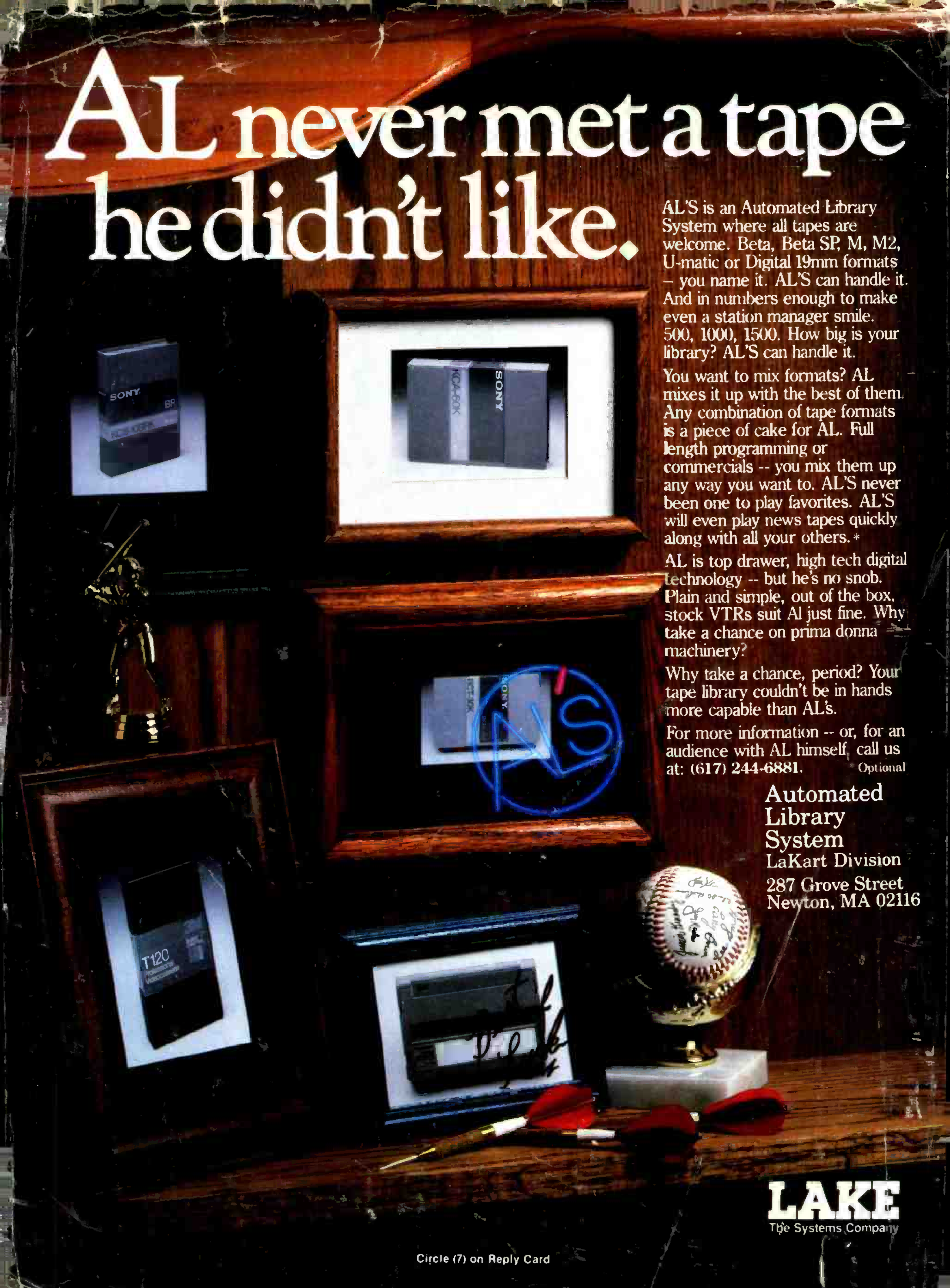
Broadcast Engineering

May 1987/$3

Transmission systems special report

Seeing between the lines pg. 116



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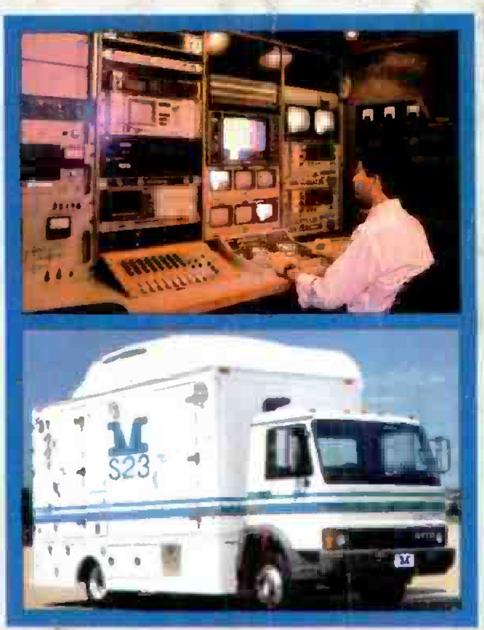

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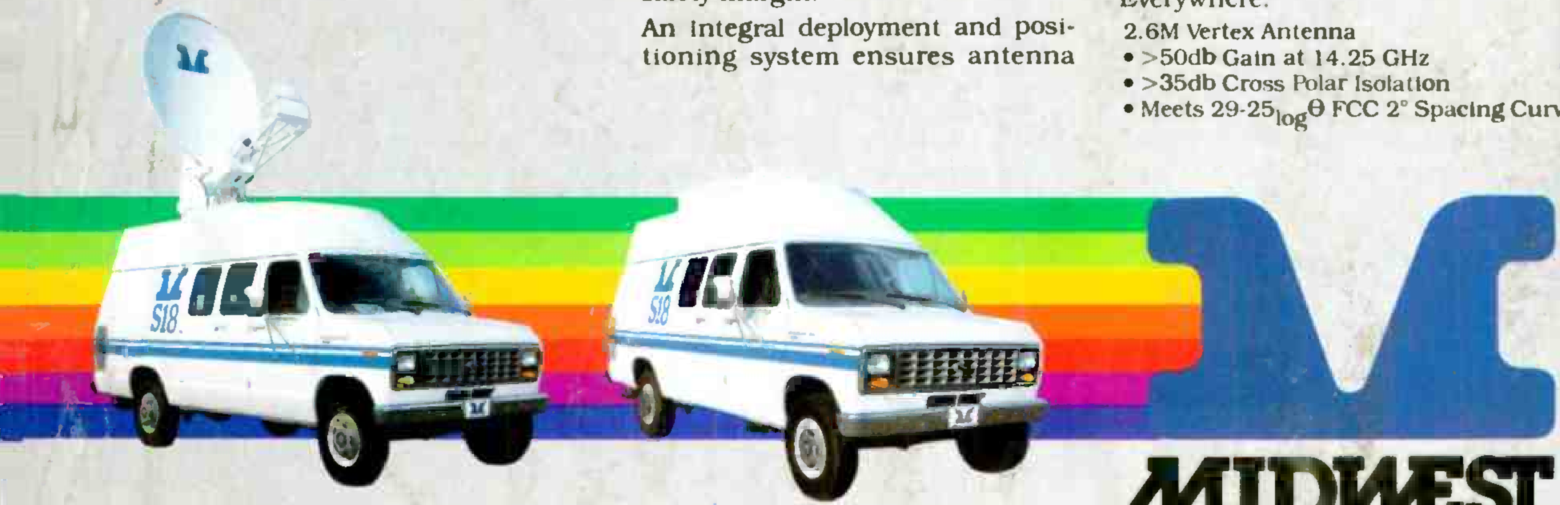

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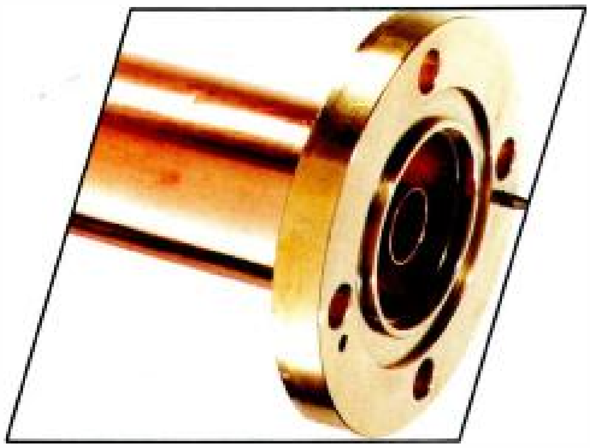
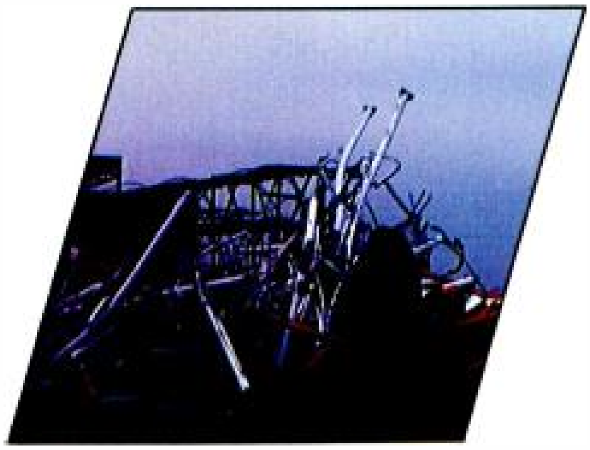
Contents

May 1987 • Volume 29 • Number 5

Page 26



Page 64



Page 93

BROADCAST ENGINEERING

TRANSMISSION SYSTEMS SPECIAL REPORT:
The transmission plant is the heart of any radio or TV facility. The most basic requirement of the engineering department is to keep the transmission system—from the STL to the antenna—in good working order. We examine this critical area of station operation in our Transmission Systems Special Report:

ON THE COVER
Power tubes are the heart of high-power broadcast transmitters. They provide high gain, power-dissipation capability and reliability in a single package. The industry's need for devices capable of higher output and greater reliability is being met with new processes and materials. Shown is a 3CX12,000U7 power tube, designed for VHF-TV applications. (Photograph by Doug Schwartz, Flightspeed Graphics, Santa Clara, CA. Tube provided by Varian Eimac.)

DEPARTMENTS

HOW THE SK-110D PUTS AN END TO THE REIGN OF ERROR.

With the SK-110D, Hitachi has created a studio broadcast camera with microprocessor technology so accurate that registration errors and time-consuming setup are things of the past.

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HITACHI

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Lanesborough acquires Ampex

Allied-Signal and Lanesborough Corporation have announced that they have signed an agreement for the sale of Allied-Signal's Ampex unit to Lanesborough for $479 million, plus the assumption of certain liabilities.

Lanesborough intends to finance the transaction through a combination of its own equity and an offering of debt or equity securities. In the interim, Lanesborough has arranged for credit facilities with commitments of up to $475 million from a major New York bank.

Under the agreement, Ampex will be acquired by a newly formed subsidiary of Lanesborough, which plans to operate Ampex with its present management and organizational structure. The transaction was expected to be completed by the end of May, pending regulatory and other approvals.

Lanesborough, which is privately held, manufactures a variety of specialty chemical products for sale in the United States and abroad.

Allied-Signal (an advanced technology company focused on aerospace, automotive products and engineered materials) announced last December that it was selling Ampex and six other units in its Electronics & Instrumentation sector.

USC/SMPTE seminar telecast via satellite

The Hollywood section of the Society of Motion Picture and Television Engineers and the Continuing Education Division of the School of Cinema-Television, University of Southern California, are sponsoring a 1-day spring tutorial seminar titled, *Electronic Post-Production for Film and Videotape: The 'New Wave' in Electronic Post-Production—An Update.*

The seminar will be held on the USC campus on Saturday, May 16, from 8:45 a.m. to 3:30 p.m. (Pacific Daylight Time). It will be telecast via satellite to universities and colleges coast-to-coast.

Escalating production costs have refocused attention on electronic post-production as an effective technology that might yield cost savings as well as creative flexibility. More than two dozen TV series have been post-produced electronically during this past 1986-87 season, with new techniques being developed and redefined daily.

Seminar attendance is open to industry professionals, students and interested individuals. There is a $50 registration fee for SMPTE members, $60 for non-members and $30 for students. Lunch is included in the registration fee. Due to space limitations, early registration is required.

To register in the Los Angeles area, and for additional information on other schools participating in the telecast of the SMPTE/USC spring tutorial seminar on electronic post-production, call the Continuing Education Division of the USC School of Cinema-Television at 213-743-7469, extension 6.

Continued on page 164

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.

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 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 Volume 29, No. 5 (USPS 338-130) is published monthly (except in the fall, when two issues are published) by Intertec Publishing Corporation, 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212. Second Class Postage paid at Shawnee Mission, KS and additional mailing offices. POSTMASTER: Send address changes to BROADCAST ENGINEERING, P.O. Box 12983, Overland Park, KS 66212.

ISSN 0007 1794 $2.00 + $0.00.

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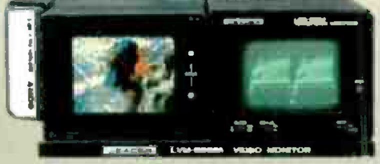

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Building upon success

Teamwork. Two groups working together toward a common goal. That definition sums up the cooperation between the Society of Broadcast Engineers and **Broadcast Engineering** magazine on the 1987 SBE National Convention. This joining of forces represents an affirmation that SBE and **BE** have common goals: the instruction of radio and TV engineers and the advancement of broadcast engineering as a profession. Planning for the '87 convention is based on the solid foundation of last year's program. We're *building upon success.*

The first annual SBE National Convention and **Broadcast Engineering** conference drew more than 2,000 attendees, and 154 exhibitors that occupied 260 booths, to the St. Louis convention center. As planning continues for this year's show, we invite you to attend the convention and be a part of the SBE's showcase event.

Because of the excellent facilities in St. Louis and the city's central location, the '87 show will again be held at the A.J. Cervantes Convention Center, Nov. 10 to 12. St. Louis is an attractive location for several reasons. It is centrally located, the airport is extensively served by major airlines, large hotels are located nearby, and shopping and tourist centers are within walking distance. A visit to the SBE National Convention can—in fact—be a pleasurable experience for the entire family.

The best aspects of the '86 show will carry over to this year's event:

- *High-quality attendees*—More than 90% are engineers who understand the differences between products, want hands-on experience with new equipment, and have purchasing responsibility.
- *Truly a national convention*—Attendees come from 48 states and seven countries.
- *Excellent accommodations*—Reasonable hotel and restaurant facilities are within walking distance.
- *Affordable registration costs*—The central focus of the convention and technical sessions is education of the members of the society—not just to make money. Registration costs for the show have been priced within reach of all broadcasters.

Organization for this year's event will be handled the same as last year. The SBE and members of the St. Louis chapter will coordinate the convention exhibition. **Broadcast Engineering** magazine will organize the technical seminars under the guidance of consultant John Battison, conference chairman.

This event is a showcase for society activities and an opportunity for working engineers and technical managers to meet and discuss common needs. The popular SBE regional conventions continue to be an important element of society activities, but the November gathering provides a central focus for the national organization.

Technical decisions need to be made by technical people. The SBE National Convention and **Broadcast Engineering** conference offers the opportunity to view the latest in broadcast equipment and to attend top-quality technical seminars. Make a commitment now to your own professional growth, by sending in your advance registration card. You will find two easy-to-fill-out forms bound into this issue (see the *reader service cards* that begin on page 141). Two forms are provided, one for you and one for a colleague.

Invest in your future by attending the 1987 SBE National Convention and **Broadcast Engineering** Conference. Build upon *your own success.*

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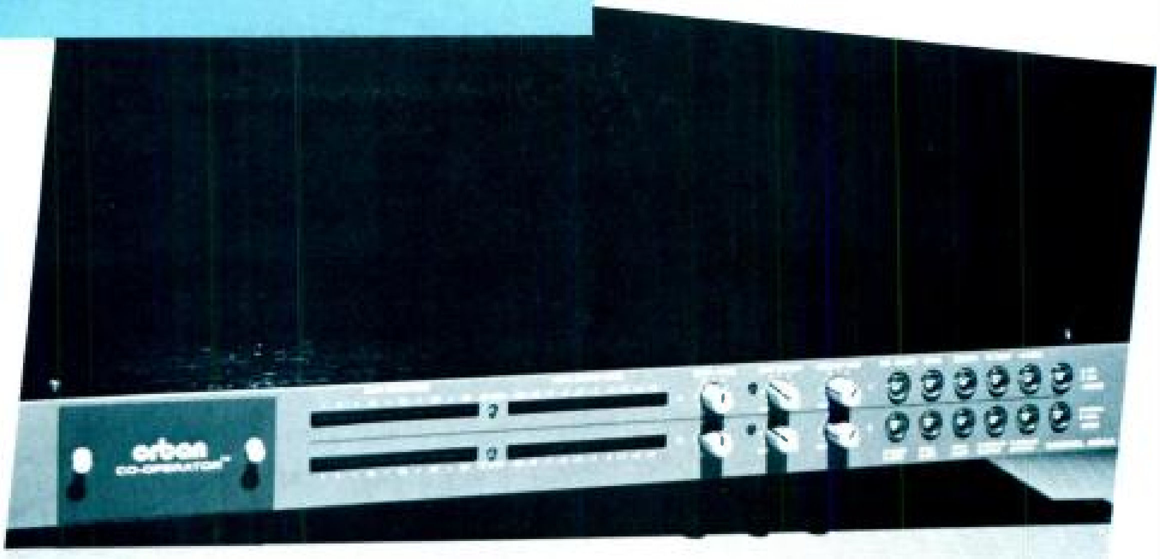

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Audits discourage false financial certification

By Harry C. Martin

The FCC is making random checks of the backup financial documentation required of construction permit applicants who have certified their financial qualifications. The checks are being conducted as part of prehearing processing. In cases where an applicant has a large number of pending broadcast applications, the commission is authorized to question the validity of the applicant's financial certification. Each applicant selected for audit, whether at random or as a result of an actual question about the validity of a certification, will have to submit all of the documentation on which it relies to support its certification.

The commission eliminated the requirement for detailed financial showings as part of its deregulation program. The certification procedure was designed to conserve commission resources by eliminating the need for analysis of financial documentation, especially from the thousands of applicants who do not become commission licensees. By replacing the documentation requirement with financial certification, however, the commission was careful to emphasize that it was not modifying the basic requirement that applicants have sufficient net liquid assets on hand or available to construct and operate a proposed station for three months without revenue.

Based on the commission's experience over the past five years, a number of broadcast applicants have certified their financial qualifications without any basis or justification. The audit procedure is intended to discourage false financial certifications while preserving the deregulatory benefits of the certification procedure. If a financial certification check reveals that an applicant's certification is false, hearing issues will be designated to determine whether the applicant is financially qualified and whether the applicant is guilty of misrepresentation.

New ownership reporting requirements

The commission has issued a new ownership reporting form (Form 323), which has been mailed to all commercial broadcast licensees. Most stations must file the report by Aug. 3. Beginning Feb. 1, 1988, non-exempt licensees must annually update their ownership reports on the anniversary date of the filing of the station's license renewal application. Licensees of multiple broadcast stations with different renewal anniversary filing dates may select a single date on which to submit their annual ownership reports, but those reports may not be submitted more than one year apart. After the initial Aug. 3 filing, licensees may submit a certification that no changes have occurred, in lieu of filing a new ownership report.

The only commercial licensees exempt from these filing requirements are partnerships entirely composed of natural persons and sole proprietorships.

FM reclassification procedures

In a public notice issued in late March, the commission outlined how its reclassification of FM facilities pursuant to Docket 80-90 will be implemented now that the March 2 deadline for upgrade applications has passed. The commission accepted applications up to March 2 by Class B and C stations seeking to meet minimum power and height requirements in order to avoid reclassification to a lower class.

This example shows how the reclassification system is being implemented.

Station WXYZ operates on a Class C channel currently allocated to Center City. Center City and the channel are listed in the Table of Allotments. WXYZ operates on this channel with facilities of 20kW at 100m above average terrain. The station also has a construction permit to modify its facilities to increase power to 100kW at 100m. An application was filed by the close of business on March 2, to modify the WXYZ construction permit to operate with facilities of 100kW at 400m. The reclassification procedures affect station WXYZ and its allotment in the following ways:

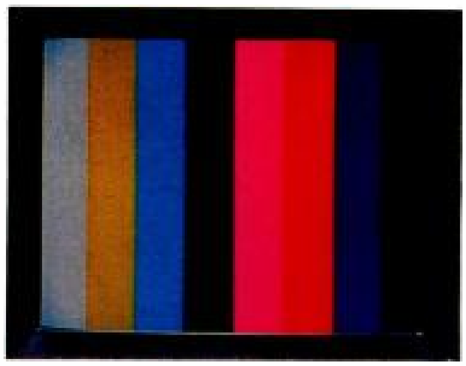
- The existing license is reclassified to C2.
- The construction permit is reclassified to C1.
- The application is classified as C.
- The class of this channel on the Table of Allotments is not reclassified because the application requesting full Class C facilities was on file by the close of business on March 2.

Any other applicant will have to protect WXYZ's licensed site as a C2, the site of its construction permit as a C1 and the proposed site in its application as a C. The eventual grant of a license to WXYZ for the proposed facilities will cause the Class C channel to be retained in the Table of Allotments and the station will continue to operate as a full Class C facility. However, if the application is returned later or dismissed, the class of this channel in the Table of Allotments will be reclassified to C1 to reflect the class of the construction permit. Other applicants would then only have to protect the station's licensed site as a C2 and the site of its construction permit as a C1. If the construction permit expires, the class of the channel on the Table of Allotments will be classified as C2 to reflect the class of the existing license. Other applicants will then only have to protect WXYZ's licensed site as a C2.

The commission made special provisions to protect the classification rights of applicants in hearing status who are not eligible to amend specifications for minimum facilities for their classes. Also protected are stations that do not fit into any particular class under the current rules. Such stations will not be reclassified until after the commission completes its pending rulemaking in Docket 86-144, which proposes an index method of classification. Furthermore, Class B stations with their transmitters located in Zone I or IA are being reclassified as B or B1.

If an upgrade application filed by an existing station before the March 2 deadline is found insufficient, the applicant will be given one opportunity to correct all deficiencies before the application is returned. Such applicants will be given 30 days to correct noted deficiencies and any other deficiencies that may exist in the application. If, after this 30-day period, the application still contains deficiencies, it will be returned and the allotment reclassified.

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



The Klystrode stirs interest at NAB

By Don Markley

The Varian Klystrode was shown again at this year's NAB Convention in Dallas. As expected, it was found in the Varian booth and in a transmitter shown by Comark.

The Klystrodes displayed were models X2253 and X2252. The X2253 is used for channels 14 through 35 and the X2252 is used for channels 36 through 69. This is a 60kW peak visual power amplifier tube that is furnished in a transmitter using a 500W driver.

The transmitter on display had been in operation for several weeks at the Comark factory and had operated with an overall plant efficiency of 71% (60kW peak visual power and 6kW aural power). This plant efficiency could be compared to a 60kW klystron transmitter, which would provide a plant efficiency of 51%. Plant efficiency relates the visual and aural power output to the actual electrical service consumed from the ac power lines.

The first Klystrode transmitter is expected to be installed this fall at WBFF in Baltimore. The unit will be a superpower transmitter that will use six Klystrodes in parallel to produce 360kW of visual power and 36kW of aural power. That transmitter currently is under development.

Markley, BE's consultant on transmission facilities, operates D. L. Markley & Associates, a consulting firm in Peoria, IL.

Trade-offs

It appears that the price for a Klystrode transmitter will be slightly higher than that for a comparable klystron-equipped system. The Klystrode transmitter will exceed the klystron transmitter price by about $70,000 per visual power amplifier. A 120kW transmitter using Klystrodes would cost about $120,000 more than the comparable transmitter with klystrons. However, the power savings should recover this cost over the life of the system.

Two primary factors enter into the increased price. First, the Klystrode transmitter requires a 500W driver stage that is not needed in the klystron. Second, the Klystrode uses a 30kV *regulated* beam supply. Obviously, this piece of hardware is more expensive than the unregulated supplies used in klystron assemblies.

The Klystrode uses water to cool the collector. The remainder of the tube is cooled by forced air.

The plant efficiency also is assisted by the fact that the magnet-focusing power is less than 300W for the Klystrode. This greatly reduces the size of the magnet-power-supply system and eliminates the need for water-cooled coils.

Work is proceeding at the 60kW level and the 30kW transmitter should come along later. This appears to be a highly desirable development, based upon the current UHF transmitter market. In addition, the real efficiencies of the Klystrode come into play when the higher power levels are considered. It is in the 220kW and above ranges that the efficiency advantages become overwhelming for a Klystrode amplifier system.

Operating considerations

Both Comark and Varian believe that the life expectancy of the Klystrode will be about the same as that of the klystron. The filament assemblies are roughly comparable and there is no reason to assume any significant difference in life expectancy. The price of the 60kW Klystrode is about equal to the price of a 60kW external cavity klystron.

Varian will furnish the magnetic frame, magnet coil, input cavity, double-tuned output cavity and input and RF couplers. In short, the complete box, ready to roll, is supplied by the company. It is only necessary to provide the normal operating voltages and RF drive to obtain what promises to be the highest efficiency visual amplifier on the market.

Other than Comark, manufacturers appear to be taking a *wait-and-see* attitude concerning this new device.

The general consensus seems to be that the Klystrode sounds like a wonderful box and engineers will look at it again when a few of the Klystrodes have 20,000 hours of field use. Unfortunately, this is a penalty that any new product must pay before its final acceptance in the marketplace.

Hopefully the actual introduction of the device into an on-the-air TV facility will boost the Klystrode in the broadcast industry.

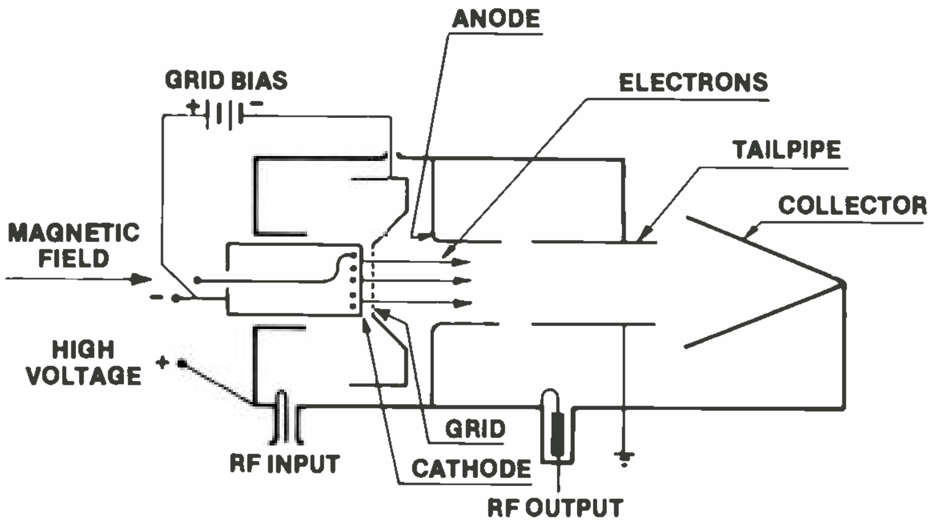


Figure 1. *Schematic representation of the Klystrode device, which combines the features of a klystron and a tetrode.*

The mic mixer you would have designed yourself–The Shure M267.

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The M267 gives you the improvements you've told us were most important. Every channel has a mic line level switch for maximum flexibility. There's also a built-in limiter to keep the M267 from overloading at critical moments. The unit contains a built-in battery pack that utilizes three standard 9-volt batteries. Simplex (phantom) power and a peak LED are standard, too.

The M267 oscillator provides a clean 1 kHz tone, and is located on the front of the unit for simple access. The headphone output is also on the front and includes a level control. IC design, along with active gain controls, provides greater headroom and quieter operation.

For location work or even studio post-production, the M267 carries on Shure's reputation for reliability and ruggedness.

For more information on Shure's complete line of mixers, call or write Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, IL 60202, (312) 866-2553.

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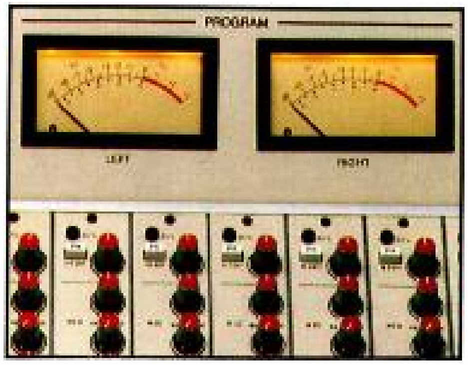

Reviewing FCC field-strength rules

By John Battison, P.E.

Several years ago, the FCC repealed the requirement for a complete annual audio proof-of-performance. From my conversations at many stations, it appears that one important element left in the rules has gone unnoticed. Although it is no longer a rigid rule that an audio proof be performed, it still is necessary to make an annual brief equipment performance measurement.

In the good old days, most of the rules pertaining to AM and FM technical matters were contained in neat little compartments. For instance, the AM rules were listed in 73.1-199 and FM rules were listed in 73.200. Now, Part 73 rules number in the thousands. References contained within this document are complex, but critical to a station's operation. A lack of knowledge about these regulations could lead to disaster. The material in Part 73.44 is a perfect example.

Current requirements

Part 73.44 lists the requirements that must be met by AM transmitters. The allowable transmitter tolerances are based on the date the transmitter entered service. A casual reading of the rules might give the impression that there is no requirement that an annual emission check be made or that annual records are unnecessary. However, this is not the case.

Section 73.1590, *Equipment Performance Measurements*, details when the equipment measurements must be made. An abbreviated list of the conditions that trigger the need for the tests is shown below (see the FCC rules for exact wording):

- upon initial installation of a new/replacement transmitter;
- modification of existing transmitter or system;
- installation of AM stereo transmission equipment;
- installation of FM stereo transmission equipment;
- as required by other provisions of the rules or license; and
- annually for AM and FM stations, with no more than 14 months between measurements.

A close reading shows that only AM stations have to make annual measurements. FM and TV (aural) stations must provide data showing compliance by the attenuation of spurious and harmonic radiation if any changes in the transmitter or associated equipment have taken place. The specific requirements for FM spurious emissions are listed in 73.317.

Apparently, the tests for FM stations do not have to be performed annually as required for AM stations. However, in the event of an inspection, you must be able to demonstrate that your equipment complies with the above specifications.

The commission recently modified the rules concerning interreference. The new rules eliminate the need to refer to 73.1590. This change points up the importance of keeping abreast of any changes.

Report form

Last month I promised to provide an example of an AM emission report form, which has worked well for me. The form, shown in Table 1, makes it relatively easy to properly record all of the pertinent data. The form can be modified as necessary to fit your particular needs.

Complete the form for each measurement location. When all of the required measurements have been made, properly file the data. The information may be requested by an FCC inspector. Perhaps even more important, the data can be a valuable source of information in the coming years as you need to adjust the antenna array.

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

ANNUAL EQUIPMENT PERFORMANCE REPORT

DATE:

STATION____________

FREQUENCY____________kHz.

POWER____________kW. MODE: DA/NON DA________

PLACE OF MEASUREMENT____________

DISTANCE____________MI. (______kM)

FUNDAMENTAL____________kHz. FS.____________MV/M

2nd HARMONIC____________kHz. FS.____________MV/M

3rd HARMONIC____________kHz. FS.____________MV/M

F TO ± 30kHz. BETTER THAN – 25dB. ____________

F TO ± 75kHz. BETTER THAN – 35dB. ____________

F TO MORE THAN ± 75kHz. BETTER THAN – 80.99dB. ____________

BETTER THAN – 80dB. ____________

TRANSMITTER INSTALLATION DATE:____________

COMMENTS:

SIGNED:____________

***Table 1.** An equipment performance report form such as this can ensure that all of the required data is available for inspection or maintenance purposes.*

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Traveling Wave Tube basics

By Elmer Smalling III

Although TWTs are used extensively as power amplifiers in satellite communications, few people are familiar with their operation. The traveling wave tube amplifier operates in a fashion similar to the klystron. That is, an electron beam is velocity (current) modulated by a radio signal. A microwave radio wave is made to travel along a helix that is concentric with an electron beam generated by a hot cathode.

As the electron beam travels along the helix (known as a slow-wave circuit), the radio energy input to the TWT causes bunching of the electrons, which then decelerate, losing energy to the radio wave. In this fashion, power from the electron beam is added to the radio frequency energy providing amplification of the radio signal. The amplified radio signal is delivered to a matched load (transmission line) at the end of the helix. The electron beam is absorbed by a collector at the end of its trip.

There is a version of the TWT where the microwave energy travels in the opposite direction to the electron beam. This is called a backward-wave tube and is used primarily as a microwave oscillator. Traveling wave tubes may have a bandwidth as great as 100% at the fundamental operating frequency.

Efficiency

Early traveling wave tubes had about 10% efficiency. Although this seems rather small, the tubes were operated at relatively high power (1,000W to 500,000W) so that the 100W to 50,000W output signal was still much greater than most klystrons or magnetrons could provide at the time.

TWT efficiency may be increased in two basic ways. First, the electron beam that travels down the center of the helix tends to slow as it gives up energy to the radio signal. This causes the two beams (radio and electron) to get out of step. The favorable bunching that takes place between the two beams is destroyed and the TWT loses its efficiency. Increasing the electron beam operating voltage will help improve the phase coherence and operation.

Second, additional energy may be collected from the electron beam by a specially constructed collector that has a series of depressions off-axis to collect unused electrons from the spent beam. Efficiencies of 45% to 50% are attainable.

Intermodulation distortion

TWTs are susceptible to intermodulation distortion when multiple carriers are introduced as in doubly illuminated or multiple SCPC transponders. These IM products may be found at frequencies that are displaced from the fundamental carriers by the difference in frequency between them. It is easy to see that, when there are multiple carriers present, the potential for very severe IM exists. The best fix for IM is to operate the TWT below saturation. The power must be reduced (backed off) in proportion to the number of carriers and their relative power. It is important to adjust TWT back off according to the manufacturer's recommendations as transponder loading conditions change.

Harmonics

Because of the wide bandwidth and non-linear operating characteristics under saturation conditions, TWTs become excellent second harmonic generators. It is not uncommon to have −10dB second harmonics at the output of a TWT. The range of the harmonic generation is the fundamental frequency and bandwidth.

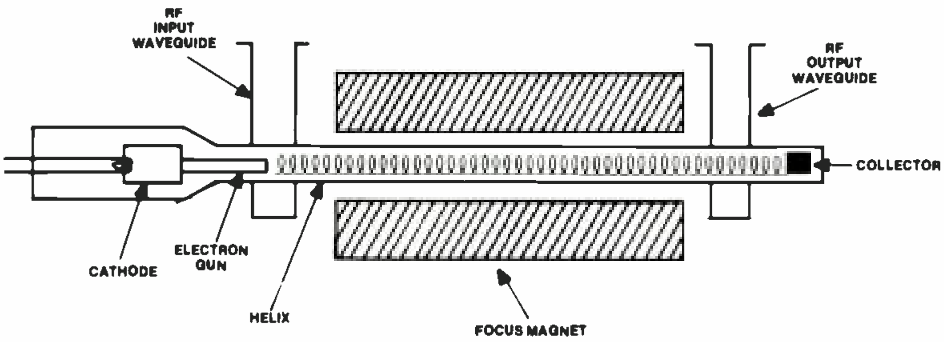
A fix for harmonic generation requires injecting a coherent harmonic signal with a controlled phase and amplitude along with the fundamental carrier so that they interact and the total effects of the harmonics are minimized. Harmonics may be measured by using a spectrum analyzer.

AM/PM conversion

AM/PM conversion is the change in phase angle between the input and output signal as the input signal varies in amplitude. The cause of this distortion in TWTs is a reduction of the electron beam velocity as the input signal level increases. This causes a greater energy exchange between the electron beam and the RF wave. At a level −20dB below the input power required for saturation, AM/PM conversion is negligible. Below this point, AM/PM distortion sharply increases.

Phase sensitivity

When the velocity of the electron beam in the TWT is changed by any one or a number of factors, the phase of the output signal will change. The primary causes of beam velocity changes are variations in: cathode temperature, grid voltage, anode voltage and cathode voltage. It is important that the TWT power supply be extremely well regulated (less than 0.2%) to prevent beam velocity changes and, in turn, output signal phase changes. BE



TRAVELING WAVE TUBE

Figure 1. The traveling wave tube (TWT) adds power from the electron beam to RF energy, amplifying the RF signal.

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

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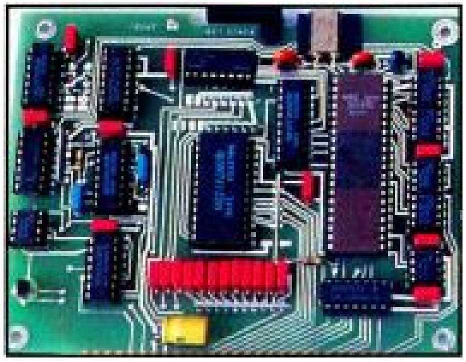

Inside digital technology

By Gerry Kaufhold II

Flip-flops and gates can be combined into digital counter circuits. Some of these original counter circuits were developed using vacuum tubes.

Kaufhold is an independent consultant located in Tempe, AZ.

FLIP-FLOP D	B	C	A	HEX CODE	DECIMAL CODE	AND GATE OUTPUT
0	0	0	0	0	0	0
0	0	0	1	1	1	0
0	0	1	0	2	2	0
0	0	1	1	3	3	0
0	1	0	0	4	4	0
0	1	0	1	5	5	0
0	1	1	0	6	6	0
0	1	1	1	7	7	0
1	0	0	0	8	8	0
1	0	0	1	9	9	0
1	0	1	0	A	10	1
1	0	1	1	B	11	0
1	1	0	0	C	12	0
1	1	0	1	D	13	0
1	1	1	0	E	14	0
1	1	1	1	F	15	0

***Figure 1.** The truth table for possible states of four flip-flops and AND gate of a 1-in-10 counter shows the short transition back to 0000 at the AND gate output during condition 1010.*

The operation of counter circuits expands on the action of a simple flip-flop. A "clock" signal causes the first flip-flop to toggle. The next "clock" signal causes the first flip-flop to toggle again, but this time, the output of the first flip-flop causes a second flip-flop to toggle. This basic circuit can be chained almost indefinitely, creating a series of circuits that divide by two. The 4020 binary ripple counter is an excellent example of the divide-by-two digital counter.

The reason the word "clock" is set off by quotation marks is this: The counting circuit is accepting an edge-triggered signal, and performing an operation. Because the counting circuit is a flip-flop, the term "clock" means any edge-triggered signal that satisfies the voltage-level and timing constraints required to make the flip-flop toggle the states of its outputs. Manufacturers' data sheets label this input pin of the counting device as "clock". A counting circuit is not necessarily using the master clock signal of the digital bus.

Count-to-10 circuit

Because very little usefulness can be derived from dividing anything continually by two, a practical circuit might be one that counts to 10, 100, 1,000 and 10,000 (just as the old frequency counters did).

The circuit in Figure 2 uses a 4-input AND gate, connected to the outputs of four cascaded flip-flops. Notice the organization of the four inputs to the AND gate. These four bits create a nibble, which has 16 possible unique states from 0000 through 1111 (0 through 15 decimal).

When you look at figure 1, observe that the 10th combination of bits (1001) represents a decimal nine. As long as the inputs to the AND gate range from 0000 through 1001, the output of the AND gate is LO. As soon as the combination (1010) for decimal 10 occurs, the output of the AND gate goes HI, which resets all four flip-flops, and the output of the AND gate returns LO. If this LO-to-HI-to-LO pulse is sufficient to toggle the input stage of the next 4-bit count-to-10 circuit, then the counting can go on accumulating from tens to hundreds to thousands.

The transition that takes place when the AND gate toggles loads 0000 into the flip-flops. The next "clock" input begins counting at 0001 again. The 0000 combination and the 1010 combination actually overlap each other, so the circuit counts to 10, even though it appears as though it is going through 11 transitions. The possible states above 1010 never occur.

Because the succeeding count-to-10 circuit is being "clocked" by the output of the preceding count-to-10 circuit, the second circuit is actually a count-to-100 circuit. By repeating this circuit four times, a count-to-10,000 circuit can be accomplished.

The duration of the pulse from the AND gate must be great enough to both toggle the next counter stage and to effect a complete reset of the four counting flip-flops. This is accomplished with circuitry found onboard a counter chip.

