera, don't rush through the process. Shown are members of the WJZ-TV staff preparing for an upcoming newscast.

Production studio camera selection is a major event for any TV station, and an especially important one for the broadcast engineer. A correct choice means everyone shares in the glory of perfect pictures. But if things go wrong, the staff will be lined up outside your door. The prospect of *computer-controlled* systems is one that necessitates more careful decision-making.

WJZ-TV is a typical station, in that most of our studio shows do not challenge the specifications of a modern production camera. The last tenth of a decibel in the signal-to-noise ratio, or the last 0.001% error in registration does not mean much in the daily operation of the station. What *really* matters is always having all cameras in service and color-matched with no setup time—cost effectively, of course.

In 1983, when our search for replacement studio cameras began, conditions dictated that the cameras be set up and controlled by computer. As we all know, picture quality is a subjective judgment, and only your best video operator can really differentiate between *good* pictures and the *very best* pictures. A computer-controlled production camera, however, can turn the entire staff into your best video operators.

Ross is engineering manager at WJZ-TV, Baltimore.

What we wanted

When we started looking at new studio cameras, our shopping list included two sections—the *must* and the *wish* items. We felt the camera must:

- Produce the highest quality pictures.
- Produce high-quality pictures consistently.
- Be easy to operate.
- Be 100% reliable.
- Be easy to maintain.

The items on our wish list included:

- Adjustable crosshairs for the viewfinder.
- Contours from the red channel.
- Power and video at the camera head for a teleprompter.
- An RS-232 output driving a printer for a hard copy of all current camera parameters.

During the purchase decision process, a number of things came to our attention that may help you in your next purchase.

How *auto* is auto?

At the outset, you should know that full auto setup means different things to different manufacturers. If a tube is changed, some cameras require a considerable number of adjustments by hand before the computer can take over again. It would be wise to check, for example, how soon the camera would be ready to use after a tube is changed, and how many manual adjustments are needed. Find out, too, whether the camera offers the capabilities for manual setup.

When the sales engineers bring demo cameras to the station, ask them to change a tube. Then, while the tube is out, have them strip down some of the optical path, a deflection yoke and anything else that looks interesting. It should be a snap for them to remove

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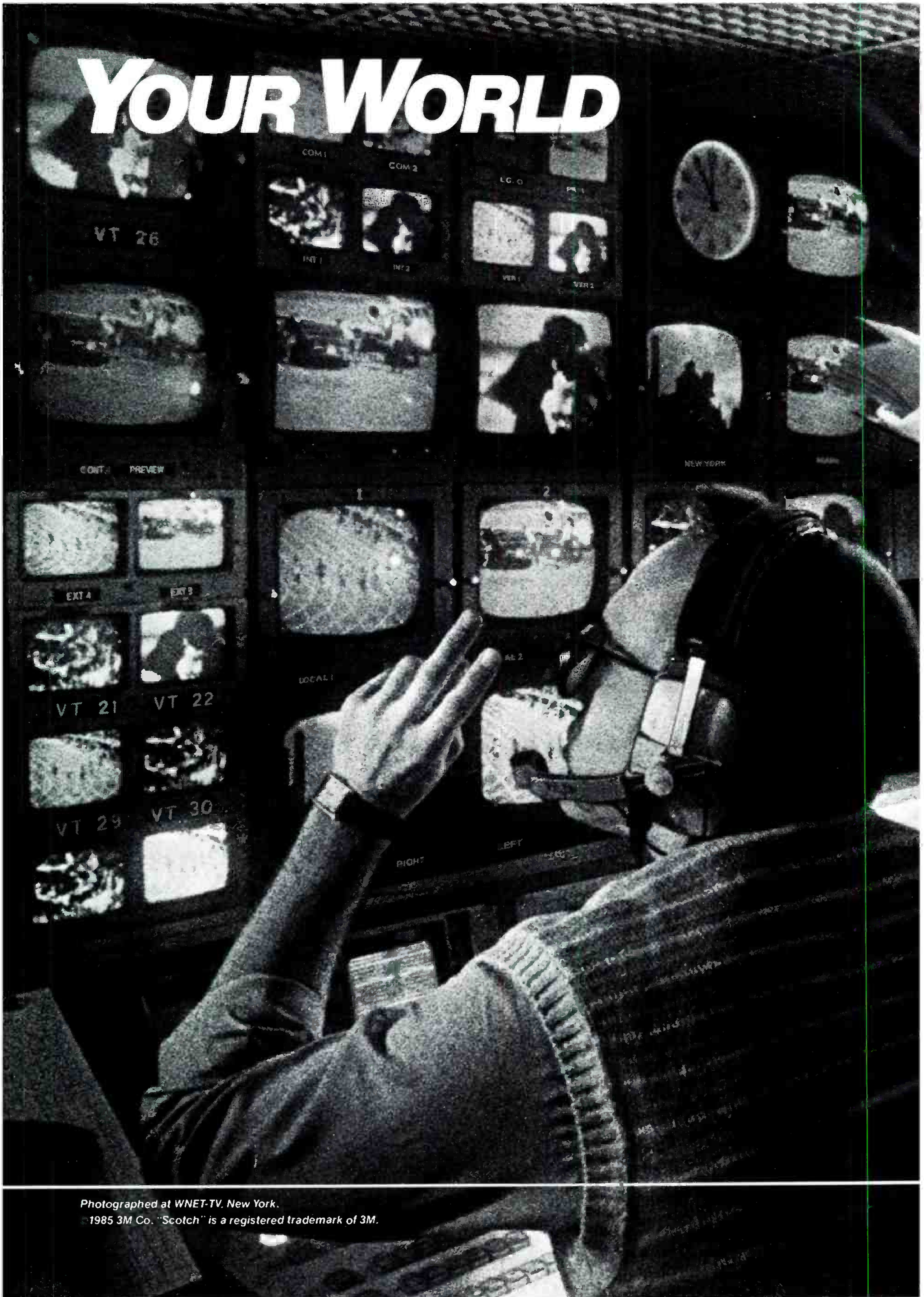

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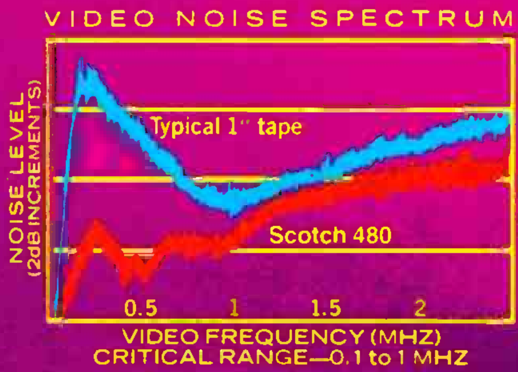

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Continued from page 64

these components. If not, remember that it's only a matter of time before one of your maintenance people will be changing a tube or cleaning the optical path. The mechanical design and the computer system should allow easy removal of anything and also help to restore the camera to service quickly.

If the camera requires no tweeking after a tube change and can be back in service quickly after replacement of a component, the camera can probably qualify as fully automatic. Anything less than fully automatic may create production and maintenance headaches, as the camera and its components age.

Manufacturers work hard to stay ahead in the great setup race, but the bottom line is that they all offer at least two types of setup:

1. Full auto, used after tube replacement, etc., and
2. The day check procedure run once a day.

Optically speaking

The automatic procedures generally use a test pattern from a diascope that is located in the lens or in the camera head itself. If the diascope is in the camera, easy exchange of lenses is possible for production or service purposes. To account for the front lens elements, a lens file must be used to store differences between the correct setup with the diascope as compared to setup through the lens.

Because the various lens range extenders alter the perfect registration, two requirements must be met: There must be a system to store lens parameters, and there must be an access to the stored data as the camera operator changes extenders.

Not all cameras can accept an output from the lens to a control lens file switching system. If the lens file capability is specified, desirable settings should include registration, shading, white balance and flare.

The alternative to lens files is to use lens systems with integral diascopes. In order to set up properly, the computer system must work separately with each lens as it is mounted on the camera. The trade-off is one of setup time.

Proper gray scale tracking is a must for high-quality day-to-day pictures. The lens flare compensation circuit should hold the black levels constant over a wide variety of lighting changes. If you plan to use a teleprompter, remember that the mirror will probably alter the flare settings. Be sure to mount the mirror before critical settings of flare circuits are made.

Camera tubes can have a definite effect on picture quality. We found that 25mm lead oxide devices had more than enough resolution. The 25mm size produced sharp pictures with an advantage of an extra lens f/stop over the same lens with 30mm tubes. A comet-tail suppression grid for the handling of highlights performed well.

Head specifics

How you get signals to and from the camera head is really your choice, but triax does allow the use of a simpler and more affordable camera patch panel. The video circuits from the head to the CCU, and the type of cable used, should have a wide signal bandwidth.

The camera should allow for internally generated, as well as externally generated, test signals to be injected into the video amplifiers in the head. It is extremely frustrating to think you have a cable problem, and not be able to use any of the standard test signals.

During the demonstration, ask to inject a multiburst signal into the video amp in the camera head. Then observe what the signal looks like after it has traveled through a camera cable twice the length of what you will be using. Not only will you determine whether it is possible to inject test signals, but also whether response and bandwidth capabilities are acceptable. Auto cable compensation can be checked, too.

Make sure that you can power the

teleprompter from the camera head and check for a prompter video connection. You should not have to depend upon the use of the external viewfinder video circuit. The viewfinder video lines are designed for the convenience of the operator in special situations. There should not be a trade-off required to use the teleprompter.

Similarly, red, green and blue signals for chroma-keying will undoubtedly be needed from time to time. Although the camera head may have RGB outputs, keying signals should also be available at the CCU. Leave those on the head for test purposes.

Product support

Computer-controlled cameras are definitely software-based. As you near your final choice, do not allow yourself to be tied into the current software revision. If you've had any experience with computers, you know that where there is software, there may be bugs. The manufacturer of a computer-based system should provide low-cost updates to the operating program. Work out the details for gaining access to any and all future software revisions at a reasonable price.

An important consideration before making the purchase is the availability of spare parts. What arrangements are made to get spares to you fast? Does the manufacturer have a program that allows modules to be swapped if failures occur? Is the program reasonably priced?

Unexpected pluses

Reliability was on our shopping list of *musts* when we set out to look at camera systems. We learned that, with reliability, another feature is desirable: diagnostics. The camera that seldom breaks can lead to a maintenance staff that gets lost when it is necessary to work on the system. Diagnostics to assist in locating problems and restoring the unit to service is a must.

Versatility of the control computer is also important. Not all systems allow camera heads to be swapped between CCUs and still maintain signal quality. Such a capability would be valuable when least expected.

Contours from green are traditionally used to provide image enhancement. Although green is present in nearly all televised scenes, red may also be a prevalent color. The ability to add contours derived from the red channel is a definite plus. Though we initially included contours from the red channel only on our wish list, we would not willingly go back to green contours only.

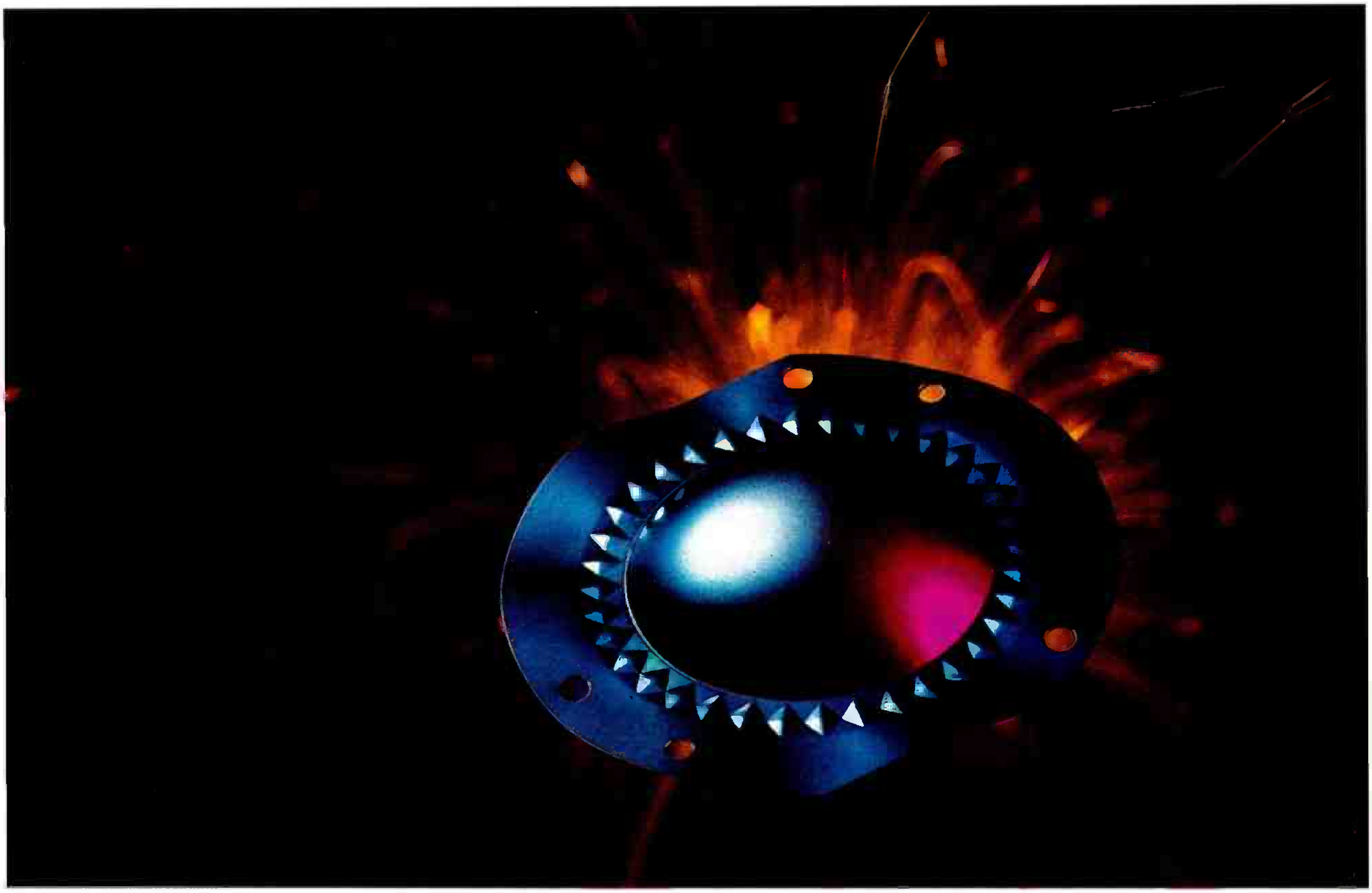
With our previous cameras, we always allowed an hour for setup. You can imagine how delighted we are with a camera that can be ready from standby in just a few minutes. But more important than the time savings is the picture quality, with no discernible color-matching problems.

Quality/features vs. cost.

The process of selecting *the* cameras for WJZ-TV was a time-consuming one, but our experience has shown that the time spent was warranted. Our choice of automatic computer-controlled cameras not only met our original *musts;* it granted our *wishes* as well.

Certainly, there are other features and specifications that you will want to consider as you look for your new camera. The CCU and operations panels, for example, should be on your list if you desire to manually set up. If manual adjustments are performed, some type of status feedback adds a feeling of security. If the system under consideration includes a printout of camera parameters, such manual changes should be included on the hard-copy document. Special color-shading matrix modules may fit your needs. Your situation could easily lead to a different set of musts and wishes than we assembled.

If your engineering department, like most, works under a stringent budget, you will be looking for the highest quality and the best value for your dollar. Even if your goal is not a fully automatic camera, these suggestions should prove helpful to you in your search. [BE]

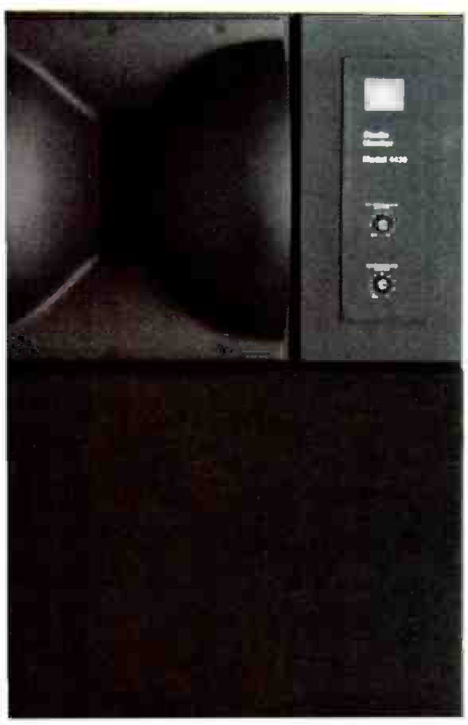


JBLs unique titanium diaphragm and "Diamond Surround" bring new purity and consistency to high frequency response.

It Took JBL Science, A Nitrogen Explosion, And Pure Titanium To Give You Perfected High Frequency Sound.

High frequency sound has always fought with the technology that brings it to the ear. The driver diaphragm has been most vulnerable, pushed to the breaking point, unable to hold uniform frequency response.

JBL scientists decided to fight back. They exploded nitrogen into a remarkable metal, pure titanium, encircling their unique diaphragm with a vibration-absorbing "Diamond Surround," so revolutionary it warranted its own patent.



The result? A diaphragm that delivers and sustains a power and purity to high frequency response never before approached in the industry.

Perfecting titanium technology is just one of innumerable ways in which JBL science is re-shaping the quality of sound. From driving your studio monitors in a demanding final production mix, to critically evaluating in detail actual on-air signal quality, JBL audio systems are focused on the most exacting demands of the broadcast professional. To find out which system is designed to meet your specific requirements, contact your authorized JBL professional products dealer today.

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Circle (51) on Reply Card

Extending camera tube life

By D. P. Mouser

Because camera tubes represent a substantial investment for a TV station, a regular maintenance program is a must for getting your money's worth.

A technician prepares to check the condition of a camera tube. Parameters measured include sensitivity, resolution, geometry, signal uniformity, lag, blemishes, highlight overload protection and beam characteristics.
Courtesy of EEV

When the lead oxide (PbO) target camera tube was first introduced in the '60s, it gave television an entirely new look. A new level of image resolution was achieved by the relatively small target exposure area. Equally significant were the lower light level capabilities of the target material. An eventual reduction in tube size, combined with the low light capability, was instrumental in the development of modern ENG cameras.

Today, PbO tubes are used in virtually every color broadcasting country in the world. They may be specified for almost every type of studio, EFP and ENG color camera manufactured. Their ability to perform equally well in wide-ranging lighting conditions is enhanced with spectral highlight compensation.

Although the performance of PbO devices meets high standards, obtaining and maintaining peak performance requires care in handling and operation. The following procedures will help assure that a lead oxide camera tube will fulfill the useful life it owes you.

Mouser is Leddicon applications manager for EEV Ltd., Chelmsford, England.

1. Storage

• Store tubes with the faceplate uppermost, preferably in a rack or container and free from shock. The gimballed containers in which many tubes are shipped provide a high degree of protection.

• Keep the plastic faceplate protector in place at all times. No part of the tube should be subjected to high ambient light levels.

• Ensure that ambient temperature during storage does not exceed 30°C for any significant length of time.