Once designers solved the problem of making circuits count digitally, they applied this discovery to make circuits that add or subtract. These preliminary add or subtract circuits were first called *accumulators* and this term has carried over into use with microprocessors, which all have at least one accumulator register that is used for simple add/subtract operations.

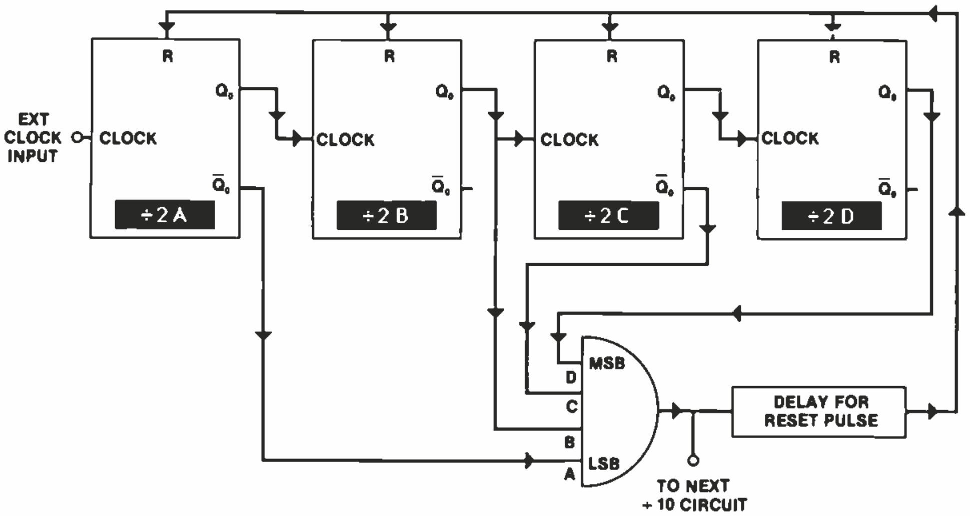

***Figure 2.** A count-to-10 circuit using flip-flops and one AND gate receives its drive from an external clock at logic level.*

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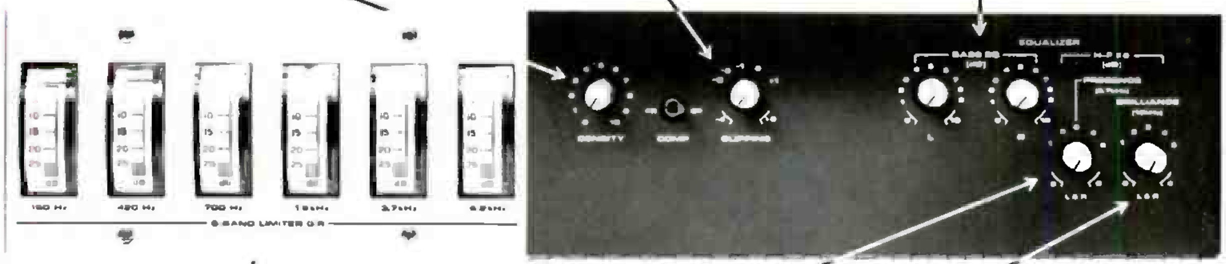

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This is good news because the time-constants and other processing parameters in a pure, integrated Orban system have been carefully harmonized to achieve an overall sound that's *loud* and *bright*, yet remarkably *open* and free from audible side-effects.

The XT2 also excels in the most difficult of processing tradeoffs—delivering loudness on music while keeping speech free from clipping distortion. Credit this uniquely capable performance to Orban's patented multiband distortion-cancelled clipping system—which we were able to implement in the XT2 system because the XT's circuitry is fully *integrated* into the processing system, not just tacked onto the front.

The XT2 lets you have it all: natural sound, source-to-source consistency, loudness, clean voice, and adjustability that lets you tailor bass and treble to your taste and format requirements. And thanks to its efficient single-chassis construction and its use of the main 8100A power supply, it lets you have the next step in Optimod processing at an exceptionally reasonable price: $2075 (suggested list).

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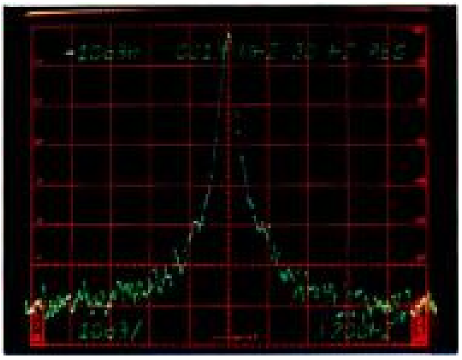

Prevent problems by planning ahead

By Mark A. Bunker

During the life of a tower, antenna systems and transmission-line installations are constantly changed.

Simple techniques can be employed for sharing new or existing tower resources. When it comes to antennas, the single most efficient way to save money is to share transmission lines for multiple applications. If one transmission line is shared by just two RF systems, windloading is cut considerably. Because a second line is no longer required, installation time and costs also are reduced. The more sharing, the lower the windloading and installation costs.

Crossband couplers

Crossband couplers are commonly available for the purpose of combining and separating several RF systems and antennas into the same transmission line. Although only a few square inches in size, units suitable for tower use can handle up to several hundred watts with only a fraction of 1dB loss per channel.

The most common crossband couplers take the form of a Y or T, where a single common connector is the combination or split between two filter sections or ports. The higher-frequency port is a multisection bandpass filter, flat over the band covered. The low-frequency port is a low-pass filter with a response from dc to the maximum bandpass frequency, and maximum cutoff at the high-frequency port band. Multiband operation is accomplished by stacking a second coupler's common port onto the low-pass port.

Bunker is an engineering supervisor at KSHB-TV, Kansas City, MO.

Typical ENG installation

Consider a new ENG system, to be installed on a 1,100-foot TV tower. The 2GHz microwave horns are to be installed at the 1,000-foot level along with a UHF (450MHz band) dispatching 2-way. In addition, an existing VHF (150MHz band) paging system antenna is to be replaced and added to the system. An additional 200 feet of transmission line is required between the tower base and the equipment, bringing the total to 1,200 feet. Table 1 shows a comparison of a 3-line system and two alternate installations using a single line and two crossband couplers at each end.

Although the material cost of 1⅝-inch line is slightly higher, lower installation labor costs tend to even out the overall expense. Although the price of 1⅝-inch shared line is not as attractive, loading factors are less critical than those of their 3-line counterparts. The system also is open to a future expansion on the 900MHz band by the simple addition of an antenna and two crossband couplers.

Inband combining

Inband combining is accomplished with off-the-shelf combiners containing an arrangement of sharp bandpass resonant cavities and one or two port isolators. It brings with it special problems. Power from multiple transmitters must be reduced to microvolt levels at the outputs of companion transmitters in order to eliminate first-order intermodulation products.

The idea behind inband transmit combiners is that most combining losses and isolation can be accomplished with shape cavity filters. Remaining energies are blocked from the other transmitter outputs by an isolator in each of the outputs, which acts as a "check valve" for the RF of that transmitter. In cases in which frequencies are within a few kilohertz, the cavities are replaced with hybrid couplers, providing a total combination loss of at least −4dB, with −70dB isolation for a 2-channel system.

Inband receiver coupling presents a different problem. Relative loss can be minimized by an amplifier/splitter arrangement, but any inband transmitters also must be isolated from receiver inputs. Additional cavity filters in transmit-and-receive lines will resolve most simple combining combinations. However, if an additional transmission line is available for band sharing, a second receive-only antenna will greatly simplify receiver requirements through isolation by sheer separation of transmit-and-receive antennas.

Cellular and trunking 2-way systems typically use the 2-line, 2-antenna concept. Vertical separation of transmit-receive antennas provides the major receive isolation, while transmit combiners handle transmit isolation. Combining eight to 16 individual systems with little degradation is quite practical with this arrangement.

The separate receive antenna performs the added benefit of eliminating receive-line losses. A tower-mounted pre-amp boosts the signal at the antenna, lowering transmission-line loss by at least the gain of the pre-amp. Pre-amp power is fed down the transmission line itself, eliminating the need for extra cabling. Pre-amp redundancy is provided by either bypassing the pre-amp when power is removed, or by using a switchable backup amplifier.

Frequency	150	450	2GHz	150	450	2GHz	150	450	2GHz
Foam Line Size	1/2"	7/8"	7/8"	Shared 7/8"			Shared 1-5/8"		
Line Weight	164	378	378	---	378	---	---	378	---
Coupler Loss dB	---	---	---	-1.4	-1.4	-0.8	-1.4	-1.4	-0.8
Total Loss dB	-8.1	-10.5	-24.6	-6.8	-11.9	-25.4	-4.8	-7.9	-17.6
Total Weight	920 lbs.			378 lbs.			920 lbs.		
Total Area	19.91 sq.ft.			7.73 sq. ft.			13.94 sq. ft.		

Table 1. *Comparison of 3-line system and alternative single-line systems. Figures are typical, and do not allow for connectors, patch cables, line supports and their mounts.*

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Management
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Bring about change, not a tug of war

By Brad Dick, radio technical editor

By its nature, the broadcast industry is constantly changing. Just when you think you've mastered the latest piece of equipment, something new comes along. For some people, the change brought about by new technology is exciting and challenging. For others, it's frightening. Perhaps the most alarming aspect of new technology is the prospect of it changing the way we do our jobs.

Many stations are struggling between the desire for change and the disappointment that results from problems in implementing these changes. Improperly handled, new technology in the workplace can become a tug of war that everyone loses. Let's look at a real-world example—the use of automation.

Friend or foe?

Jim was both excited and worried about the company's decision to proceed with the plan to install automation equipment. He believed that, in the long run, automating the spot playback and program recording would be beneficial. But, as director of engineering, he also worried about the effect the new technology might have on his staff.

The station planned to purchase the spot player and other automation equipment within the next quarter. He would then have a couple of months to install it and work out the bugs. At most, he had six months to have everything working properly.

It wasn't the hardware installation that caused him so much concern. Jim had to convince the operating staff that the equipment would not mean unemployment. He had already obtained a commitment from the company that no one would lose a job as a result of the installation of the automation equipment. Still, Jim wondered how some of the operators would adapt to the new way they would be expected to perform their jobs. He also wondered how he should go about introducing them to the changes that were about to take place.

The employee's perspective

Changes in station operations and methods are seldom confined to the technical aspects. They require that employees modify not only how they perform tasks, but even more important, how they view their jobs. The new methods must be feasible and efficient from an objective standpoint. Even more important, the changes must be acceptable to the employees who must implement them.

The added factor of employee acceptance makes the problem of introducing changes different from purely technical problems in several ways. For example, the quality of the solution—in this case, automation—and its acceptability are different characteristics, and do not necessarily go together. A second complication stems from the fact that although management can control solution quality by handling the decision-making, employee acceptance is inherently voluntary. Acceptance of the changes is not subject to the will of management. This factor is often overlooked. In most cases, however, it is impossible to implement even the best technical solution without cooperation by the employees.

It's not uncommon for management to attempt to force change upon employees, with predictable consequences. Failure to obtain employee acceptance of the changes merely aggravates the problem. In some instances, employee resistance is expressed directly in the form of grievances, work stoppages and open hostility toward management. In technical areas, resistance can be expressed in ways such as restriction of output, waste, low-quality work and even sabotage.

Management's responsibility

An effective manager recognizes the potential for these types of problems long before announcing plans for significant changes in the workplace. The avenue typically used by management to prevent the problems is education. Facts and arguments are presented to the staff with the expectation that, given the same information, the employees will take a similarly favorable view toward the desired change.

To the extent that resistance is based on incorrect or insufficient information, this tactic may help. However, resistance to change usually is rooted in feelings of insecurity, distrust of management's motives and anxiety about the future. In these instances, information does little to reduce the employees' anxiety.

Lack of success with the "selling" approach has led to research into other methods. A common tactic involves the "Y" management approach discussed last month. Typically, the supervisors meet with the employees to discuss the current problems and proposed changes. On the surface, the process appears to be an exchange of information, or a consultation.

The method used to develop this exchange of information varies greatly. However, it is essential that an attempt be made to identify the employees' feelings and ideas. The bottom line is that management always reserves the right to accept or reject the employee contributions as it sees fit. However, if that position is overemphasized during the preliminary discussion phase, it can cause a great deal of damage to the communication process.

The two methods of obtaining acceptance are quite different. The selling approach emphasizes the presentation of management's point of view, while the consultative approach is designed to solicit an expression of employee opinions. In this sense, the latter method is a further step toward consideration for the welfare of employees. The two methods are alike in that both reserve the decision-making function for management with the intent to protect the quality of the decision.

The automation example is typical of the changes being faced by many stations today. As automation becomes more prevalent, people must change the way they do their jobs. The real issue is not the loss of jobs, although that may happen in some cases. The greater issue is how to help the worker adapt to a new way of completing a task.

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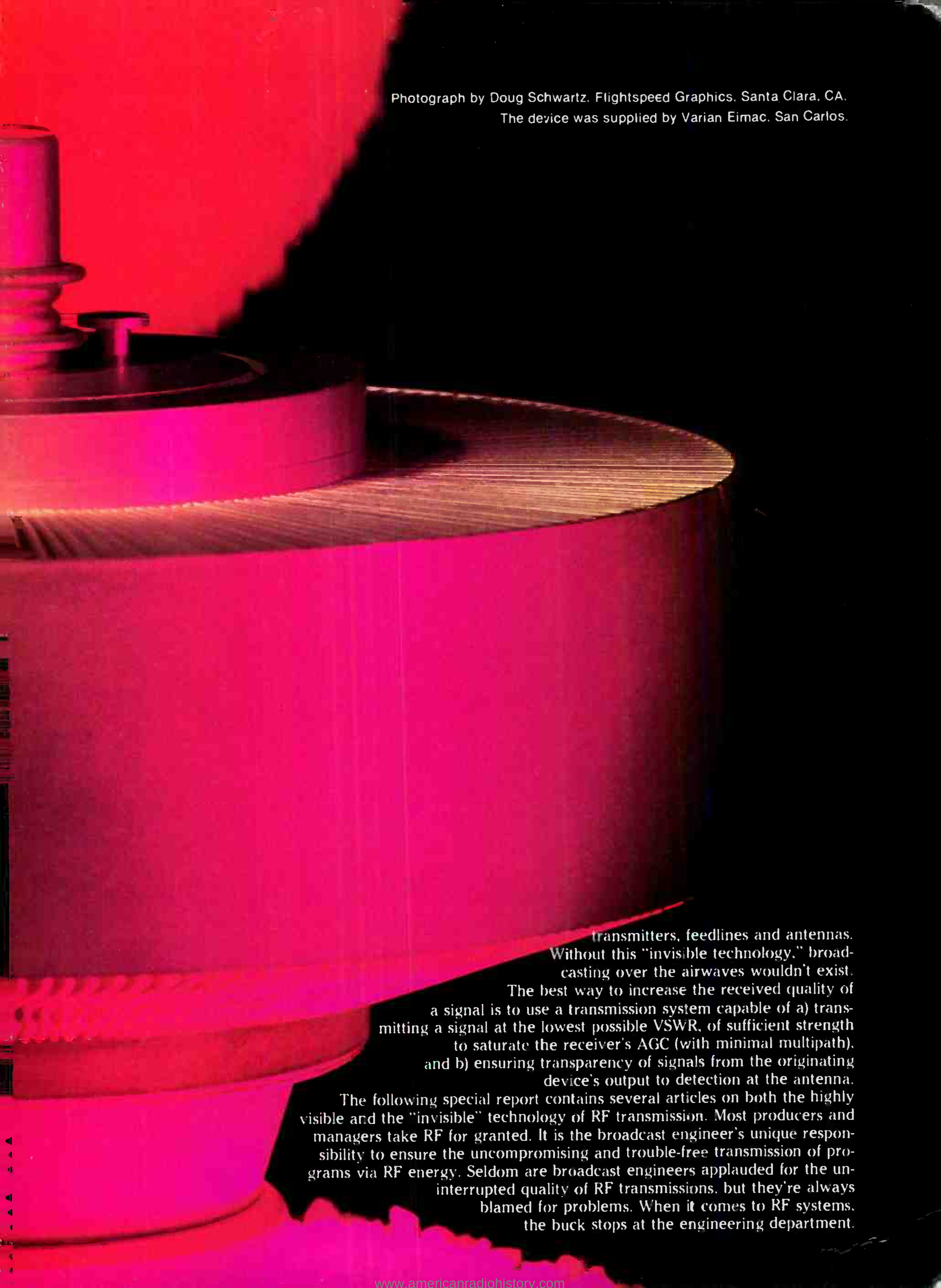
Transmission systems special report

The RF chain is the link between programming and your audience.

The process of broadcasting pictures and/or sound requires the interfacing of several systems. Relatively minuscule electrical signals generated by the pickup device are amplified and sent through a switching/mixing device, then through processing gear to ultimately modulate an exciter, producing a small amount of RF energy. This energy is amplified and directed through a feedline to a transmitting antenna. At the other end, the signal is picked out of the air by a receiving antenna, detected, amplified and sent to the screen and/or speaker(s).

Each system in this process presents the opportunity to constrain the overall technical quality of a received program. The performance of any subsystem, such as media storage, tape editing and production, also will be restricted by any system in the chain between the subsystem and the antenna.

The high visibility of tape formats, pickup devices and myriad other hairsplitting pros and cons of production technology makes it easy to overlook the foundation of broadcasting:



Photograph by Doug Schwartz, Flightspeed Graphics, Santa Clara, CA.
The device was supplied by Varian Eimac, San Carlos.

transmitters, feedlines and antennas. Without this "invisible technology," broadcasting over the airwaves wouldn't exist.

The best way to increase the received quality of a signal is to use a transmission system capable of a) transmitting a signal at the lowest possible VSWR, of sufficient strength to saturate the receiver's AGC (with minimal multipath), and b) ensuring transparency of signals from the originating device's output to detection at the antenna.

The following special report contains several articles on both the highly visible and the "invisible" technology of RF transmission. Most producers and managers take RF for granted. It is the broadcast engineer's unique responsibility to ensure the uncompromising and trouble-free transmission of programs via RF energy. Seldom are broadcast engineers applauded for the uninterrupted quality of RF transmissions, but they're always blamed for problems. When it comes to RF systems, the buck stops at the engineering department.

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Inside FM power amplifiers

By Jerry Whitaker, editorial director,
and Clarence Daugherty

To get the most out of a cavity PA FM transmitter, you need to know how it works.

Cavity amplifiers for FM service are viewed by many users as just so much black magic. You know that they work, and how to make them work when a problem occurs, but you're not quite sure *why* they work. The theory of operation, however, is fairly straightforward. And like most things in electronics, cavity amplifiers are easy to understand, once you understand them.

Daugherty is a senior broadcast technology instructor at Harris Corporation, Quincy, IL. Additional information for this article was contributed by the engineering staff of Broadcast Electronics, Quincy, IL.

Two basic types of cavity amplifiers are used for FM service: ½-wavelength and ¼-wavelength systems.

The ¼-wavelength cavity

The ¼-wavelength PA cavity is common in today's FM transmitting equipment. The design is simple and straightforward. A number of variations can be found in different transmitters, but the underlying theory of operation is the same.

At left, an interior view of a cavity designed for FM applications of up to 50kW output power. This cavity uses the 4CX40,000G tube, shown at right. A movable anode plate resonates the cavity at the chosen frequency. The loading loop can be seen on the back cavity wall.

A typical ¼-wave cavity is shown in Figure 1. The plate of the tube connects directly to the inner section (tube) of the plate-blocking capacitor. The blocking capacitor can be formed in one of several ways. In at least one design, it is made by wrapping the outside surface of the inner tube conductor with multiple layers of 8-inch-wide and 0.005-inch-thick polymide (Kapton) film. The exhaust chimney/inner conductor forms the other plate of the blocking capacitor. The cavity walls form the outer conductor of the ¼-wave transmission line circuit. The dc-plate voltage is applied to the PA tube by a cable routed inside the exhaust chimney and inner tube conductor.

In the design shown in Figure 1, the screen-contact fingerstock ring mounts on a metal plate that is insulated from the grounded-cavity deck by a Kapton blocker. This hardware makes up the screen-blocker assembly. The dc-screen voltage feeds to the fingerstock ring from underneath the cavity deck through an insulated feedthrough assembly.

Some transmitters that use the ¼-wave cavity design use a grounded-screen configuration in which the screen-contact fingerstock ring is connected directly to the grounded cavity deck. The PA cathode then operates at below ground po-

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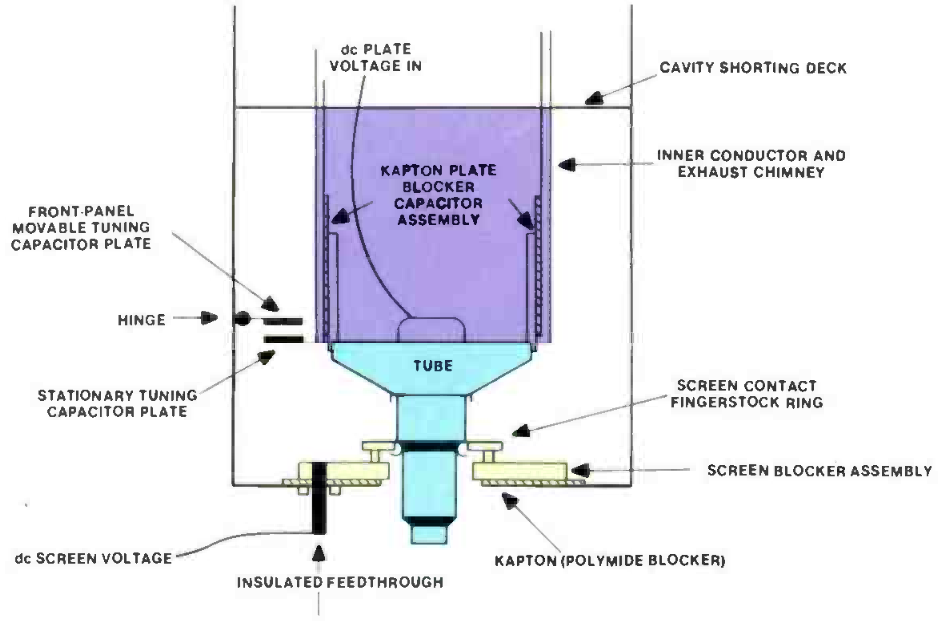

Figure 1. The layout of a common type of ¼-wavelength PA cavity.

tential (in other words, at a negative voltage), establishing the required screen voltage to the tube.

The cavity design shown in Figure 1 is set up to be slightly shorter than a full ¼-wavelength at the operating frequency. This makes the load inductive and resonates the tube's output capacity. Thus, the physically foreshortened shorted transmission line is resonated and electrically lengthened to ¼-wavelength.

Figure 2 illustrates the paths taken by the RF-circulating currents in the circuit. RF energy flows from the plate, through the plate-blocking capacitor, along the inside surface of the chimney/inner conductor (because of the skin effect), across the top of the cavity, down the inside surface of the cavity box, across the cavity deck, through the screen-blocking capacitor, over the screen-contact fingerstock and into the screen grid.

Figure 3 shows a graph of RF current, voltage and impedance for a ¼-wavelength coaxial transmission line. It shows that infinite impedance, zero RF current and maximum RF voltage occur at the feed point. This would not be suitable for a practical PA circuit because arcing would result from the high RF voltage, and poor efficiency would be caused by the mismatch between the tube and the load.

Notice, however, the point on the graph marked at slightly less than ¼-wavelength. This length yields an impedance of 600Ω to 800Ω and is ideal for the PA-plate circuit. It is necessary, therefore, to physically foreshorten the shorted coaxial transmission-line cavity to provide the correct plate impedance. Shortening the line also is a requirement for resonating the tube's output capacity, because the capacity shunts the transmission line and electrically lengthens it.

Figure 4 shows a graph of the RF current, voltage and impedance presented to the plate of the tube as a result of the physically foreshortened line. This plate impedance is now closer to the ideal 600Ω to 800Ω value required by the tube's anode.

Tuning the cavity

Coarse tuning of the cavity is accomplished by adjusting the cavity length. The top of the cavity (the cavity shorting deck) is fastened by screws or clamps

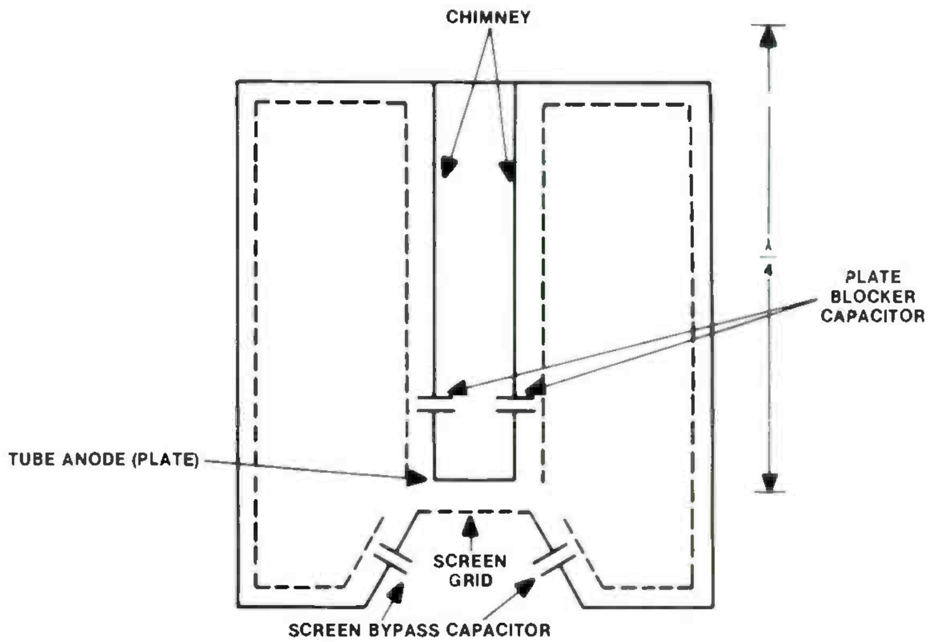

Figure 2. The RF circulating current paths for the ¼-wavelength cavity shown in Figure 1.

and can be raised or lowered to set the length of the cavity for the particular operating frequency.

Fine tuning is accomplished by the variable-capacity plate-tuning control that is built into the cavity. In the example shown in Figure 1, one plate of this capacitor, the stationary plate, is fastened to the inner conductor just above the plate-blocking capacitor. The movable tuning plate is fastened to the cavity box, the outer conductor, and is mechanically linked to the front-panel tuning control. This capacity shunts the inner conductor to the outer conductor and can vary the electrical length and resonant frequency of the cavity.

The ¼-wavelength cavity is inductively coupled to the output port. This coupling is usually on the side opposite the cavity access door. The inductive pickup loop can take several forms.

In one design, it consists of a half-loop of flat copper bar stock that terminates in the loading capacitor at one end and feeds the output transmission-line inner conductor at the other end. The inductive pickup ideally would be placed at the maximum current point in the ¼-wavelength cavity. However, this point is located at the cavity shorting deck and when the deck is moved for coarse tuning, the magnetic coupling will be changed. A compromise in positioning, therefore, must be made. The use of a broad, flat copper bar for the coupling loop adds some capacitive coupling to augment the reduced magnetic coupling.

Adjustment of the loading capacitor matches the 50Ω transmission-line impedance to the impedance of the cavity. Heavy loading lowers the plate impedance presented to the tube by the cavity. Light loading reflects a much higher load impedance to the amplifier's plate.

The ½-wavelength cavity

The ½-wavelength PA cavity has been used extensively in FM transmitting equipment. The design can take a number of forms, but the underlying theory of operation remains the same.

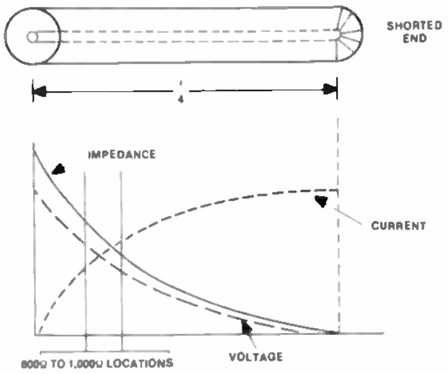

Figure 3. A graph of the RF current (...), RF voltage (---) and RF impedance (——) for a ¼-wavelength shorted transmission line. At the feed point RF current is zero, RF voltage is maximum and RF impedance is infinite.

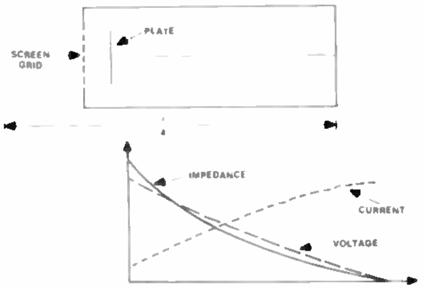

Figure 4. A graph of the RF current (...), RF voltage (---) and RF impedance (——) produced by the physically foreshortened coaxial transmission-line cavity.

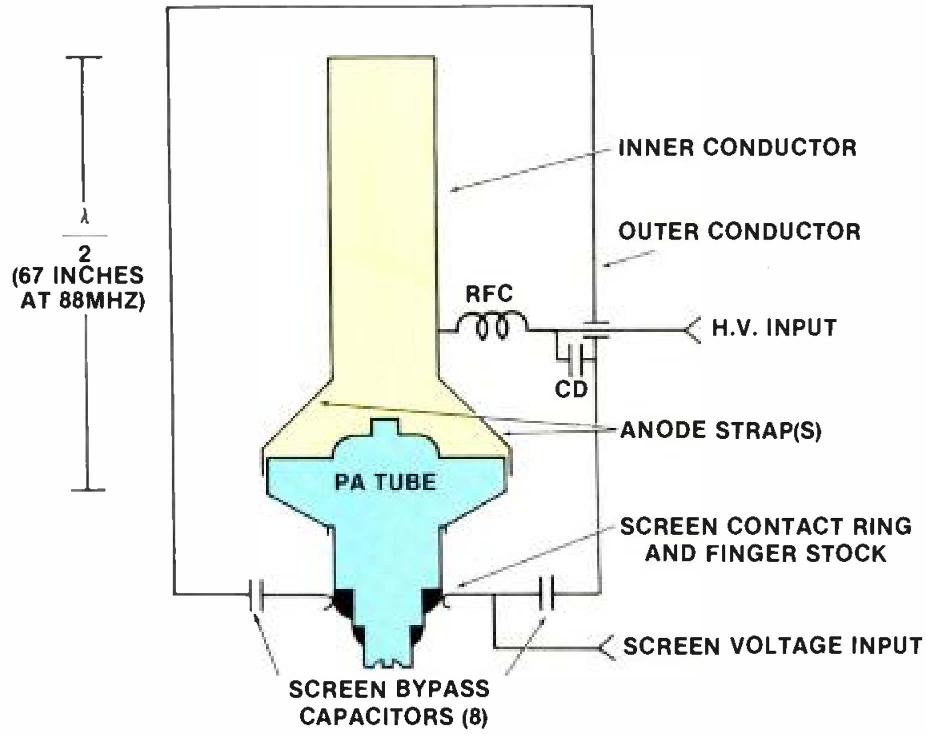

Figure 5. The ½-wavelength PA cavity in its basic form.

The design of a basic ½-wavelength PA cavity is shown in Figure 5. The tube anode and a silver-plated brass pipe serve as the inner conductor of the ½-wave transmission line, and the cavity box serves as the outer conductor. The transmission line is open at the far end and repeats this condition at the plate of the tube. The line is, in effect, a parallel resonant circuit for the PA tube.

The physical height of the circuit shown in Figure 5 (67 inches) was calculated to operate at 88MHz. To allow adequate clearance at the top of the trans-

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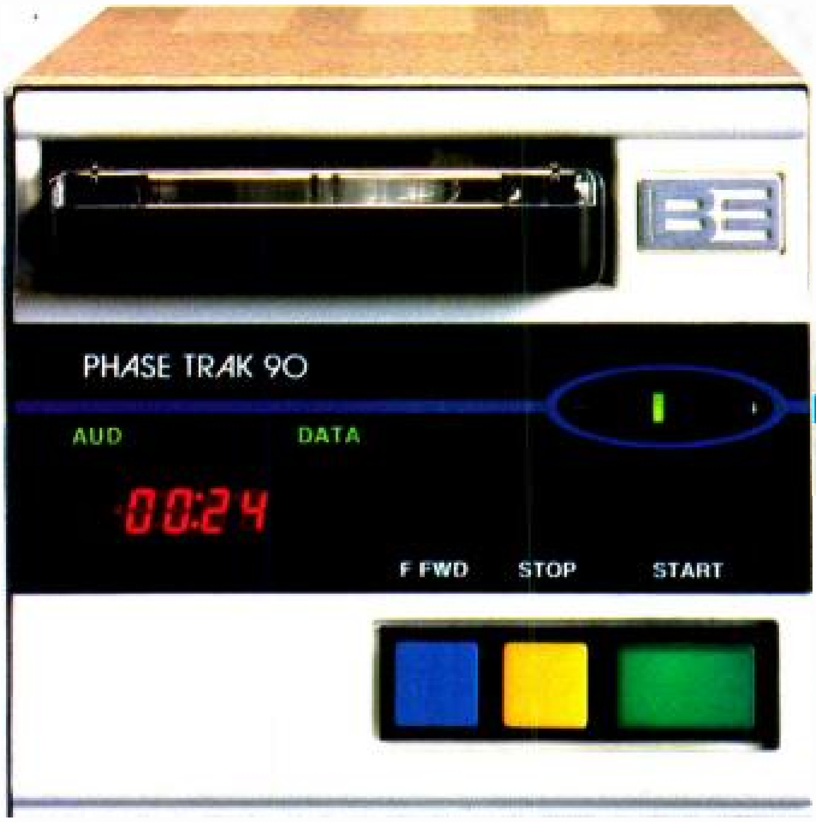

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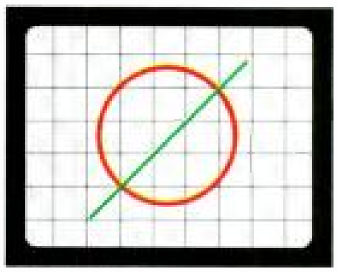

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mission line and space for input circuitry at the bottom of the assembly, the complete cavity box would have to be almost 8 feet tall. This is too large for any practical transmitter.

Figure 6 shows RF voltage, current and impedance for the inner conductor of the transmission line and the anode of the tube. The load impedance at the plate is thousands of ohms. The RF current is, therefore, extremely small and the RF voltage is extremely large. In the application of such a circuit, arcing would become a problem. The high plate impedance would also make amplifier operation inefficient.

Figure 6 also shows an area between the anode and the ¼-wavelength location where the impedance of the circuit is 600Ω to 800Ω. As noted previously, this value is ideal for the anode of the PA tube. To achieve this plate impedance, the inner conductor must be less than a full ½-wavelength. The physically foreshortened transmission-line circuit must, however, be electrically resonated (lengthened) to ½-wavelength for proper operation.

If the line length were changed to operate at a different frequency, the plate impedance also would change because of the new distribution of RF voltage and current on the new length of line. The problem of frequency change, therefore, is twofold: The length of the line must be adjusted for resonance and the plate impedance of the tube must be kept constant for good efficiency.

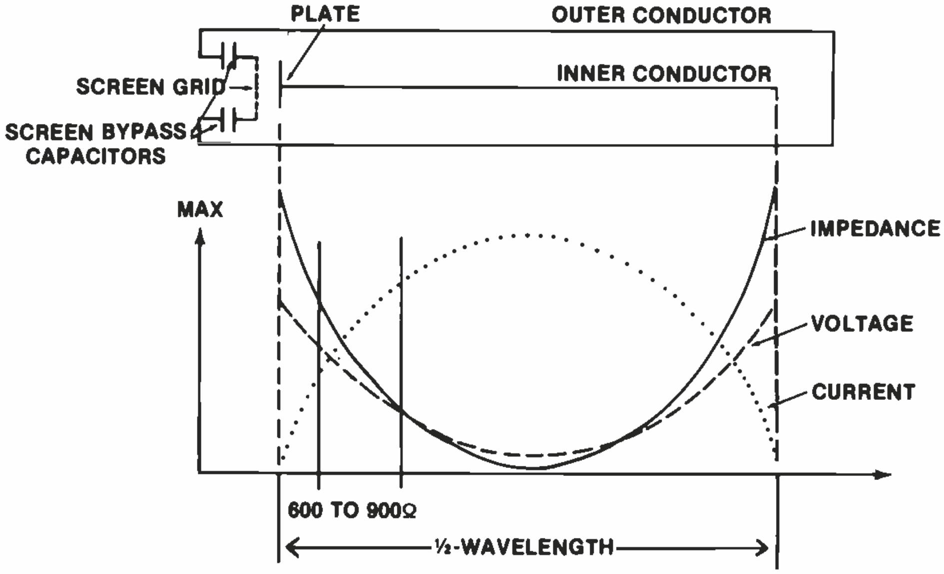
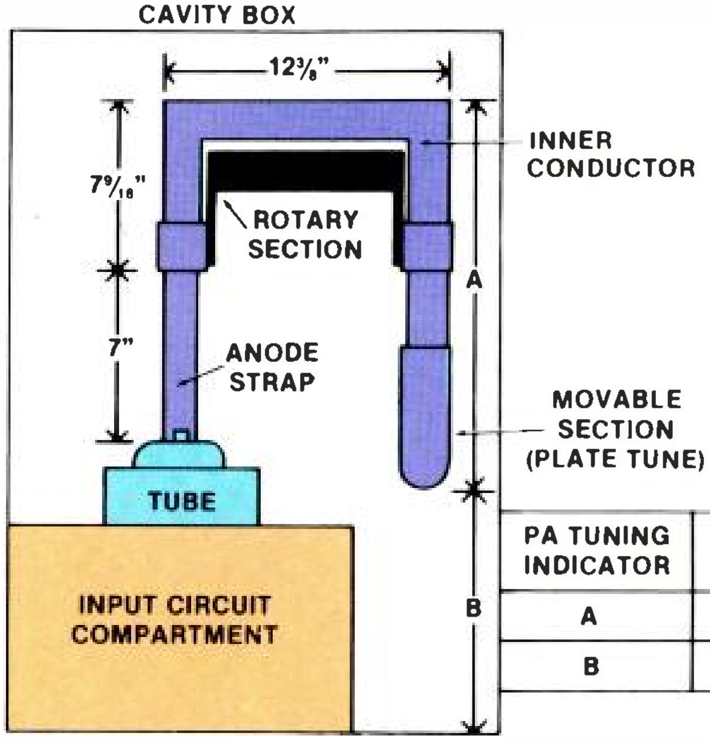


Figure 6. *The distribution of RF voltage, current and impedance along the inner conductor of a ½-wavelength cavity.*



PA TUNING INDICATOR	000	MAX
A	18 1/16	13¾
B	8 1/16	12⅜

Figure 7. *The configuration of a practical ½-wavelength PA cavity.*

A practical cavity

To accommodate operation of the transmitter at different frequencies while keeping the plate impedance constant, two forms of coarse tuning and one form of fine tuning are built into the ½-wave PA cavity.

Figure 7 shows the tube and its plate line (inner conductor). The inner conductor is U-shaped to reduce the cavity height.

With the movable section (the plate tune control) fully extended, the inner conductor measures 38 inches and the anode strap measures 7 inches. The RF path from the anode strap to the inside of the tube plate (along the surface because of the skin effect) is estimated to be about 8 inches. This makes the inner conductor's maximum length about 53 inches.

This is too short to be a ½-wavelength at any FM frequency. The full length of a ½-wave line is 54.7 inches at 108MHz and 67.1 inches at 88MHz.

The coarse-tuning and fine-tuning provisions of the cavity, coupled with the PA tube's output capacity, resonate the plate line to the exact operating frequency. In effect, they electrically lengthen the physically foreshortened line. This process, along with proper loading, determines the plate impedance and, therefore, the efficiency.

Lengthening the plate line

The output capacity of the tube is the first element that electrically lengthens the plate line. A ½-wave transmission line that is too short offers a high impedance that is both resistive and inductive. The tube's output capacity resonates this inductance. The detrimental effects of the tube's output capacity are, therefore, eliminated.

The anode strap and the cavity inner-conductor rotary section provide two methods of coarse frequency adjustment for resonance.

The anode strap (shown in Figure 7) has less of a cross-sectional area than the inner conductor of the transmission line. It, therefore, has more inductance than an equal length of the inner conductor. The anode-coupling strap acts as a series inductance and electrically lengthens the plate circuit.

At low frequencies one narrow anode strap is used. At mid-FM frequencies one wide strap is used. The wide strap exhibits less inductance than the narrow strap and does not electrically lengthen the plate circuit as much.