2. Conditioning

• Do not leave the PbO tube on the shelf, unused, for an extended time. To prolong its shelf life, a regular monthly conditioning procedure is recommended.

• In the absence of a conditioning fixture, tubes should be run with filaments only at 6.3V for two to three hours. If the tube is conditioned in a camera, where its use is subsequently intended, target preconditioning is suggested to ensure that its characteristics are correct for the particular color channel. This can be done with the camera viewing a uniformly lighted white card. The target should be *overscanned* to produce a nominal peak white signal current.

3. Faceplate cleaning

Before shipping, tube faceplates are cleaned and inspected for picture cleanliness, then a paper tissue and faceplate protector are put into position.

• Use only recommended lens tissues and strictly avoid cleaning fluids. This is important in the case of tubes with an infrared reflecting filter deposited upon the anti-halation stud surface.

• Ensure that the *anti-flare* mask is in the correctly oriented position.

4. Installation in the camera

• Use care when inserting the tube into the yoke, particularly if an anti-flare mask is not used. The edge of the anti-halation stud can be chipped easily, allowing light penetration and spurious signals in pictures.

Only Panasonic® delivers a ½" recorder with color playback in the field.

Is it a "wrap" or isn't it? Now you can tell right on the spot. Because the Panasonic Recam™ AU-220 is the only ½" VCR that gives you the quality of 1" color playback in the field. So you can instantly see what you've shot. Either through the viewfinder or a monitor.

Consider the facts: The Panasonic AU-220 records, utilizing the M-Format, on standard ½" VHS cassettes. Yet it delivers the kind of picture quality that's long been the broadcast standard. Luminance is 4.0mHz (typical). Chrominance is 1.0mHz. While the video S/N is every bit as good as 1" with chrominance better than 50dB.

For total flexibility, the AU-220 includes a built-in switchable SMPTE time code generator. And it's compatible, not only with component analog video equipment, but also with YC and NTSC.

The Panasonic AU-220. 1" color quality from ½" tape makes it one of a kind.

For more information, call your nearest Panasonic regional office. Northeast: (201) 348-7336. Southeast: (404) 925-6772. Central: (317) 852-5973. West: (619) 941-3387. Canada: (416) 624-5010.

Panasonic
Broadcast Systems

Circle (53) on Reply Card

ANOTHER BROADCAST INNOVATION FROM MATSUSHITA ELECTRIC

• Correct orientation of the tube in its yoke is indicated by an index line on the tube base. It should be uppermost in the plane of the frame scan. This line also determines the orientation of the *quality rectangle* of the target and assists in location of the target single narrow band contact for *low output capacitance* (LOC) tubes.

• Fit the camera socket to the tube base with care. Once the tube has been clamped into position in the yoke, do not attempt to turn the tube inside the yoke.

• Carelessness can result in air leaks through the metal to glass pin seals and cause irrevocable damage to the tube. Damage to components in the camera may also occur.

5. Camera voltage compatibility

Check that the correct operating voltages exist in the camera. Keep in mind the following:

• A positive grid No. 1 voltage required for a *diode gun* type tube can cause irreparable damage to the cathode of a *triode gun* type device.

• Low voltages at grids 2, 3 and 4 can result in poor performance. Parameters most affected are cathode emission, an enhancement of picture framing, beam pulling and a reduction in resolution.

6. Care during operation

• Tube filaments should be on for a minimum of 10 minutes before beam current is drawn. This is particularly true for tubes that use higher wattage filaments. During the delay, the cathode assembly temperature is allowed to stabilize after an initial fast rise in temperature.

• On initial setup, ensure the target is overscanned and that subsequent scan adjustments are to the correct format. Progressive underscanning to combat scan burn will result in deteriorated performance and shortened life of the tube.

• Gross overexposure to highlights can result in target fatigue and severe changes in target characteristics. Avoid excessive highlight sources within the picture whenever possible.

• Light biasing to improve the beam readout efficiency is a useful aid in reducing lag. It is most effective if the light bias-induced dark current value is adjusted to a minimum that is consistent with the least differential red, green and blue residual signals that are produced while the camera views a moving white area on a black background. The current value is typically not greater than 5nA.

• Further increasing light bias values to enhance overall response will usually cause picture deterioration, with undesirable components appearing in the output signal, particularly with extended red devices.

Bias lighting to reduce lag may be adjusted through an in-base control on some tubes.
Courtesy of EEV

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The HOTRONIC AE61 upholds the standards of performance and easy operation that so many TBC users demand. While paring size and weight to the barest possible minimum, it does not sacrifice the rigid Hotronic standards of reliability and longevity. This product is not merely transparently *respectable*. It is transparently *superb*! The AE61 is custom-designed for the increasingly quality-conscious world of the 80s. The demand for quality in the 80s has *sharpened* the character of the AE61 — the standards of Hotronic have *formed* it!

Offered at $6000.

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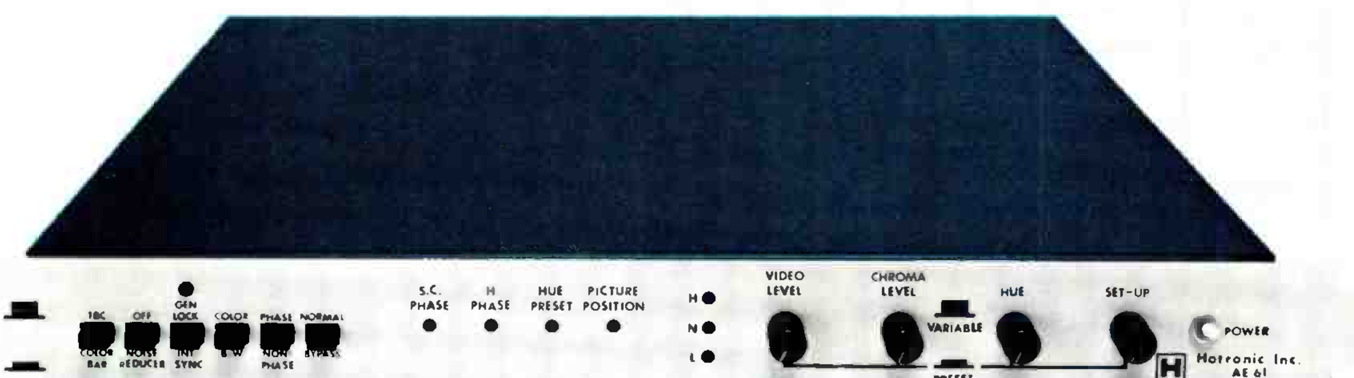

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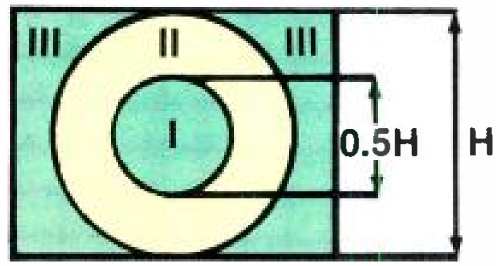

Figure 1. Three generalized zones in the scanned area of the camera tube target are considered for target integrity.

The life of a tube

Making sure that a camera continues to provide the highest quality signal requires a considerable investment—just for tubes. The expense of backup tubes can be reduced, however, by not changing tubes in sets. Some operations automatically change all tubes when a specific number of operating hours is reached. You must weigh the practical aspect (of changing it before it fails) of that type of procedure against the economic factor.

Other users prefer to monitor the image quality, changing only those tubes causing degradation of the quality. Similarly, when catastrophic failure of a tube occurs, only the failing device needs to be changed. Of course, more attention must be paid to the signal being produced in this much less expensive procedure.

Spots, smudges or blemishes in the target result in uneven modulation of any signal current between black level or dark current and white level or peak signal current. These output signal variations may produce undesirable visual areas in the picture. If blemishes become objectionable, change only the involved tube. Judicious setting of target voltage levels may aid in hiding spots momentarily, but is not an appropriate long-term repair method.

Typically defined, an acceptable tube will have no blemishes within zone I, a circle of diameter equal to half the height of the scanned area. (See Figure 1.) Zone II may have a maximum of two spots in the area between zone I and a circle of diameter equal to the height of the scanned area. As many as three spots may occur in zone III, which is the remaining picture area outside of zone II.

Lead oxide pickup tubes for today's TV cameras must meet exacting specifications. Barring catastrophic failure, these tubes should provide excellent service for at least 1000 hours of active beam current time. Many engineers have reported tube lives extending beyond 1500 and 2000 hours. Some degradation of high-frequency response is possible as the tube ages. These maintenances recommendations should help your operation to obtain equally impressive extended tube life and picture performance.

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

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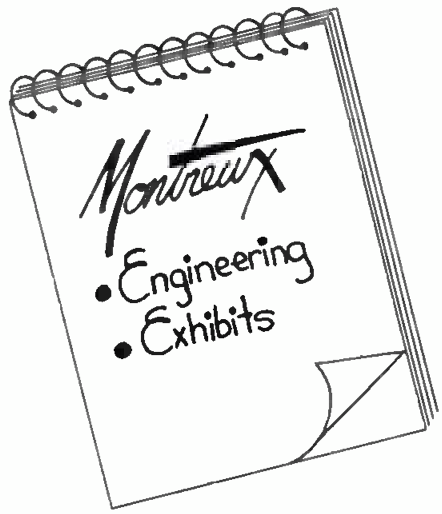
Show replay

Montreux offers a look at the future

By Carl Bentz, technical editor



The 14th International TV Symposium and Technical Exhibition, Montreux, Switzerland, set new attendance records. The biennial event attracted more than 35,000 attendees (from 50 countries), and exhibitors numbered more than 200. Manufacturers and attendees squeezed into the main Palais de Congress exhibit area, the roof, surrounding grounds and nearby hotels. Business was brisk throughout the exhibits.

In the seminars, discussions focused on extended and high-definition TV, digital and component analog signals, DBS and small format video recorders. To most attendees, the future of TV broadcasting was less a question of *what*, than it was *when* and *how*.

For our viewers

Perhaps the most interesting of the demonstrations at Montreux offered a look at tomorrow from the consumer's point of view. That exhibit, called the *Living Room of the Future*, combined extended TV imaging with HDTV technology, MAC transmissions with videodisc sources, improved VCRs with the home movie TV camera and consumer services via the broadcast signal and home computer. Multiple-channel audio enhanced 20- and 40-inch 5:3 aspect pictures. The only significant item missing was one of today's televisions, which would have provided an interesting comparison.

The Viewer's Choice brought nine top broadcasting and equipment manufacturing executives face to face with three journalists to discuss the many choices of information and entertainment now available to TV viewers. The insight provided by these industry experts was a helpful gauge in evaluating the probable impact of today's sources, tomorrow's technology and viewing habits on the future of mass communications.

Recording systems

The topic of small format recording systems opened the technical presentations. Papers reviewed the SMPTE-designated Type L (Betacam) and Type M (M-format) ½-inch systems, as well as the two ¼-inch formats currently in standards contention. Discussions of 8mm formats described a system with a 4-head scanner operating at 60rps or even 120rps. An 8mm preview showed a digital recording format with a metal particle or evaporated tape medium for 22 minutes per cassette.

CBS continued to back the Betacam format, while Julius Barnathan of ABC said he expects to stay with ¾-inch equipment, particularly in light of the improved performance highband U-matic products to be available soon.

Steve Bonica, vice president of engineering at NBC, spelled out his network's view of a format smaller than U-matic, which sounded similar to a rerun of an M-II format specification sheet.

Improved definition

HDTV overshadowed most other topics, and the conclusion was that it will become popular. Two major questions remain to be answered: *when?* and *which method?*

Robert Hopkins, executive director of ATSC (USA), placed a time limit of sometime in 1985 for the approval of a worldwide standard. Hopkins predicted that if no decision on a standard is forthcoming this year, then no single predominant system will be likely, and de facto systems will reign. ATSC supports the NHK system.

The 1125/60 approach was highly visible in cameras, monitors, a prototype telecine and an electronic graphics system. A demo production from RAI (Italy) and a commitment by VOIR Studio 57 (Paris) to begin HDTV production in 1986 strengthened the NHK position.

Detracting from 60-field systems, however, were concerns of 50-field (PAL and SECAM) broadcasters about the potential difficulties in converting to 60Hz equipment. A suggestion was made to consider a 90-field system for reduced flicker. One prototype camera supported a 1249-line/50-field format. And an additional 50-field system has been proposed to the EBU by the Soviet Union. Meanwhile, the EBU continues investigating technical aspects and political considerations and predicts a recommendation for a world HDTV production standard by early fall of 1985. The HDTV timetable remains debatable, partly because it could be delayed by the high cost of consumer equipment.

Joe Flaherty, CBS, admitted that two field rates are problematic. He suggested that now is the time to change one or both. Unless some conclusion is reached, Flaherty believes, CATV, VCRs and videodiscs will become the source of higher definition.

Direct broadcast

Given the wideband nature of HDTV and digital signals, and the limited spectra for terrestrial broadcast, the most likely transmission method remains DBS. Although U.S. DBS has experienced faltering financial support, various European broadcasters and manufacturers foresee DBS within the near future. Although there are technological (PAL vs. SECAM) and ideological conflicts in Europe, various DBS services are said to be imminent. One target date of mid-1986 remains scheduled for regularly scheduled European DBS transmissions to begin.

In the digital domain

Digital, as well as analog, components were discussed in the seminars, where cautions were noted by John Baldwin, IBA. Baldwin sees definite benefits in digital production techniques in dynamics, S/N and multiple-generation capabilities. However, he noted possible artifacts of digitized components that could degrade composite TV reception. Despite Baldwin's cautionary remarks, a demo music video, produced by the Societe Francaise de Production of Paris in a developmental all-digital studio, garnered viewer enthusiasm.

Digital video recording appears close to international standardization. Demos and discussions show the DTTR (digital TV tape recorder) is nearing a standard format, with an EBU recommendation pending.

Products and plans

Most of the products displayed were designed primarily for use in the areas of PAL and SECAM. A proliferation of graphics equipment was notable. Most audio products were geared toward stereo, to answer interests of multichannel sound now available in Japan, the United States and Germany. The subject of stereo audio, however, was low-key.

If you want to plan ahead, the 15th Montreux symposium will be June 11-17, 1987. Expanded exhibit space is planned, but housing and parking for the event is likely to again be critically limited.

FROM HAIRPIN TURNS TO STRAIGHTAWAYS, THE SPEED OF SOUND HAS NEVER BEEN SO SMOOTH.

For years, sloppy tape transportation and handling have made the audio engineer's day much harder than it had to be.

This tormenting state has come to an end with the introduction of Sony's APR-5000 2-track analog recorder, available in a center-track time code version.

The APR-5000's precise handling and numerous advanced features make the audio engineer's day run much smoother. For example, the APR-5000's 16-bit microprocessor manages audio alignment with a precision that's humanly impossible. And the additional 8-bit microprocessor opens the way for extremely sophisticated serial communications. In tandem, they reach a truly unique level of intelligence.

Not only does the APR-5000 do its job well; it does it consistently. The die-cast deck plate and Sony's longstanding commitment to quality control maintain that the APR-5000 will hardly need time off.

All of which results in a consistent sonic performance that'll stand even the most critical audio professionals on their ears.

For a demonstration of the recorder that transports analog audio to a new fidelity high, contact your nearest Sony office:
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Southern Region (615) 366-0333;
Central Region (312) 773-6000;
Western Region (213) 537-4300;
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SONY
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People

The Association of Federal Communications Consulting Engineers (AFCCE) has elected the following new officers for 1985-86: **Warren P. Happel,** P.E., Scripps-Howard Broadcasting, president; **Charles I. Gallagher,** P.E., consulting engineer, vice-president; **Ronald D. Rackley,** P.E., du Treil-Rackley, secretary; and **Alan E. Gearing,** P.E., Jules Cohen & Associates, treasurer.

Jim Holt has been named director of marketing for Electro-Voice, Buchanan, MI. Holt will be responsible for tactical marketing efforts in EV's music, professional, pro sound reinforcement and commercial business sectors.

Barry D. Umansky, deputy general counsel for the National Association of Broadcasters, has been named president of the Electromagnetic Energy Policy Alliance (EEPA). EEPA's membership consists of users and producers of electrical/electronic systems who support the formulation of responsible policy related to electromagnetic energy.

Mathew S. Ceterski has joined Recortec, Sunnyvale, CA, as vice president of marketing. Before joining Recortec, Ceterski spent 10 years with Sony Corporation of America in marketing and sales management.

Tom Canavan has been appointed vice president and general manager of A.F. Associates, a designer and fabricator of video systems, and distributor of video products. Canavan has been with AFA since 1977, and most recently was manager of the systems division.

Michael Cullen, Marc Feingold and **Shuichi Homma** have all been appointed to new positions within Sony Tape Sales, a division of Sony Corporation of America, Park Ridge, NJ. Cullen has been appointed midwest regional sales manager of industrial videotape products, working out of Itasca, IL. He will be responsible for sales to broadcasters, duplicators and production houses in a 13-state region. Feingold is the new national dealer tape sales manager, a newly formed position in which he will coordinate industrial tape sales efforts. Homma has been named technical manager for industrial videotape products, and will provide an information resource on all Sony professional and industrial videotape while handling technical customer assistance.

Richard Sirinsky has been named director of sales at CMX, Santa Clara, CA. His experience includes 24 years with Ampex, and most recently he was vice president and general manager of AF Associates.

Business

Cross TV adds SSL audio

Solid State Logic has completed an audio system upgrade for Cross TV Video Center, Tokyo, with the addition of an SL-6000E stereo mixing system. Twenty-eight mono I/O and four stereo channels, plus 32 group multitrack routing and triple stereo mix groups will be used for separate music, effects and dialog mixes. Cross TV has found the 5-machine integral synchronizer system to be valuable in mixing automation. This is the fifth major independent video installation for SSL in Japan.

ADO is scheduled for WABC

Ampex Corporation will provide the 500th ADO system to be manufactured to WABC-TV, New York. The contract calls for a 2-channel effects unit to be part of a package that also includes three VPR-3 VTRs.

All digital studio opens in Paris

Thomson-CSF Video, France, is developing a fully digital TV studio in collaboration with TDF (TeleDiffusion de France). Included in the system will be digital color correction, A/D and D/A converters and a fixed image analyzer that incorporates a 2048-pixel CCD imaging system.

The studio system already has been used by Polygram and the Societe Francaise de Production (SFP), Paris, to produce a music video presentation. The 4½-minute clip was well received by observers at the TV Symposium in Montreux.

Chameleon enters European picture

A new office for *Chyron Corporation* has opened in London to provide sales and service activities in continental Europe, Scandinavia and the United Kingdom. Technical support will be provided on all Chyron products, including the Chameleon paint and VP character and graphics generators. In addition to the London office (telephone 01-258-3999), product assistance is available through Ampex and GEC-McMichael Ltd.

Link and GVG enter joint venture

Grass Valley Group has formed a joint venture with *Link Electronics*, Andover,

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UK, to manufacture the Link/Grass Valley sync generator. Link already provides distribution for GVG in the United Kingdom. The new generator will be sold worldwide through the GVG and Link networks.

Swiss television to carry teletext

Logica, London, is under contract to supply a network of Context teletext and Supertext subtitling equipment to Swiss Teletext Corporation. The initial 8-computer network will be used to develop a multilingual teletext magazine for transmission on the Swiss national broadcasting service. From the Biel, Switzerland, editorial center, French and German material will eventually be joined by Italian language information.