At the upper end of the FM band, two anode straps are used. The parallel arrangement lowers the total inductance of the strap connection and electrically lengthens the plate circuit only a small amount.

The main section of the plate resonant

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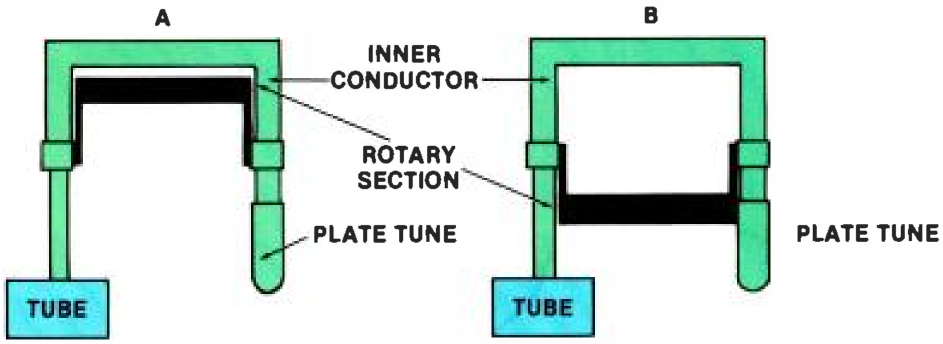

Figure 8. *Using the cavity's movable section to adjust for resonance. Diagram (A) shows the rotary section at maximum height and (B) shows the rotary section at minimum height.*

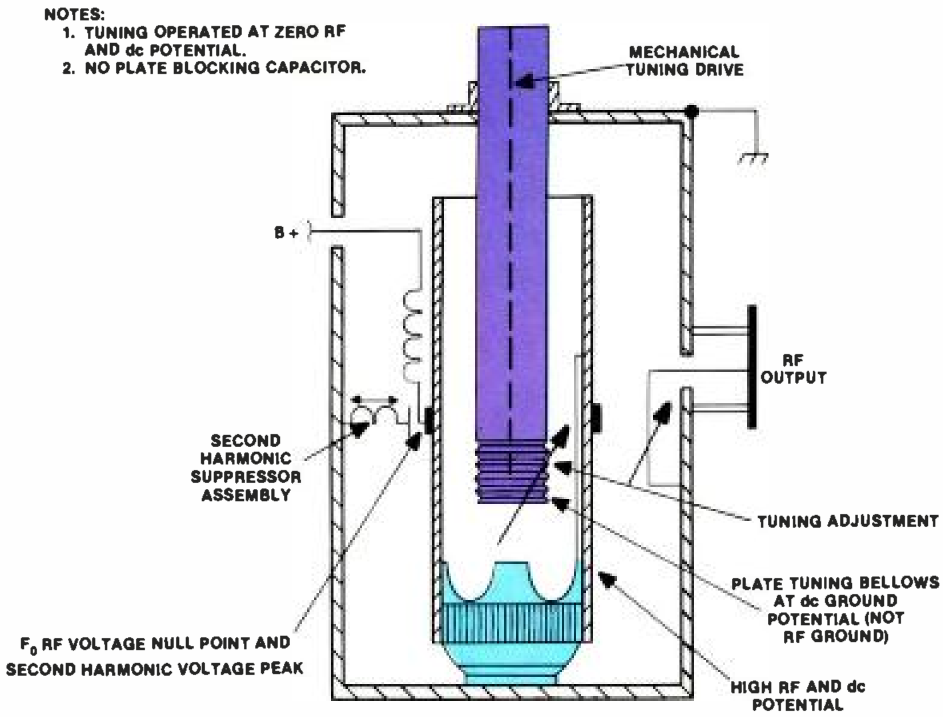

Figure 9. *The basic design of a folded ½-wavelength cavity.*

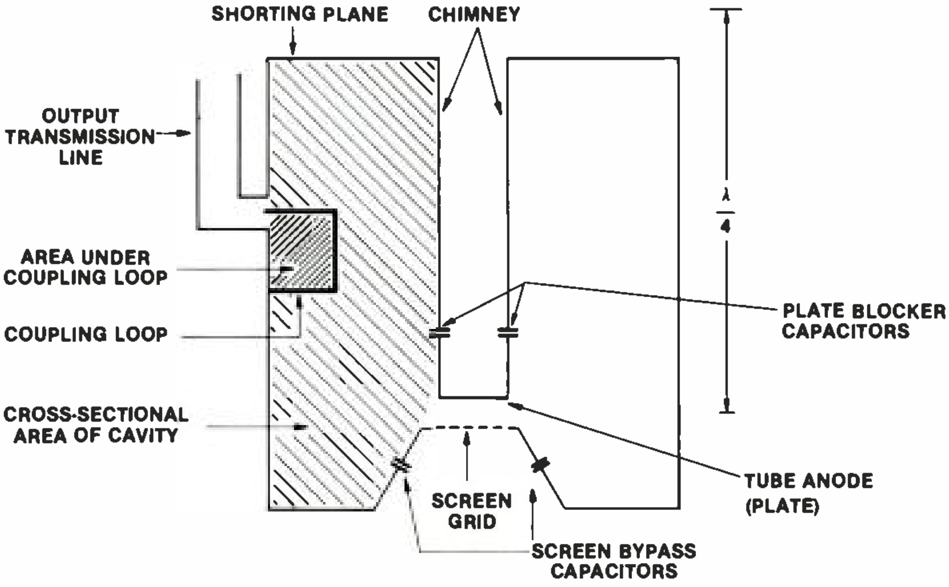

Figure 10. *The use of inductive coupling in a ¼-wavelength PA stage.*

line, together with the rotary section, function as a parallel inductance. RF current flows in the same direction through the transmission line and the rotary section. Therefore, the magnetic fields of the two paths add.

When the rotary section is at maximum height, the magnetic coupling between the main section of the transmission line and the rotary assembly is maximum. Because of the relatively large mutual inductance provided by this close coupling, the total inductance of these parallel inductors increases. This electrically lengthens the transmission line and lowers the resonant frequency. The concept is illustrated in Figure 8(A).

When the rotary section is at minimum height, the magnetic coupling between the two parts of the inner conductor is minimum. This reduced coupling lowers the mutual inductance, which lowers the total inductance of the parallel combination. The reduced inductance allows operation at a higher resonant frequency. This condition is illustrated in Figure 8(B).

The rotary section provides an infinite number of coarse settings for the various operating frequencies.

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

The folded ½-wave cavity

A special case of the ½-wavelength PA cavity is shown in Figure 9. The design employs a folded ½-wave resonator constructed with coaxial aluminum and copper tubing. This cavity arrangement eliminates the high-voltage blocking capacitor and high-current shorting contacts of conventional designs by connecting the main transmission-line resonant circuit conductor directly to the anode of the power tube. A grounded, concentric transmission-line center conductor tunes the cavity with a variable re-entrant length inserted into the end of the main conductor opposite the tube.

The main conductor (the fixed portion of the plate line) is insulated from ground and carries the anode dc potential. High-voltage power is fed at the fundamental frequency RF-voltage null point, approximately ¼-wavelength from the anode, for easy RF decoupling. A large surface area without sliding contacts results in minimal loss.

Incorporated into the tank design is a second-harmonic suppressor. Rather than attenuating the second harmonic after the signal has been generated and amplified, this design essentially eliminates formation of second-harmonic energy by series-LC trapping the second-harmonic waveform at the point where the wave exhibits a high impedance (approximately ¼-wavelength from the anode). The basic LC circuit placed here will essentially eliminate the second-harmonic component in the plate-current waveform. The second harmonic will peak in voltage at the same point that the dc-plate potential is applied.

Plate tuning is accomplished by an adjustable bellows on the center portion of

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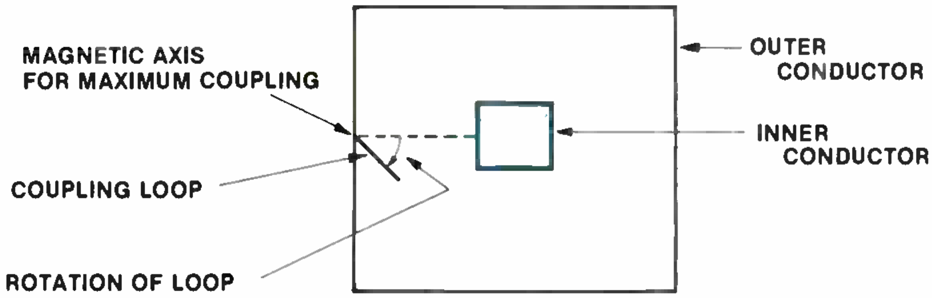

Figure 11. The top view of a cavity showing the inductive coupling loop rotated away from the axis of the magnetic field of the cavity.

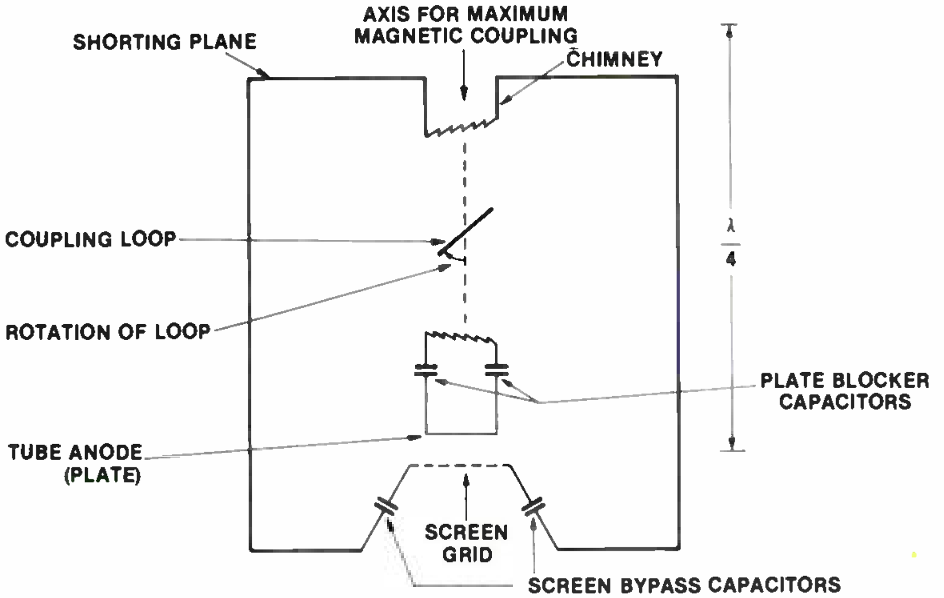

Figure 12. A cutaway view of the cavity showing the coupling loop rotated away from the axis of the magnetic field.

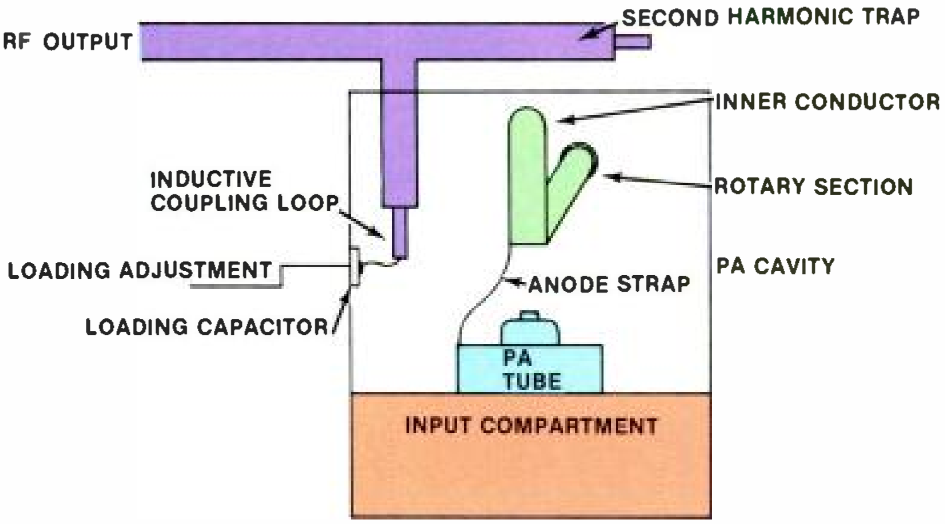

Figure 13. The location of the inductive coupling loop and loading capacitor in a ½-wavelength FM PA stage.

the plate line, which is maintained at chassis ground potential.

Output coupling is accomplished with an untuned loop intercepting the magnetic field concentration at the voltage null (maximum RF current) point of the main line. The PA-loading control varies the angular position of the plane of the loop with respect to the plate line, changing the amount of magnetic field that it intercepts. Multiple phosphor-bronze leaves connect one side of the output loop to ground and the other side to the center conductor of the output transmission line. This allows for mechanical movement of the loop by the PA-loading control without using sliding contacts. The grounded loop improves immunity to lightning and static build-up on the antenna.

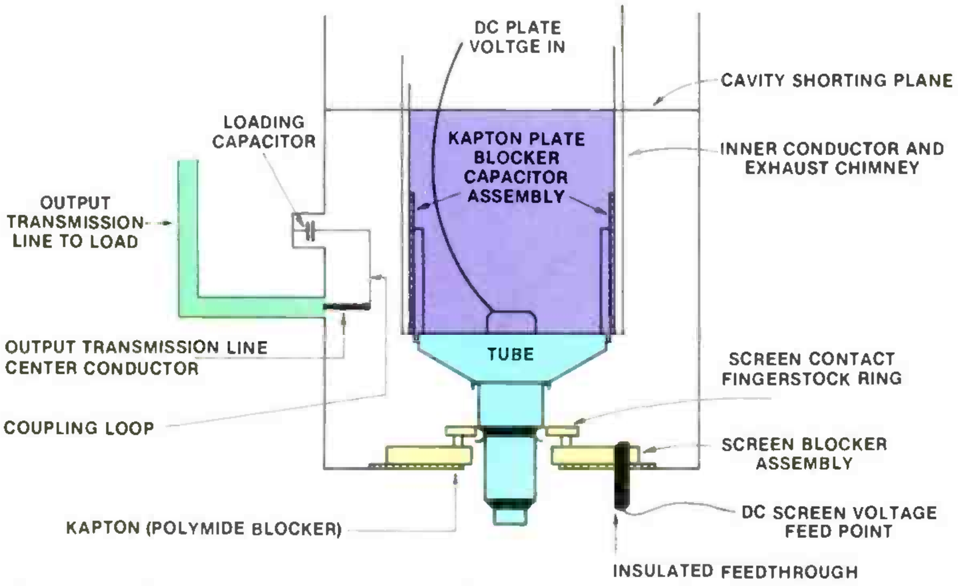

Figure 14. *The position of the inductive coupling loop in a ¼-wavelength FM cavity amplifier. Note that the loop is located away from the points of maximum RF voltage and current.*

Circulating currents

When current flows on one conductor of a transmission line cavity circuit, an equal magnitude current flows in the opposite direction on the other conductor. This means that a large value of RF-circulating current is flowing in a cavity amplifier's outer conductor (the cavity box). All of the outer conductor's circulating currents start at and return to the screen grid.

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

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

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

Output coupling

Coupling is the process by which RF energy is transferred from the amplifier cavity to the output transmission line. Both capacitive (electrostatic) and inductive (magnetic) coupling methods are used in cavity RF amplifiers, and in some designs, combinations of the two are used.

Magnetic coupling

Magnetic coupling employs the principles of transformer action. The efficiency of the coupling depends upon three conditions:

(1) The cross-sectional area under the coupling loop, compared to the cross-sectional area of the cavity. (See Figure 10.) This effect can be compared to the turns ratio principle of the transformer.

(2) The orientation of the coupling loop to the axis of the magnetic field. The

Continued on page 42

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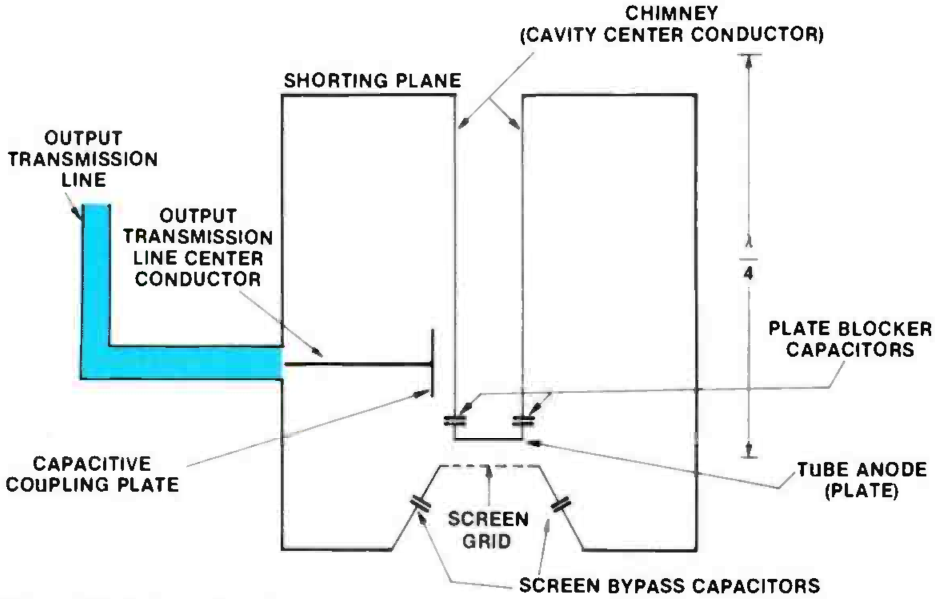


Figure 15. *A ¼-wavelength cavity with capacitive coupling to the output load.*

Continued from page 38

coupling from the cavity is proportional to the cosine of the angle at which the coupling loop is rotated away from the axis of the magnetic field. (See Figures 11 and 12.)

(3) The amount of magnetic field that the coupling loop intercepts. The strongest magnetic field will be found at the point of maximum RF current in the cavity. This is the area where maximum inductive coupling is obtained. Greater magnetic field strength also is found closer to the center conductor of the cavity. Coupling, therefore, is inversely proportional to the distance of the coupling loop from the center conductor.

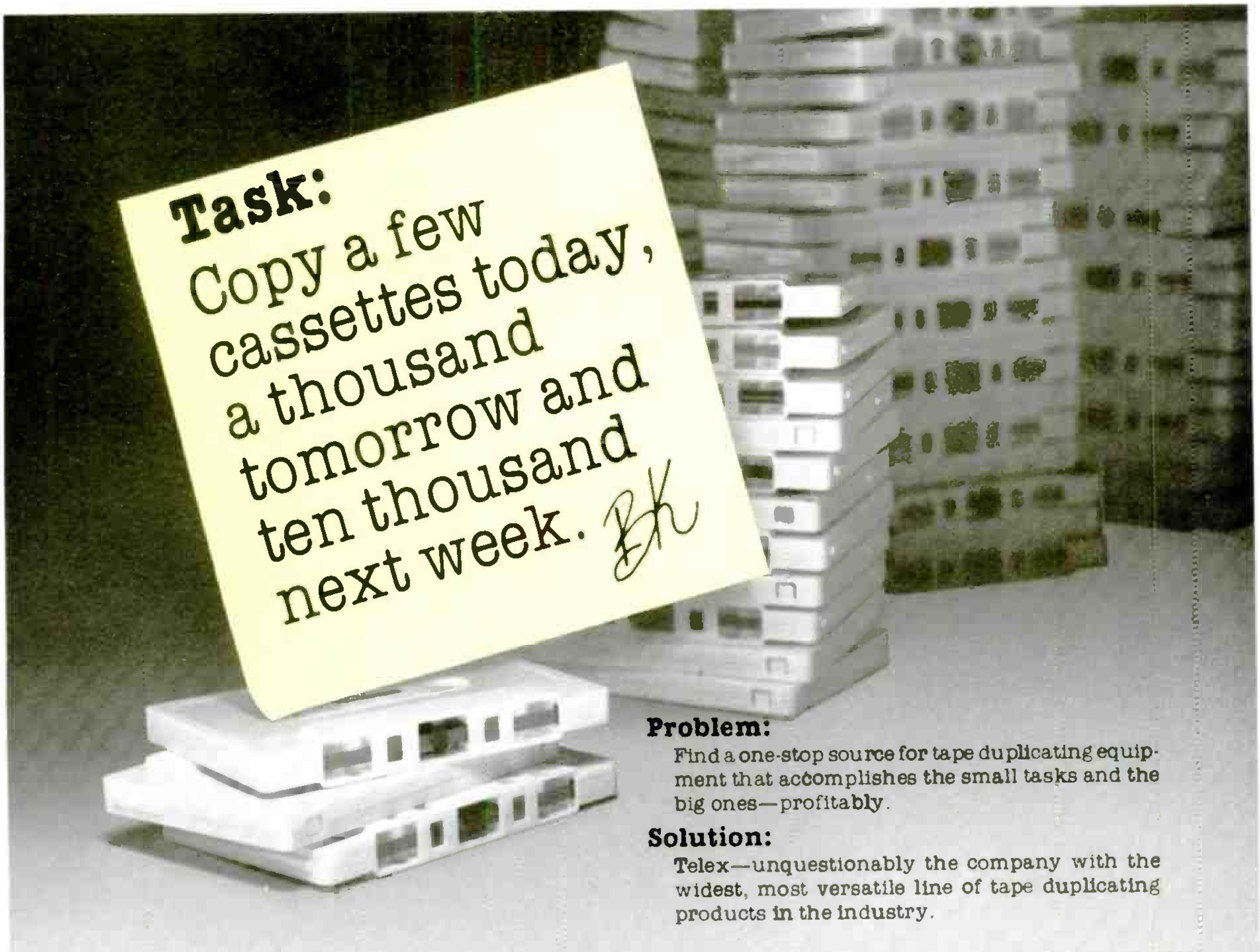
In both ½- and ¼-wavelength cavities, the coupling loop feeds a 50Ω transmission line (the load). The loop is in series with the load and has considerable inductance at VHF frequencies. The inductance will reduce the RF current that flows into the load, thus reducing the power output. This effect can be overcome by placing a variable capacitor in series with the output coupling loop, as shown in Figures 13 and 14. The load is connected to one end of the coupling loop and the variable capacitor ties the other end of the loop to ground. The variable capacitor cancels some or all of the loop inductance. It functions as the PA-stage loading control.

Maximum loop current and output power occurs when the loading capacitor cancels all of the inductance of the loading loop. This lowers the plate impedance and results in heavier loading.

Light loading results if the loading capacitance does not cancel all of the loop inductance. The loop inductance that is not canceled causes a decrease in load current and power output, and an increase in plate impedance.

Capacitive coupling

Capacitive coupling, which physically appears to be straightforward, often baffles the technician because of its unique characteristics. Figure 15 shows a cavity amplifier with a capacitive-coupling plate positioned near its center conductor. This coupling plate is connected to the output load, which can be a transmission line or a secondary cavity (for TV serv-



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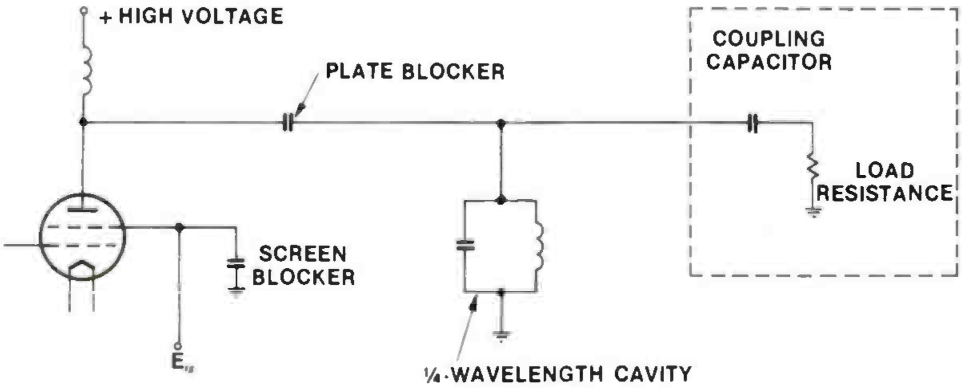

Figure 16. The equivalent circuit of a ¼-wavelength cavity amplifier with capacitive coupling.

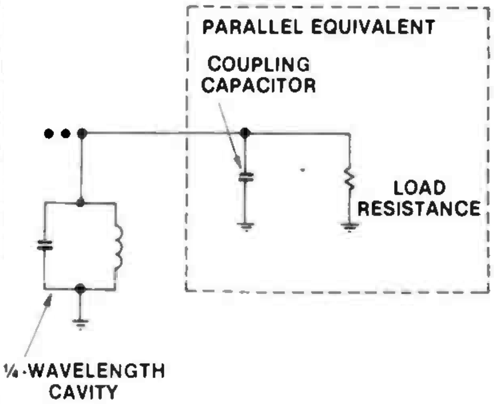

Figure 17. The equivalent circuit of a ¼-wavelength cavity amplifier showing how the series capacitive coupling appears electrically as a parallel circuit to the PA tube.

ice). The parameters that control the amount of capacitive coupling are: the area of the coupling-capacitor plate (the larger the area, the greater the coupling) and the distance from the coupling plate to the center conductor (the greater the distance, the lighter the coupling). Maximum capacitive coupling occurs when the coupling plate is at the maximum voltage point on the cavity center conductor.

To understand the effects of the capacitive coupling, the equivalent circuit of the cavity must be observed. Figure 16 shows the PA tube, cavity (functioning as a parallel resonant circuit) and output section. The plate-blocking capacitor isolates the tube's dc voltage from the cavity. The coupling capacitor and output load are physically in series, but electrically they appear to be in parallel, as shown in Figure 17. The resistive component of the equivalent parallel circuit is increased by the coupling reactance. The equivalent parallel coupling reactance is absorbed into the parallel resonant circuit, thus, the necessity to retune after changing the PA stage coupling (loading). The coupling reactance can be a series capacitor or inductor.

The series-to-parallel transformations are explained by the following formula:

$$R_p = \frac{R_s^2 + X_s^2}{R_s} \text{ and } X_p = \frac{R_s^2 + X_s^2}{X_s}$$

Where R_p = effective parallel resistance;
R_s = actual series resistance;
X_s = actual series reactance; and
X_p = effective parallel reactance.

Although there are many similarities among various cavity designs, each one imposes its own set of operational requirements and limitations. No two cavity systems will tune up in exactly the same fashion. Therefore, closely follow the manufacturer's instructions on tuning. Given proper maintenance, a cavity amplifier will provide years of reliable service. BE

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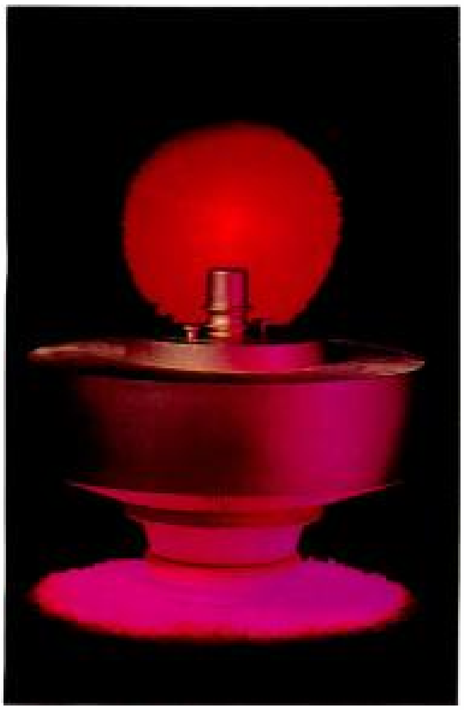

Fine tuning FM final stages

By Geoffrey N. Mendenhall, P.E.

Tuning the output stage of an FM transmitter is more than a peak and a dip process.

Some engineers, even after several years of work, still don't understand the proper procedure for final-stage tuning. Many engineers simply tune for a peak in output and a dip in current, assuming that is all that is required. Improper tuning can affect both a transmitter's efficiency and its audio performance. Because the tuning of each transmitter is slightly different, understanding how the tuning controls affect the transmitter may enable you to improve your transmitter's performance.

Mendenhall is vice president of engineering for Broadcast Electronics, Quincy, IL.

Importance of tuning

Tuning the tube-type power amplifier output stage usually involves several different interacting adjustments. The output circuit's resonant frequency is adjusted to minimize plate current by a control called *output tuning*. The power output level is adjusted by a control called *output loading*. A third kind of adjustment called *screen voltage* is related to the setting of the output-loading control in amplifiers that use a tetrode tube.

Tuning the power-amplifier input stage generally involves two kinds of adjustments. The grid-circuit resonant frequency is set by the *input-tuning* control. The input-impedance match is set by the *input-matching* control. Some newer transmitter designs eliminate the input-matching control by incorporating broadband-matching networks.

Correct adjustment of these controls is essential not only in achieving peak efficiency, but also in making the passband of the amplifier as transparent as possible to the wideband FM signal that must pass through it. When automatic power control (APC) is used with tetrode amplifiers, you also must provide headroom in the tuning procedure. Providing sufficient headroom is important if screen overloads are to be avoided.

Achieving peak efficiency, adequate APC headroom and a centered passband all simultaneously generally is not possible. A reasonable compromise is the best objective when tuning the final stage.

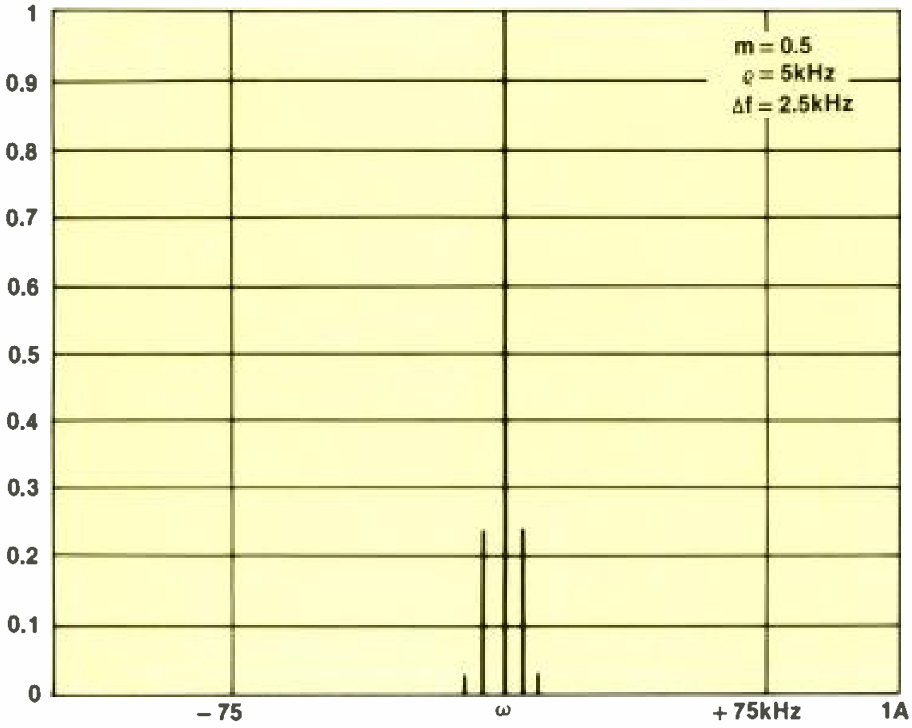

Figure 1. As the modulation index increases, so does the number of sidebands. Shown here is the RF spectrum with a modulation index of 0.5.

FM modulation theory

The radio frequency FM signal consists of pairs of sidebands spaced from the carrier frequency by multiples of the modulating frequency. Theoretically, the RF output spectrum contains an infinite number of these sideband components. When the modulation index M (frequency deviation divided by modulating frequency) is small (0.5), the amplitude of

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$E(t) =$	total RF output voltage
$A[J_0(M)\sin\omega c(t)]$	carrier amplitude
$+[J_1(M)\sin(\omega c + \omega m)t]$	first-order upper sideband
$-[J_1(M)\sin(\omega c - \omega m)t]$	first-order lower sideband
$+[J_2(M)\sin(\omega c + 2\omega m)t]$	second-order upper sideband
$+[J_2(M)\sin(\omega c - 2\omega m)t]$	second-order lower sideband
$+[J_3(M)\sin(\omega c + 3\omega m)t]$	third-order upper sideband
$-[J_3(M)\sin(\omega c - 3\omega m)t]$	third-order lower sideband
$\pm[J_n(M)\sin(\omega c \pm n\omega m)t]$	higher-order sidebands

Where:
A = the unmodulated carrier amplitude constant
J_0 = the modulated carrier amplitude
$J_1, J_2, J_3 \ldots J_n$ = the amplitudes of the nth-order sidebands
M = the modulation index
$\omega c = 2\pi Fc$, the carrier frequency
$\omega m = 2\pi Fm$, the modulating frequency

***Table 1.** Carrier and sideband amplitude and phase can be described by the equations shown here.*

the second- and higher-order sidebands also is small. The output consists mainly of the carrier and the pair of first-order sidebands. This is illustrated in Figure 1.

The total transmitter RF output power remains constant with modulation, but the distribution of that power into the sidebands varies with the modulation index. This means that the power at the carrier frequency is reduced by the amount of power added to the sidebands.

As the modulation index is increased, as in wide-deviation FM broadcasting, the higher-order sidebands become more prominent. The carrier amplitude and phase (J_0) as well as the sidebands (J_1 through J_n) can be expressed mathematically by making the modulation index (M) the argument of a simplified Bessel function. The general expression is shown in Table 1.

The numeric values of the Bessel functions (J_0 through J_n), which express the amplitudes of the various frequency components, can be found in mathematical tables.

Figures 2 and 3 illustrate the frequency components present for modulation indexes of five and 15, respectively. Note that the number of significant sideband components becomes quite large with a high-modulation index. Depending upon the modulating frequency, the total bandwidth occupied can extend beyond ±75kHz from the carrier.

This single-tone modulating frequency analysis is useful in understanding the general nature of FM, and for making tests and measurements. When program modulation is applied, there are many more sideband components present. These components also vary so much that sideband energy becomes distributed over the entire occupied bandwidth rather than appearing at discrete frequencies. A graphical representation of how the Bessel function values for the carrier and the first eight pairs of sidebands vary with the modulation index is shown in Figure 4.

After examining the Bessel function and the resulting spectra, it becomes clear that an FM signal's occupied bandwidth is far greater than the amount of deviation from the carrier. In fact, the occupied bandwidth is infinite if all the sidebands are taken into account. This means that for perfect information demodulation, a frequency-modulation system would require the transmission of an infinite number of sidebands. In practice, an acceptable quality signal can be transmitted within the limited bandwidth assigned to an FM channel.

Continued on page 52

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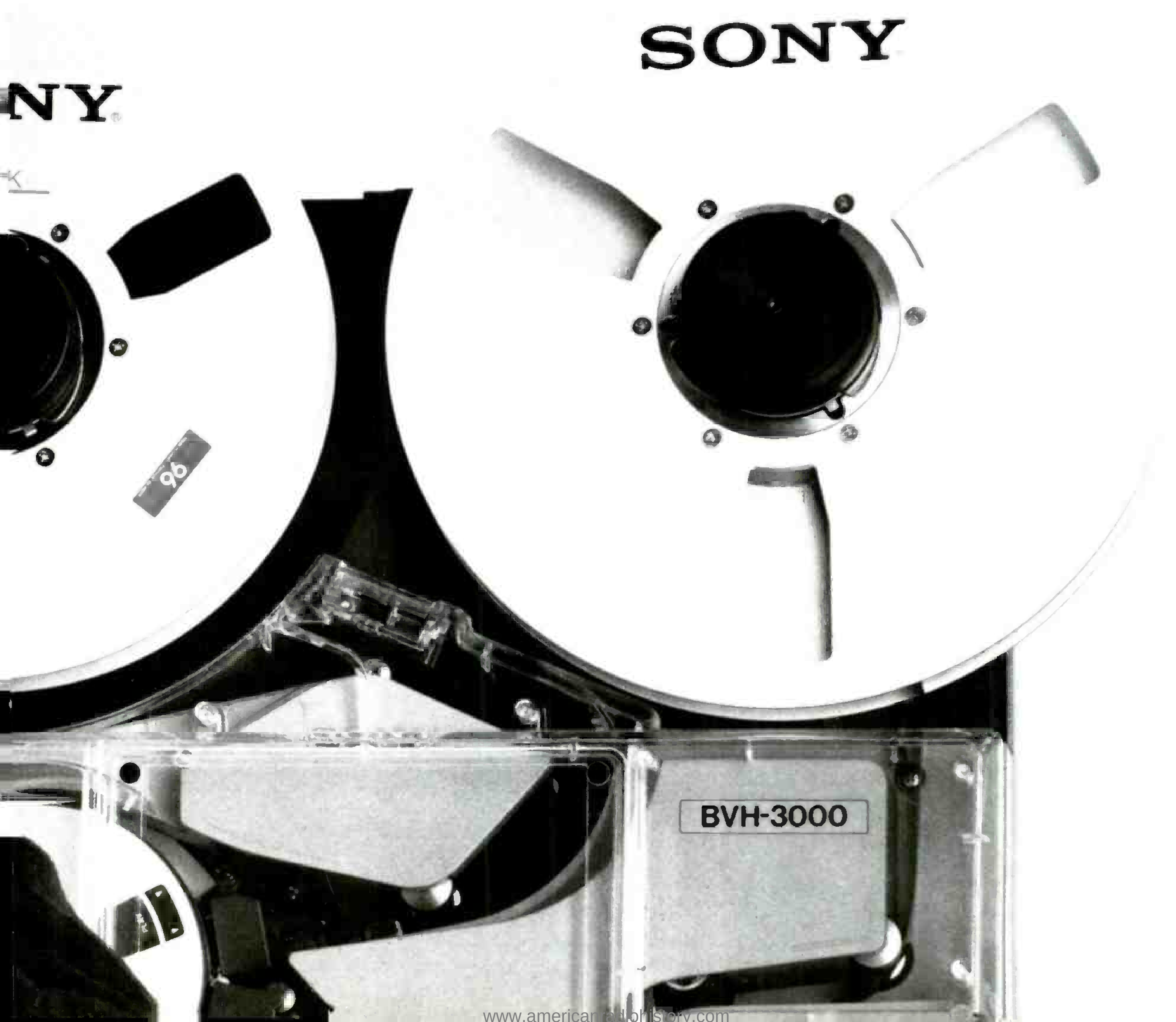

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Bandwidth vs. distortion

Figure 5 depicts a perfect FM modulator connected to a perfect demodulator via a wide-bandwidth RF path. The resulting demodulated baseband (see Figure 6) contains no distortion components.

The effects of an RF bandpass filter on the RF spectrum of a composite baseband signal are shown in Figure 7. The signal consists of a stereophonic baseband modulated at 4.5kHz with only one channel of audio and an unmodulated 67kHz SCA subcarrier. The only distortion evident on the RF spectrogram is the attenuation of sidebands greater than 200kHz from the center frequency and the amplitude differences between the lower and upper sideband pairs.

The corresponding effects observed on the demodulated baseband spectrum for the same signal are shown in Figure 8. Note the creation of many undesired intermodulation terms that will cause crosstalk into subcarrier bands. The distortion shown in this FM system is a result of the limited bandwidth available for the modulation index being used.

Tuning affects sidebands

In a transmitter, the higher-order FM sidebands will be slightly attenuated in amplitude and shifted in phase as they pass through the final amplifier stage. These alterations in the sideband structure are introduced by the amplifier passband and produce distortion in the receiver. The amount of distortion is dependent on the available bandwidth vs. the signal's modulation index.

For a given bandwidth limitation, the distortion usually can be minimized by centering the amplifier's passband on the signal being transmitted. This causes the amplitude and phase errors to equally and symmetrically affect both the upper and lower sidebands.

Tuning an amplifier for maximum power output or best efficiency does not necessarily result in a centered passband. One way to center the passband is to tune the amplifier for minimum synchronous AM modulation while applying FM modulation to the transmitter.