RCA awards OEM contract to EECO

EECO, Santa Ana, CA, has entered into an original equipment manufacturer (OEM) agreement with the broadcast systems division of RCA, Gibbsboro, NJ. RCA will incorporate EECO video equipment into its video systems, which are marketed in the United States and internationally to the broadcast and video markets. EECO's current video products line includes the EMME computerized editing system, which provides control of multiple VTRs and a production switcher through the use of interchangeable work stations; the new IVES (r) II desktop post-production editing system, which features many pre- and post-production capabilities in a compact desktop unit; and a full line of time code peripheral equipment, including time code generators and readers.

Modulation Associates supplies weather network

Modulation Associates, Mountain View, CA, announced that the company is receiving the add-on orders from Kavouras, Minneapolis, to supply the satellite data transmission equipment for major expansion of the Kavouras Weather Data Network. Kavouras provides weather data services to TV broadcast stations, utility companies, the military and state and local governments. Data is transmitted from Minneapolis via the Modulation Associates SCPC (single channel per carrier) solid-state satellite uplink to receiving earth stations across the country. The additional orders from Kavouras are for the Modulation Associates SCPC data SAT receivers, which are installed at these receive sites.

By using the Modulation Associates

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Plus one of the lowest head wear tapes in the industry. That alone will prevent a lot of headaches.

In the field or in the edit room, no matter what hardware you're using, you should be using our new Sony V1-K K Series 1." Because it's even more of a good thing.

SONY

Professional Tape Division

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satellite transmission equipment, Kavouras can transmit the data at 56kbits/second, 50 to 60 times faster than possible with Kavouras' traditional land line network. Also, a much lower bit error rate is possible with the satellite links.

Bosch supplies equipment for several countries

The Ministry of Information in Oman will have an outside broadcast vehicle that was supplied 10 years ago by the TV systems division of *Robert Bosch GmbH*, Darmstadt, Germany, modified in line with the latest technology. The updated Bosch video system will include type R 51 ME mixers, a matrix, pulse generation and color and black-and-white monitors. Bosch will also equip a studio for Oman TV with the new R 61 ME compact mixer, a 30x30 matrix for audio and video and synchronizers for external video signals.

Christliche Medien GmbH, founded by the Youth Mission and Welfare Organization in Altensteig, Germany, will also have Bosch equip a TV studio for its media work. Bosch will supply two BCN 51 VTRs, two KCP 60 color cameras, an R 51 ME compact mixer, the monitor panel and a production desk.

In Brazil, Bosch has supplied stationary and portable VTRs (BCN 51, BCN 21) and KCF cameras to the new TV station Nassau Editora in Vitoria; TV Educatica in Porto Alegre has purchased additional BCN 51 VTRs and KCP 60 cameras; and another BCN multistandard machine for the reception and exchange of international programs has been ordered by Embratel for its satellite station in Sao Paulo.

And, as part of a UNESCO development aid program, Bosch has delivered video equipment to the National Council for Education (NCAT) in Delhi, India, for the production of training programs for schools throughout the country. Indian engineers will be given a 4-week training course at the Darmstadt training center, concentrating on the Mach One electronic editing system, which controls an R 61 ME compact mixer with control function memory and BCN 51 VTRs.

Rockwell supplies weather radar for TV

A ground-based, color Doppler weather radar system manufactured by the Collins Avionics Divisions of *Rockwell International*, Cedar Rapids, IA, has now been installed at 30 sites in the United States. Since the first installation at WZZM-TV in Grand Rapids, MI, in June 1983, the Collins Doppler radar has been put into operation in a wide range of markets.

The Collins Doppler radar allows weather reporters to display turbulence, identifying potentially damaging areas of a storm in addition to conventional displays of varying rainfall intensity and storm signatures. Turbulent areas are depicted in a single color—magenta—and no special training is required to interpret turbulence, as compared to earlier-generation Doppler weather radar.

A patented technique uses pulse-air processing to measure speed of rain particles relative to one another. The changes in relative rain particle velocities—turbulence—indicate the twisting, violent movements of air within a storm that have the potential for causing injury or property damage. Elimination of ground clutter allows storms to be tracked as close as one mile from the transmitter site.

New products boost Paltex sales

With sales of 35 digital effects video systems in the first six weeks of 1985, *California Paltex*, Tustin, CA, has broken its sales and production records. In 1985 to date, Paltex delivered NTSC editing systems approaching the 200 mark in all formats internationally. Paltex cites the introduction late last year of its Esprit editing system and the Gemini digital effects system as a major contributing factor in the company's success in 1985.

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Circle (75) on Reply Card

Paltex will continue to maintain its 6-day work week, as opposed to its normal 4-day work week, to keep up with the demand in accordance with the 30-day delivery schedule for current products.

MTC moves to larger facility

Mycomp Technologies, Costa Mesa, CA, has recently moved into a 16,000-square-foot facility to meet demands from the video duplication and broadcast industries for its microprocessor-based machine control components and signal distribution products. The new facility, located at 200 McCormick Ave., Costa Mesa, CA 92626, is the home of MTC's corporate, administrative and marketing offices and the manufacturing and assembly plant.

Panasonic and EECO reach marketing arrangement

The computer products division of *Panasonic Industrial*, Secaucus, NJ, and EECO, Santa Ana, CA, have entered into a marketing arrangement for EECO's still-frame audio products. EECO will supply and service specially designed versions of its EECODER SES-300 encoding system and VAC-300 decoder which are fully compatible with Panasonic's TQ-2023F and TQ-2024F optical disc recorders and players. The optical disc recorders and players and still-frame audio system will be marketed through Panasonic's network of distributors and dealers, who will integrate the two products into full systems that match the application requirements of the end customer.

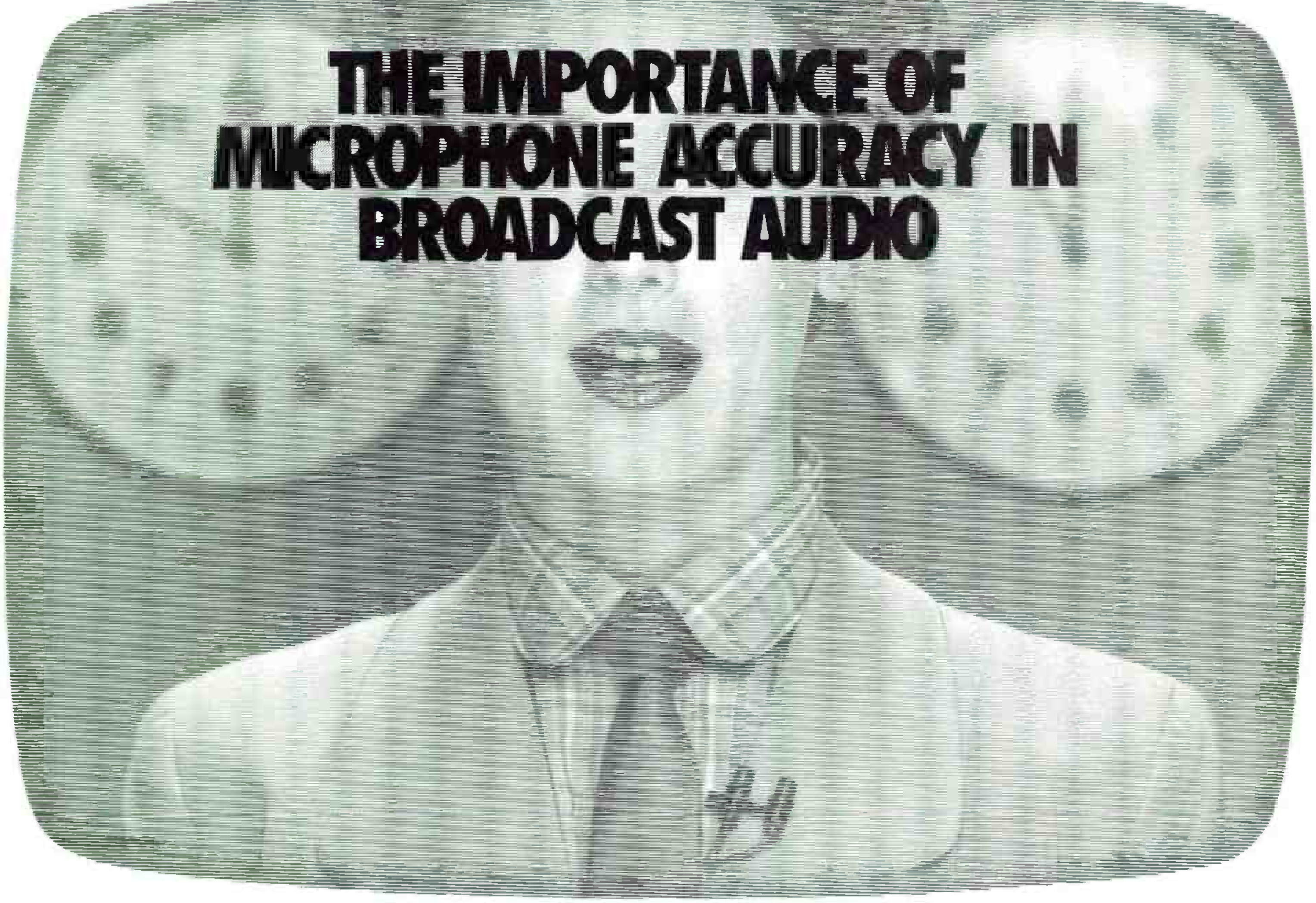
The system allows users to compress and encode up to 10 seconds of audio narration, music or sound effects in one NTSC video frame. When combined with the Panasonic optical disc recorder and its 8-inch recordable videodisc, up to 66⅔ hours of audio can be stored on one recordable videodisc.