Types of AM modulation

The perfect FM transmitter has an absolutely constant output, regardless of FM modulation or power-supply variations. In practice, there is always some residual amplitude modulation of the FM transmitter output. There are two types of AM modulation that are of interest to the FM broadcast engineer:

- Asynchronous AM modulation is measured without FM modulation and is primarily related to power-supply ripple.
- Synchronous AM modulation (inciden-

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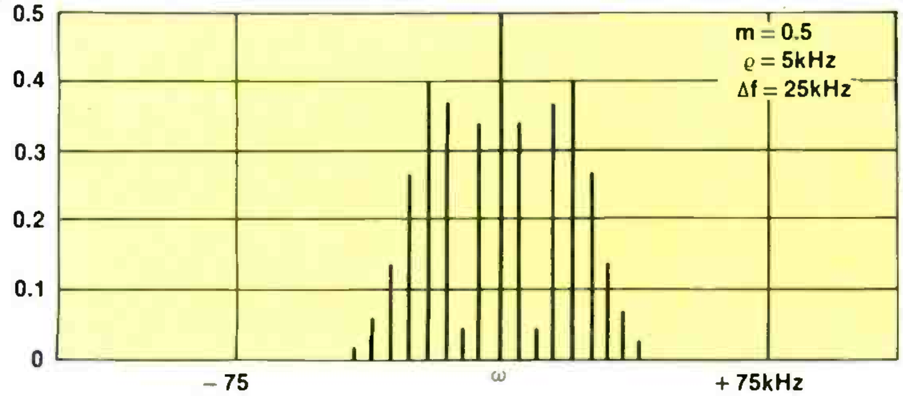

Figure 2. RF spectrum with a modulation index of 5.

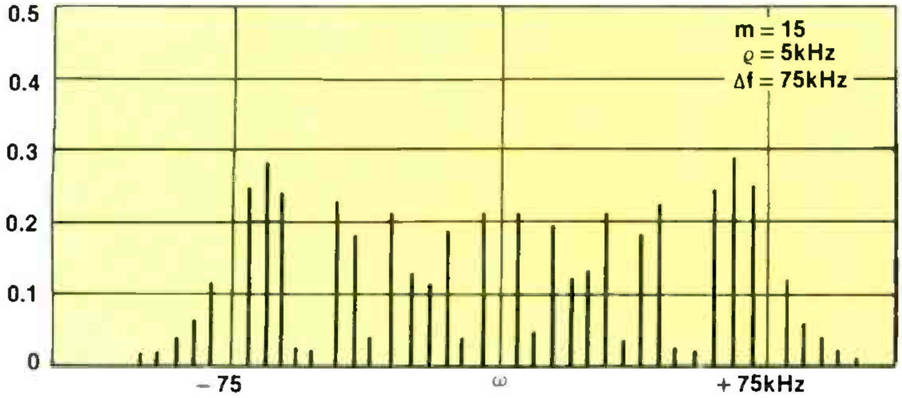

Figure 3. RF spectrum with a modulation index of 15. Note the dramatic increase in occupied bandwidth, as compared with Figures 1 and 2.

tal AM), which is measured with FM modulation, is related to the tuning and overall system bandwidth.

Asynchronous modulation

Residual amplitude modulation of the transmitter output, primarily due to power-supply ripple, is measured with an AM envelope detector. Most FM modulation monitors include an AM detector for this purpose. This detector should include 75μs de-emphasis in its output. The residual AM noise in a properly operating FM transmitter will be at least 50dB below the level that represents 100% amplitude modulation of the carrier. If the transmitter is unable to meet the 50dB requirement, the problem usually can be traced to a power-supply component or to a line imbalance in a 3-phase system.

Synchronous AM

Synchronous AM is a measure of the incidental amplitude modulation introduced onto the carrier by the presence of FM modulation. This measurement is useful for determining the proper transmitter tuning. Because all transmitters have limited bandwidth, there is a slight drop-off in power output as the carrier frequency is swept to either side of the

Continued on page 58

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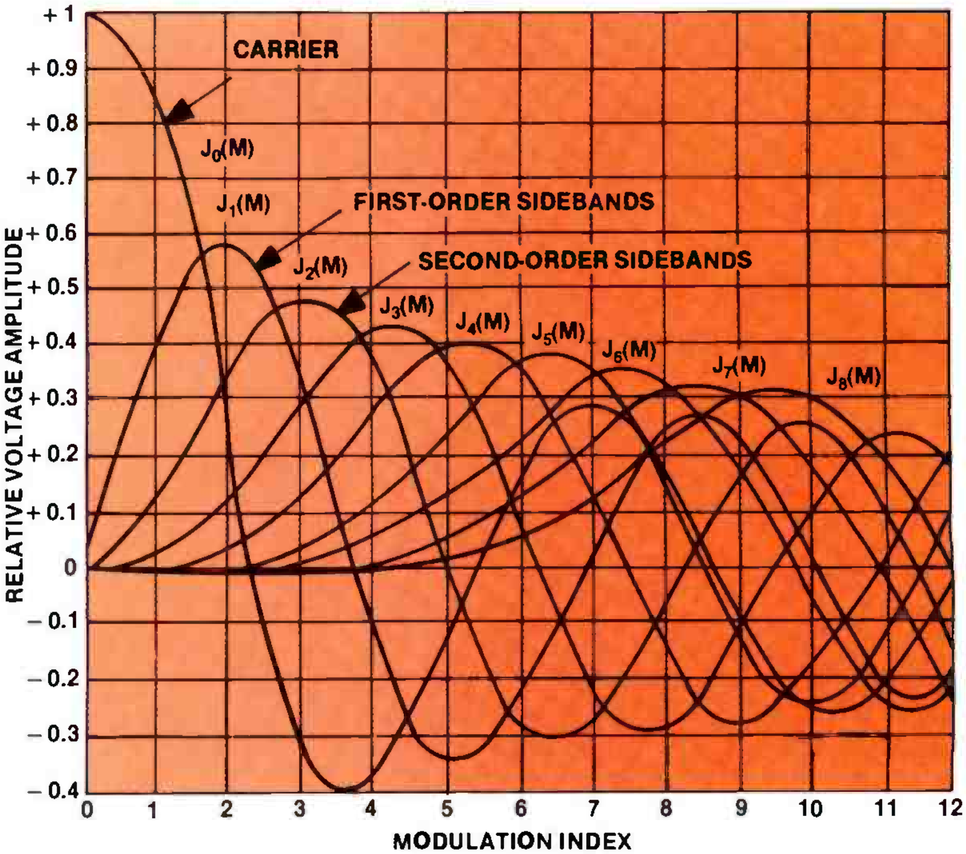

Figure 4. The Bessel function graph illustrates the relationship between the carrier and sideband amplitudes to modulation index.

Continued from page 54

center frequency. This slight change in RF output level follows the waveform of the signal being applied to the FM modulator. The result is AM modulation produced in synchronization with the FM modulation. The concept is similar to the slope detection of an FM signal by an AM detector and a tuned circuit.

Both types of AM noise measurements are made directly at the transmitter output (or an accurate output sample). No amplifying or limiting equipment can be used between the transmitter output and the AM detector because non-linearities in this equipment can actually modify the AM noise level.

Because the transmitter cannot be fully amplitude-modulated, an equivalent reference level must be established indirectly by first measuring the RF-carrier voltage. Refer to the instructions provided by the detector manufacturer to determine this reference level. Generally, the reference level is determined by setting a carrier-level meter to a specified reading or obtaining a specific dc-voltage level without modulation at the detector diode's output.

Measuring synchronous AM gives the station engineer an idea of the system's overall bandwidth and whether the passband is positioned correctly. Tuning for minimum synchronous AM will assure that the transmitter passband is properly centered on the FM channel.

A synchronous AM measurement of 40dB or more below equivalent 100% AM is acceptable. Some of the newer single-tube transmitters can be adjusted for 50dB or more synchronous AM suppression. Table 2 approximates the overall system bandwidth for a given AM noise measurement.

Tuning for peak performance

All transmitter optimization should be done with the automatic power control system disabled. This prevents the APC from chasing the tuning adjustments in an attempt to keep the output power constant. The transmitter should be connected to the normal antenna system, rather than to a dummy load. Because the antenna resistance and reactance will be different from the dummy load, the optimum tuning point of the transmitter will be different for the two different loads.

The transmitter should be tuned for normal output power and proper efficiency according to the manufacturer's instruction manual. The meter readings should closely agree with those listed on the manufacturer's final test data sheet if the transmitter is being operated on the same frequency at the same power level into a proper load.

Input tuning and matching

The input-tuning control should be adjusted for maximum grid current and then fine-tuned interactively with the input-matching control for minimum reflected power to the driver stage. Note that the point of maximum grid current may not coincide with the minimum reflected power to a solid-state driver. This

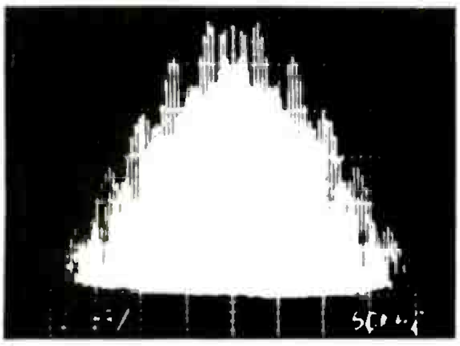

Figure 5. This wideband RF spectrum acts as the test signal for the comparisons.

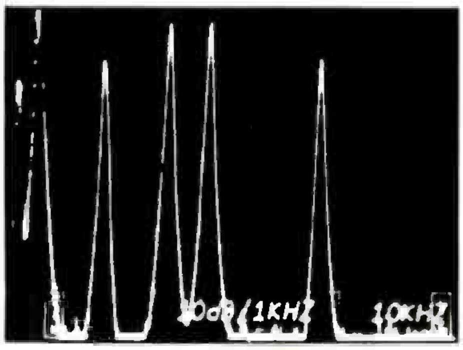

Figure 6. Note the lack of distortion products after the signal has passed through a perfect FM demodulator and wide-bandwidth RF path.

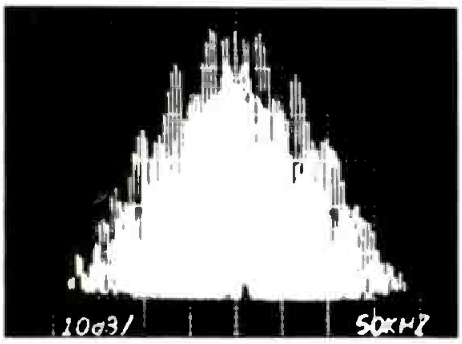

Figure 7. The original signal has now been passed through a bandwidth-limited system. The only visible distortion is for signals greater than 200kHz removed from the carrier.

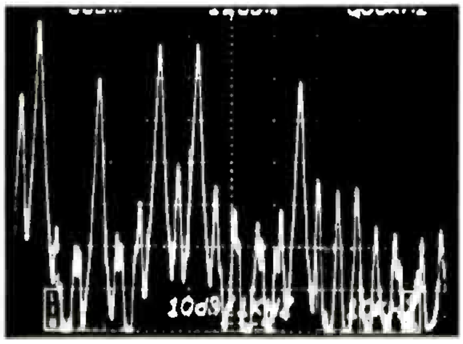

Figure 8. The resulting baseband signal shows intermodulation distortion products.

is because a solid-state driver actually may deliver more power at certain complex load impedance than into a 50Ω resistive load.

The main objective during input tuning is to obtain adequate grid current while

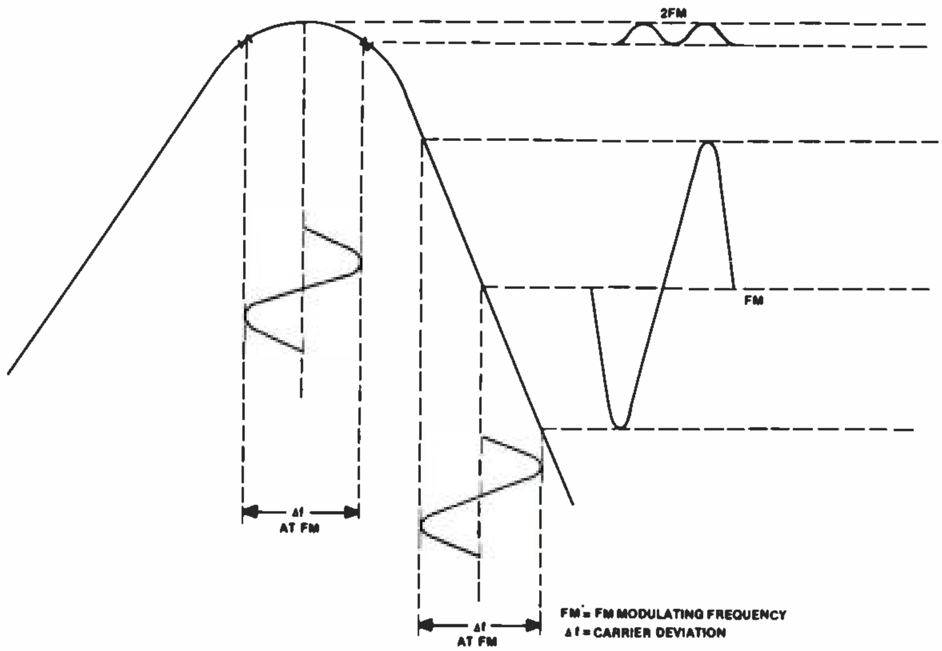

Figure 9. *At the point of minimum synchronous AM, the demodulated output from the AM detector will double in frequency.*

PEAK-TO-PEAK SYNCHRONOUS AM (BELOW EQUIVALENT 100% AM) (WITH ±75kHz AT 400Hz FM)	APPROXIMATE BANDWIDTH (−3dB)
−40dB	1.1MHz
−45dB	1.4MHz
−50dB	2 MHz
−55dB	2.5MHz
−60dB	3.4MHz

Table 2. *The RF amplifier bandwidth can be estimated by first measuring the peak-to-peak synchronous AM noise. Using that result, obtain the approximate bandwidth from the chart.*

providing a good match (minimum reflected power) to the coaxial transmission line from the driver. In the case of an older transmitter with a tube driver, the driver-plate tuning and the final grid tuning combine into one control, which is adjusted for maximum grid current.

Output tuning

The output-tuning control adjusts the resonant frequency of the output circuit to match the carrier frequency. As resonance is reached, the plate current will drop while both the output power and screen current rise together. Under heavily loaded conditions this dip in plate current is not very pronounced, so tuning for a peak in screen current is often a more sensitive resonance indicator.

Amplifiers using a folded ½-wave cavity display little interaction between output tuning and output loading. This is because the output-coupling loop is located at the RF voltage null point on the resonant line. Interactive adjustment of output tuning and output-loading controls is required for ¼-wave cavities because changes in loading also affect the frequency of the resonant line.

Output loading

There is a delicate balance between screen voltage and output loading for amplifiers using a tetrode tube. Generally there is one combination of screen voltage and output loading at which peak efficiency occurs. At a given screen voltage, increasing the amplifier loading will result in a decrease in screen current, while a decrease in loading will result in an increase in screen current. As the screen voltage is increased to get more output power, the loading also must be increased to prevent the screen current from reaching excessive levels. Further increases in screen voltage without increased loading will result in a screen overload without an increase in output power.

APC headroom

APC feedback systems used in many transmitters regulate the power output around a predetermined set point. The selected set point accommodates typical variations in ac-line voltage or changes in other operating parameters.

Most modern FM broadcast transmitters use a single high-gain tetrode as the final amplifier stage. In these transmitters, adjusting the screen voltage provides a fine adjustment of the output power.

For each power output level there is one unique combination of screen voltage and output loading that provides peak operating efficiency. If the screen voltage is raised above this point without a corresponding increase in loading, there will be no further increase in power output with increasing screen voltage and screen current. If the screen voltage is increased without sufficient loading, a screen current overload will occur before the upward adjustment in power output is obtained.

To avoid this problem, it is a good idea to tune the transmitter with slightly heavier loading than necessary. This practice allows the transmitter to achieve the desired power output level and still provide approximately 5% of headroom in the adjustment range.

The output loading can be adjusted for a peak in output power 5% over the desired level. After this point is reached, the screen voltage can then be reduced enough to return to the desired power level. This procedure will allow sufficient headroom for a screen-voltage APC system. Although the result is a small compromise in efficiency, the practice permits the transmitter power output to increase by up to 5% without encountering a screen overload.

Minimizing synchronous AM

After the correct loading point has been set, FM modulate the transmitter 100% (±75kHz) at 400Hz. Carefully adjust the transmitter's input and output tuning controls for minimum 400Hz AM modulation as detected by a wideband envelope detector (diode and line probe). The input matching and output-loading controls should not need any further adjustment. It is helpful to display the demodulated output from the AM detector on an oscilloscope while making this adjustment.

Note that as the point of minimum synchronous AM is reached, the demodulated output from the AM detector will double in frequency from 400Hz to 800Hz. This is caused by the reduction in output power, which is symmetrical about the center frequency. The effect causes the amplitude variations to go through two complete cycles for every one FM sweep cycle (see Figure 9). It should be possible to minimize synchronous AM while maintaining output power and sacrificing only a small amount of efficiency in a properly operating power amplifier.

A precision envelope detector

Care must be taken when making these measurements to ensure that the test setup does not introduce synchro-

Evolution of broadcast transmission lines

By Geza Dienes

The transfer of RF energy is an art and a science, with a little plumbing tossed in.

Today's sophisticated circular waveguide represents great strides in the development of broadcast transmission-line technology. We have come a long way since the days of 2-wire line. How did we get here? The answer to that question lies in the evolution of broadcast transmission-line technology.

The early days

In the early days of dc it was obvious that a pipeline must be provided for the electrons moving from the source of supply (the negative side of a battery) to the load, and then to a place of disposal (the positive side of a battery). Two metallic wires connected one side of the load to each pole of the battery. The wires did not need to be of equal length, nor was their relative position important. Remember the lab experiments with scattered wires, connections and switches you performed during Electronics 101 class in college?

Dienes is senior research engineer with Andrew Corporation, Orland Park, IL.

Soon, however, came *wireless*, working on the principle that alternating current flow creates an alternating electromagnetic field, which travels through space and is detectable from far away. A new means of information transfer and communication was born. Because wireless transmission is similar to seeds thrown into the wind, the concept of *broadcasting* was applied to generating time-varying electromagnetic fields throughout a large region in space. The industry had a name.

The 2-wire line

The efficient and controlled conversion of energy from alternating current to electromagnetic fields is performed by the antenna. For convenience (among other reasons) the antenna typically is located some distance away from the RF generator. Transferring the energy from the generator to the antenna requires some type of transmission line. One solution was the 2-wire line.

The behavior of transmission lines is described by the so-called *telegrapher's equation* developed circa 1897. The equation is based on Maxwell's description of electromagnetic propagation and provides solutions for various parameters of transmission lines, including the velocity of propagation, impedance and attenuation. Simplified versions of this equation were adapted and developed for specific transmission line configurations, such as the 2-wire coaxial lines and various types of waveguide.

The 2-wire term refers to a transmission line that consists of two parallel wires separated by a constant distance that is small compared to a wavelength. All alternating current flow causes radiation, but because the current flow in the two wires is in opposite directions, the electromagnetic field generated by one wire tends to oppose and cancel the field generated by the other wire. As long as the distance between the wires of the 2-wire line is small in relation to a wavelength, the net radiation from the transmission line is negligible.

The 2-wire transmission line was extensively employed in the early days because of its many attractive features. The frequencies used for broadcasting were generally less than 30MHz, so a wire

Photo by Bernard J. Surtz. Courtesy of Andrew Corporation.

Foam dielectric coaxial cable allows optimal selection of feedlines.

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spacing of 6 to 8 inches was small enough to prevent unwanted radiation and, at the same time, large enough to avoid voltage breakdown. The line could be homemade with a minimum of equipment and the materials required were readily available.

The advantages of this transmission line, such as simplicity, low cost, ease of manufacture and high-power handling capability, were designed to offset some of its deficiencies, which included environmental exposure, general vulnerability and personnel safety considerations.

The need for a better transmission line

By the early 1930s, radio had taken over the land. As the number of transmitting stations mushroomed, so did the potential for interference. To minimize the possibility of one station interfering with others, rules governing radiation were developed. These requirements often included the need for specialized antenna patterns and a change in radiation patterns during nighttime operation. To fill the need, multitower AM broadcast arrays were developed.

These multi-element or multitower AM arrays produced the correct antenna pattern only when the proper phase and amplitude relationship was maintained among the tower members. Delivering the RF energy to each tower in the proper manner was the task of the transmission line. Precisely preset conditions must be maintained over time, regardless of changes in the environment surrounding the antenna system.

Because the typical 2-wire line was exposed to the elements and there was some interaction among the multiple 2-wire lines, it was not surprising that difficulties were encountered in producing an electrically stable transmission-line system for feeding multi-element AM arrays. The environment, snow, ice and intercoupling tended to change the preset phase and amplitude delivered to each element of the array from day to night and from season to season. A more stable, environmentally tolerant transmission line was needed to improve control of RF transmissions.

During this same time, the telephone communication industry also needed a better transmission line. The desire to lay undersea cable to provide telephone communications among continents created the need for a transmission line that could withstand extreme outside pressures, could be electrically shielded and sealed against the elements, and would exhibit a reasonably low attenuation. Coaxial line was the natural candidate.

Coaxial transmission line

The coaxial transmission line consists of two concentrically arranged cylinders. The shielding is provided by the outer cylinder or outer conductor. Because all electrical fields are confined between the two cylinders, current does not flow on the outside of the outer cylinder. The entire line can be made to withstand large pressures from within or from outside the cable.

The first coaxial transmission-line sections for broadcast application were manufactured by hand. Tubes used in the manufacturing of these early coaxial-line segments generally were in sizes developed for the plumbing industry—⅞ inches, 1⅝ inches, 3⅛ inches and 6⅛ inches.

The impedance of a coaxial line is related to the relative diameters of the inner and outer conductors and is easily controlled. Coaxial lines with a large variety of impedances were developed over the years for diverse applications. The 50Ω impedance, a compromise between power-carrying capability and attenuation, became the industry standard. Up until the mid-1950s, a combination of two impedances, 51.5Ω (because of the available commercial tubing) and 50Ω (because of the newly established industry standard) was used. The 75Ω coaxial line, typically used by the TV industry, was chosen because it provided the lowest attenuation.

Commercial availability of coaxial transmission line dates to the mid-1930s. Victor J. Andrew (founder of Andrew Corporation) handmade his first coaxial line components in January 1937. These were coaxial components with flanges, hand-soldered onto each end of the outer conductor tubing with the center conductor supported on ceramic beads. The entire ceramic bead and center conductor assembly was then pulled into the outer conductor.

The proliferation of AM stations between 1930 and 1940 provided a growing market for commercial coaxial-line components. The majority of transmitters tended to be low power by today's standards, with power outputs typically less than 5kW. FM broadcasting appeared in the mid-1930s and later proved to be commercially viable.

The 1940s brought about major advancements in transmission-line technology. World War II, the development of television and the frequency change for FM broadcasting from 50MHz to the 88MHz to 108MHz frequency band all motivated this research and development effort.

The requirements of military operations and the invention of radar prompted a great deal of research, most of it by MIT, into both coaxial and waveguide transmission lines for high power and high frequency. The frequency change of FM broadcast from the 50MHz to 100MHz band was significant because the 2-wire transmission line had either too much extraneous radiation or was too closely spaced for power breakdown at these frequencies. Also, it was just too vulnerable to the elements.

The industry developed standards covering the power levels and frequency bands of various sizes of coaxial lines. These standards included a 75Ω 6-inch-diameter coaxial line for TV use, a 180Ω 3-inch-diameter line for radar use and a 50Ω line for general-purpose use.

Over the years a wide range of coaxial lines became available, ranging from 1/16 inch to 9 inches in diameter. The largest known coax (14 inches in diameter) was manufactured in 1961 for a cyclotron carrying 50MW of RF power. The flexible, continuous-length coaxial cable using a solid dielectric material for insulation and a braided outer conductor also dates to that time period.

Flexible coaxial cable for broadcast

One of the most significant advances in coax manufacturing technology was the development of a manufacturing technique that allowed the production of long, continuous lengths of large coaxial cables. Two types of cables were developed over the years. One had a smooth outer conductor and the other had a corrugated outer conductor for greater flexibility.

This meant cables could be manufactured in sizes up to 9 inches in diameter. These flexible cables could be installed in continuous lengths up to several hundred feet, and required only one connection to the mating equipment at each end. The cable could be shipped on reels in a compact manner, reducing both shipping and installation costs. An outer jacket of a plastic material protected the cable from the elements. This was a boon to the broadcast industry because the cable provided high reliability, educed maintenance and installation costs and also made direct burial possible.

These cables are marketed under a variety of trade names. The typical manufacturing technique for such cable includes continuous seam welding of thin copper strips to form the inner and outer conductors, with a continuous dielectric material and annular or helical corrugations to provide flexibility.

During World War II, the FCC stopped

issuing construction permits for new broadcast stations. The pent-up demand caused explosive growth after the war when hundreds of AM, FM and TV stations mushroomed all over the United States. The public accepted television with open arms and the number of TV receiving sets increased from 10,000 in 1946 to more than 12 million by 1951.

The growth of the TV broadcast industry became so vigorous that in 1948 the commission was forced to freeze the issuance of TV construction permits pending implementation of interference regulations. Subsequently, competing stations covering the same market were vying with one another to provide better-quality sound, picture and reception. This placed demands on the performance of the transmission line. To improve performance, the manufacturers responded with more sophisticated coaxial-line designs that included polyethylene inner conductor supports instead of ceramic bead supports, improved inner connector (bullet) designs, pressurization equipment to protect the large and expensive transmission-line installations and grounding systems to protect against lightning.

Power levels also were increasing to provide better coverage and greater signal strength to the user. The increasing output of transmitters required larger coaxial transmission lines to handle the higher powers and more precisely controlled manufacturing techniques to better control the propagation parameters.

Coaxial line for UHF television

By the mid-1950s, many of the major markets were using all the available VHF TV channels. In order to enter one of these TV markets, the broadcaster had to apply for one of the UHF channels. UHF TV frequencies, being much higher than VHF frequencies, have three disadvantages. First, the propagation of UHF frequencies is not as favorable as VHF frequencies, especially over the horizon. Second, TV sets are not as sensitive to UHF frequencies as they are to VHF frequencies. Third, the free-space attenuation, the apparent loss of signal as a function of distance, is greater for the UHF frequencies than for VHF. In order to provide comparable performance, the commission allowed a greater effective radiated power (ERP) for the UHF stations. In fact, the ratio is almost 20 to 1.

Some of the allowable increased ERP may be generated by using a higher-gain antenna. However, the antenna alone cannot offset this large difference, so still higher-power transmitters were developed for the UHF frequencies. Thus, while transmitter powers for a typical VHF station are in the 30kW to 60kW range, the power output for a UHF station is in the 50kW to 220kW range. Carrying the output of such high-power transmitters to the antenna places tremendous demands on the transmission line.

The limitation of coaxial line

The designer of a coaxial transmission line was caught between the jaws of a vise. To produce a coaxial transmission line with a 75Ω impedance, typically used for UHF broadcasting, the inner conductor diameter is 3.6 times smaller than the diameter of the outer conductor. That, of course, means that the resistance of the inner conductor is 3.6 times higher than the resistance of the outer conductor. However, both conductors have to carry the same current. The heat generated by this current, or the I^2R losses, are, therefore, nearly four times higher on the center conductor than on the outer conductor. The center conductor thus tends to heat up. The coaxial line is like a vacuum thermos bottle in the sense that there basically is only one means of heat escape from the center conductor, and that is radiation.

Radiation, however, is a very inefficient means of heat transfer and the center conductor needs to be reasonably hot for the transfer to take place at all. If the center conductor gets too hot, oxidation occurs. A softening of the insulating material that supports the center conductor also may take place. Limits, therefore, must be placed on the amount of power that may be carried by a coaxial line.

The natural response to this problem would be to manufacture a larger-diameter line that would have a larger-diameter inner conductor and, therefore, less I^2R heat loss. Unfortunately, if the outer and inner diameters of the coax are increased too much, a new mode of propagation may exist in the coaxial line, which is highly undesirable. The designer must carefully select the size of a high-power coaxial line to be as large as possible but not to exceed that dimension that allows an unwanted mode of propagation.

Once the proper coaxial transmission-line size has been determined, one more serious problem remains, which also is the result of heat developed on the center conductor. Because the center conductor runs at a temperature that is typically as much as 65.55°C to 104.4°C hotter than the outer conductor, there will be relative length change between the two conductors. The center conductor will grow in length as a result of its higher temperature.

To accommodate the expansion at each junction point between consecutive coaxial-line segments, a sliding center conductor contact must be provided. This sliding contact allows the center conductor to expand and contract as its temperature varies while providing con-

Coaxial transmission line consists of two concentric cylinders aligned on a single axis, insulated from each other.

tinuity from one segment to another.

The inner conductor temperature is not constant with time, but varies as a function of transmitter power output. When the station goes off the air the inner conductor cools off, and when power is applied again it heats up and expands. This causes a cyclic variation of the inner conductor length and causes the end of the center conductor to slide back and forth on the stationary center conductor (often referred to as a bullet), which is caught between the mating section flanges.

Unfortunately, the periodic sliding action can cause metal shavings to flake off both the center conductor and the connector and roughen the sliding surfaces. These metal shavings fall on the insulators and, if enough accumulates, provide a current path across the support insulator. The result will be a flashover and a destroyed transmission line. Also, the increased contact resistance caused by the roughed-up sliding surfaces will generate extra heat, which could eventually result in a portion of the center conductor melting, another threat to the line. Most major high-power transmission-line failures occur due to one or both of these conditions.

Coaxial line for UHF television

To provide a coaxial transmission line with the highest possible reliability, development is under way for a coaxial line without sliding contacts. The result is a new series of coaxial line. This line uses an inner connector (bullet) similar to the traditional sliding inner connector, but the new connector, once inserted into the mating section, has a contact pressure high enough to prevent sliding. Center conductor growth and shrinkage is accommodated by a built-in bellows. The bellows segment acts like an accordion, stretching and compressing as needed. This design eliminates the sliding action that is the root cause of most transmission-line failures. To date, thousands of feet of 6⅛-inch line has been installed in

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Rectangular waveguide

At the turn of the century, several investigators predicted the possibility of guiding electromagnetic waves inside hollow metallic pipes. The cross-sectional dimension of the pipe would have to be about ½-wavelength. For low frequencies (long wavelengths) the pipe size would have to be enormous, on the order of tens or even hundreds of feet. This simply was not practical.

During World War II, much emphasis was placed on the development of high-frequency generating equipment to be used for radar. The study and development of transmission lines for the guiding of high frequencies was a by-product of radar development. MIT and other research centers conducted theoretical studies as well as practical experiments with waveguides of various shapes and types. By 1945, there was sufficient theoretical and practical know-how available to apply these newly developed transmission-line technologies in the commercial field.

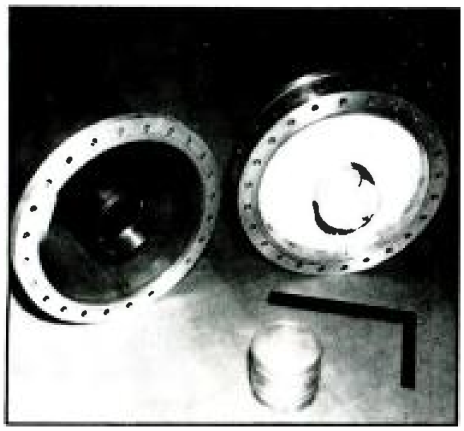
Waveguides provide low attenuation and exceptionally high power capability. They do not have a center conductor so the problem of cooling the center conductor is eliminated. All resistive heat loss is developed on the surface of the hollow pipe, which is in direct contact with the outside environment. Heat transfer may take place from the hollow pipe to the environment via both convection and radiation, so cooling is quite efficient. In addition, the attenuation of waveguide is much lower than the attenuation of coaxial line for a given frequency. Therefore, less heat is developed on the waveguide conductor itself. Waveguide appeared to be an ideal transmission line.

As the power output of UHF TV stations increased to the 110kW and 220kW levels, waveguide, as a reliable alternative to coaxial transmission line, became more attractive. Rectangular waveguide with a cross-section of roughly 15"x7.5", although much larger than a 6- or 8-inch-diameter coaxial line, could provide reliable service with low attenuation. In the late 1950s and early 1960s several UHF TV stations were using rectangular waveguide. To date, these stations report high reliability.

Typically, the waveguide is manufactured from welded aluminum sheet metal. It is somewhat more expensive than coaxial line, but produces greater reliability, especially at high power levels.

VHF/UHF TV competition

The 1960s and '70s saw a proliferation of UHF TV stations. Many of these stations were constructed in markets domi-



The world's largest known coax, 14 inches in diameter, was designed for a cyclotron.

nated by long-established VHF stations. In order to compete, the UHF stations had to offset the disadvantages of broadcasting at the higher frequency. Owners of these stations began to realize that successful competition required excellence in coverage and that superior coverage was the result of the proper balance among several important performance requirements.

First, it is desirable to radiate the maximum practical ERP. In some cases, emitting the maximum legal ERP of 5MW (mean) is essential. Second, it is mandatory that the antenna system be designed to provide the optimum coverage. This requirement implies the use of UHF TV antennas with moderate but never high elevation directivity, and a great deal of null-fill. Because ERP is a product of power input to the antenna and antenna gain, which is limited by the requirement to provide optimum coverage, the only way to achieve a high ERP is to use more RF power. So, in the final analysis, the UHF TV station owner was forced to use a very high-power transmitter to be successful in the major markets.

The choice of transmission line had become limited. A coaxial line of the largest possible diameter, typically 8 or 9 inches, was only marginally adequate at these power levels. The other choice was waveguide. After considering the cost of being off the air for transmission-line repairs, more and more high-power stations opted for rectangular waveguide.

One additional factor also influenced the choice. The effectiveness of TV coverage, especially that of UHF, is significantly increased with antenna height. Realizing this, many stations not blessed with nearby mountains built tall towers, up to 2,200 feet in height. This, of course, required long transmission lines. The attenuation of the transmission line became significant and rectangular waveguide, having a much lower attenuation, offered an additional advantage over coaxial line.

Circular waveguide

Although rectangular waveguide seemed to be a panacea for all transmission-line problems, it is not without disadvantages. The most disturbing one is the inability of rectangular waveguide to retain its shape under internal pressure. Pressurizing a transmission line is done to prevent the entry of moisture and is considered essential to long-term reliability.

These large metal waveguide sections tend to bow outward as a result of internal pressure, and assume a slightly rounded shape. Flanges and flange connections are much stronger than the sheet metal waveguide body and will retain their rectangular cross-section even under considerable internal forces. As the rectangular waveguide is pressurized, the cross-section of the rectangular waveguide body will change from an essentially perfect rectangle at the flange joints to a slightly rounded shape, change back again at the next flange joint and so on.

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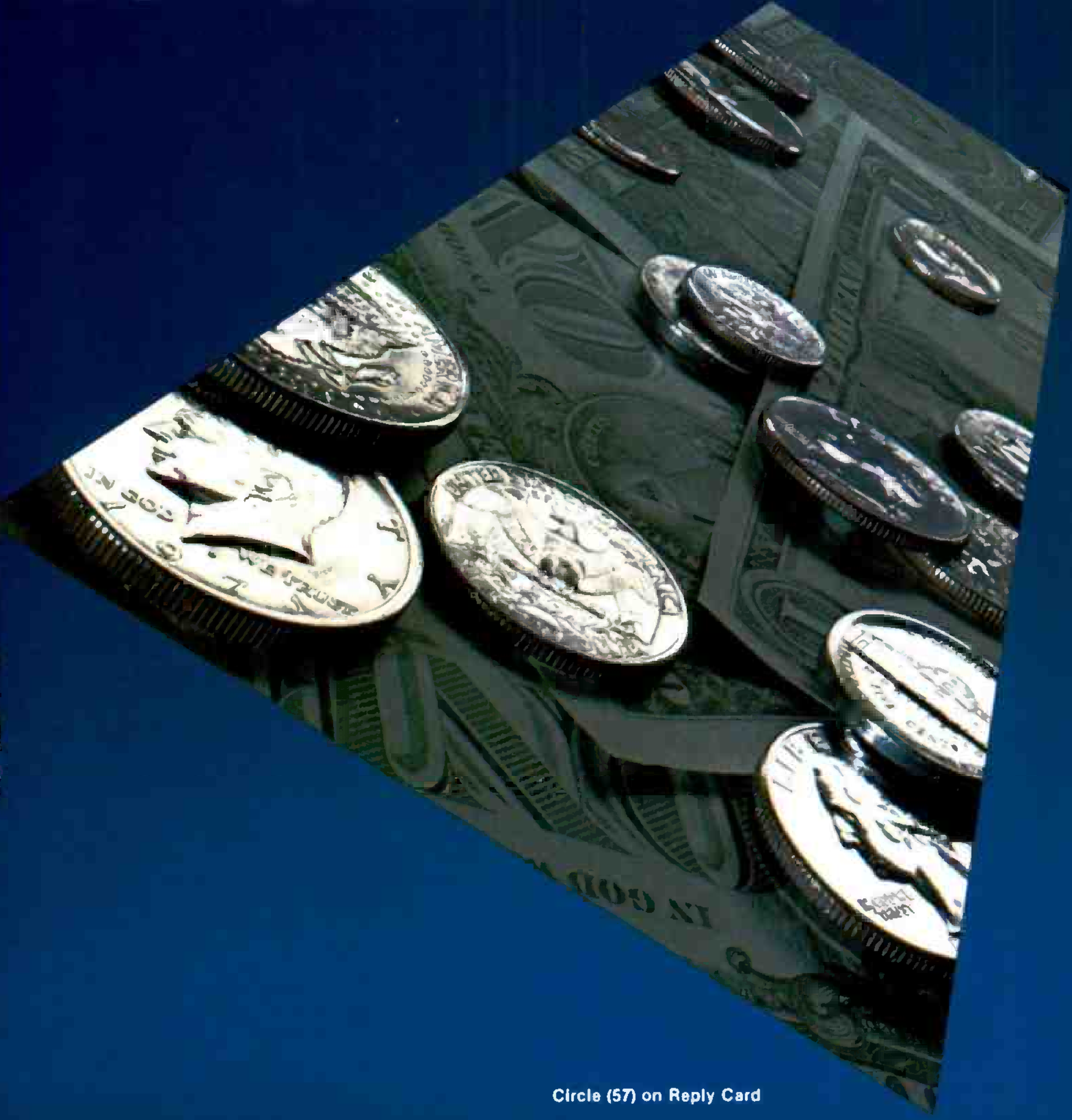

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The 90° circular bend made it possible to use circular waveguide from the transmitter to the antenna.

The net result is that periodic discontinuities develop along the line, causing high VSWR and ghosting. This phenomenon occurs even at fairly low pressures, on the order of 1lb/in^2 or less, so sophisticated pressurization systems had to be developed with dump valves to prevent excessive pressure in the line. Without a dump system, excessive pressure could develop, due simply to rising ambient temperature.

The rectangular cross-section also is less than an ideal aerodynamic shape. The windload produced by rectangular waveguide is much larger than for coaxial line, because it is larger and because of its rectangular shape. As a result, waveguide requires stronger and more expensive towers to support it. In addition, the associated slightly loose supporting system could allow the rectangular waveguide to develop excessive lateral movement, causing severe vibrations on the tower.

Circular waveguide, developed to address some of these problems, is simply a cylindrical tube of sufficiently large diameter to allow the propagation of electromagnetic waves. The advantage of circular waveguide is its round cross-section, which provides for a smoother airflow around it, causing a far lower windload than rectangular waveguide for the same frequency. In addition, circular waveguide will withstand large internal pressures without deformation. This eliminates the periodic discontinuity problem caused by pressurization.

Furthermore, a circular waveguide of the proper dimensions will provide lower attenuation than a rectangular waveguide of approximately the same dimensions. Because of its round shape, circular waveguide is able to propagate energy in two polarizations simultaneously. At this time, however, only one of the polarizations is used for UHF TV applications.

Circular waveguides have been used for microwave transmission as far back as the early 1950s by the Bell System. Many long-haul microwave systems constructed since then use a circular waveguide 2.8 inches in diameter in conjunction with a horn antenna on 4GHz and 6GHz communication routes. The first commercially available circular waveguide system for 6GHz was developed in 1960 for the Wisconsin Bell Telephone Company, and was installed in the Madison area.

The first circular transmission line systems were brought to the market in 1982 for UHF TV transmission. Soon after installation, however, ghosting and time-varying VSWR problems were noted and the cause was traced to trapped energy inside the waveguide. As a result, some planned circular waveguide installations were either put on hold or were redesigned to use a different transmission-line approach pending resolution of the moding problem.

A new design was introduced to the market in 1983, incorporating a 90° circular waveguide bend, which is used to connect the vertical run on the tower to a horizontal circular waveguide run leading to the transmitter building. Until this time, either coax or rectangular waveguide was used to connect the bottom end of the vertical circular waveguide run to the transmitter. The first transmission line system consisting entirely of circular waveguide was installed in 1983 at KIHS-TV in Los Angeles.