Real World Tech moves

Real World Technologies Group, Costa Mesa, CA, has announced that the company is moving to larger quarters. The new location permits expansion of office, manufacturing and warehouse space to accommodate increased business.

Real World Technologies manufactures products for commercial television, radio and recording companies as well as design and installation of facilities for these same markets. The new address is 130 McCormick Ave., Suite 109, Costa Mesa, CA 92626.

THE IMPORTANCE OF MICROPHONE ACCURACY IN BROADCAST AUDIO



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

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

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

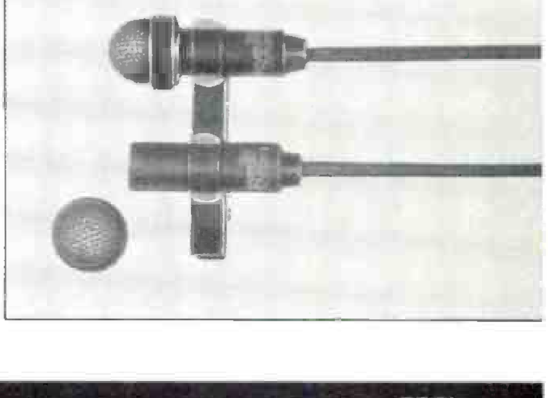
In broadcast, Beyer's concept of "accuracy" means the difference between a microphone that can focus in on a specific voice and produce a totally realistic, professionally acceptable performance, and a mic that simulates a performance by only capturing the bare outline or "silhouette" of an announcer's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

Sensitive and natural-sounding, the MCE5 picks up the "whole truth" of audio broadcast sound because of an unusually wide frequency range (20Hz to 20kHz) and exceptionally fast transient response for any mic, let alone one that is virtually invisible on camera. Because the MCE5 has a uniform omnidirectional pickup pattern, mic placement is not critical and the announcer's head can move without going "off mic." Handling noise is kept to an absolute minimum so the MCE5 picks up the voice, not the rustling sounds of the announcer's expensive silk tie.

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

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

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



Circle (47) on Reply Card

ACCURACY IN AUDIO **beyerbroadcast))))**

New products

Modulator and demodulator

The FM supertrunk model 8100 modulator and model 8200 demodulator introduced by *Phasecom* allow long-range video transmission with little or no signal degradation. The 8100/8200 also provide faithful reproduction and excellent S/N ratios by using ultralinear modulation through UHF IF and minimal differential phase and gain. Both provide bandwidth versatility of 12MHz to 18MHz, while delivering from 17dB to 28dB FM improvement. The most common supertrunk application is the transfer of channels from a satellite earth station to a CATV headend.

Circle (255) on Reply Card

Audio program analyzer

The Quantaural QA100 audio program analyzer from *Potomac Instruments* is designed to provide a quantitative analysis of the entire broadcast audio signal. The QA100 accepts monaural or stereo audio input signal from a receiver, tape recorder, modulation monitor, production studio output or audio-processing equipment. Measurements are displayed on a meter and four multifunction LED bar graphs, and include maximum peak level, overall audio processing effectiveness (average level), tightness of sound and processing control (peak density), tonal balance and consistency, stereo image width, pre-emphasis and aural intensity.

Circle (257) on Reply Card

8-way combiner

M/A-COM Cable Home Group has announced an active 8-way commercial combiner with 10dB gain that is suitable for private cable and cable TV systems. The new combiner features a frequency range of 50MHz to 300MHz, with a total ±1dB cable equivalent ripple. Operating temperature extremes are from −40° to +50° Celsius, with 95% non-condensation, and input and output impedances are 75Ω with a between-port isolation of −40dB.

Circle (258) on Reply Card

Video head wear gauge

Head wear and head life measurements for most Beta, VHS and U-matic video recorders can be made using the new universal head protrusion and eccentricity gauge from *Tentel*. The gauge can determine remaining head life, and can be used for eccentricity measurements to allow replacement of the scanner drum. It measures in microns and ten thousandths of an inch, and will not harm fragile video heads.

Circle (259) on Reply Card

Portable mini/microcomputer regulator

Sola, a unit of General Signal, has introduced a portable mini/microcomputer regulator that will protect sensitive electronic equipment from virtually all ac power problems except total line failure. The regulator extends the range of Sola's plug-in power conditioner line up to 3kVA, and with increased load capacity and multiple output receptacles, the unit also allows several electronic devices to economically share the same source of conditioned power. The unit's design holds output voltage steady within ±3% of nominal even when input voltages fluctuate as much as ±15%. It provides brownout protection by holding output voltage within NEMA voltage specifications of −5% despite line voltage drops as low as 65% of nominal.

Circle (260) on Reply Card

Volt-ohmmeter

Triplett's new Digi-Probe volt-ohmeter has extended resistance ranges of 200Ω and 20Ω, plus an additional 200mV dc voltage range and improved accuracy. The shirt-pocket-sized tester features exclusive styling and a new 3½-digit, 12mm LCD with visual indication of function, overrange, units, polarity, decimal and low battery. Auto-ranging on the Digi-Probe provides 1-hand touch-and-test readings, and an instant-tone continuity test includes actual resistance measurements. Volts, ohms and continuity are selected with a simple function switch.

Circle (261) on Reply Card

Ku-band TVRO earth station

The TVRO earth station from *Scientific-Atlanta* is designed for reception of Ku-band signals from the European Communications Satellites (ECS) and Intelsat V. The system consists of the series 9000 antenna with elevation over azimuth mount and dual polarized feed, the model 6611 video receiver and the series 9370 low-noise block converter. The series 9000 is a low-cost 2.8m antenna with eight interchangeable die-stamped reflector panels and full arc coverage.

Circle (263) on Reply Card

Design/composing system

The Creator 1000 by *Barco Industries Video & Communications* is a full-color design tool to help the artist visualize ideas quickly. The 16-million-color palette, painting, image manipulation and type facilities are controlled through software control designed from the artist's point of view. Along with real time image digitizing are output options of video, screen resolution film or high resolution of 2000 lines (768x512 pixels) and 4"x5" transparencies.

Circle (402) on Reply Card

MOSFET power amps

Two high-performance power amplifiers designed to bring the advantages of MOSFET technology to engineered sound system applications are available in the Hi-Tek professional series from *Bogen*. The 125W HTA-125 and 250W HTA-250 are capable of continuous operation at rated output power with less than 0.5% THD from 20Hz to 20kHz. Each has a frequency response at full rated power of ±1dB, 20Hz to 20kHz and output regulation better than 2dB from no load to full load. Residual hum and noise is at least 90dB below rated output, and full rated output requires an input of only 500mV for high impedance and 150mV for low impedance.

Controls on each front panel are an overload shutdown LED indicator and an illuminated on/off power switch. Rear panels have an overload reset switch, input level control, input and output connections, an ac line fuse and a 3-wire grounded auxiliary receptacle for up to 300W. A switch for a low-cut filter of −10dB at 100Hz is located internally.

Circle (299) on Reply Card

M-format camera

Panasonic's AK-30E RECAM camera features ⅔-inch Plumbicon tubes as standard items, along with dual outputs for standard PAL or Y/U/V component outputs for AU-100 or AU-220E VCRs. A S/N ratio of 60dB is attained in the super low-noise mode, with registration accuracies remaining within 0.05%, 0.1% and 0.25% across the image. Also, the 6-way adjustable viewfinder exhibits safety zone and target marker picture framing aids as well as iris, battery, audio level, video level and filter ID indicators.

Circle (400) on Reply Card

Portable TV measuring system

The model 323 by *Klaus Heucke GmbH* combines signal measurement capability with a 10-inch color CRT for monitoring TV signals in VHF, UHF and CATV midband spectra. Envelope and synchronous detection modes are provided. Designed for CCIR B and G formats, IF frequencies of 33.16, 33.4 and 38.9MHz also are included. Special facilities are included for making measurements on videotex signals as well as German 2-channel audio. Digital control includes an IEC-bus interface.

Circle (401) on Reply Card

Circle (78) on Reply Card

Maintain network-quality color performance with B&K-PRECISION NTSC video test instruments

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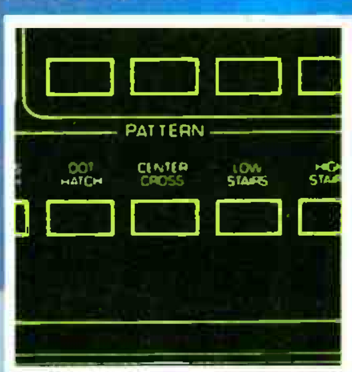

1260 generates 12 patterns, including circle, bar and crosshatch patterns

1265/1270 FEATURES:

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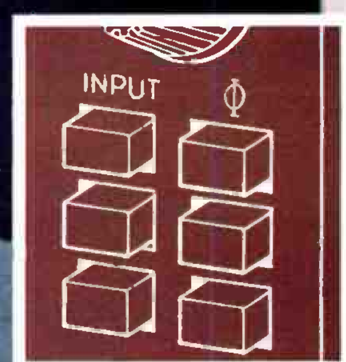

1270 offers simple set-up and selectable inputs

For the complete picture on these new video test instruments, see your local distributor or call B&K-PRECISION at 1 312 889 9087.

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Circle (79) on Reply Card

Studio and OB camera

The Marconi/GEC-McMichael Mark 10 TV camera is designed around 18mm diode gun Plumbicons, while keeping small-size, light-weight and low-cost factors. Two motorized filter wheels offer color correction, ND and effects filters. Usable with a wide selection of lenses, the camera includes a rotatable, tiltable viewfinder that provides a lens zoom angle indicator. Automatic features include centering, black-and-white balances. Stable circuit design removes the need for extensive computer setup.