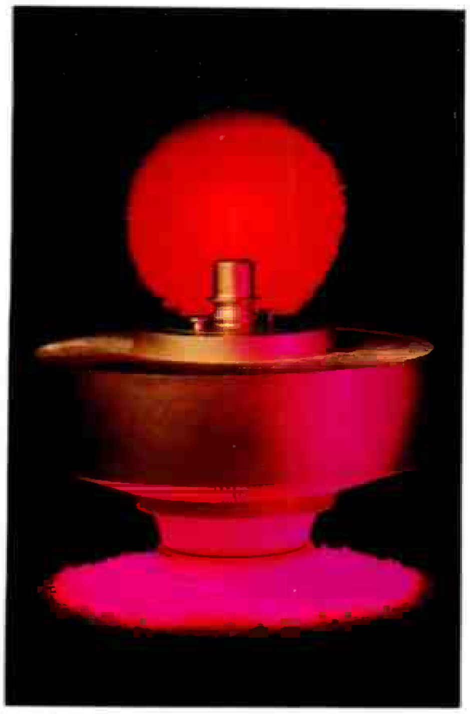
Where do we go from here?

Most VHF TV stations as well as FM and AM broadcasting stations are adequately served by the coaxial transmission line currently available, so most new development will take place in transmission lines for UHF TV and special applications.

The trend toward centralizing FM broadcast facilities is one possible special application. In some large markets several FM broadcasters unite to install a common antenna and transmission line system using a broadband master antenna that is centrally located. The transmission line for these systems must carry the combined power of up to eight FM transmitters. Increased reliability and power-handling capacity of the large coaxial lines used for this purpose are needed, and perhaps other forms of transmission lines are also needed.

Other possibilities include the use of a single waveguide run for more than one UHF channel simultaneously. This might be accomplished with filterplexers on the input and output of a rectangular waveguide run. Circular waveguide is capable of propagating two polarizations that are decoupled by 20dB to 40dB and could be used to transmit the frequencies of two UHF channels without the use of filterplexers. Many obstacles must be conquered to achieve acceptable performance with either approach.

The variety of requirements and solutions to transmission-line problems in the ever-changing and demanding field of broadcasting will continue to require dogged determination and ingenuity.



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By Dane E. Ericksen, P.E.

Use your computer to select the best transmission line.

A recurring task for the RF engineer is to determine losses for various types of transmission lines. This article will describe a truly universal curve-fitting program that will determine the loss at any frequency, for all types of commonly used transmission lines such as foam dielectric cables, flexible and rigid air dielectric cables and circular, rectangular and elliptical waveguide.

The program allows the transmission-line type to be specified by the manufacturer's model number rather than by an arbitrarily assigned number. The curve fits are highly accurate, typically within 1% of the manufacturer's data.

LINE TYPE	A	B	C
DIELECTRIC DC-375 3⅛″ RIGID LINE	1.004E-2	1.000183961	4.893E-1
ANDREW ACX675 6⅛″ RIGID LINE	3.552E-3	1.000128943	5.542E-1
ANDREW LDF4 ½″ HELIAX	2.519E4	6.599E-2	---
ANDREW LDF5 ⅞″ HELIAX	2.051E-4	3.491E-2	---
BELDEN 8240 RG-58/U	3.372E-1	1.000020485	5.650E-1
BELDEN 8241 RG-59/U	9.867E-4	3.332E-1	---
BELDEN 9273 RG-223/U	4.510E-1	1.000142553	4.938E-1
ANDREW WC1500 CIRCULAR WAVEGUIDE	1.214E13	1.006424244	−5.772E0
ANDREW EW127 ELLIPTICAL WAVEGUIDE	5.908E14	1.000254204	−3.815E0
TIMES FIBER TX656 0.565″ FEEDER CABLE	6.818E-2	1.000135259	4.850E-1

Table 1. Curve-fit coefficients for some commonly used cables and transmission lines. Where only two coefficients are given, the best fit is a coax function rather than a Hoerl function.

Curve types

Early literature[1] for coaxial transmission lines suggested an equation of the form $Y=a\cdot F^{1/2}$, where F is the frequency in megahertz and Y is the specific attenuation in decibels per 100 feet. Current reference works[2] use a more refined form, $Y=a\cdot F+b\cdot F^{1/2}$.

This article introduces a Hoerl function curve as a universal transmission line curve-fitting equation. A Hoerl function takes the form $Y=a\cdot b^F\cdot F^c$, where F is the frequency in megahertz, Y is the specific attenuation and a, b and c are constants. It will be shown that a Hoerl function generally is a better fit to manufacturer's data for coaxial cables, and additionally, accurately models waveguide losses.

Least squares curve fitting

A *least squares curve-fitting* technique is used to determine the optimum coefficients for the curve fit. The general approach of this is to assume a particular equation type, then derive the coeffi-

Ericksen is an engineer with Hammett & Edison, consulting engineers, Alameda, CA.

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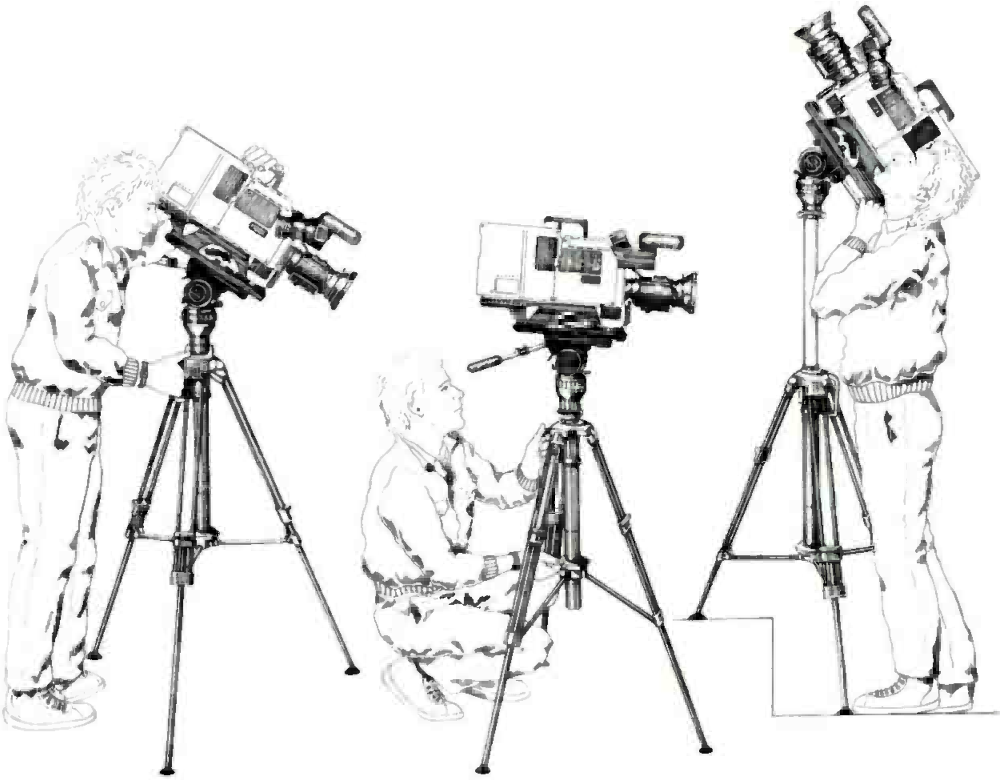


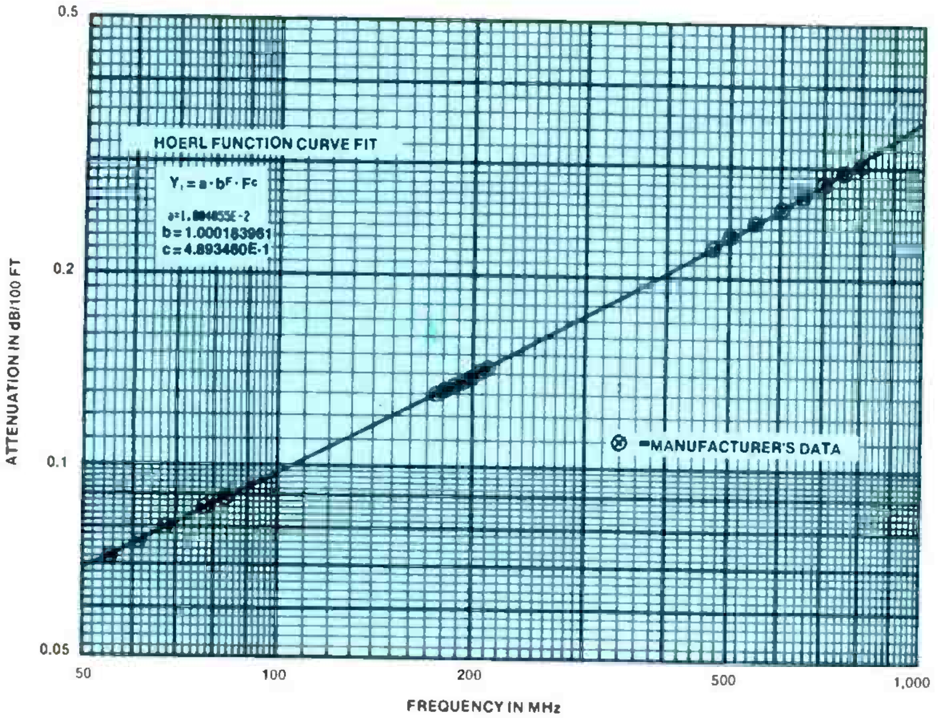


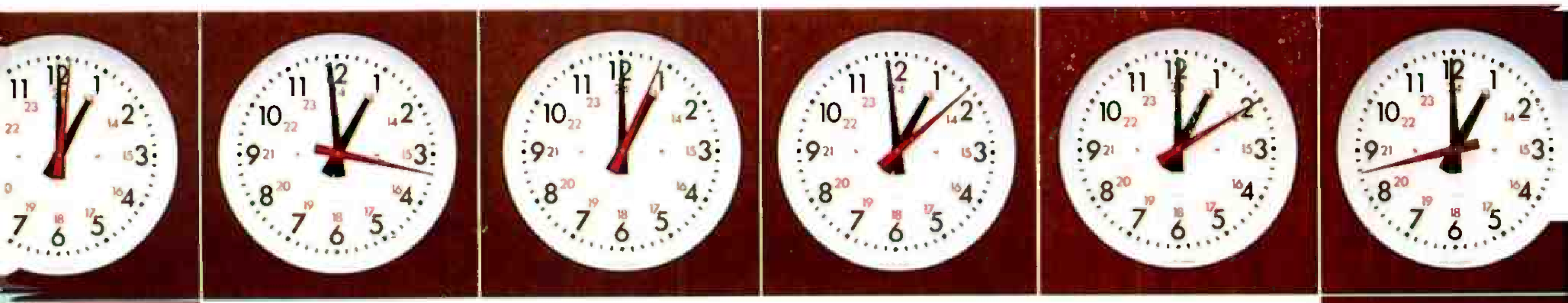
Figure 1. *Plot of Hoerl function curve fit to manufacturer's data for 3 1/8" air dielectric rigid coaxial line.*

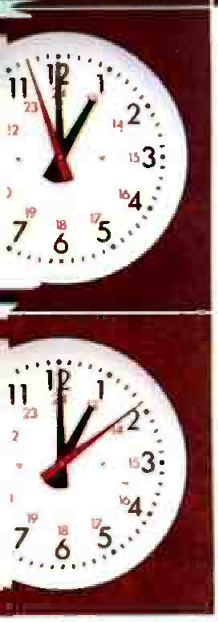
cients that give the smallest sum of the squares of the errors between the originally given points and the corresponding points generated by the mathematical expression being used to model the data. This is accomplished by writing the equation for the sum of the squares of the errors, taking the partial derivations to zero to define the minimum error, and finally solving for these constants. A related article, "The Coax Function," shows the derivation for the $Y=a \cdot F+b \cdot F^{1/2}$ curve type, hereafter referred to as a *coax* function.

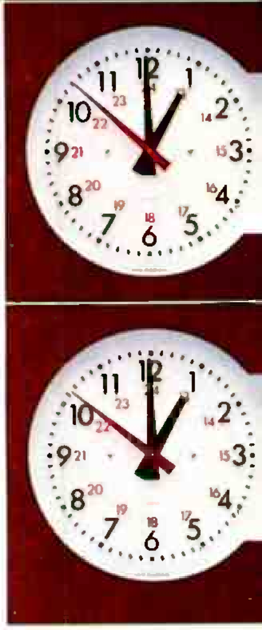
Modern programmable calculators and personal computers are good at performing summations and algebraic manipulations. This is fortunate, because the solutions for the constants a, b and c for the Hoerl function curve fit are much more involved. Because of their complexity, the solutions are not given here. For information about obtaining detailed documentation, see the "Editor's note" at the end of this article.

Application of formulas

Two computer programs were written by the author for the Hewlett-Packard HP41CX programmable calculator. The first program, COEFFICIENT, is used to enter specific attenuation vs. frequency







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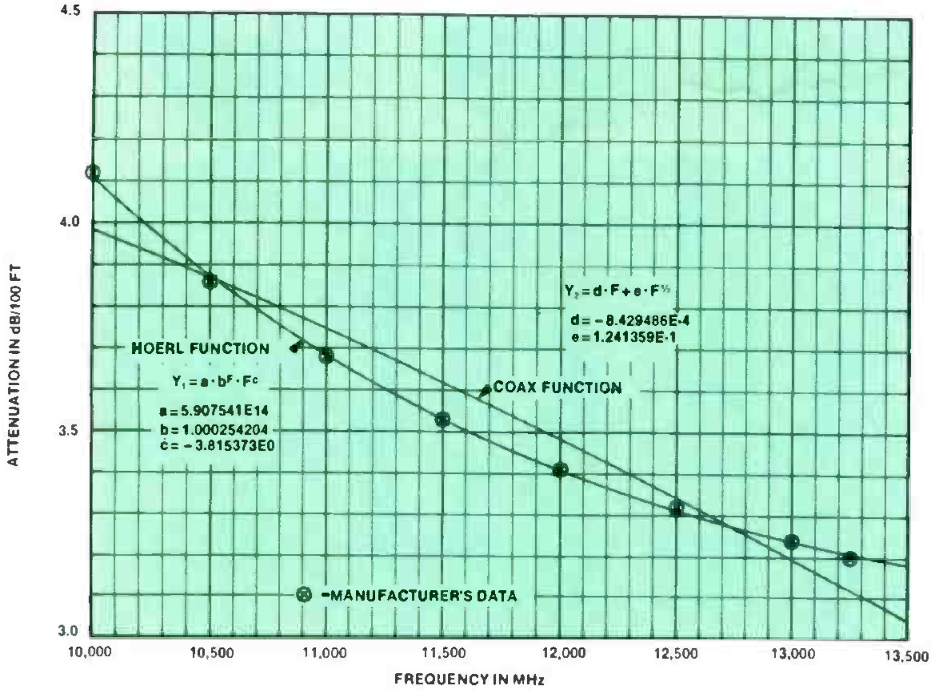

Figure 2. *Comparison of Hoerl function and coax function curve fits to the manufacturer's data for Andrew type EW-127 elliptical waveguide.*

from the manufacturer's data. After all (F, y) pairs have been entered, the program calculates the coefficients for the coax function and the Hoerl function curves. The program then goes back to each F value, calculates the corresponding y value, and compares the calculated y value to the given y value.

The *rms error* (the square root of the mean of the errors squared) in percent is then determined for both curves, as well as the largest percentage error for each curve. This allows a quick evaluation of the best curve type for a given set of data. For waveguides and coaxial cables below 30MHz, the Hoerl function curve fit has proved to be significantly more accurate than the coax curve fit. For coaxial cables above 30MHz, the Hoerl function is generally more accurate, but not always; the error tabulations must be examined to see which curve gives the best curve fit.

Accuracy

For the 46 transmission-line types curve-fitted by the author, 35 had rms errors of less than 1%, 43 had rms errors of less than 1.5%, and all had rms errors of less than 2%. Greater accuracy generally is possible only if the manufacturer has tabulated the specific attenuation at the

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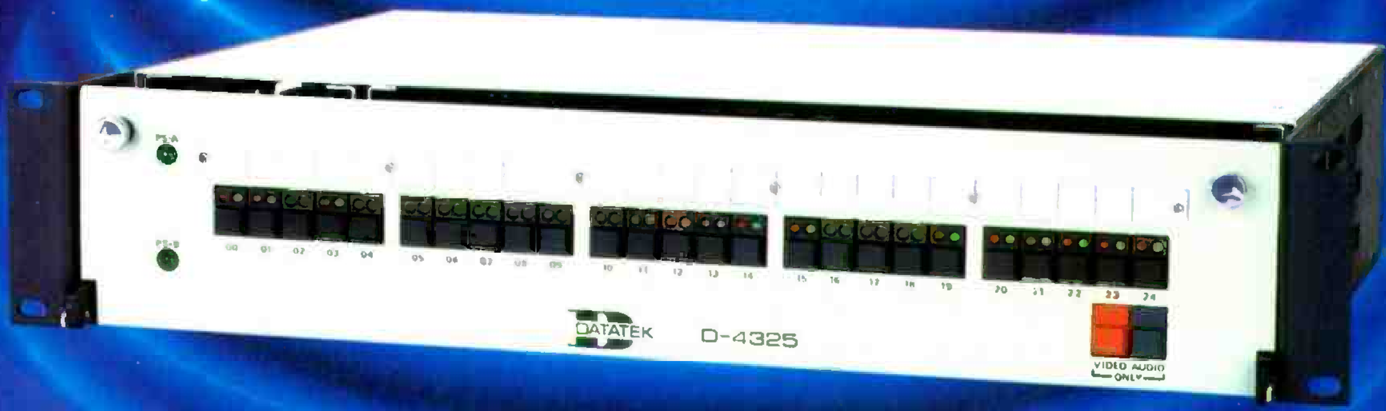

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frequency of interest. In any case, 1% to 2% accuracy usually is sufficient for practical purposes. Thus, the curve-fitting procedure is essentially transparent; that is, the errors introduced by the curve-fitting technique generally are less than normal manufacturing tolerances.

Examples

Consider a curve fit to 3⅛-inch rigid line. The Hoerl function rms error is 0.49% and the maximum error, at 801MHz, is 1.22%. The coax function rms error is 1.15% and the maximum error, at 67MHz, is −2.28%. A plot of the Hoerl function curve fit against the manufacturer's data is shown in Figure 1.

Now consider a curve fit to ½-inch foam dielectric coaxial cable. The Hoerl function rms error is 0.42% and the maximum error, at 1,500MHz, is 1.24%. The coax function rms error is 0.14% and the maximum error at 1MHz is 0.36%. In this case, the traditional coax function curve fit is slightly superior to the Hoerl function curve fit, but the Hoerl function would be acceptable for practical purposes. (See Table 1.)

Waveguide applications

The Hoerl function also can be used to accurately model waveguide losses. For

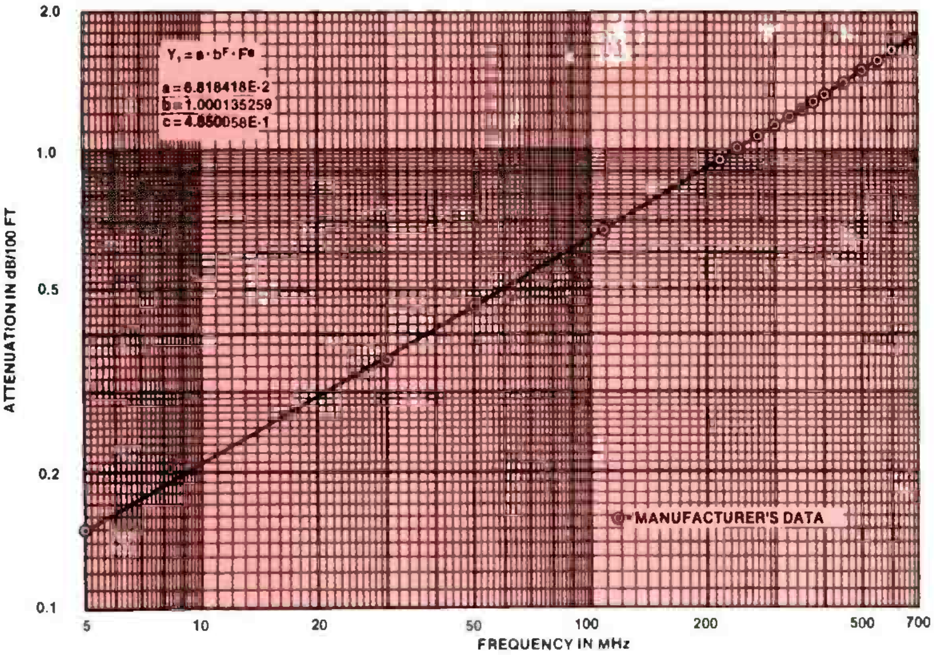

Figure 3. Hoerl function curve fit to Times Fiber type TX565 feeder cable. The curve accurately models specific attenuation over 5MHz to 30MHz, as well as over the higher frequencies.

example, consider an elliptical waveguide commonly used in the CARS (community antenna relay service) microwave band. Over the 10GHz to 13.25GHz frequency range for this waveguide, the Hoerl function curve fit rms error is only 0.21% and the maximum error, at 10.5GHz, is only 0.35%. By comparison, the coax function rms error is 2.05%, and the maximum error is −3.30%. Figure 2 plots both curves against the manufacturer's data.

A similar situation exists for UHF TV circular waveguide. The Hoerl function curve fit over the waveguide frequency range of 620MHz to 740MHz results in an rms error of 0.09% and a maximum error of 0.16%. The coax function curve fit over the same frequency range results in a 1.14% rms error and a −2.25% maximum error.

CATV design applications

The superior accuracy of the Hoerl function curve fit below 50MHz is particularly advantageous for the design of ca-

```
TYPE RG8 CABLE

F IN MHZ
Y IN dB/100 FT

F, ENTR, Y, R/S

F1=50.00
Y1=1.200

F2=100.00
Y2=1.800

F3=200.00
Y3=2.700

F4=400.00
Y4=4.200

F5=700.00
Y5=5.800

F6=900.00
Y6=6.700

Y1=a(b↑F)(F↑c)

a=1.150069E-1
b=1.000001494
c=5.980461E-1

Y2=dF + eF↑0.5

d=2.051349E-3
e=1.637256E-1

F=50.00 MHZ
Y1=1.1935 dB/100 FT
ERR=-0.54%
Y2=1.2603 dB/100 FT
ERR=5.02%

F=100.00 MHZ
Y1=1.8067 dB/100 FT
ERR=0.37%
Y2=1.8424 dB/100 FT
ERR=2.36%

F=200.00 MHZ
Y1=2.7351 dB/100 FT
ERR=1.30%
Y2=2.7257 dB/100 FT
ERR=0.95%

F=400.00 MHZ
Y1=4.1413 dB/100 FT
ERR=-1.40%
Y2=4.0951 dB/100 FT
ERR=-2.50%

F=700.00 MHZ
Y1=5.7900 dB/100 FT
ERR=-0.17%
Y2=5.7677 dB/100 FT
ERR=-0.56%

F=900.00 MHZ
Y1=6.7310 dB/100 FT
ERR=0.46%
Y2=6.7580 dB/100 FT
ERR=0.87%

RMS ERRORS

  Y1=0.85%
  Y2=2.55%

Y1 MAX ERR=-1.40%
Y2 MAX ERR=5.02%
```

Figure 4. *Example printout for the COEFFICIENT program, using the manufacturer's published data for Belden type 8214 RG-8/U coaxial cable. To avoid confusion between the constants "a" and "b" for the Hoerl and coax functions, the printout identifies the coax function coefficients as "d" and "e"; that is,* $Y = d \cdot F + e \cdot F^{1/2}$.

The coax function

The normal or matched-line attenuation in decibels per 100 feet is:

$A_{100} = 4.34R_t/Z_0 + 2.78f\epsilon^{1/2} \cdot F_p$, where

$R_t = 0.1(1/d + 1/D)f^{1/2}$ and

D = diameter of inner surface of outer coaxial conductor in inches

d = diameter of center conductor in inches

f = frequency in megahertz

ϵ = dielectric constant relative to air

F_p = power factor of dielectric at frequency f

This equation can be rewritten in the form $Y = a \cdot X + b \cdot X^{1/2}$. A least-squares curve fit gives the following equations for a and b:

$$a = \frac{\Sigma X \cdot \Sigma X \cdot Y - \Sigma X^{3/2} \cdot \Sigma X^{1/2} \cdot Y}{\Sigma X \cdot \Sigma X^2 - \Sigma^2(X^{3/2})}$$

$$b = \frac{\Sigma X^2 \cdot \Sigma X^{1/2} \cdot Y - \Sigma X^{3/2} \cdot \Sigma X \cdot Y}{\Sigma X \cdot \Sigma X^2 - \Sigma^2(X^{3/2})}$$

ble TV systems using the 5MHz to 30MHz subsplit frequencies (channels T-7 through T-10). For example, consider a typical 0.565-inch foam dielectric feeder cable designed for cable TV applications: At 5MHz, the Hoerl function curve-fit error is only −0.71% and the overall, or rms, error is 0.56%. In contrast, the coax function curve-fit error at 5MHz is −6.33%, and the rms error over the entire frequency range is 1.70%. Clearly, the Hoerl function curve fit does the better job, as shown in Figure 3.

Applying the results

Figure 4 demonstrates the COEFFICIENT program for curve fitting to RG-8 cable. This same program has been run for all transmission lines of interest and a second program, COAX, is used to apply the results. The COAX program is a *working* program that is retained in RAM, whereas COEFFICIENT is loaded and run only when coefficients for a new transmission-line type are needed. There are three simple prompts for COAX:

- the cable type, which is normally the manufacturer's type number such as LDF-5, HJ7 or EW20;
- the frequency in megahertz; and
- the transmission-line length in feet.

The COAX program then applies the appruprиate curve type and cuefficients, using the transmission-line type as a glubal label. The program outputs are a readback of the transmission-line type; a 1-line description of the cable type (for example, "½-inch foam," "1⅝-inch air" and "6⅛-inch rigid"); a readback of the frequency and line length; and the line attenuation in decibels. Sample printouts are shown in Figure 5.

The decision whether the Hoerl function or the coax function best fits the manufacturer's data over the frequency range of interest is left to the user. When performing the 1-time entry of coefficients for a particular transmission-line type, an internal flag is used to let the COAX program know whether the coefficients pertain to a Hoerl function or to a coax function.

Let the program do the walking

This program provides a convenient and accurate means for the RF engineer to answer such common questions as "What is the attenuation of 153 feet of ⅞-inch foam dielectric cable at 951MHz?" or "What is the loss for 582 feet of 3⅛-inch rigid line at 103.9MHz?" The accuracy is quite sufficient for use in preparing FCC filings.

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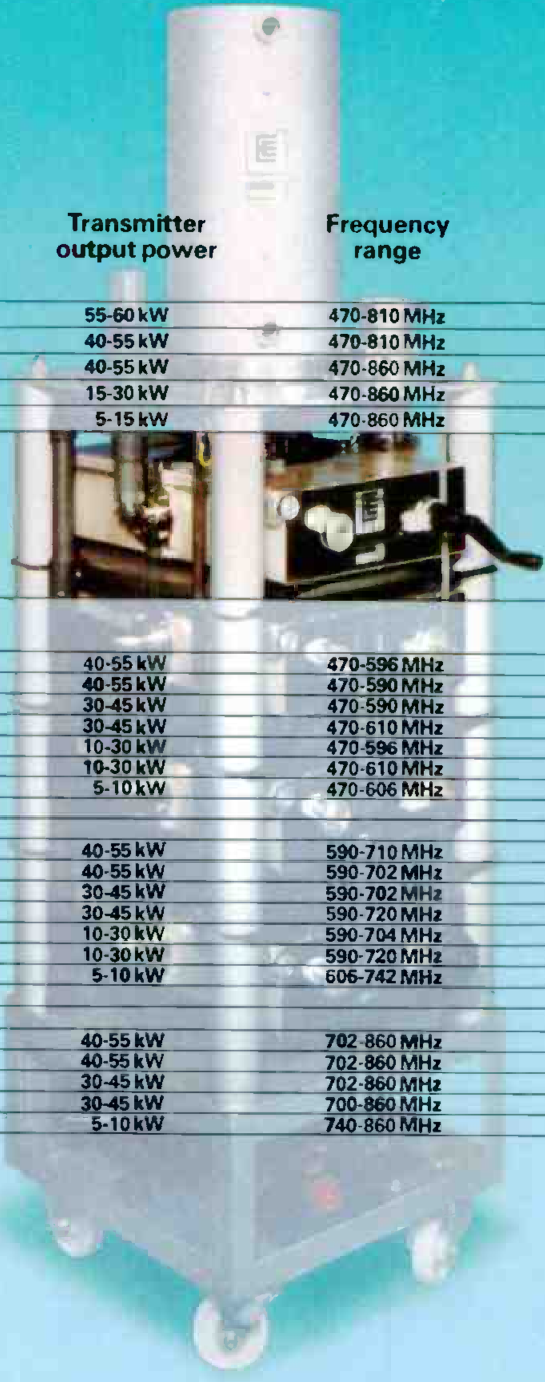

WIDEBAND SERIES	Transmitter output power	Frequency range	Typical Sync efficiency
K3672BCD	55-60 kW	470-810 MHz	44% to 48%
K3572BCD	40-55 kW	470-810 MHz	43% to 46%
K3272WBCD	40-55 kW	470-860 MHz	42% to 45%
K3271BCD	15-30 kW	470-860 MHz	42% to 47%
K3270BCD	5-15 kW	470-860 MHz	42% to 47%

STANDARD SERIES			
Low Band			
K3276HBCD	40-55 kW	470-596 MHz	38% to 43%
K3382BCD	40-55 kW	470-590 MHz	38% to 42%
K3217HBCD	30-45 kW	470-590 MHz	40% to 42%
K3282BCD	30-45 kW	470-610 MHz	30% to 40%
K3230BCD	10-30 kW	470-596 MHz	40% to 42%
K376L	10-30 kW	470-610 MHz	34% to 40%
K370/W series	5-10 kW	470-606 MHz	29% to 35%
Mid Band			
K3277HBCD	40-55 kW	590-710 MHz	38% to 43%
K3383BCD	40-55 kW	590-702 MHz	38% to 42%
K3218HBCD	30-45 kW	590-702 MHz	40% to 42%
K3283BCD	30-45 kW	590-720 MHz	30% to 40%
K3231BCD	10-30 kW	590-704 MHz	40% to 42%
K377L	10-30 kW	590-720 MHz	38% to 45%
K371/W series	5-10 kW	606-742 MHz	32% to 35%
High Band			
K3278HBCD	40-55 kW	702-860 MHz	38% to 43%
K3384BCD	40-55 kW	702-860 MHz	38% to 42%
K3219HBCD	30-45 kW	702-860 MHz	40% to 42%
K3284BCD	30-45 kW	700-860 MHz	30% to 40%
K372/W series	5-10 kW	740-860 MHz	32% to 35%

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```
XEQ "COAX"
CABLE TYPE?
LDF5                RUN
F, MHZ?
        450.2125    RUN
L, FT?
          350.00    RUN
LDF5
7/8 FOAM
F=450.21 MHZ
L=350. FT

LOSS=2.92 dB
```

```
XEQ "COAX"
CABLE TYPE?
LDF7                RUN
F, MHZ?
          951.50    RUN
L, FT?
          185.00    RUN
LDF7
1 5/8 FOAM
F=951.50 MHZ
L=185. FT

LOSS=1.47 dB
```

```
XEQ "COAX"
CABLE TYPE?
DC375               RUN
F, MHZ?
          103.90    RUN
L, FT?
          582.00    RUN
DC375
3 1/8 RIGID
F=103.90 MHZ
L=582. FT

LOSS=0.58 dB
```

```
XEQ "COAX"
CABLE TYPE?
EW127               RUN
F, MHZ?
       12,700.00    RUN
L, FT?
           85.00    RUN
EW127
F=12,700.00 MHZ
L=85. FT

LOSS=2.79 dB
```

Figure 5. Example printouts for the COAX program.

culator to accept alphanumeric designators for global label subroutines containing the appropriate coefficients, the program does not require inconvenient arbitrary designators for familiar cable types. Just key in the manufacturer's designator, frequency and length, and let the COAX program do the walking through those hard-to-read graphs with umpteen closely spaced, easily misread curves.

Footnotes:

1. "Coaxial Cable Communications." The Lenkurt Demodulator, Vol. 6, No. 6, June 1967.
2. Reference Data for Radio Engineers, Fifth Edition, 22-13.

Bibliography:

Hald, A. "Statistical Theory with Engineering Applications," Chapter 4, Sections 4.4 and 4.8, John Wiley & Sons, London, 1952.

Kolb, William M. "Curve Fitting For Programmable Calculators." Third Edition, IMTEK, Bowie, MD.

Editor's note: Space does not permit printing the equations for the Hoerl function coefficients a, b and c or the full program listing and documentation. The complete program and documentation is available via the CompuServe Broadcast Professionals Forum at no cost beyond standard connect time charges. At any prompt (!), type GO BPFORUM. The program and documentation will be in data library DL4 under the name CRVFIT.BAS and CRVFIT.DOC, respectively. Because the program was written for a Hewlett-Packard HP41 computer, CRVFIT.BAS is an ASCII file. You will need to re-enter it in your computer's resident language.

Building and operating a tower facility

By Ray Upsahl

Understanding tower dynamics and maintenance can add to the service life of your tower.

The tower is an important component in the delivery of a broadcaster's signal to the market. Towers often support many antennas in addition to those needed to transmit signals to a station's listeners or viewers. Other antennas may be used for transmitting and receiving 2-way communications for private and public agencies. The tower's important service to the community is often taken for granted by all but the station's engineering staff.

A tower represents a significant economic investment, and is often a potential liability. The cost of an untimely tower replacement, in terms of lost income and the effort required for planning, designing, dealing with environmental concerns, use permits and public involvement, could be greater than the tower's construction cost. In addition, a tower failure in a populated area could result in a pernicious catastrophe. Although most broadcasters have emergency plans to remain on the air during the period of time when the tower might be out of service, maintenance of a station's tower structure is a concern of the highest priority.

A review of tower design and conventional code analysis methods shows variations between actual windloads and member forces and stresses associated with the different codes governing tower design. New analysis procedures for determining design wind-speed loads

Upsahl is a consulting and structural engineer with Skilling Ward Rogers Barkshire, in Seattle.

The failure of this tower was caused by either poor design, poor maintenance, or both. This problem could have been avoided.

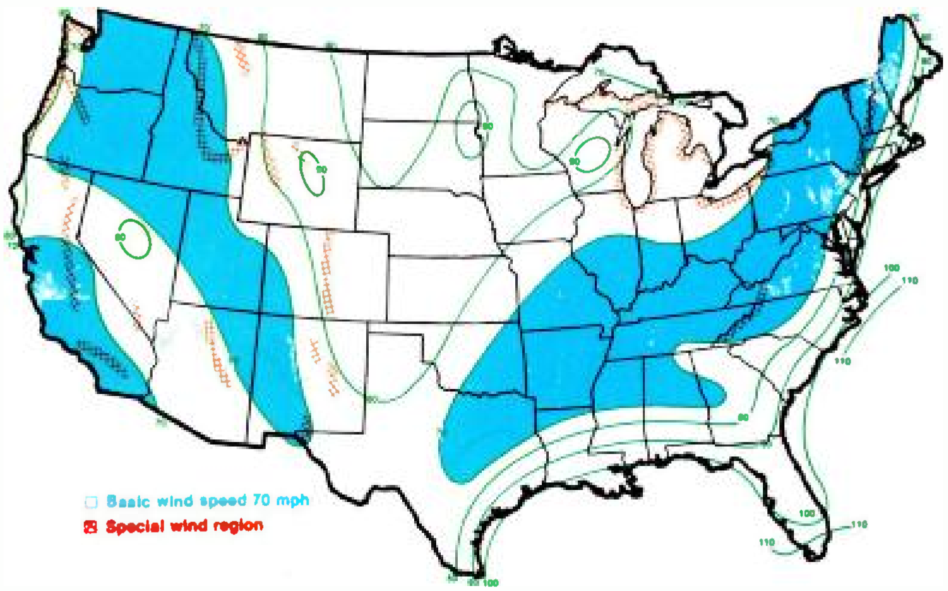

Figure 1. A map of the United States shows contours of 50-year wind speeds, measured at a distance of 33 feet from open, level terrain. The map, using National Weather Service statistical data, is the basis of standardized design wind speeds. (Information supplied by EIA.)

and member forces in dynamically responsive tower structures are based on recent findings from wind-tunnel research. Comparisons of safety factors from these analysis procedures show the differences in conventional code analysis and computed values using rigorous dynamic analysis for certain portions of example towers.

Engineering management program

The first step in an engineering management program for tower safety is to develop a tower evaluation procedure. This procedure will evaluate and document the current condition and structural adequacy of an existing tower. Evaluation is divided into three activities: field inspection, measurement of dynamic properties and load rating. The first two activities are completed in the field on the tower itself, while load rating consists of an office analysis.

A professional tower field inspection may be completed in varying levels of detail. It consists of, at least, a top-to-bottom, hands-on visual inspection combined with measurement of the tower's dynamic properties.

To conduct an effective tower inspection, a qualified structural engineer, familiar with tower structural systems, is required. The inspector that a tower owner hires must be more than a quality-control inspector who is typically concerned only with paint and corrosion protection. The professional tower inspector must have the proper training, experience, attitude, motivation, skills and the physical climbing ability to collect the necessary information. The inspector can assess the need for additional detailed inspection following an initial reconnaissance. Only then can a proper tower evaluation be completed and long-range considerations be formulated by the owner.

The duties of the tower inspector include detailed planning and preparation. The inspector will acquire and study existing drawings of the tower, if available; will establish methods for recording information in a logical fashion; and will make a permanent record of the inspection as it is accomplished, with the use of field notes, photographs and, perhaps, videotape. Although photographs provide sharper resolution than video, videotape offers the option to record valuable audio comments to accompany the visual data.

Careful planning is critical to an efficient and effective inspection procedure. The ascent of a tower can be time-consuming, particularly when equipment is carried. The inspector must be knowledgeable about tower structures and be able to safely reach each member and connection. The physical demand on the inspector limits the amount of time that can be spent on each inspection trip.

Tower inspection procedures

Professional inspectors will use the historical information such as plans, specs, shop drawings and previous inspection reports to assist in the verification of the as-built configuration. Member size and length, bolt size, cable characteristics and material properties also must be verified. The inspector will check material properties whenever possible. A low-stressed member can be removed and replaced with a new member. The mechanical and chemical properties of the low-stressed member, such as ultimate strength and weldability, can then be determined in the laboratory.

The professional inspector will use a thorough, systematic approach to inspect the foundation, structural members, connections and corrosion protection (paint). The inspector will:

- Check all joints and members for deterioration and missing, loose or corroding bolts.
- Check all guy cables for corrosion. Corrosion reduces the load capacity of the cable. Continued corrosion can cause individual strand failure, leading to reduced cable section and ultimate guy failure. The loss of one guy means the collapse of the tower.
- Inspect all welds. Ultrasonic testing is recommended in full-penetration butt welds to check for any cracks that may have developed over time.
- Check vertical members for bowing and corrosion. Look for stress concentrations as evidenced by flaking paint on the inside leg where a tower transits from one framing system to another.
- Check horizontal members for bowing, corrosion, and loose, deteriorating or missing fasteners.
- Check angle bracing and tension rod bracing. Note whether members have a bowed appearance, which may indicate insufficient compression capability for member length or tension members taking compression.
- Check for member misalignments. Misalignments may be the result of a serious problem and should be studied to determine the cause.

A continuing scheduled inspection procedure as part of a preventive maintenance program following an initial thorough field inspection will help increase the life of the tower. Establish a permanent log of inspection reports.

Tower diagnostics

The single most important factor that an owner should be concerned with is the *stiffness* of a tower. In the case of a tower structure responding to windload conditions, the less flexible the tower, the more desirable. Loose bracing and/or slack guy wires can be characteristics of overly flexible towers. Another obvious clue to overflexing is any area on a tower that continually develops paint chips.

A measure of tower stiffness is decided by determining the tower's *period of vibration* as it is deflected by applied loads. The period of vibration is the time in seconds for the tower to deflect from vertical, recover and swing past vertical, and return (or cycle) back to vertical again. For a freestanding or guyed tower with a typical height of 500 to 1,000 feet, a period of two seconds is good, while a period of five seconds is not good. A

Continued on page 98

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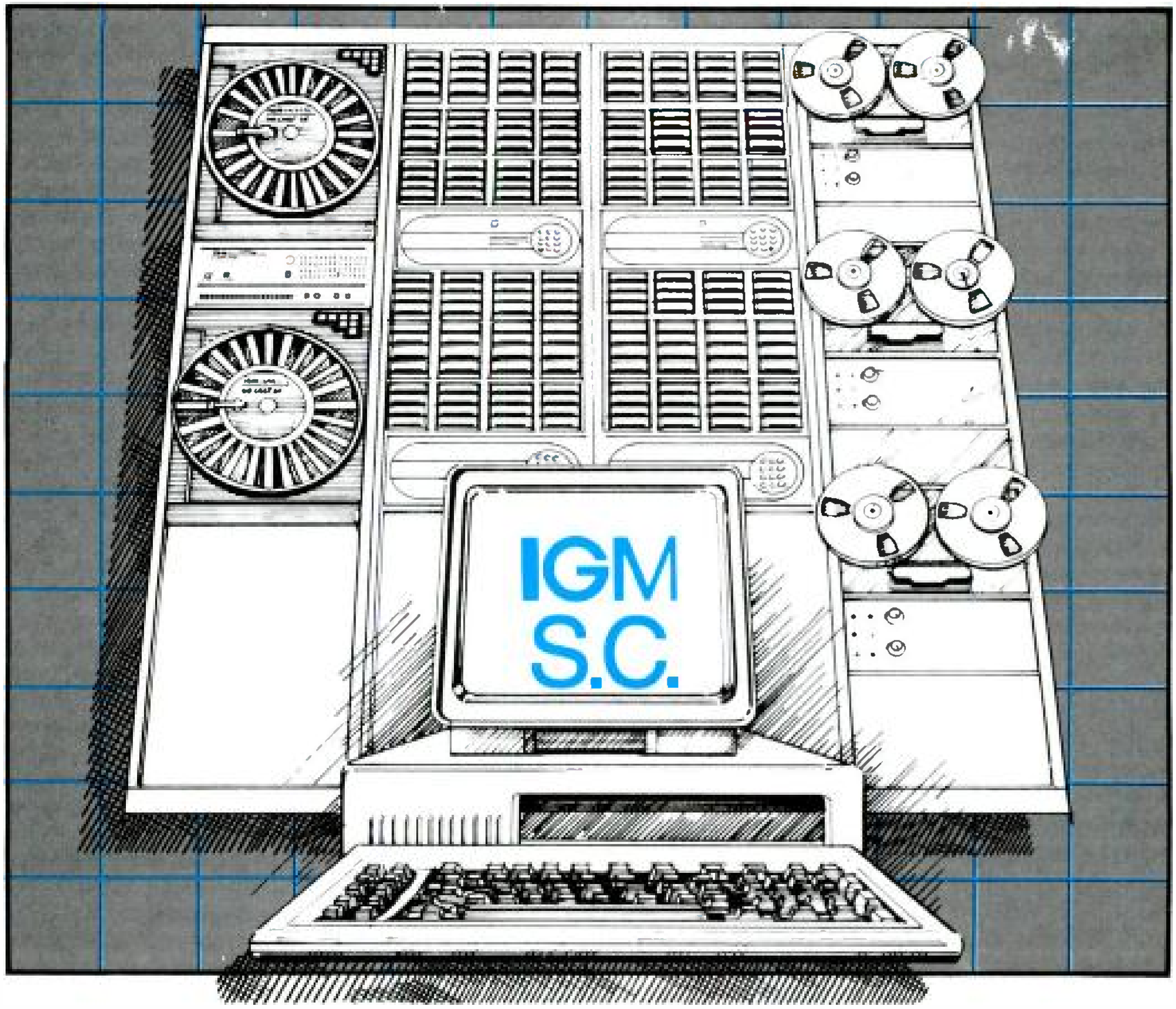

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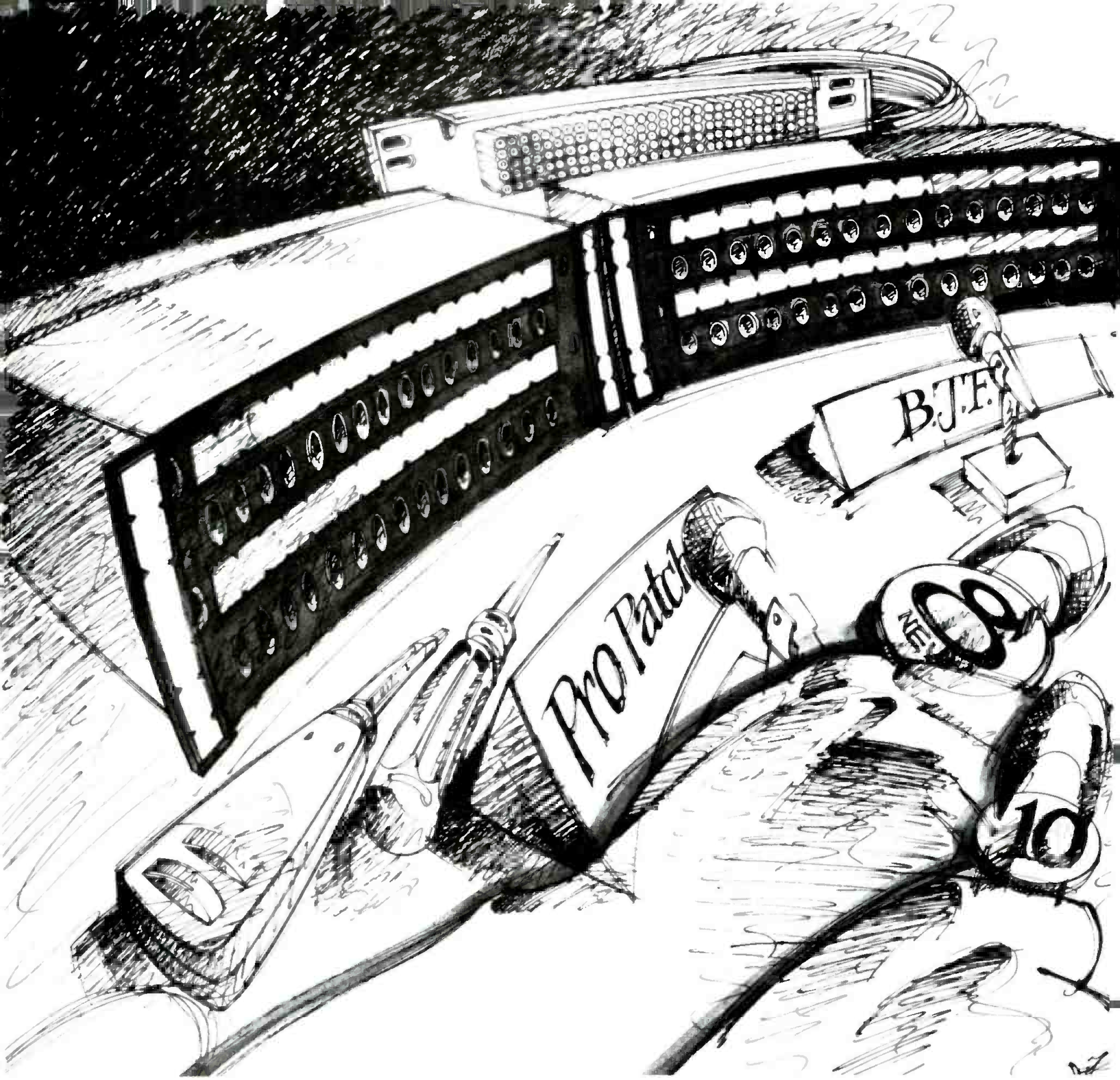

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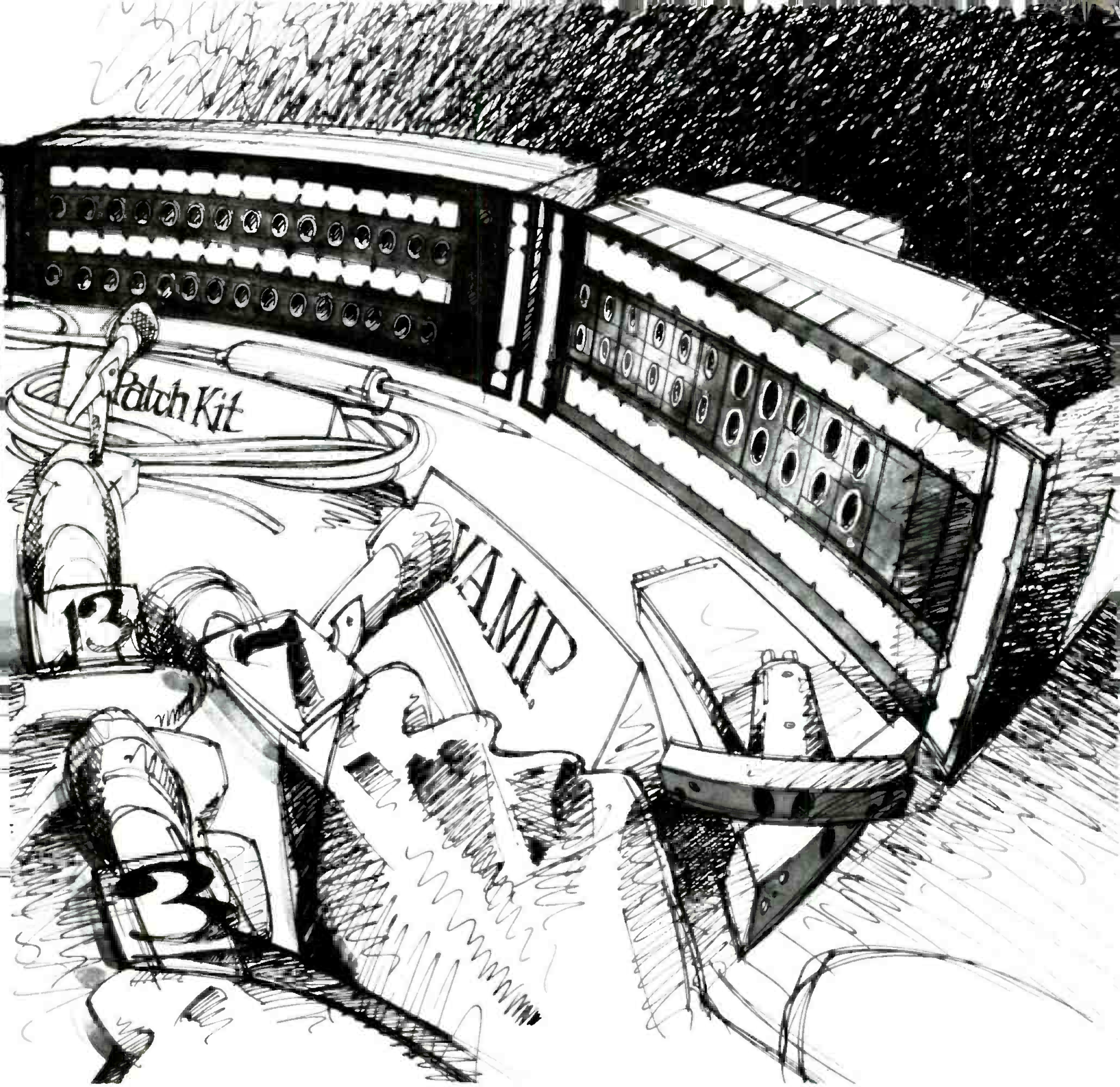

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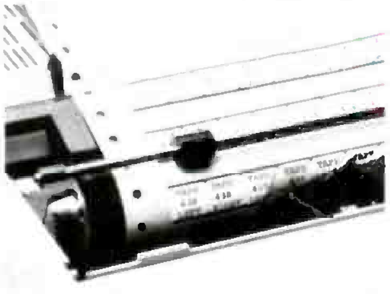

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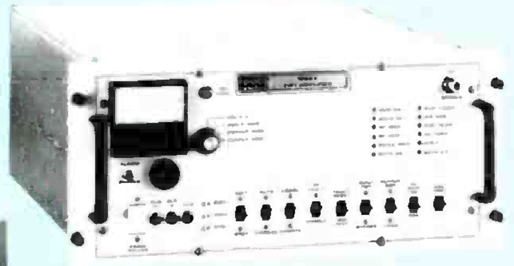

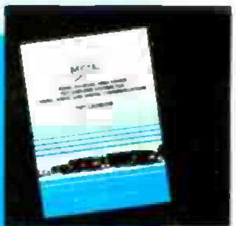

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tower with a longer period of vibration builds greater stresses in certain members as it sways back and forth in the wind. In fact, a 10% change in the period of vibration will result in a 20% change in dynamic stresses.

The period of vibration for a tower can be calculated if you know the structural system configuration and member properties, or it can be measured in the field. Measurement of the tower's actual period of vibration is preferable to calculation, which assumes a perfect structural system. The comparison of these two measurements can yield valuable information regarding the actual dynamic performance of the tower. One relatively simple method to measure the tower's period in the field is to observe the movement of the tower during a strong windstorm by videotaping it.

Use of accelerometers is a more scientific technique for determining the period of vibration. It is reliable, accurate and provides other useful information. Accelerometers are mounted at various levels of the tower in triplets, to record all directional and torsional periods. Data from each accelerometer can be transmitted and plotted on the ground. A print-out chart allows an accurate determination of primary periods along with damping properties. This information quickly indicates a number of maladies, such as a tower that is too flexible, loose guy wires and loose and/or inadequate bracing.

The load rating of a tower is accomplished by office analysis using information acquired in the field. Analysis uses the as-built characteristics of the tower's structural system, its current condition and the actual or calculated period of vibration. The tower's structural system geometry and member properties are modeled on a computer. Any weak links (or limiting members) of the overall structural system can be identified. The capacity these members should carry is determined to enable the overall system to meet the required capacity of the design loads.

Upgrading or repair

Initiate an upgrading or repair program as soon as possible to correct deficiencies identified in the field inspection or load-rating analysis, such as corrosion or structural problems. Touch-up for general corrosion problems or complete rehabilitation of the protective-coating system can be accomplished by painting contractors, particularly bridge painters.

Structural repairs that require replacement of members or connections and/or extensive retrofitting activities necessitate the hiring of a specialized tower contractor. A limited number of qualified

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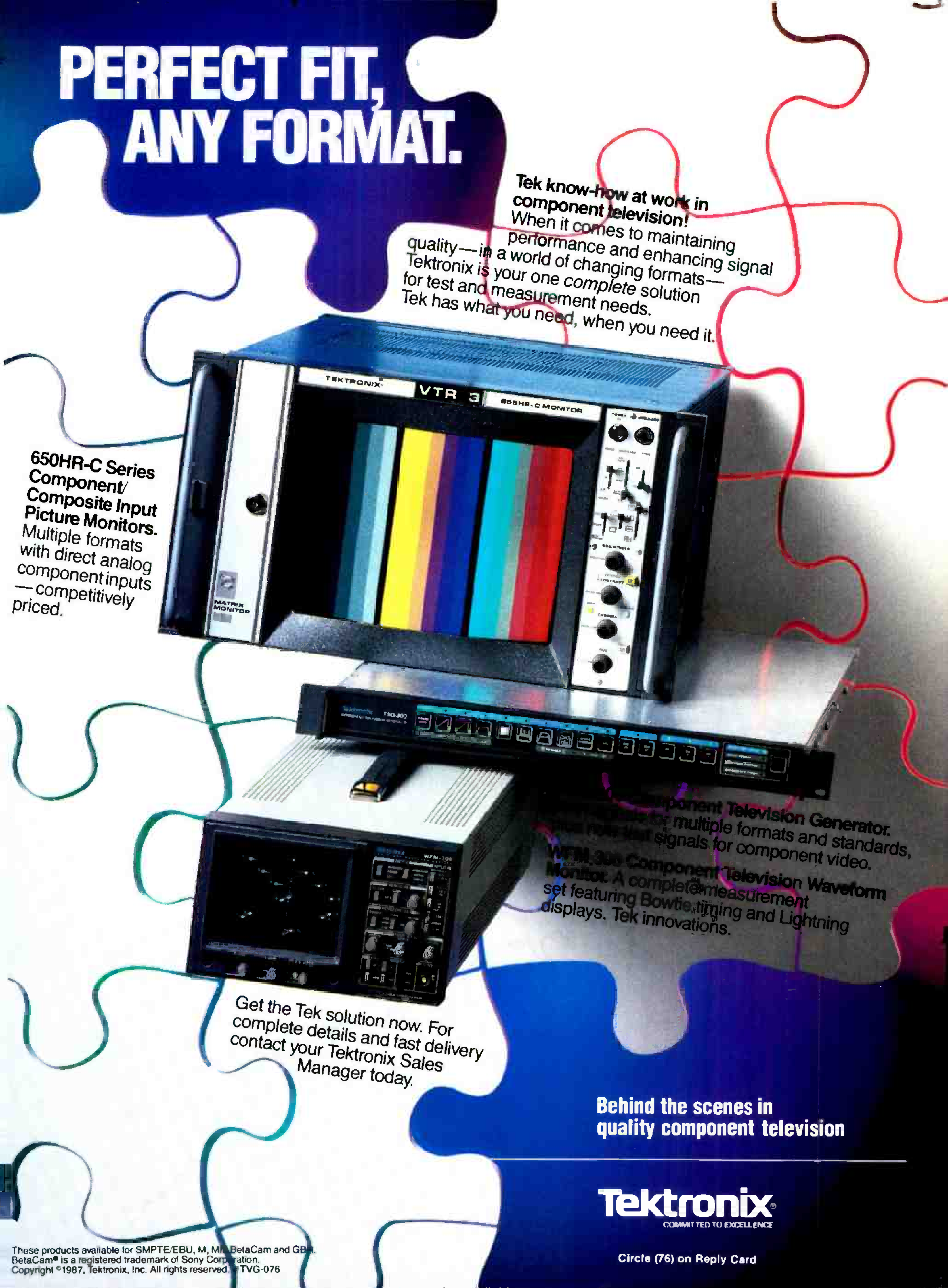

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Continued from page 98
contractors are available. Consequently, it is difficult to openly bid retrofitting work. Tower owners generally must negotiate with a select group of specialized contractors who are invited to submit proposals. Requests for proposals must be carefully scheduled. Qualified contractors are perpetually busy—often too busy to respond.

The report documenting tower evaluation, including field inspection, dynamic monitoring and load rating, will list any deficiencies and will make recommendations for necessary action. Routine problems such as painting, member or connection repair, bolt replacement and antenna-mounting adjustments can be corrected by contractors without further engineering effort. Owner participation, other than construction surveillance or a call for third-party inspection, is limited.

If overstressed conditions are found, further engineering efforts are required to design needed improvements and prepare contract documents. Upon discovery of an overstressed condition, complete a thorough analysis of the condition and develop alternative methods of correction. A cost-effective evaluation of various alternatives will allow the tower's owner and the structural engineer to establish a plan of action and priorities. Prepare contract documents and select a contractor to complete the retrofitting work.

The majority of deficiencies discovered during tower evaluation that require correction fall into two basic categories: needed maintenance and repairs (corrosion, loose or damaged parts), and structural inadequacy of the tower at design wind speed.

The most significant problem found on some towers is an overstressed condition existing in the top portion of the tower. The conventional static analysis used in most existing and new tower designs produces towers that lack stiffness and strength in the top portions. These overly flexible towers have long periods of vibration with attendant higher stress in the structural members than was allowed for in the original design, because dynamics were not considered.

Towers with overstressed conditions exhibit flexibility for several reasons including the use of high-strength steel in the design, or the use of a wider-spaced bracing system in the top portion of the tower. These factors allow a tower to meet static load conditions, but cause a lack of stiffness for high dynamic loads.

Several alternatives are available to correct this compressive-buckling overstressed condition. Material can be added to structural members to increase capability and/or to reduce stress. The tower also can be stiffened to reduce the period of vibration, the dynamic loads, member forces and stress.

Good designs usually involve an optimization process of adding a cross-sectional area to key structural members and stiffening the structural system by adding bracing. Other methods of stiffening include tightening existing bracing and connections. In guyed towers, recalculating forces and retensioning cables also may increase stiffness.

The preferred technique to analyze different combinations of methods is to use a computer model for evaluation of design efficiency. The model takes into consideration the aerodynamics of the added materials and icing as it reanalyzes tower stiffness and dynamic stresses. The construction cost of each method also is determined by computer to obtain the most efficient and least-cost alternative.

Tower structure is a function of materials, fabrication, erection, protective coating, mobilization and general conditions. Tower costs are relatively sensitive to labor. Simple solutions using fewer, easily fabricated and erected material additions or changes are usually

the most cost-effective. Typically, the cost of strengthening the top portion of a tower runs from 5% to 15% of the existing tower value.

Retrofit programs have often successfully returned tired towers to full capability in meeting their design capacity. These same programs also can develop additional capacity to meet the requirements for additional transmission equipment. Analysis, as a side benefit, yields information on the best location for these facilities relative to the strength and minimum antenna displacements.

Other alternatives worth mentioning that can increase stiffness include: adding guys, widening the distance across the faces of the tower, adding tuned mass dampers and spreading the tower legs. These methods are effective, but may not always be practical.

The replacement of antennas with lighter-weight antennas may seem expensive, but it can prove remarkably effective in reducing dynamic stress in the upper portions of towers. In one case, reduction of antenna weight by 2.6 tons resulted in a 60% to 80% reduction in dynamic stress in the upper portion of a guyed tower.

Preventive maintenance program

Tower maintenance is necessary for the continued operation of the tower structural system and the mounting system for additional specialized equipment such as antennas and cables. In general, the term *maintenance* can be divided into corrective maintenance and preventive maintenance.

A carefully considered and implemented preventive maintenance program consists of an initial professional tower evaluation including field inspection, measurement of dynamic characteristics and load rating, plus completion of any necessary repairs or upgrading. This should be followed by execution of a regularly scheduled inspection and maintenance program at the station level (see Table 1). Do not depend on station personnel to accurately assess the structural condition of a tower.

New equipment additions

A continuing demand exists for installations of new equipment on towers. Many times, permitting agencies are reluctant to allow mounting of additional equipment on existing towers without further analysis. Once a tower is load rated and a computer model exists, an analysis can easily be provided showing additional capacity, if it exists.

When making new equipment additions to towers, reduction in tower member loads and stresses may be realized by using lightweight equipment. Reduction in the weight of main TV antennas allows substantial reduction of stresses in existing towers and more economical designs of new towers.

Tower analysis practices

In tower design, the structural engineer designs a structural system capable of resisting the vertical gravity loads (dead loads) of the structure, such as structure weight, equipment, antennas and ice, and lateral loads (live loads), such as wind and seismic loads. In the case of tower structure, the wind-induced loads are much greater than the self weight or seismic loads and, therefore, control in the design.

The design procedure is relatively simple. The designer enters the design code, obtains a design wind pressure for a particular geographic location and applies it against the exposed frame of the structure, including icing. The cantilever movements and shears are then determined for the freestanding tower. For the guyed tower, the multiple or continuous span movements and shears are computed. A structure is then designed to resist these forces.

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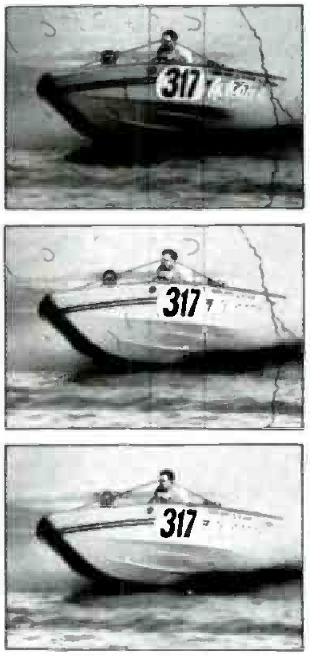

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STRUCTURE		**FOUNDATIONS**	
Alignment	Y A	Base Details	Y
Paint	Y A	Guy Anchors	Y
Corrosion	Y	Insulators	Y
Members	Y A	**OPERATIONAL**	
Connections	Y A	Safety Devices	D
Vibration	Y	Ladders	D
GUYS		Elevators	M S
Tensions	Y A	Antenna Mountings	Y A
Strands	Y A	Conduits & Waveguides	Y A
Corrosion	Y	Lighting & Fixtures	D A S
Sockets	Y A		
Pins	Y		
Insulators	Y		

Y = YEARLY   A = AFTER STORMS
M = MONTHLY   S = MFGR'S SPECS
D = DAILY

Table 1. *Once a tower has received its initial professional inspection, implement a station-level inspection program. Schedule a complete cleaning and painting every seven to 10 years. Consider replacing guy lines if they are corroded or if tensioning records show a decrease in tension per manufacturer's recommendations.*

known plays an important role in the analysis and design of tower structures. Some loads, such as gravity, can be determined with extreme accuracy, while other loads, such as the wind, are not well known. Wind-induced loads do not have a constant value that can be entered into a static structural analysis. The variability of the load placed upon a tower structure by the wind is defined by its turbulent properties and probability of strength and occurrence. Additionally, variable windloads cause tower structures to exhibit dynamic behavior, which introduces additional bending load due to swaying motion and complicates further analysis.

Until recently, a complete understanding of how the wind acts upon a structure had not been developed. Also, designers did not have the means to accomplish the required sophisticated analysis. As a result, designers, manufacturers and public agencies charged with tower construction responsibilities incorporated into the design codes what was thought, at the time, to be the most prudent approach to determining wind-induced loads. In part, this amounted to a standardized method for approximating wind-pressure envelopes on structures that, with any luck, developed a design value greater than actual design wind pressures for designed wind speeds.

Suggested design wind pressures for geographic areas of the United States were mapped. Dynamic effects, if recognized by a code, were usually handled by a globally applied load increase. Designers could only hope that when a tower experienced its design wind speed, the allowance for the windloading on a member was at least as great as what was actually imposed.

Code authorities and the industry continue to monitor tower failures and the success of the overall system. Historically, the number of factors used to determine windloads has increased with each new edition of the various design codes. The latest additions, although allowing conventional analysis, recognize the importance of dynamic behavior and recommend a more rigorous approach to analysis, especially in the case of towers.

Wind speed and exceedence frequencies

Wind-speed or wind-pressure criteria for tower design are well documented. Figure 1 shows the Electronic Industries Association (EIA) standard ANSI/EIA-222-D map of basic wind speed. The map geographically defines fastest-mile wind speed, 50-year contours and special wind regions. The wind speeds are measured at a distance of 33 feet above ground level. An exposure coefficient is used to include tower height in computations.

EIA standards take into account one set of standards, scaled up by a factor of approximately 2, to compensate for dynamic loads. Although EIA-222-D (which becomes effective June 1) is an improvement nver EIA-222-C, it still is not perfect. The dynamic windload factor is a comprnmise, not accounting for the true dynamics of heavy loads on top of a tower. As a result, the bottom is somewhat overdesigned, and the top of the tower is underdesigned. Dynamic mast weight distribution typically requires strength improvements by a factor of 3 in the tnp section of a tower compared with static designs.

In several sectinns of the purchaser check list in the appendix of EIA-222-D, buyers of new towers are alerted to the fact that it is their responsibility to verify and specify windload and iceload requirements. In the real world of dynamic interaction with static loads, any set of standards based on static measurements alone provide only a starting point for tower design.

The American National Standards Institute (ANSI) standards use the same basic wind-speed map. The Uniform Building Code (UBC) is more primitive, and adopts the ANSI code for wind-speed contours. However, the 1985 UBC has shown some increases in wind speed for various locations.

Wind-speed data and wind-speed probability or exceedence frequencies are compiled from decades of records by the National Weather Service (NWS) at more than 129 locations in the United States. Wind information for these locations includes various wind-speed rates by definition, wind-speed probability of occurrence, directional probability and magnitude.

One of three wind-speed measurements appears as the statistical wind speed. The *fastest-mile wind* is the highest recorded average speed at which a mile of wind passed the station. The *fastest-minute wind* is the highest recorded wind velocity sustained for one minute. The *peak gust* is the highest recorded instantaneous wind speed. The fastest-mile and fastest-minute wind speeds average out to approximately the same value, and peak gust values are typically 1.3 times the fastest-minute wind.

Previous studies for extreme wind analysis and structure design have established the annual fastest-minute wind as the most appropriate design value. Newspapers usually report peak gust speeds during storms. Design wind speeds are sustained values and normally would be less dramatic.

When determining a design wind speed, the structural engineer, as directed by the design code, acknowledges a risk factor. This risk factor is defined as

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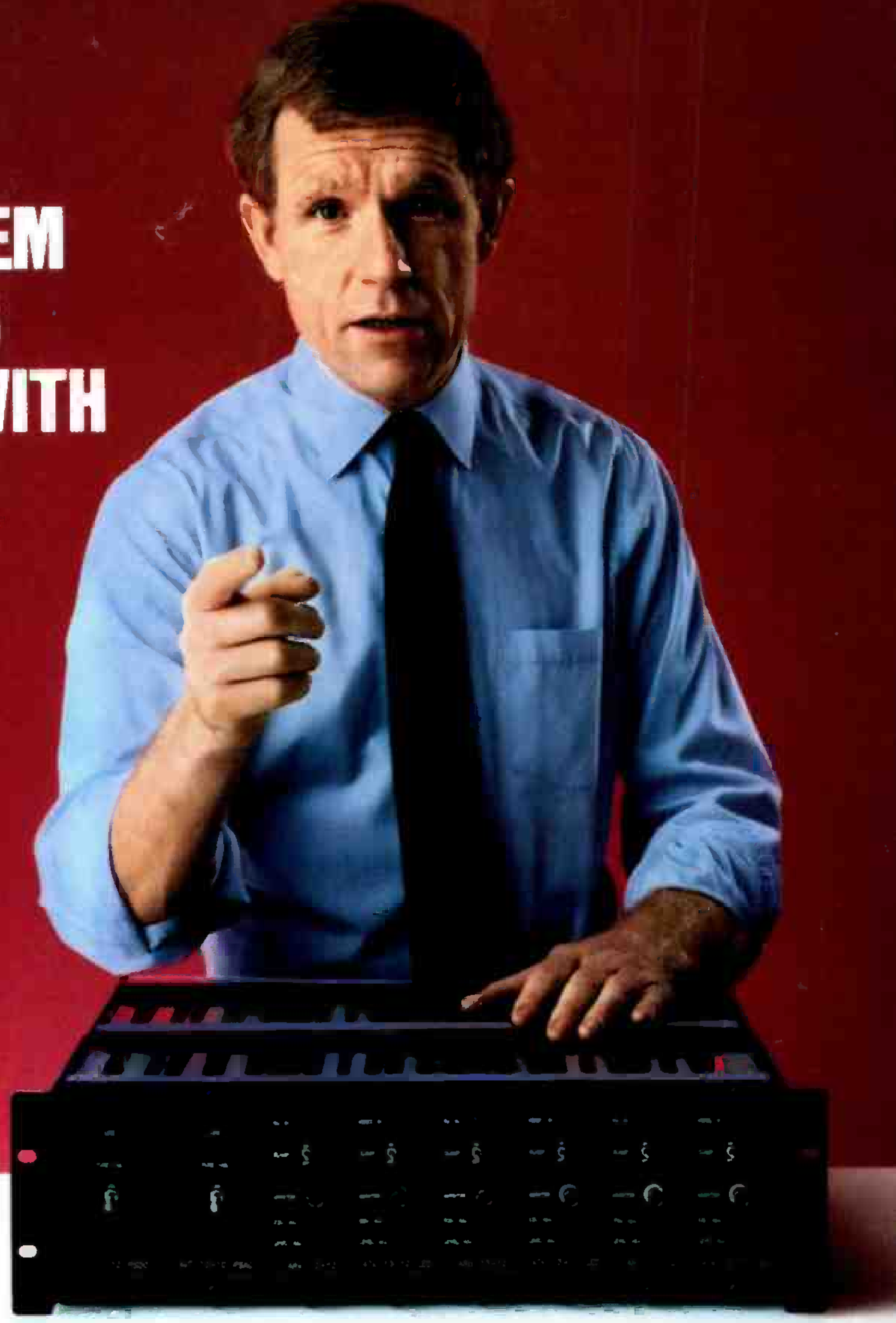

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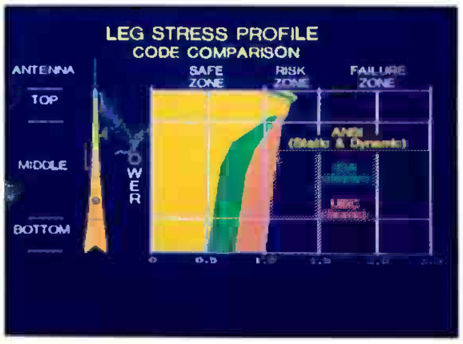

Figure 2. A leg-stress profile compares computed stress on the compression leg (the leg away from the direction of the wind) for three freestanding towers of like geometry, designed using wind pressures defined by different codes. The horizontal axis represents allowable stress, where 1 = 100%.

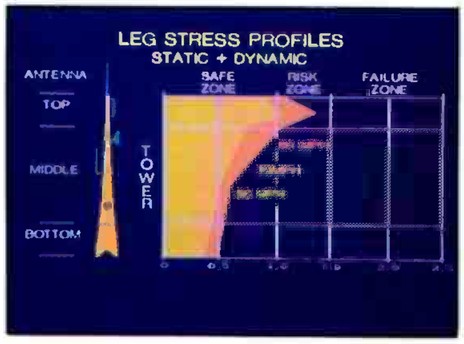

Figure 3. The differences in the static and dynamic leg stress on the same towers as in Figure 2, based on different static design wind speeds.

the probability or acceptability that a windstorm exceeding the design wind speed could occur during the scheduled lifetime of the structure. Most codes require this to be at least the 50-year windstorm or event.

Unfortunately, the 50-year windstorm commonly is thought of as a wind speed exceeded once every 50 years and not likely to occur for another 50 years. Statistically, however, a 50-year event is defined as one that has a 2% probability each year of being exceeded. This establishes the level of risk that a wind speed exceeding the design wind speed has a 2% chance of occurring during each year of the scheduled lifetime of the structure.

Findings from advanced analysis

Figure 2 shows the comparison of leg stress resulting from a load-rating analysis of freestanding generic towers of like geometry, but designed using wind pressures (same design wind speed) as defined by each of the codes shown. The leg described is the compression leg of a 3-legged freestanding tower. It is located on the side *away* from the direc-

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tion of the wind and is most vulnerable to buckling. The horizontal axis represents the level of stress computed by means of rigorous analysis in this leg at each vertical elevation of the tower (vertical axis) using the loads and resulting characteristics of the tower as would be designed by means of each code.

The leg stress (horizontal axis) is represented by a ratio of the computed load in the tower leg divided by the allowable load. A factor of 1 on the horizontal axis represents 100% of allowable stress in the leg and 0.5 represents 50% of allowable leg stress. The horizontal axis also is divided into zones of risk.

The profile shown in Figure 2 is what is believed to be the actual stress occurring in the leg at each elevation. The conventional static analysis and individual code standards that defined each of the generic towers predicted that the leg stress at each elevation would be at 100% of allowable. The actual stress (as computed) shows that the example UBC-complied tower actually is overstressed throughout its entire height. The ANSI and EIA codes generally produce towers

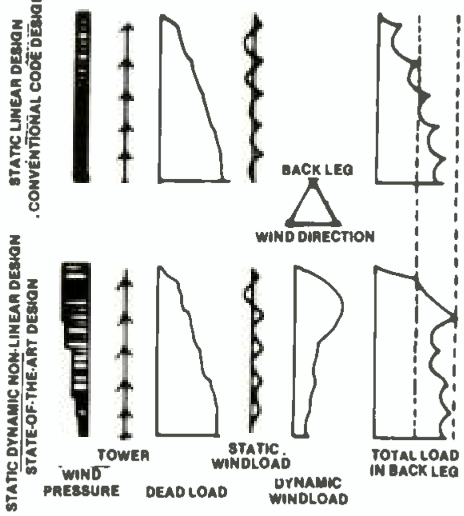


Figure 4. *When dynamic forces are considered, some guyed towers may be at more of a risk than owners may realize.*

understressed in the bottom portion, while all codes produce towers overstressed in the top portion.

This condition of overstress has been determined to exist in many towers. One indication of physical distress in a system is paint that has flaked off members following a severe windstorm. Towers displaying this symptom must be strengthened.

The goal in designing a new tower or retrofitting an existing tower is to determine the actual windloads with a high degree of accuracy based on a particular wind-design speed. Then, a new tower structure can be designed or an existing tower strengthened so that the allowable leg stresses (horizontal and diagonal member stresses) achieve exactly 100% of allowable stress at every elevation in the tower. This profile would be represented as a vertical line at 1 in Figure 2.

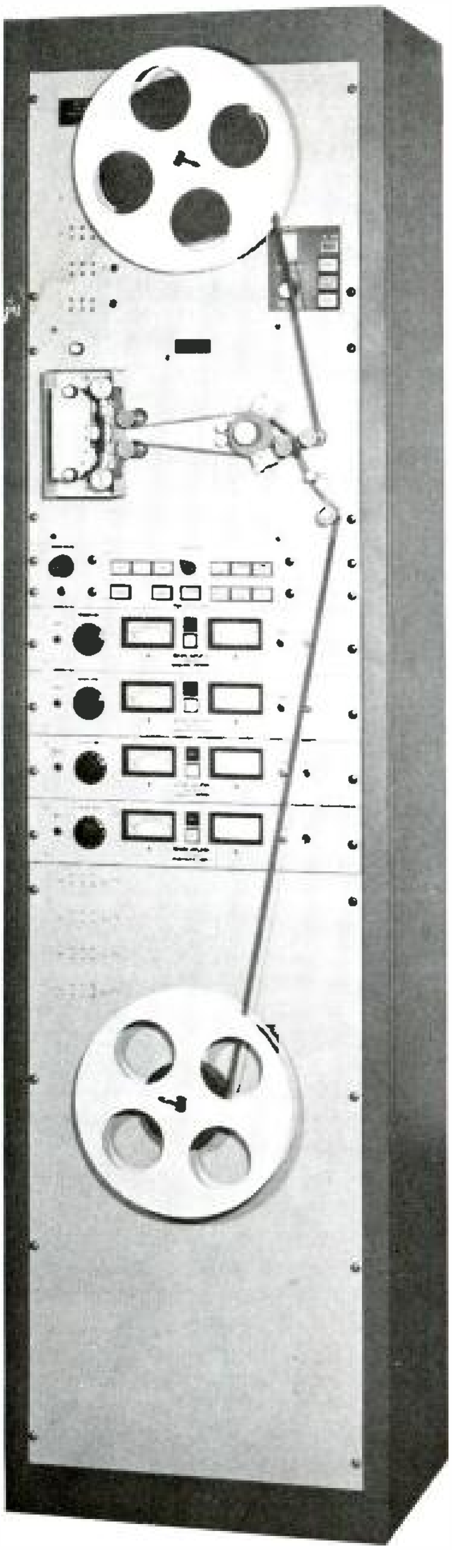
Figure 3 illustrates the differences in leg stress (static and dynamic) for the same freestanding generic towers based on different wind-design speeds. For an 80mph design wind speed, the leg stresses are in the risk zone, while for a 50mph wind speed, stresses are only 50% of allowable. Many tower owners might say "But my tower has stood up for so many years!" They should note, however, that in many parts of the country, the design wind speed has not been experienced since a tower was erected.

Static and dynamic stresses increase rapidly with increasing wind speeds. The static stress increases by the square of the velocity (a doubling of wind speed increases the stress fourfold), and the dynamic stress increases by even a higher factor of approximately the power of 2.5.

Guyed towers

Guyed towers display non-linear behavior that makes their evaluation much

MTE



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more complex than for freestanding towers. Figure 4 compares the total load on the back tower leg determined by the conventional analysis procedure of static linear design, to the static-dynamic, nonlinear approach. The back leg is vulnerable to compression buckling.

The conventional approach determines a wind pressure that is applied to a tower structure. The total load in the back leg is determined by combining the dead load with the static windload. In the static-dynamic procedure, a wind pressure also is applied to the tower. The total load on the back leg is determined by combining the dead load, plus the static windload, plus the dynamic windload.