Circle (403) on Reply Card

SP VCRs

Sony Corporation has introduced the BVU-850P and BVO-150P highband VCR systems. Currently available for PAL use only, the systems feature horizontal resolution that is increased from 260 TVL in standard mode to 300 TVL in SP mode. The S/N ratio remains at 46dB in both modes. Audio facilities include improved head characteristics, Dolby C processing and an integral audio mixer. For studio integration, a multicore TBC connection is available. Compatibility with standard BVU systems is maintained.

Circle (404) on Reply Card

HD telecine system

The Mark III from *Rank Cintel* develops 1125-line, 60-field images from 35mm film using flying spot techniques. The prototype model uses a fixed film speed of 24fps to develop the 5.33:1 aspect ratio images with 2:1 interlacing. An effective video bandwidth is noted as 20MHz with a horizontal scan frequency of 27kHz. Digital storage contains two frames of R, G and B signals with a capacity of 100Mbits.

Circle (405) on Reply Card

HDTV monitor

Automatic sync selection is featured on the TV18-25 monitor from *Hiradastechnika*. Desktop or rack-mount models operate from 50Hz/60Hz power ranging from 98V to 242V, while accepting signals in 525 or 1049 TVL/60Hz and 625 or 1249 TVL/50Hz formats. These 15-inch monochrome monitors are suggested for picture evaluation and measurement applications.

Circle (406) on Reply Card

TV pattern/test generator

Philips Test & Measurement Equipment offers the PM5515 series of test-pattern generators with RF, IF, midband CATV and video signal outputs for CCIR and RTMA NTSC and PAL use. On all members of the series, RGB components may be selected as an option. The –TX model has five teletext pages and a wallpaper test pattern for teletext equipment adjustments, as well as dual sound channel facilities for CCIR Type G (PAL). Ten complete programs of patterns, frequencies and sound settings may be recalled with a single button. Any of 70 patterns or combinations may be selected for monitor, receiver and VCR testing.

Circle (407) on Reply Card

Sine wave inverters

Powermark Division of Topaz has announced its series Z sine wave inverters for providing reliable dc-to-ac power conversion. The series Z inverters are designed especially for applications requiring stable ac power with accurate frequency control; an integral part of each system is a constant-voltage transformer that provides a low-distortion sinusoidal output with ±0.5% frequency stability. The transformer also provides primary-to-secondary isolation, current limiting and exceptional output voltage regulation.

Protective features of the series include input circuit breakers, reverse polarity protection at the input and overload and short-circuit protection with automatic recovery. High and low input voltage detectors turn off the inverter if the dc input voltage strays above or below the specified voltage range. The inverters are available in 50Hz and 60Hz models, with power ratings from 200VA to 2000VA; input voltages range from 12/24Vac to 250Vac. All models feature built-in automatic/manual restart selection, low harmonic distortion and design simplicity.

Circle (300) on Reply Card

Audio distribution amp

Bonneville has introduced another member to its family of audio distribution amplifiers. The stereo DA-106 employs computer-aided techniques to model the in-circuit response of high quality audio transformers, resulting in transparent audio characteristics.

Slide-out modules on the DA-106 allow customizing for specific needs: 600Ω outputs can be selected for driving telephone lines or a choice of 600Ω, 150Ω or 70Ω can be made for in-plant distribution. The DA-106 works well to distribute audio or real time SMPTE signals.

Circle (301) on Reply Card

Graphics work station

Megatek, manufacturer of high-performance graphics systems, has introduced the MEGAstation 3300, a graphics work station that essentially provides a dedicated host, while still maintaining the option of sharing resources with non-graphics functions. It supports a broad range of graphics applications including electronic or mechanical design, simulation, C^3I and mapping.

The MEGAstation 3300 features Megatek's Whizzard 3300 series of computer graphics systems with the new MicroVAX II from Digital Equipment Corporation, a DMA interface providing parallel communications with speeds up to 1.5 megabytes per second and Megatek's proprietary Graphics Engine with a throughput of 400,000 2-D absolute vectors per second.

Optional modules can be added to the standard 3300 configurations including 3-D hardware and a clip, rotate, scale and translate (HCRST) module, which allows for intermixing of 2-D and 3-D graphics displays simultaneously.

Circle (302) on Reply Card

Audio line amp with VOX

Monroe Electronics has introduced the model 3138B audio line amplifier with VOX. This 3" x 5" circuit card is intended for use in telephone and other communication systems where low-level amplification, audio level control or audio controlled switching is required. The unit can be configured as a single- or dual-stage compression amplifier, an AGC amplifier or as an audio amplifier without AGC or compression. A quiescent noise muting squelch, if enabled, is adjustable over the entire −46dBm to +20dBm input signal range and provides a 5ms attack time and an adjustable 1- to 5-second release time. A momentary or latching SPDT VOX relay output is also provided. Other user-programmable features include selection of high or low input impedance and an adjustable −20dBm to +8dBm audio output level. Wall and rack-mount enclosures are available.

Circle (303) on Reply Card

Tricolor tripods

Gitzo has announced three special models of its Reporter Performance tripod with Rational 2B head. In addition to their standard gray, charcoal and safari olive green finish, the tripod is available in the French national colors.

As with all other Gitzo tripods, monopods, heads and accessories, the tricolor tripods are covered by the full Gitzo lifetime warranty buyer protection.

Circle (304) on Reply Card

Transportable TVRO system

Satellite Systems introduces a transportable TVRO system designed for professional video downlink service. Two commercial receivers with commercial modulators are housed onboard, and the 3800 requires only an RG-59 cable to connect it with the customer. Video performance for the TVRO system is range tested to provide 12dB carrier-to-noise at 33dB EIRP, and the video-to-noise ratio is 51.4dB.

Circle (315) on Reply Card

Portable prompter

Tekskil Industries has designed a prompting system specifically for portable video cameras. The 909 prompting system comes complete with camera viewing unit, script transportation unit, monitor and imaging camera. The system's cast-aluminum camera mount supports the camera directly over the 9-inch imaging monitor, providing balance over the tripod head without need for counterweights.

Circle (316) on Reply Card

Delta gun color monitors

Ikegami Electronics has introduced a series of high resolution Delta gun color monitors. The 10 series is available in both 14-inch (13V, TM14-10RH) and 20-inch (19V, TM20-10RH) models. Features include American standard phosphors; beam feedback circuitry to provide state-of-the-art long-term black level stability of less than 1%; 9-zone active convergence that reduces convergence error to 0.5mm; I/Q demodulation axis to ensure color reproduction; comb filter to provide wideband luminance signal; and Delta gun CRT technology that makes for increased brightness and resolution.

Test features include crosshatch signal, residual subcarrier detection and H and V delay, and both monitors are available in either cabinet or rack-mount configurations. The TM14-10RH is 10½ inches high (six rack units), and the TM20-10RH stands 15½ inches high (nine rack units). Each monitor also provides R-Y, B-Y signal outputs, and R-G-B input operation is available as a separate option.

Circle (305) on Reply Card

150MHz oscilloscope

A quad input, dual independent time base 150MHz oscilloscope featuring ±2% vertical accuracy, 500µV/div vertical sensitivity and 20kV accelerating potential has been introduced by *B&K-Precision*, a division of *Dynascan*. The model 1596 has a low profile design and light weight, and fills field service as well as on-the-bench R&D applications. Features include 500µV/div sensitivity to 70MHz and 1mV/div sensitivity to 100MHz and 5m/div sensitivity to 150MHz; waveforms are viewed on an 8x10 division rectangular CRT with internal graticule, scale illumination and 20kV accelerating voltage.

In addition to standard sweep features, the model 1596 features a dual model in which the A sweep and B sweep operate independently of each other. Two signals can be viewed in different sweep times in the dual mode; trigger modes include auto, norm and single sweep operation. The model 1596 also features 20ns/div sweep speed (2 ns/div with X10 magnification); 20MHz bandwidth limiter to eliminate high frequency noises when viewing low frequency signals; video sync circuitry for viewing video signals; channel 1 output to hook up to frequency counter or peripheral equipment; and beam finder to quickly locate elusive traces.

Circle (307) on Reply Card

Sweet 16

Fujinon's brand new A16x9.5RM with macro focusing.

The basic ENG lens has grown up. At 16X, Fujinon's newest zoom is longer without being heavier. It's brighter without being bulkier. The F-stop at the full 152 tele position is better than that of lenses that don't zoom as far. Any way you look at it, it's a better lens and a better value. Here are all the reasons why:

- Longer focal length
- Macro focusing
- Better ramping
- Better transmission
- Rugged construction
- Fujinon quality, support and service
- Shorter M. O. D.
- Lighter weight
- Lower distortion
- Higher MTF
- Higher brightness/contrast
- More optional accessories
- A great price

Built to perform better on your camera and budget, the A16x9.5RM comes with auto iris, a smooth servo zoom, and a maximum aperture of F1.7—absolutely flat from 9.5mm to 114mm. At full tele, it only drops to F2.0. It weighs less, too, even though its servo unit is housed in a weather-protected cast aluminum case, not plastic.

The new A16x9.5RM...a better buy by any standard. For more information or a demonstration, contact the Fujinon location nearest you.

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Circle (86) on Reply Card

Bar/dot and sync generator

Visual Information Institute has developed a complete bar/dot pattern generator with a built-in TV sync generator. As a test generator, the model 15 produces bar and dot patterns in the standard 14x17 element format, which are used to check performance of transmission coaxial cables, recorders and other TV equipment. The generator produces pulses required for synchronizing monochrome cameras, displays and accessory equipment. It can also serve as master sync source for an entire system, providing four independent sync outputs with each source terminated at 75Ω.