Note the differences between the load curves for static windload because of the variability in guy forces, which are treated as springs. The most important comparison is that of total load determined between the two procedures. The static-dynamic procedure defines a much greater load than the conventional static procedure.

Wind-engineering technology

Wind-tunnel research since the 1960s has provided a considerable amount of knowledge about fundamental mechanisms of wind characteristics and wind-loading effects. The design and construction of such structures as the 110-story World Trade Center in New York and the 1,800-foot freestanding CN Tower in Toronto have assisted in the development of wind-engineering technology. It is well known that structure loads, specifically loads in structural members induced by winds, primarily depend on: a) the probabilities that certain wind speeds are reached; b) the turbulent properties of the wind; and c) the dynamic properties of the structure.

Turbulent wind characteristics include wind speed, direction, turbulence and correlation, local effects and special conditions. Most design codes recognize the variation in wind speed relative to the probability of exceedence, and also with height above ground level.

The static velocity profile of wind (velocity relative to the distance from the ground) is not uniform, but increases approximately with a parabolic relationship from ground level up to 1,000 or 2,000 feet. This elevation also is called the *wind gradient*. Velocity up to the gradient level is dependent upon surface conditions. Trees and houses slow the velocity down so that it approaches zero at ground level. However, up to some heights, the velocity increases and approaches its uniform maximum value, not changing above that level.

The wind also is directional. In any geographic location, the probability of high winds usually is far greater from one particular direction than other directions. Most codes disregard directional effects, which are best handled by wind-tunnel tests.

The turbulence of wind dominates the response of flexible structures such as radio and TV towers. These big wind eddies may be thought of as wind impulses randomly thrown at the structure. Wind impulses can load the tower at different levels, at regular or irregular time intervals with varying energy, causing the tower to sway.

Any combination of these parameters is possible, and certain turbulent patterns will affect a structure more severely than others. These patterns depend on a structure's drag coefficient and surface shape. Fortunately, these impulses are not very well correlated. When a big wind hits a part of the structure, it is likely that smaller winds simultaneously hit on other parts of the tower. This correlation is taken into account as well as the turbulence in dynamic analysis.

Geographic location, topography and upstream exposure can be important. A 10% sloping hill can increase wind speed by 20% as it passes over, resulting in 50% higher loads on a structure placed on top of the hill. If logic is based solely upon this parameter, then hilltops make better locations for windmills than towers.

A tower has a natural mode of vibration in every direction. The individual mode-shape functions are geometric descriptions of a structure's natural response to external stimuli. They are affected by the design, the masses and their distribution, and the properties of the members within the structure.

The fundamental mode is the shape the tower assumes as it sways back and forth, with the horizontal deflection measured from the vertical axis and varying as it proceeds up the tower. The greatest deflection is at the top for the first (fundamental) mode. Higher modes may have the maximum displacement at other elevations. An infinite number of higher mode shapes exists, variable with different geometry or mass distribution.

Building designers must be careful in controlling the sway or drift of buildings. Uninhabited towers, however, sway more and act differently than buildings. However, towers are often designed by the same codes used by building designers or by industry codes that do not take into account the differences between towers and buildings.

A delicate relationship exists between a structure's mass and its stiffness. Stiffness describes the amount of force needed to move a structure a given distance. High stiffness in a structure is desirable, but expensive, if achieved with large amounts of material. Heavy mass also is less easily moved by the wind. However, as the mass of a structure increases, its

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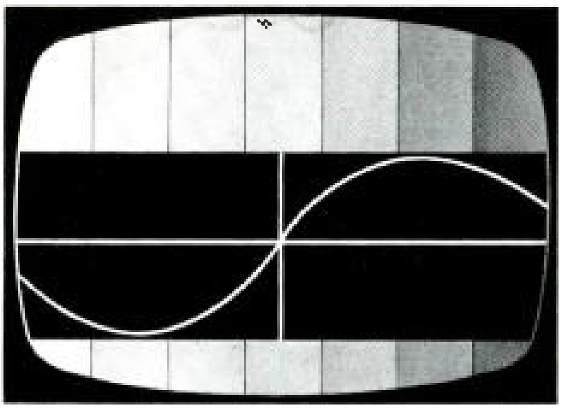

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period of vibration also increases, leading to less desirable higher stresses in resisting members.

Mass must be increased somewhat to increase stiffness, because stiffness depends primarily on the size and geometric spacing of member elements. Large masses, therefore, are acceptable, provided they are accompanied by adequate stiffness. Simply adding dead weight to increase mass (such as heavy antennas), is detrimental because it lengthens the period and does not add stiffness. Modern structures use fewer and fewer materials for economic reasons. Stiffness must be achieved through ingenious framing systems.

Structural damping is the capability of a structure to resist dynamic motion and to return to a static, stationary state. During an ongoing dynamic event, a structural system's damping capability limits it from entering a continuously increasing state of excitation. With zero damping, the structure would sway more and more with each cycle from energy added by the wind. Thus, the same amount of energy must be removed from the system as added, to prevent destruction of the system. Radio and TV towers have little damping, perhaps 0.5% of critical. Unfortunately, this is a low value that makes them dynamically sensitive.

Aerodynamics represents the remaining property of turbulent wind. Fortunately, towers do not normally exhibit serious problems, unlike the infamous Tacoma Narrows Bridge, the suspension bridge that destroyed itself in the wind. However, aerodynamics must be assessed if vortex shedding could occur where a structure has large movements in the crosswind direction. Other aerodynamic properties such as drag coefficients for members are defined by their shape and angle to the wind.

Many of the basics of wind engineering were learned in wind-tunnel testing, which is the most realistic method of evaluation. Unfortunately, these tests are complex, and relatively expensive for a structure that costs less than $10 million. In a wind-tunnel test, all the surrounding terrain, including buildings and neighboring towers, would be modeled.

Advanced computer analysis

Computer analysis allows towers to be observed the way they act in the real world. Computer methods go to greater lengths to accurately determine wind-induced loads by considering the characteristics of turbulent wind and the dynamic properties of tower structures, than do conventional design-code-governed static analyses. Once structural loads are defined, finite element analysis of the tower's structural system determines member forces and stress values. Computers can be used to analyze and load rate existing towers as well as design new towers.

A tower owner's obligation

A structural engineering review of radio and TV towers shows that most towers can benefit from an engineering management program. Once a professional tower evaluation program is completed and the tower is on a regularly scheduled preventive maintenance program, an owner should have an excellent understanding of the structural adequacy of the facility, and confidence in obtaining full use of the facility during its expected service life.

It will behoove the owners of existing towers to thoroughly review their present management programs and initiate necessary changes without delay. If you are considering erecting a new tower, a close working relationship with your structural engineer can assure that you will get the most for your investment.

Editor's note: This article was adapted with permission from a presentation by R.D. Upsahl at the 1986 NAB engineering conference.

Computer analysis of tower structures

Computer analysis procedures for flexible tower structures consider the tower as being subjected to two parts of windload: static load due to a leaning away from a roughly steady wind, and dynamic load due to a fluctuating about the static position because of turbulence in the wind. Once determined, these two load parts can be combined to obtain the various total windloading cases. Many load cases exist because the various dynamic mode shapes of the structure are produced by windloads.

Static windload analysis determines the average leaning position of the tower for the average wind speed encountered during a design wind-speed storm, usually the 50-year event. Drag coefficients of structural members exposed to the wind used in determining the windloads at each level of the tower are obtained from charts produced by the International Association for Shell and Spatial Structures[1]. These coefficients probably will be universally adopted by future design codes for lattice structures. The dynamic components or displacements of the tower then move around this mean position.

Dynamic windloads are determined by a computer program that calculates the dynamic displacements occurring at each level of the tower through integration techniques. These techniques consider the basic components of the structure's mass, period of vibration, damping, turbulence and correlation.

The original research and concepts of dynamic response in structures used in computer analysis were developed by A.G. Davenport[2]. Ongoing wind-tunnel research by Davenport, director of the Boundary Layer Wind Tunnel Laboratory at the University of Western Ontario, Canada, and others on individual parameters, has defined them more accurately.

ANSI recognizes the procedure by providing simplified charts applicable to buildings. Current tower analysis procedures follow the same intent, except in a much more detailed method, specifically designed for towers.

Once static and dynamic windloads are determined, the information is input into a mainframe computer that uses an enhanced version of STRUDL (structural design language) to model the entire structural system of the tower. Tower computer models often contain more than 3,000 members. STRUDL's finite element analysis procedures determine forces and stresses for all of the many load cases in each structural member of the tower.

Non-linear behavior, as observed in guyed towers, requires several iterations of this procedure. Conventional static analysis of guyed towers treats the system as a multiple-supported beam. Guys are considered as fixed supports where they connect to the tower.

Analysis recognizes guy connections or supports as exerting variable levels of load. When the tower moves away from the wind, force in front guys increases, but at a variable rate depending on guy inclination and size. Force in the back guy decreases in a similar manner. The force in the guy is a function of windload and distance displaced, much like a spring. In fact, some computer-analysis programs treat these supporting guys as springs.

Analysis of non-linear systems requires many iterations by a computer, which results in more of a tuning process. Guyed towers still need much research to be fully understood.

Bibliography

1. "Recommendations for Guyed Masts," The Working Group on Guyed Masts of the International Association of Shell and Spatial Structures, Madrid, Spain, 1981.
2. Davenport, A.G., "The Response of Slender Line-Like Structures to a Gusty Wind," *Journal of the Structural Division ASCE*, December, 1983.

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Seeing between the lines

By Carl Bentz, special projects editor

To see is to believe, but when your video monitor isn't truthful, what then?

You cannot deny the need for calibrated and well-maintained waveform monitors and vectorscopes at a video facility. Without these test instruments, you have no real assurance of your signal quality. Relative levels of various parts of component and composite formats play essential roles in producing signals that meet FCC guidelines. Relative phases of the chroma elements determine how color will appear in the final product.

In the last analysis, however, you base your judgment of equipment adjustment and overall picture quality on another instrument—the video picture monitor. As you make the assessment, you place a good deal of faith in that monitor, in its capabilities and in its setup. You expect *what you see* to be *what you get*.

It's not surprising that video monitors are everywhere in TV stations and production facilities. They appear in master control, in technical and recording areas, in the studio, in editing suites, in previewing rooms, in offices and in graphics production areas. For each application, you want the best, most truthful picture possible. It would be nice if you could use a top-of-the-line monitor at every viewing location. However, financial practicality suggests that utility or grade II units will satisfy most of the viewing needs. Master control or grade I monitors should be reserved for areas of critical evaluation, such as master control and production studio control rooms.

Acknowledgments: Barco, Conrac, Lenco, Tektronix and Videotek assisted in the preparation of this article.

Reliability requisites

Differences between grade I and II monitors occur in design characteristics and features. Both are of more concern in critical evaluation and observation applications than for other viewing needs. No matter what type of monitor you plan to use, you want reliability. In this respect, a master-control monitor outshines the utility monitor and accounts for the added cost of master-control units.

Active components—transistors, ICs and tubes—require operating voltages within specified ranges to perform their interrelated duties. The power supply must develop the correct initial potentials to bias numerous network voltage dividers. The power supply, in turn, depends upon an external ac-voltage source, and, as a result, is vulnerable to the anomalies of the external source. For a reliable power supply, the design must account for and cope with possible problems inherent in the ac-power system.

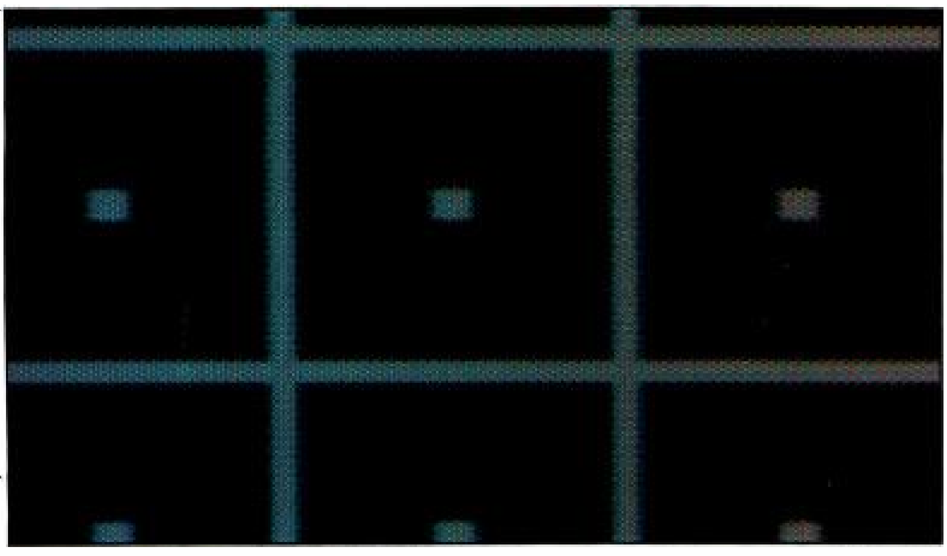
One method of increasing reliability of the power supply is to conservatively select circuit elements with specifications that exceed the expected conditions. Design goals call for all components to have at least a 50% safety factor overhead. If a design calls for a resistor to dissipate 0.5W of energy, then the component should be rated for 0.75W minimum.

Because 1W resistors are the next power rating step above 0.5W, a 100% overhead results. Other components of the power supply also should meet or exceed similar desired overhead ratings.

Operating electrical components generate heat. Reducing the local build-up of heat calls for ventilation around heat-generating and heat-sensitive components. Heat sinks provide more efficient transfers of heat to the surrounding air by effectively increasing the surface areas of components.

A reliable power-supply design also introduces protection against external forces. Fuses or circuit breakers primarily protect the power supply and internal circuitry from itself, in case a component fails and causes excess current to flow. Power-supply regulator circuits clamp the voltage and current levels that are applied to different sections of the system. In addition, regulators try to maintain constant levels as the power source varies over a reasonable range.

If the 110Vac drops by a few volts, the



Courtesy of Tektronix

An extreme close-up of the screen shows how groups of dots are illuminated by a convergence pattern.

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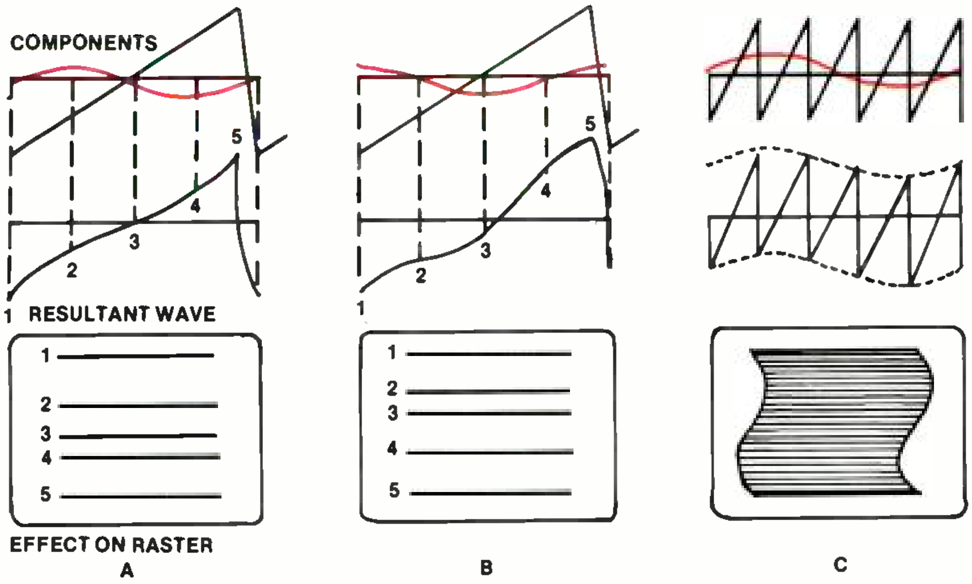

Figure 1. The effects of 60Hz hum on vertical (A and B) and horizontal (C) scan linearity.

first noticeable effect with an unregulated supply is normally in the vertical height of the picture. Regulation in the power supply tends to maintain a specified B+ voltage and to reduce size variation within reasonable ac-line variations.

Although relatively small voltage variations can result in some undesirable effects, large variations can cause failure. The equipment in a broadcast station needs help to survive voltage transients. Ideally, a studio has a regulation system on incoming mains to trim off large spikes. Transient-reducing devices can be placed in the power-supply input circuit for added protection.

Operating linearity in monitor functions also contributes to reliability. Video amplifiers are designed for specific amounts of gain. If a stage becomes unstable with respect to gain, following stages may be overdriven or moved to a point on bias characteristics that causes non-linear action. Picture highlights or blacks become compressed or expanded with changing bias. The display does not reliably represent the input signal.

Monitor spec sheets relate image size and picture brightness. The specification rates performance from 10% to 90% of average picture level (APL). As the picture brightness increases, size tends to increase. The increase in beam current as the image becomes brighter causes a related reduction in magnetic sweep field effectiveness.

Sweep circuits demand linearity. Interlaced scanning places special demands upon horizontal and vertical deflection voltages and currents. Non-linearities in the long vertical sawtooth ramp waveform quickly become more obvious than similar errors in horizontal sawtooth ramps. For lines of field 2 to fall exactly between those of field 1, the ramp should be as straight as possible, even though it involves non-linear characteristics of RLC time constants. Figure 1 illustrates the effects of 60Hz hum interacting with vertical and horizontal components of

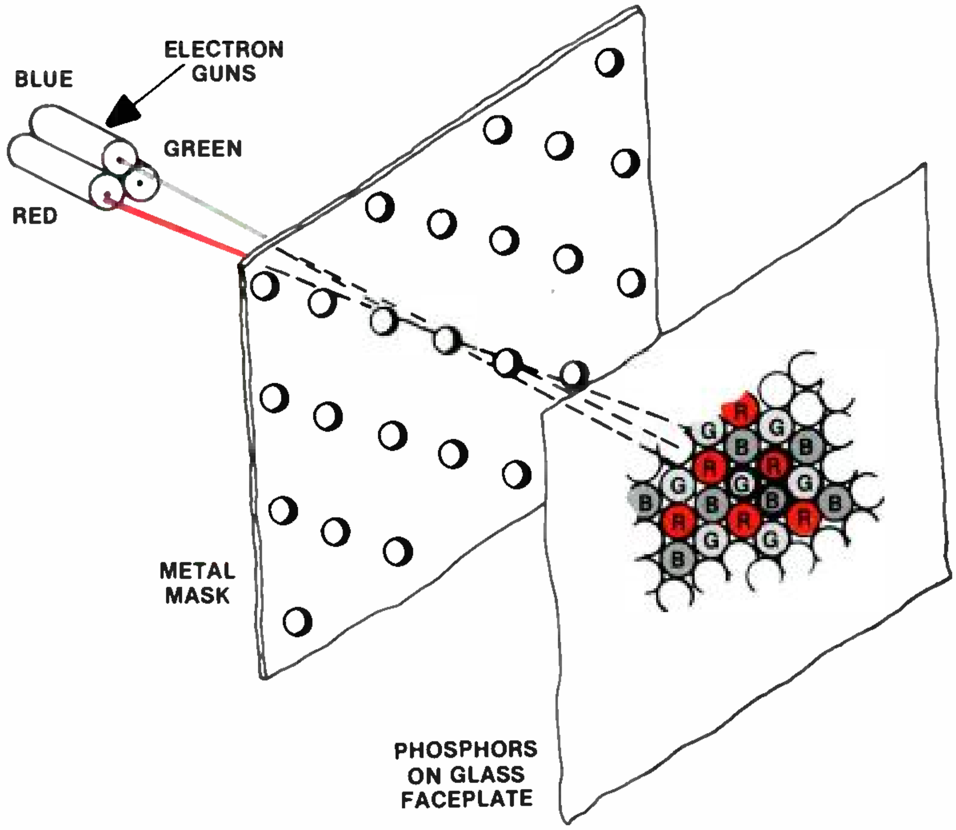

Figure 2. The delta-delta CRT structure produces a more precise image than other types, but requires more care in static and dynamic convergence. This type is common in higher-resolution monitors.

the video signal. The difference between 60Hz and the 59.94Hz scanning frequency causes the signal degradation (Figure 1C) to move upward through the picture.

Adding to sweep linearity problems is the need for corrective variations to be added to the waveforms for each color. For convergence, a high degree of linear control of the non-linear corrective adjustments, such as pincushions and tilts, is essential.

Composite chroma decoders also require linear control. Circuits that mix and separate signals are technically non-linear, but their operation should not be altered by signal or power-level changes.

In component input monitors, decoding accuracy may be less critical, but linearity of multiple channels is a must. Producing a consistent gray scale requires that color-channel gains in RGB monitors must remain constant, relative to one another. R–Y/B–Y, U/V and other color-difference component systems need stable decoding or rematrixing circuits to drive the red, green and blue circuits.

Grade 1 monitors require more tightly controlled color phosphor specifications. Standard phosphors are selected to produce their greatest light output at specified wavelengths of red, green and blue, and to display a particular color temper-

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ature. U.S. and European grade I monitors use different color specifications.

CRTs for utility and grade II monitors have less stringent phosphor purity requirements. The phosphors may produce light colors of a broader bandwidth with a result of less precise color-temperature control and a reduction in CRT price.

The construction of picture tubes follows one of four different gun/mask configurations. The *delta-delta plan* (see Figure 2) originated with NTSC color. It remains a popular configuration although it needs more attention to convergence adjustments.

Medium-resolution CRTs usually use a spacing of 0.43mm between the centers of the phosphor dots. High-resolution models, particularly useful with graphics equipment, use a dot-pitch of 0.31mm and reduced horizontal column-to-column spacing of 0.22mm. The beamwidth could be narrowed to a 0.5mm diameter, close to that of monochrome CRTs. However, cathode loading increases as beam diameter is reduced, decreasing the useful life of the cathode. Normally, the beam illuminates four or five openings in the shadow mask for acceptable brightness performance. A broader beam reduces moire effects when repetitive patterns result in *beats* beat with the spatial

Clean screen for keen greens

With home appliances, the single most common repair during a service call is to plug the appliance into the power outlet. With video display devices, one of the most common complaints is a picture that appears blurry, hazy or dim. A number of electronic reasons can be given for such problems, but often the repair is as simple as a diluted ammonia and water solution on a soft cloth.

The high-voltage potential (≈ +24kV) applied to the HV anode connection of the tube creates a static electric field. Dust, smoke and other airborne particles are attracted by the field to the glass.

Cleaning the monitor screen with any liquid solution should be carefully done. Although there should be no problem in the liquid becoming an electrical conductor, the possibility always exists. Remove power before servicing.

Inside the monitor, various potentials form an efficient dust precipitator. An excessive build-up of dirt can cause an arcing of high voltage, which can lead to eventual failure. If the build-up becomes too heavy, it also is possible that ventilation is affected, causing overheating to occur.

Dust in the monitor cabinet can provide a home for a variety of insects. Cockroaches, common residents in TV stations, can be the cause of monitor failure and even circuit damage, if they move among the components when the power is on. Points of heat would make them more likely to move. One reason for the problem is that monitors are often mounted in ways that make regular cleaning inside the cabinet inconvenient.

In the final analysis, it's easy to keep your monitor operating at its peak and producing the best possible picture with the input signal available.


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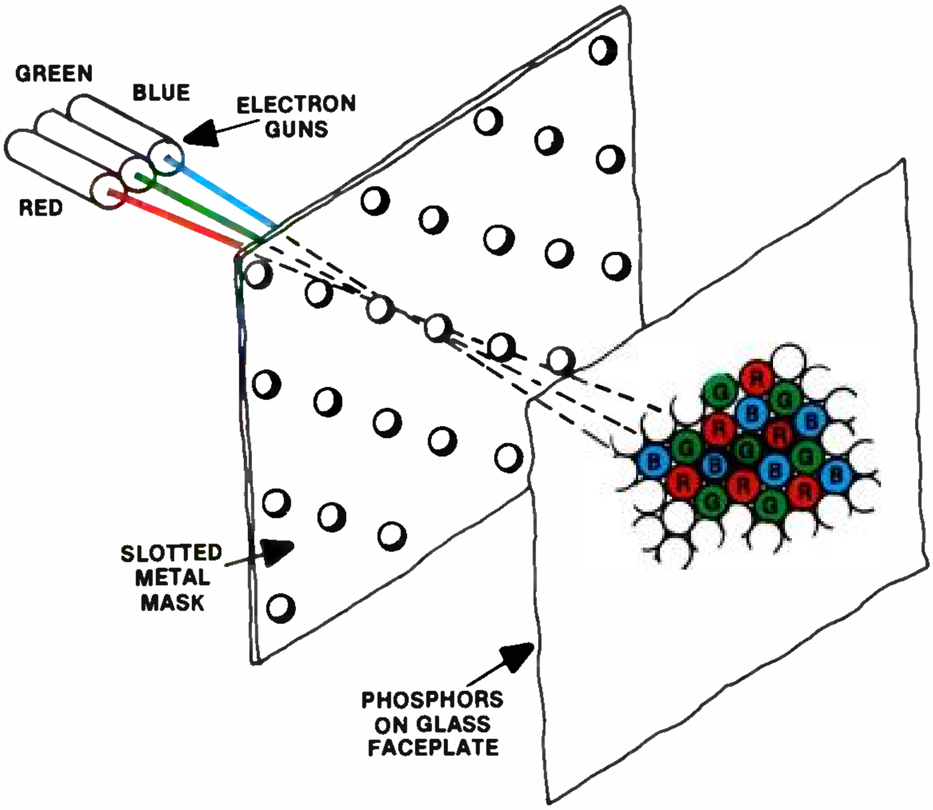


Figure 3. A PIL dot CRT is self-converging. Because all three beams can be made to originate at the same vertical angle, fewer convergence problems exist.

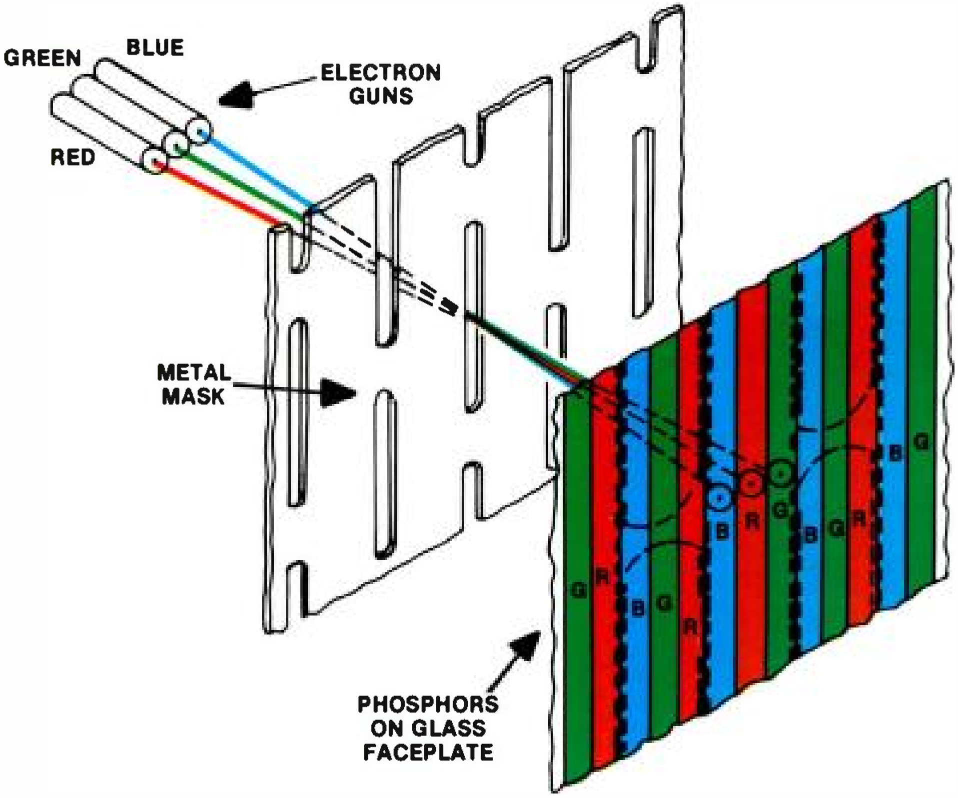
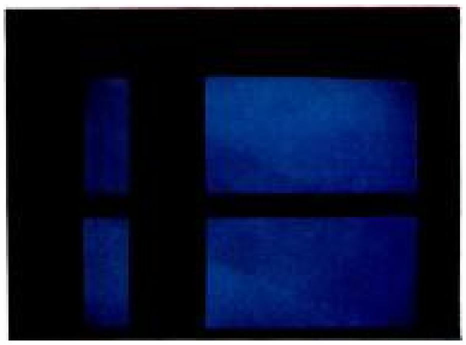


Figure 4. An in-line-slot CRT introduces greater separation among the slots of the shadow mask for more support, thus reducing resolution. As a result, the beam is larger, but more electrons reach the phosphors, producing a brighter picture.



Courtesy of Tektronix

Use of the cross-pulse mode allows the structure of the blanking interval contents to be seen.

frequency of the holes in the shadow mask.

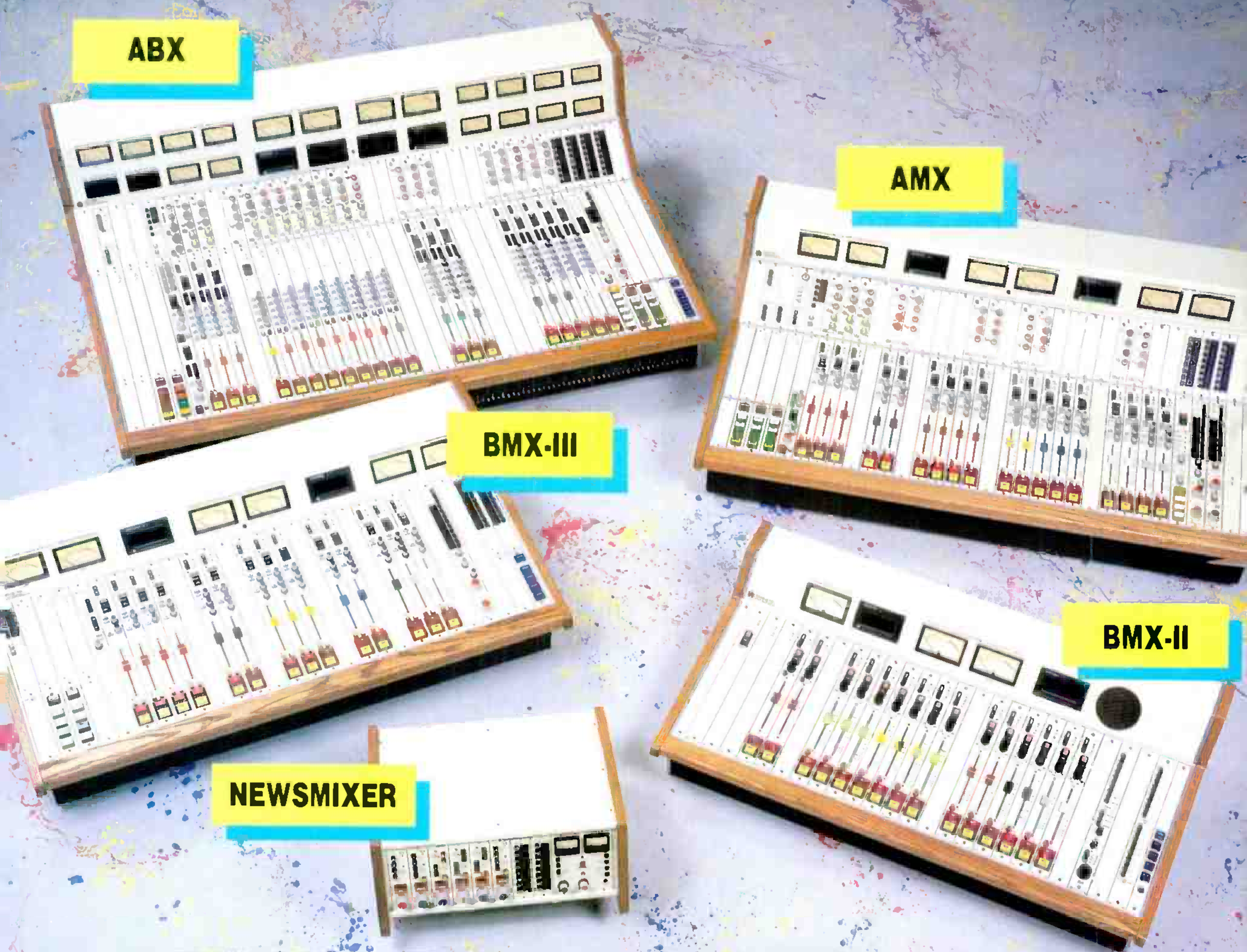
The PIL dot structure avoids some of the delta-delta problems with the precision in-line arrangement shown in Figure 3. The three side-by-side guns, rather than a triangular arrangement, direct the beam through a normal dot mask to illuminate a linear array of dots, rather than a delta format. Although the beam is actually oval in shape, the holes in the mask and the phosphor dots essentially remain circular as in the delta type.

The PIL design brings a self-converging nature to the tube, reducing the amount of convergence circuitry in the monitor. The differences between the two types of CRTs and their convergence systems reduce the compatibility. In other words, although a PIL tube probably will work in a delta monitor with reasonable success, the opposite replacement would be less successful. Deflection parameters of the two types differ considerably and the necessary convergence circuitry is lacking.

Preceding the PIL CRT was the in-line/slot mask design (see Figure 4). For structural stability, the mask slots are separated more than a dot format with the horizontal pitch of the phosphor stripes from 0.7mm to 1mm. This type of display requires a larger beam spot size. Illumination of the screen is more efficient, because fewer beam electrons are blocked by the mask. This format is not suggested for critical viewing, but it serves non-critical imaging well. Convergence concerns are reduced, compared with delta-gun formats.

Another in-line CRT, the *single-gun* form (see Figure 5), combines three beam-forming structures into the single gun. Vertical strips, supported from their ends behind a cylindrical faceplate, form the mask structure. (Other CRT types use a spherical shape.) Vertical resolution approaches infinity, but a more limited horizontal specification results from the practical width of the strips. Phosphors for this CRT are arranged as stripes, similar to the in-line/slot.

An advantage of this tube structure is



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that it requires a single electronic lens to bring the three beams into focus as they pass through slots in the mask. Fewer convergence requirements and a bright image make this CRT useful in less critical viewing environments. Some engineers advise against the single-gun CRT in grade I monitors because they think that signal disparities are not sufficiently apparent.

Some monitor systems include *beam current feedback*. Beam feedback stabilizes overall picture color and quality by maintaining a more constant color black. Variations in black level usually display images with some discoloration.

Extended-life CRTs use a different design for the surface in the cathode for an enhanced electron output. (See Figure 6.) Tube cathodes include a coating of a mixture of barium and strontium oxides to produce more electrons than a normal cathode structure. Extended-life cathodes have a special chamber with a reserve of barium oxides.

Test features

Many features provided in monitors are more useful in technical areas. One of the most common is the *delayed sweep* or *cross-pulse display*. Delayed horizontal and vertical sweep settings allow the operator to see the H and V blanking intervals. Although these portions of the picture are of limited importance for a viewing room, delayed vertical might be of interest in the tape room to aid in VCR skew adjustments.

By combining the two delays, a cross is formed on the screen that shows the virtual intersection of the two blanking intervals. With appropriate adjustment of brightness and contrast, the structure of the sync intervals becomes apparent. This information is useful during maintenance, to observe the skew error in a VCR playback deck without time base correction. This feature is not required for normal non-technical viewing.

Many engineers request a *blue gun only* display. The blue gun test allows the VTR operator to monitor noise that is generated in the blue channel during playback. The blue channel is of interest because blue chroma requires more gain to be visible than the other two channels throughout the video chain.

Another function served by the blue gun test is to aid in monitor setup. With a standard color-bar pattern displayed and the blue gun test on, the operator can adjust chroma level and phase controls alternately until the four blue bars appear equally luminant. At that point, both chroma level and phase are properly adjusted.

Some monitors include an *NTSC matrix function*, a switched function that changes how color information is decoded for display. The test introduces an RC matrix to compensate for CRTs with non-standard phosphors. At one time, this feature was suggested by several industry organizations to standardize display characteristics. Today, it is seldom included in a standard monitor package.

Aperture correction controls on monitors offer image enhancement by changing the time constant in the video circuitry. The feature typically provides from ±3dB to ±10dB gain at the higher frequencies of the video bandpass for sharpness adjustment. Along with image sharpness you may notice increased noise.

A *time-constant selection* on the monitor is important in the viewing room where a VCR may be used for playback of promos or programs. With a fast time-constant setting, monitor sync will be more affected by skew in sync from VCRs. Stable video from the production area is easily displayed on either time constant, as would be the case for a VCR output with time base correction.

To view edges of the raster, enable switchable *underscan*. The feature is useful in production areas where you must

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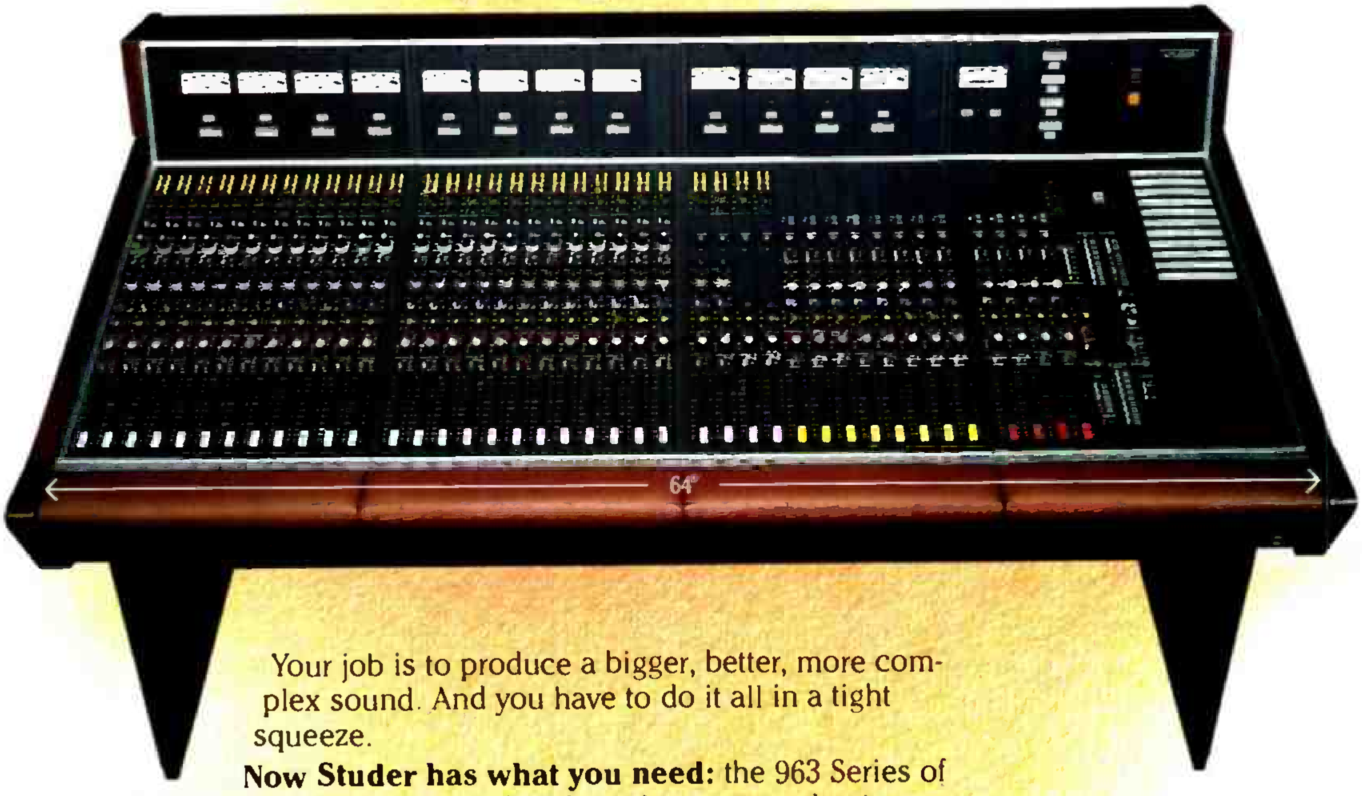

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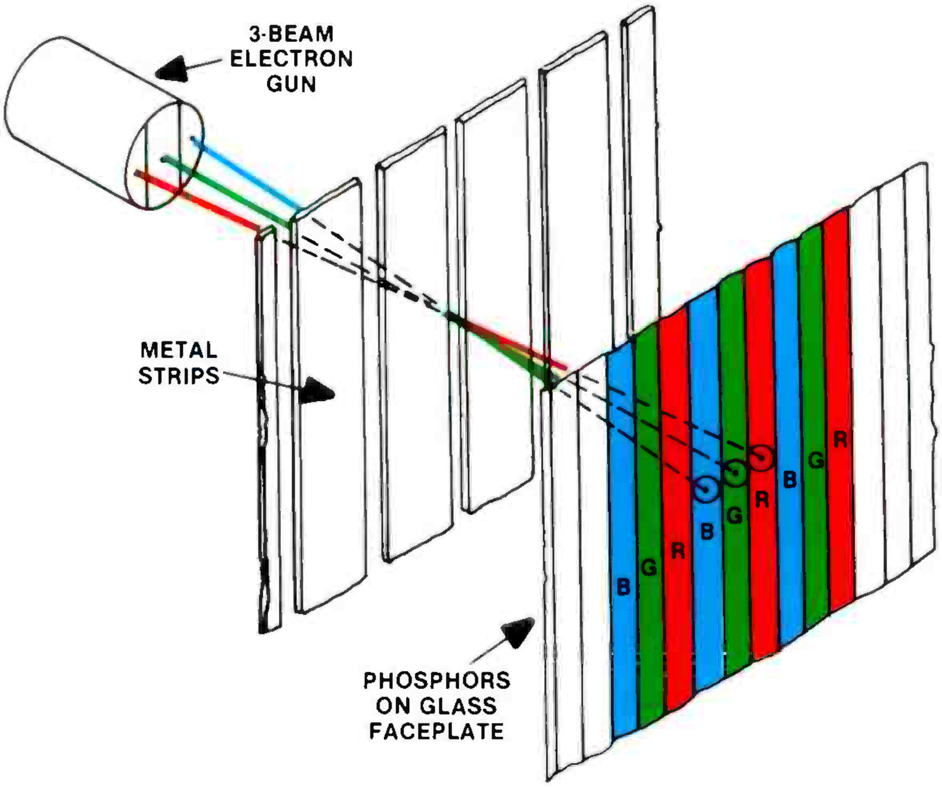


Figure 5. A single-gun CRT has a flat faceplate and produces the fewest convergence problems because all three beams are handled by a single electronic lens. The picture is bright, but signal degradation may be less visible than with a dot-type CRT.

determine if important objects will be seen by most viewers. Objects too near the edge of the raster may be off-screen.

How much overscanning occurs on a CRT screen? In the home receiver, the amount varies. Typically, the underscan amount is approximately 5% to compensate for an overscan of about 5% in normal viewing mode. A safe-area generator helps keep essential picture material in a viewable area on most screens.

Most recent in monitor design innovations is microprocessor setup and control. Operator controls use up/down buttons to signal the microprocessor circuit digitally. In some cases, the screen can be switched to show brightness, contrast, chroma levels and phase values currently stored in the control system memory as normalized values (between 0 and 255). Bar patterns with cursors visually indicate the settings of the parameter. If a permanent change is not desired, then a reset button takes all parameters back to preset conditions. This allows momentary setup changes for special purposes with instantaneous return to standard values.

Setting of parameters during maintenance can be done with an attachment

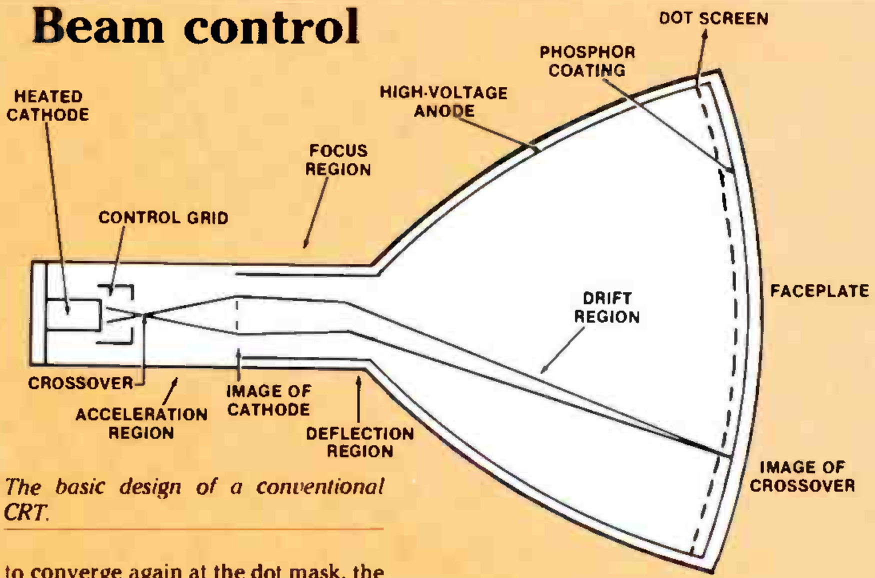
Beam control