Circle (309) on Reply Card

Audio signal generator

The PV1000 audio signal generator from *Plum Valley Engineering* features high performance, battery operation and microcomputer controllability. Frequency, sine wave attenuation and stereo output functions can be controlled manually or with an HP-41 or HP-75 microcomputer via the HP-IL data communications standard. Sine wave distortion is less than 0.25% over the entire range at zero attenuation. Features include separate front-panel analog attenuators, which provide for both outputs for balance adjustments, and a digital attenuator for sine wave control from 0dB to 69dB in 1dB steps.

Circle (310) on Reply Card

Universal counter

An 8-digit, wide range, 100MHz universal counter has been added to the Circuitmate product line from the instrumentation products division of *Beckman Industrial*. Applications for the UC10 range from simple event counting to audio and computer servicing and FM receiver repair. It features a push-button function, gate time, attenuator, frequency range and reset and self-check functions. Four gate times range from 0.1

seconds to 10 seconds, and 14 LED indicators provide visual feedback in addition to an audible signal indicating positive contact.

Circle (311) on Reply Card

Microwave FM receivers

International Microwave has introduced a series of low cost microwave FM receivers operating in the frequency range of 6.5GHz to 18GHz. Test points and adjustments are located on the front panel for easy maintenance, and options include audio subcarriers, video filters, hot standby and alarms.

The LCT microwave transmitter also released by International Microwave is designed as a companion to the LCR series receivers, and operates in the same frequency range. It has a power output of 100mW, +20dBm, and is designed for short-haul, line-of-sight communications. Applications include studio or transmitter links, CARS band security systems employing video and private users who require telephone and data transmission.

Circle (312) on Reply Card

Graphic display DMM

The model 7151 digital multimeter from *Solartron Instruments* combines the calculating power and speed of a microprocessor with the measuring advantages of a 6½-digit multimeter. Users can examine the 500 reading history file of the Solartron 7151s stored data with the analog zoom feature. It can turn an oscilloscope into a live graphic display, and has a power fail recovery feature that allows the DMM to return to its programmed tasks when power is restored.

Circle (314) on Reply Card

Broadcast sensing device

The Tape Sentry from *D.E. Winget* is a sensing device for use in broadcast automation systems to alert station personnel when the end of an audio tape is near. Tape Sentry simultaneously monitors up to six tape machines and provides a relay contact closure at the end of any tape, which will trigger external audible and/or visual alarms. The detector circuitry is triggered by sub-audible 25Hz tones of 6-second duration or longer, making Tape Sentry compatible with most leading music programming formats.

Circle (262) on Reply Card

½-inch tape truck

Winsted has introduced a tape truck for storage and transporting of ½-inch Betacam tapes. Three shelves hold 120 cased or 180 uncased tapes with open access, and an optional top shelf provides a work area. The truck is made of heavy gauge steel and rolls on 4-inch industrial ball-bearing casters; it comes in beige or gray enamel.

Circle (264) on Reply Card

Limiter/compressor/ dynamic sibilance processor

Valley People has developed a limiter/compressor/dynamic sibilance processor that offers a peak limiter, a high-quality compressor-expander package and a sibilance processor section, each controlling a common voltage-controlled amplifier. The model 440's compressor section has proprietary circuitry such as linear integration detection, peak reversion correction and anticipatory release computation. Among the functional modes of the model 440 are FM pre-emphasis compensated compression and limiting, AGC/compressor operation and an auto mode that optimizes compressor attack time, ratio and release time for 1-control operation on most types of program material. With the control circuitry of the auto mode engaged, the operator can adjust compression by adjusting the threshold control.

Circle (274) on Reply Card

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MAINTENANCE TECHNICIAN. Immediate opening for experienced TV maintenance technician. Minimum 2 years experience in component level repair of TV broadcast equipment. UHF transmitter experience helpful Contact Ken Preston, Director of Engineering, KSEE, P.O. Box 24000, Fresno, Ca., 93779. (209) 237-2424. EOE M/F. 7-85-2t

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TELEVISION PRODUCTION & MAINTENANCE ENGINEER. Los Angeles market area. $22,176-$26,916 plus general benefits. Busy and expanding college cable department seeks individual with two yrs. experience in the repair and operation of industrial production equipment. Applicants should have knowledge of automated tape players, broadband communications and microwave systems. Send resume to NOCCCD, Personnel Office, 1000 N. Lemon Street, Fullerton, CA 92634, by 8-16-85 8-85-1t

ASSISTANT ENGINEER—LARGE WEST COAST radio station seeking maintenance engineer to assist chief in evaluating and installing new equipment as well as maintaining existing equipment for AM/FM station. Minimum three years radio engineering experience plus two years college or equivalent technical training. FCC General License. EEO Employer M/F/H. Dept. 651, Broadcast Engineering, P O Box 12901, Overland Park, KS 66212. 8-85-1t

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CHIEF ENGINEER FOR GROWING NBC affiliate in the Wash. DC-Baltimore area. Must have at least 5 years television experience. Must currently be chief, assistant chief, or maintenance supervisor. Have experience with UHF x-mitter, studio and ENG cameras, ¾" and 2" tape machines, and satellite. Have good skills in personnel management, training, and budgeting. Salary commensurate with experience. Attractive benefits. Send resume and salary requirements to Personnel, WHAG-TV, 13 East Washington Street, Hagerstown, MD 21740. EOE. 8-85-1t

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Those interested in either position should apply to: Thomas E. Mintner, Vice President and General Manager, Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210.

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IMMEDIATE OPENING for experienced technician to repair electronic/electro-mechanical equipment at Dutchess Community College, 2 yr. AAS degree & 4 yrs. experience or B.S. in electronic technology & 2 yrs. experience. Apply only if you have a proven solid background in quality repair of equipment. Digital experience helpful. Competitive fringe benefits. For application phone (914) 471-4500 or apply in person Personnel Office, Dutchess Community College, Pendell Road, Poughkeepsie, NY 12601. Deadline Aug. 16; starting date Sept. 1, 1985. 8-85-1t

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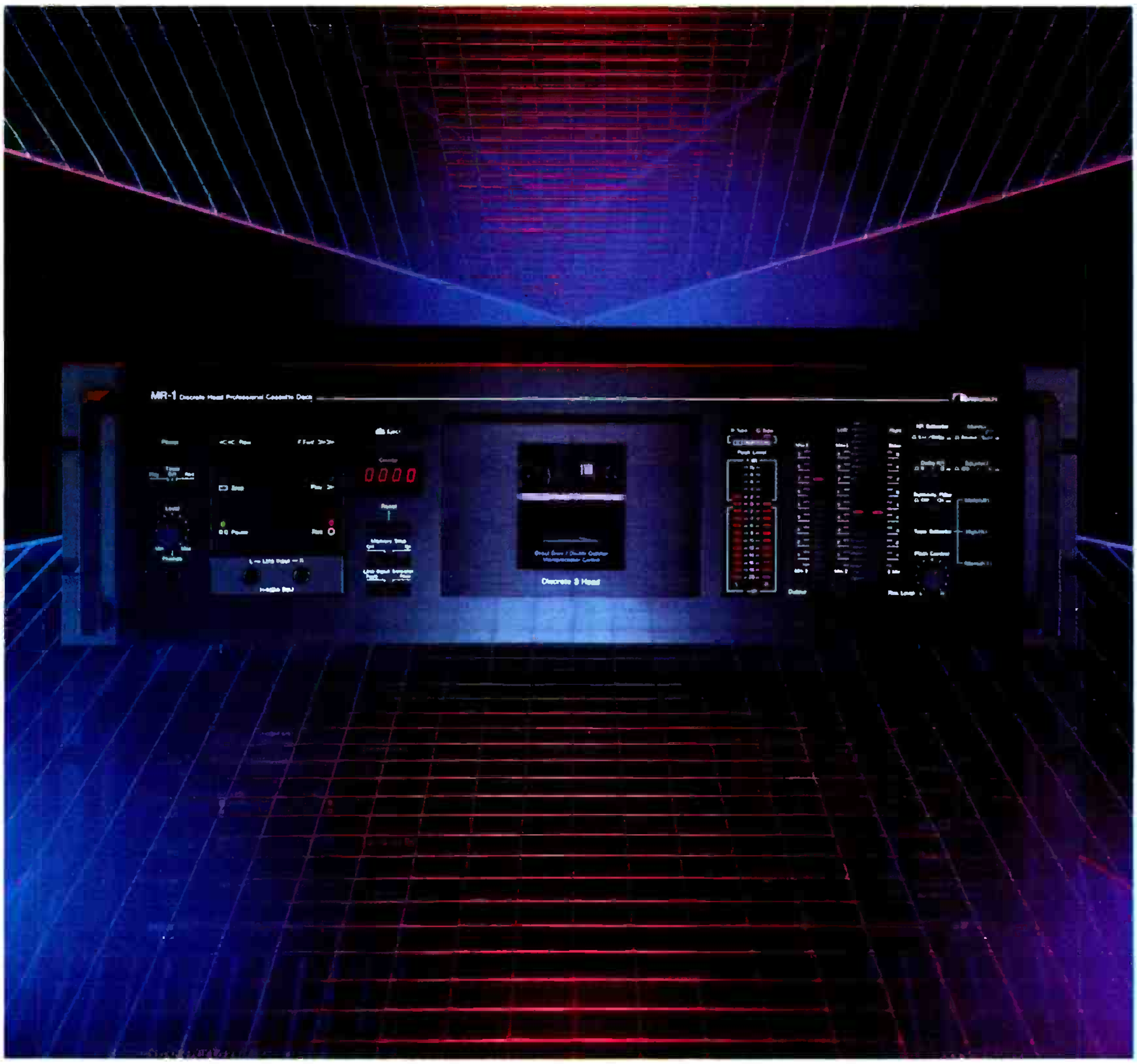

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