A cross-sectional sketch of a CRT can be used to understand how the electron beam is controlled. The beam originates in the gun as the filament heats a nickel cylinder that has been coated with barium and strontium oxides. At the operating temperature, nickel loses its magnetic properties and does not interfere with electron beam formation.

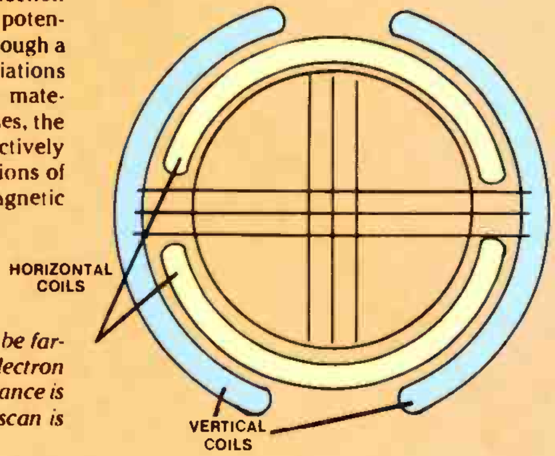
Electrons leave the cathode with nearly zero velocity and begin their journey to the faceplate along principal paths or rays. The density of each beam (RGB) is controlled by the video signal applied to the cathode terminals of the tube.

As the electrons move, they are forced by the negative charge on the control grid to move into a tightly formed beam. The effect of the control grid is due partly to its potential and partly because of its cylindrical shape, eventually causing the stream of electrons to converge much like light rays in an optical system. From this crossover point, the positive accelerating anode increases the speed of the negative particles and causes some divergence. Immediately, a focusing-field (magnetic or electrostatic) again forces it to remain in a beamlike form.

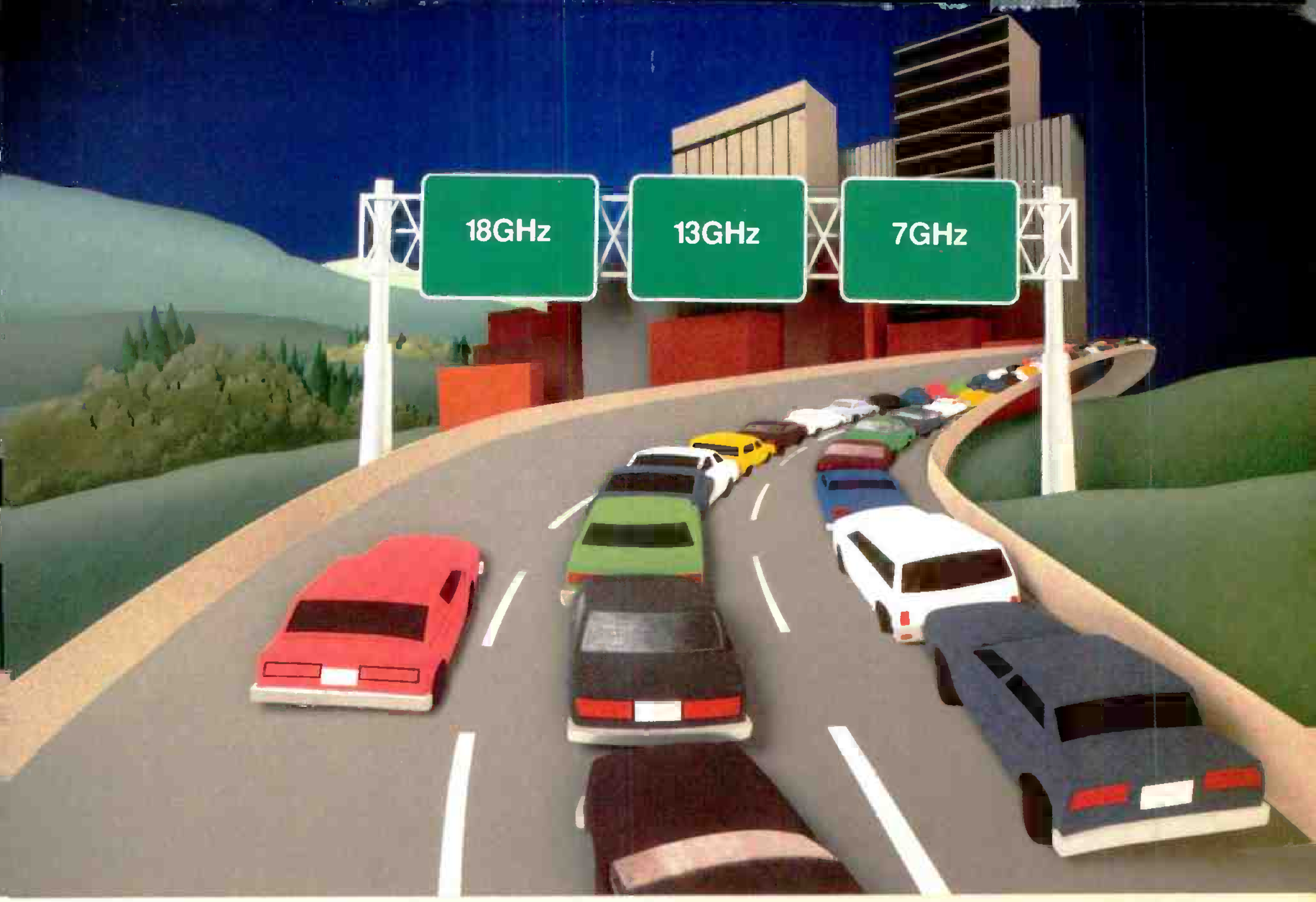
By the time the beam has reached the point where the neck expands into the tube bulb, horizontal and vertical deflection coils cause the stream to swing from side to side and top to bottom, effectively painting the picture on the faceplate. In order for the beam to converge again at the dot mask, the focus, acceleration and deflection fields must be balanced through potential and spatial separations. Although a light beam is controlled by variations in the refractive indexes of the material through which the light passes, the electron beam can be effectively shaped and guided through regions of controlled electrical and magnetic fields.



The basic design of a conventional CRT.



The vertical deflection coils can be farther from the center of the electron beam because the deflection distance is shorter and the rate of vertical scan is slower.



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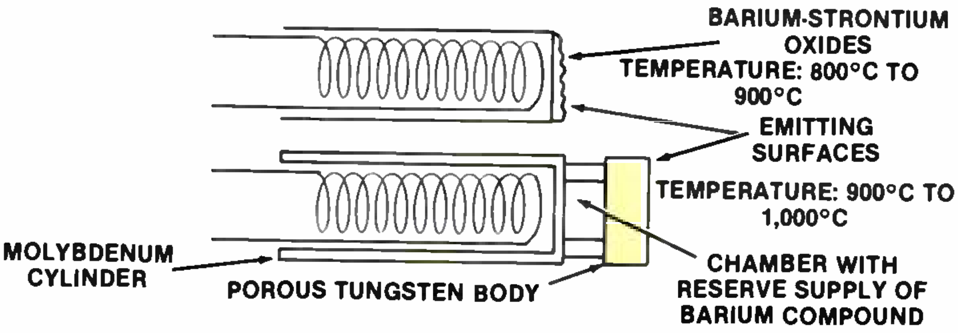

Figure 6. Conventional cathode compared with extended-life cathode (lower drawing).

that senses the color white on the screen. Because the detachable sensor plugs into a microprocessor control circuit, it can perform an automatic adjustment of color or balance controls. In some models, memories in the attachment retain settings for one or more specific monitors or for specific color temperature, allowing a quick setup to a particular standard.

A number of parameters can be controlled through microprocessor design. By electing a standards choice, the operator steps through different color modes, such as RGB component and NTSC, PAL or SECAM composite formats.

Making connections

The video inputs accepted by the monitor should be considered before the purchase is made. Most composite monitors offer a sync input, while switchable composite/component units may suggest that sync may be in green or on a separate input. Changes occurring in broadcast technology suggest that color-difference components are growing in popularity, particularly in production, where ½-inch formats must interface to other equipment. This means that you could interface among various signal formats, including RGB and composite. Although few monitors include all the possibilities, it is a subject worth discussing with manufacturers' representatives.

How important is an integral audio system? The master-control system presumably includes an audio monitor that follows video selected to the monitor. From a practical point of view, an operator assigned to master control should not be watching outside video sources. The same rule applies in the videotape room, where a utility routing switcher usually selects video and audio sources.

In the viewing rooms, however, an integral audio amplifier and speaker si. plifies the system operation for the less-technically oriented. You can drop your cassette into the VCR, turn on one switch and be in business, rather than worry about separate audio controls.

Also designed for less-technical viewing areas, rather than engineering, the combo receiver/monitor connects quickly to a VCR. The receiver/monitor not only lets one coaxial cable connect the playback unit to the display for operation on an unused RF cable, it often includes an 8- or 10-pin connector to link audio and video direct from the VCR. The operator selects VCR to observe playbacks, then presses TV or RF for off-air local channels. The receiver/monitor is for use on various staff desks when an in-house RF-distribution system is used. Not only is direct video capability available for tape, the RF tuner gives instant access to any of 12 (fewer if there are local

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Current parameters controlling the monitor display are shown in the screen. Menus direct push-button selections and parameter changes, so the user doesn't have to search for a proper adjustment tool.

channels that may cause interference) different signals to be viewed.

A look at graphics

Most computer graphics systems designed for TV applications include standard RS-170/170A sync. Any monitor probably will suffice with these systems, although some systems require two displays for complete implementation. You might select one for the output image to be a high-resolution unit. For the menu screen, a lower-resolution monochromatic CRT produces a readable operating menu image.

Graphics hardware that was designed for CAD applications may present a problem within the TV environment. Many are designed for significantly different horizontal and vertical scan rates. To successfully integrate them with standard video requires a video encoder, keyer and format interchange device (frame buffer). For the CAD-type systems, a typical TV monitor may not work properly, its success determined by scan rates and resolution.

The interest in improving video quality is increasing. The need for high-quality video monitors to support that interest is obvious. Selecting the right monitor for use in your facility is a matter of sorting through the available products and matching available features with your particular requirements.

Symposium to attract international attendees

By Carl Bentz, special projects editor

If you decide to attend the 15th International TV Symposium and Technical Exhibit, June 11 to 17, in Montreux, Switzerland, you will not be participating in just another trade show. This biennial event, sponsored by the Telecommunications Department of the Swiss PTT (Posts, Telephones and Telegraphs), concentrates on television as a medium served by terrestrial broadcast, satellite broadcast and non-broadcast, broadband CATV technologies. The event is more international than any broadcast convention in the United States, with participants from many countries around the world.

The hardware show

In the exhibit hall at the Montreux Palace Hotel and Convention Center, you should see a number of familiar faces from U.S. companies. You should recognize a number of familiar names as well. Many European manufacturers are well represented at NAB and SMPTE events by their U.S. branches or distributors, but at Montreux, the headquarter organizations are in charge. With these organizations will be a number of manufacturers who rarely exhibit in the United States.

The most recent exhibitor list includes more than 190 different companies that have requested space in the enlarged facilities. Since the 1985 Montreux Symposium, an additional 3,000 square meters of space have been constructed. An improved air-conditioning system has also been added to the entire 12,000-square-meter area.

The majority of European countries will be represented in the exhibit hall, including Austria, Belgium, Denmark, Finland, France, Great Britain, Italy, the Netherlands, Norway, Spain, Switzerland and West Germany. Contingents from non-European countries will include: Canada, Japan, Singapore and the United States.

Many of the products on display at Montreux will be in PAL or SECAM forms, rather than in NTSC, made possible through an encoder at the output of the system. Many designs that embrace analog and digital component technologies will drive the encoders.

Exhibit hours will be from 10 a.m. to 6 p.m., June 12 to 16.

The symposium schedule

The symposium will open Thursday morning, June 11, with welcoming addresses by symposium organization officials, the Mayor of Montreux and the Swiss PTT patron organization. The presentation of the Montreux 1987 Achievement Gold Award will be followed by a presentation of *Technology Trends* by industry leaders from around the world.

A reception will follow the opening ceremonies.

The afternoon session on *High-Definition Television* will examine picture, sound and RF aspects, as they relate to TV and film applications. The HDTV session will conclude, as will nearly all seminar groups, with a round table discussion for the experts and participants to exchange views on the evolution of television for tomorrow.

Friday morning, June 12, the schedule will include concurrent sessions on *Television Production Systems* and *Terrestrial Broadcast Systems and Equipment*. The production group will explore analog and digital developments from around the world, and the trends in studio and OB production and signal processing. The broadcast systems session will consider equipment innovation and topics such as digital multichannel sound and the future extension of terrestrial television to enhance HDTV use. Both sessions will end with a discussion between speakers and attendees.

Friday afternoon's schedule will present concurrent sessions for *Direct Broadcast Satellite Systems* and *TV Origination and Processing*. Participants will learn from the experience of European and Japanese DBS operations that were recently initiated. Topics of medium-vs.-high power, hybrid DBS-communications satellites and DBS economics should present insight into the transmission medium. The origination and processing session will stress innovations in cameras, switching, processing and effects equipment. Advancements in CCD technology also is scheduled.

Saturday morning, June 13, concurrent sessions will focus on *Lightweight TV Production Systems* and *Signal Distribution via Satellite and Terrestrial Means*. The production systems session will review small-format analog composite and component equipment and consider their future in high-quality production. Signal distribution topics will compare the economics of satellite operation vs. terrestrial methods with an emphasis on international program distribution for broadcast and CATV.

Saturday afternoon, concurrent sessions on *Video Recording Equipment* and *Approaches in Marketing and Planning of Cable Television* will be hosted. The explosive growth of video recording in digital and analog formats and their applications into advanced post-production techniques should lead to an interesting round table discussion.

A single session is scheduled for Sunday, June 14. *The Entertaining Screen* session will examine the effects of technical advances in the process of entertaining the viewer, but from the producer's perspective. Some previews of new material presented on a wide electronic screen will provide illustrations of the changing nature of production and entertainment values.

The general broadcast sessions will conclude on Monday morning, June 15, with *Broadcasting—The Cold Wind of Change!* This highlight session, spotlighted by a keynote speech that will view both sides of the issue, will focus on new forms of electronic entertainment now available that are eroding the effects of traditional broadcasting. Concurrent with the session will be the topic, *Progress in CATV Network Technologies*.

Monday afternoon will include two sessions of interest to both broadcast and CATV. *Satellite News Gathering* will be of interest to traditional broadcasters, as will the concurrent meeting that will discuss *Home Terminals*, a look at applications for data, text and interactive activities made possible through microelectronics.

Tuesday, June 16 and Wednesday, June 17, will be given over to topics of interest primarily to CATV participants. *Fiber-optic Trunk and Distribution Net-*

works will review the steps taken in different countries to use fiber-optic technology in CATV networking. *Advanced CATV Services* will emphasize new applications. *Interactive Cable Networks* will explore the possibility of new interactive services via cable.

Making arrangements

Time is short, so make your plans now to attend the 15th International Television Symposium in Montreux. Contact the symposium and exhibition management by phone at (+ +41) 21-63-32-20 or 21-63-12-12. Telex contact can be made at 453-283 ITVS. The management will explain registration requirements, fees and housing.

You will need a passport to travel to Switzerland. An international driver's license is strongly suggested if you intend to drive while there.

The autobahns are excellent and the trip from Geneva to Montreux takes about half an hour. If you decide to take the train from Geneva instead, keep in mind that European public transportation operates on schedule.

The rate of exchange, calculated on March 5, is about 1.5 Swiss francs to a U.S. dollar. There is a monetary exchange facility in the Montreux Palace Hotel lobby.

Pleasant scenery

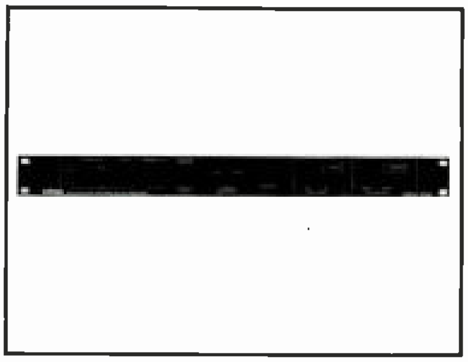
Participants at the convention will find themselves surrounded by an outstanding landscape with the hillsides covered with vineyards. Le Chateau du Chillon, a medieval fortress, is located only a few minutes' drive or train ride from the exhibit hall. It has been restored inside to its former grandeur. The structure was built over a 500-year period, back in the 9th century. Guided and on-your-own tours are available. As you stand on the bridge over the moat and look up, the incongruity of a very sound, 1,000-year-old structure and the modern autobahn that seems almost overhead is striking.

Plan for a pleasant time in Montreux and enjoy the seminars and exhibits.

Field report

Orban 275A stereo synthesizer

By James Radmann



MTS stereo television and stereo synthesis are going hand-in-hand in TV stations across the country. When WXGZ-TV began investigating the conversion, stereo programming was not, and still is not, readily available. There are a number of isolated network or syndicated stereo audio feeds. But, for the majority of TV programming, monaural audio is the norm. Because our station wanted to broadcast in stereo at all times, we needed a stereo synthesizer. We selected the Orban 275A. A block diagram of the unit is shown in Figure 1.

> ***Performance at a glance***
> - *Simple installation with barrier strip connections*
> - *Frequency response of ±0.5dB 30Hz to 15kHz in the bypass mode; ±1dB 30Hz to 15kHz in the synthesize mode*
> - *Fully automatic operation*
> - *Mono receiver compatibility in synthesize mode*
> - *Smooth crossfade between modes*
> - *Automatically corrects for switched polarity lines*
> - *Single-ended noise reduction provides a 10dB improvement in S/N*
> - *Single-channel and equal dual-channel detection and synthesis modes*

Important features

Our needs are probably similar to those of other stations across the country. The synthesizer had to automatically detect and synthesize monaural programming. Automatic operation is critical to our operation because the transmitter is located 17 air miles from the studio.

Two other important features were also needed in the synthesizer. Because most of the receivers are monaural, and will be for many years, the summed stereo left and right channels have to add back to the original mono to ensure mono compatibility. Generating a pseudo-stereo signal from a monaural signal is not difficult. However, it is more difficult to do so while keeping full mono compatibility.

The other required feature centered on reversed polarity signals. As stereo FM stations learned the hard way, reversing the phase of one audio channel (from a pair of monaural channels) destroys the monaural signal. When combined in the viewer's receiver, a feed's reversed polarization effectively nulls the monaural listener. Automatic detection and correction of reverse polarity is, therefore, desirable. The stereo synthesizer provides these features and many other useful ones.

Noise reduction

Many TV stations use little audio processing. Noise reduction equipment is even less common. The synthesizer provides user-selectable, single-ended noise reduction. The noise reduction operates only on synthesized mono material. The circuits apply a combination of program-controlled, high-frequency filtering and broadband expansion. The device typically provides up to 10dB of noise reduction on most signals. Because the noise reduction is single-ended, no encoding and decoding is required.

The synthesizer was initially installed and operated with the noise reduction turned on. It was only after the feature was manually turned off that the noise, buzz and hum produced by our projector's optical sound system became obvious. At one point, an oscillation developed in the film projector's audio exciter lamp. The oscillation produced an annoying buzz in the audio just prior to the lamp failure. Fortunately, with the synthesizer, the failure was detected in-house without the undesirable buzz being transmitted to the viewer.

Most of the noise-reduction circuitry is contained within one chip, the major elements of which are shown in Figure 2. The complex IC provides optimum signal control without operator intervention.

The dynamic filtering begins rolling off the highs at about 1kHz, unless enough highs are detected in the signal to cover the noise floor in the mid- and high-frequency range. As additional high-frequency material is detected, the filter opens to pass more of the full-range audio.

Stereo/mono detection

Detecting whether a signal is stereo or monaural is difficult. There are two basic ways that synthesizers decide whether the incoming material is stereo or monaural.

In the single-channel mode, it is relatively easy for the device to know what to do. If one incoming channel lacks audio, the synthesizer switches to stereo synthesis. In this mode, if both input channels contain audio, the device considers the material stereo and the synthesizer is bypassed. Because this method is quite reliable, many stations elect to use this operational mode.

The second detection mode can be added to supplement the single channel mode. This mode uses special circuitry to monitor the incoming channels. If the material is true stereo, or even hard-center dialogue with a low-level stereo music or audience noise background, the synthesizer recognizes it as stereo and the stereo synthesis circuits are bypassed. Because no TV facility is perfect, minor phase and level differences between the channels are ignored. An internal trimmer allows the user to determine the point at which the detection circuitry switches to stereo synthesis.

When lightning caused the loss of our regular mono (left) STL transmission channel, the automatic detection/synthesis feature really proved valuable. After the STL failed, the synthesizer automatically switched to synthesized stereo using the one good STL audio channel as the monaural source. After the defective STL channel was repaired, we switched over to the repaired channel and performed checks on the right channel. Once all of the checks were completed, one touch of the button returned the device to the automatic program-controlled operational mode.

In addition to the capability to recognize a dual/mono signal at the synthesizer's inputs, it is equally important to perform a gentle, smooth crossfade from a true stereo source to the synthesis mode. The ½-hour children's programs

Radmann is chief engineer at WXGZ-TV, Appleton, WI.

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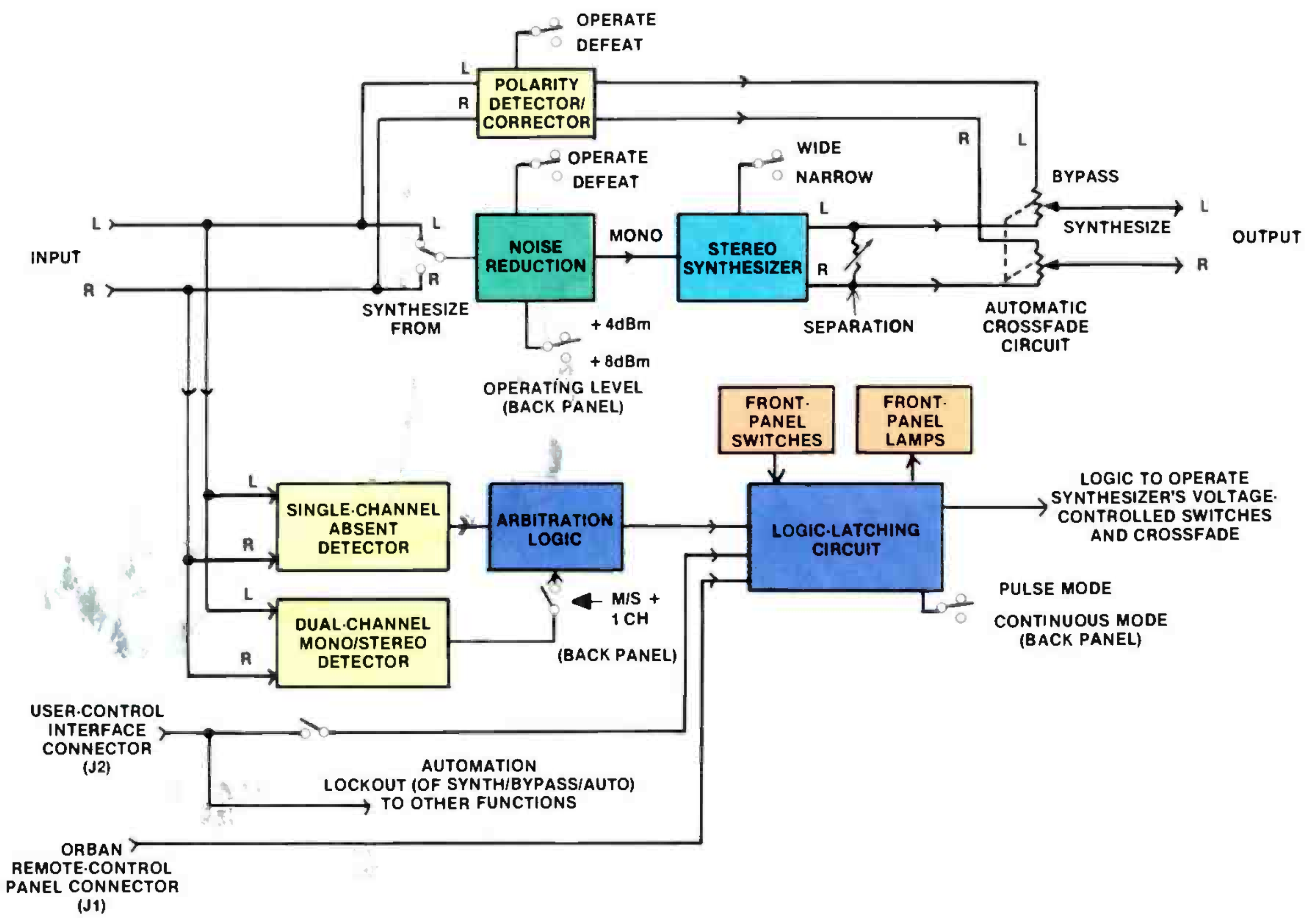

Figure 1. *Block diagram of the Orban 275A stereo synthesizer.*

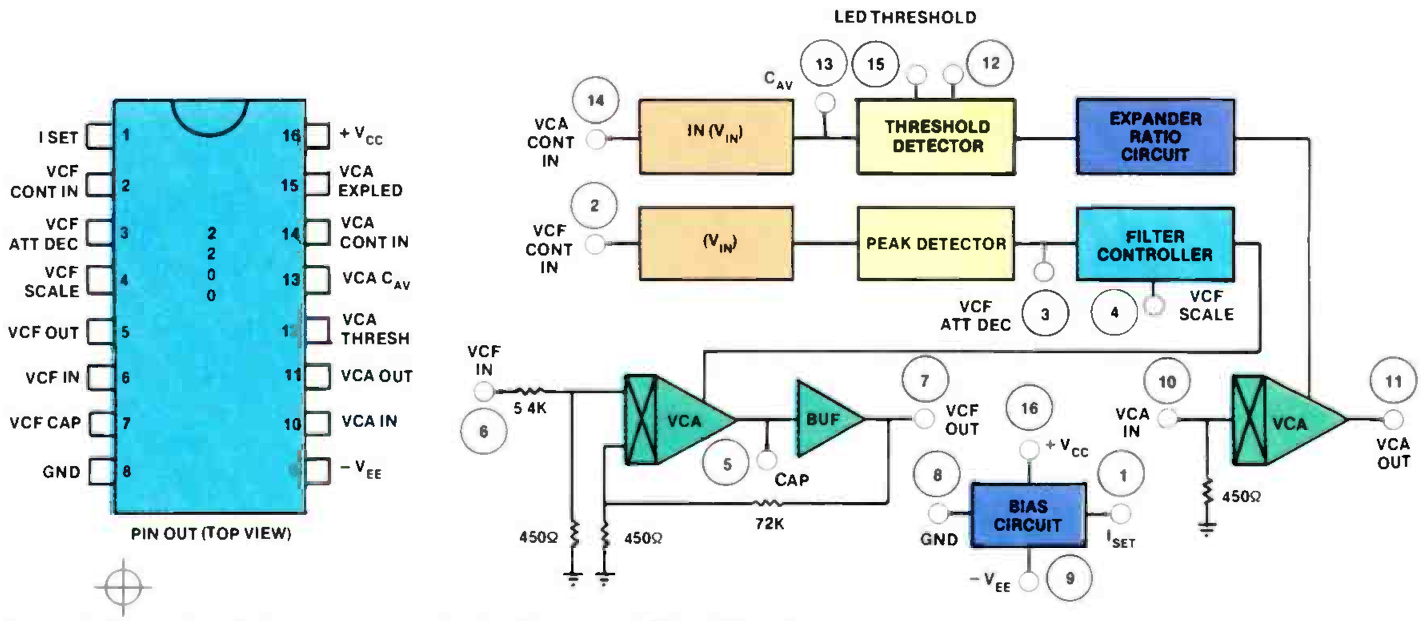

Figure 2. *The single-ended noise-reduction circuit relies on an AGC and filter chip.*

and 1-hour Fox Broadcasting programming forces the synthesizer to repeatedly detect one missing channel. Then, just as fast, the device will have to switch to the bypass mode to direct the stereo feed straight to the stereo generator. The synthesizer also detects dual-channel mono commercials. It is not fooled by minor phase differences that may exist on the tape machine. We have been quite pleased by the unit's consistency in recognizing monaural programming and switching to stereo synthesis when required.

The synthesizer creates a pseudo-stereo effect from the monaural signal by dividing the audio spectrum into several frequency bands as shown in Figure 3. Each of these bands is used to develop the left and right channels. The net effect is a complementary comb filter. The ear perceives the resulting signal as a stereo-like effect with substantial depth and relatively wide spatial perspective.

To generate the artificial L–R signal, the mono audio is first passed through a chain of phase shifters. The resulting L–R signal is then added to the monaural signal to create the synthesized left channel. The L–R signal is subtracted from the monaural signal to create the right signal. The sum of the two synthesized channels remains equal to the original mono signal, thus ensuring mono compatibility.

Two modes are provided in the synthesis mode: wideband and narrowband. The narrow mode creates many narrow frequency bands and is better suited for programs containing a great deal of dialogue. Because much of our station's programming falls into this class, we use the narrow mode most of the time.

The wide mode is suited for musical programming. This mode of operation creates only a few wide frequency bands and results in a dramatic sense of stereo space on music and effects.

A front-mounted separation control allows adjustment of the relative width of the stereo image. Once adjusted, it needs no further attention.

Remote control

All of the unit's functions can be accessed by an optional remote-control panel or an external automation system. The remote-control panel can be located up to 5,000 feet away.

If used with an automatic system, the control signals can be either continuous voltages or pulses. A back-panel switch selects the desired mode. In the pulse mode, the automation system duplicates the front-panel buttons. In the continuous mode, a continuous voltage is required to override the manual controls. The synthesizer's logic reverts to its former standby state when the voltage is removed.

Because our transmitter does not lend itself to this type of operation, we depend on the transmitter remote control for switching functions. Even so, we do not find this to be a limitation in our operation.

Maintenance

Although our station supports a stringent maintenance program, no adjustments are required on the synthesizer. At most, the unit is dusted off once a month.

The unit was opened for inspection upon delivery. Since then, the covers have not been removed. The mainte-

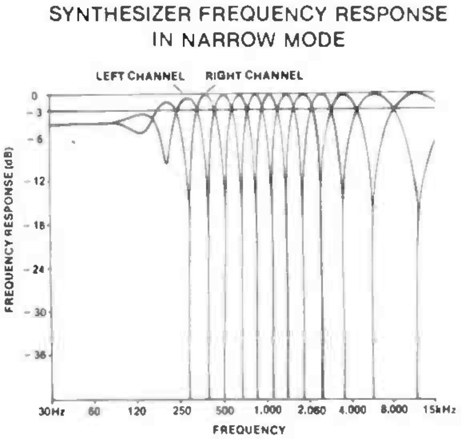

Figure 3. *Stereo synthesis begins by filtering the audio into either narrowband or wideband signals. These signals are then combined to create an L−R signal, which is used to generate the discrete left and right stereo signals.*

nance manual is thorough and contains diagrams and adjustment instructions.

One section of the manual proved to be quite useful to our operators. An entire section is devoted to use of the unit by master control operators. The manual uses just enough technical language to get the points across, and thoroughly (but simply) explains what the various controls do and how to use them. More companies should consider providing such operator instructions.

The Orban 275A stereo synthesizer has performed well since its installation. The reliability has been especially valuable because our transmitter site is more than 30 minutes away. Until networks and syndicators completely convert to stereo operation, a stereo synthesizer such as this will be needed at many TV stations.

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

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

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

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What SBE is doing for you

By Bob Van Buhler

The old question, *What have you done for me lately?*, probably has been asked of most professional organizations. Every once in a while it's a good idea to stop and remind ourselves what the national SBE office does on behalf of its members.

Certification

One important task, undertaken years ago by the SBE, has been the development and promotion of the certification program. The SBE certification program has done more to enhance the credibility and salaries earned by broadcast engineers than any project ever undertaken. SBE certification provides a way for an engineer to add distinction to a career in a visible and profitable way.

Certification also provides avenues for advancement and proof of one's competence in a field that is otherwise blurred by FCC deregulation. The SBE certification program is the industry's only universally recognized "stamp of competence." If you doubt this fact, check out the **BE** annual salary survey. The survey graphically and indisputably bears out that SBE certification is recognized by and valuable to employers. This recognition typically shows up as increased salaries to SBE certified engineers.

Further evidence of the industry's view of certification is available in the classified employment advertisements. Pick up any trade publication and examine the help wanted advertisements. Every month you see more and more references to "SBE certification preferred." Some job notices now even state that SBE certification is required. For the engineer willing to make the effort, certification provides the path to better recognition, rewards and the opportunity for higher salaries.

Other membership services

The SBE job bank is another project that can help engineers who want to improve their lots. These job bank listings will soon be posted on CompuServe in a double-blind format. The postings help serve the needs of both employers and engineers across the country. Once implemented, the information will be available 24 hours a day.

The job bank listings currently are available only through the national office and SBE *Shortcircuits*. The list of jobs continues to grow and there are more openings than applicants.

The SBE also offers a comprehensive group life insurance plan. As a part of the Engineering Associations Insurance Trust, inexpensive term life insurance is available to all SBE members. Because of the program's success, premium discounts and coverage-upgrade offers regularly are provided. Engineers working in small stations or as independent contractors often find the program as an attractive means of providing financial security to their families.

Need to rent a car? SBE members are provided discount car rental rates with at least one agency. These rates are comparable to those provided to large corporations. The latest discount rental card was issued with the membership dues notices.

The Ennes scholarship fund provides assistance to individuals studying broadcast-related technology. This assistance also is available to SBE members and their families. If you have a son or daughter or know of someone needing assistance to complete a technical education, contact the national office.

These items are but a small part of what the society does for its members. Additional information will be presented in a later column.

CompuServe forum

Although the discussion was friendly and interactive, the turnout for the CompuServe bylaws forum was sparse. Less than 20 users signed-on to the forum to talk about the proposal to amend the bylaws.

The whole issue of changing the bylaws has been around for several years. However, because of the issue's importance, everyone should thoroughly understand what the changes mean to the society. Each member should be familiar with the language and treat each proposal as a separate matter. Each proposal will be voted on individually and must stand on its own merit.

According to the SBE's attorney, the only way the bylaws can be changed is through a separate vote for each proposal. The numerous proposed revisions cannot be tied together under a single yes or no vote.

The proposed changes will appear in the next issue of the SBE *Signal*. The entire text also is available in the SBENET area of CompuServe. If neither of these methods is satisfactory, contact the national office for assistance.

Certification guides

Ready to move up to the next certification level? Study guides, which are mentioned in the certification booklet, are now available from the national office. Study guides are available for the following categories: broadcast technologist, broadcast engineer AM/FM, broadcast engineer TV, senior broadcast engineer AM/FM and senior broadcast engineer TV.

The guides can be ordered by prepayment of $4.95 or charged to a Visa or MasterCard number. Contact the SBE certification secretary at 7002 Graham Road, Suite 118, Indianapolis, IN 46220. Credit card orders can be placed by calling 317-842-0836. Be sure to specify the desired study guide when placing your order.

New officer and board member

On a roll-call vote, the SBE board of directors appointed Bill Harris as the new SBE treasurer. The appointment will continue until a new treasurer is elected this fall. Harris was an elected SBE board member and is technical director for KMJI-FM and KRZN-AM, Denver. He replaces Wally Dudash, who recently retired.

The resulting board vacancy will be filled by Stephen R. Brown, WLTE-FM, Minneapolis. Brown is chapter chairman for Chapter 17 and a certified broadcast engineer.

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

HOW WILL YOU TEST BTSC AUDIO?

Your old audio test gear won't hack it. Here are key points when evaluating new audio test equipment:

BUZZ-BEATS: Buzz beats are not harmonically related to the signal. THD + N measurements spot them by removing the fundamental, measuring everything else. Instruments that measure 2nd or 3rd harmonic at spot frequencies may not.

ABSOLUTE ACCURACY: Setup of BTSC generators for maximum separation requires measurement accuracy of 0.1 dB, channel matching to 0.02 dB, phase accuracy of 1 degree. Instruments with 0.1 dB resolution can't do it; Audio Precision's System One can.

DEVIATION SETTING: BTSC tracking demands that your stereo generator's reference level produces exactly 25 kHz deviation. Set System One's oscillator to the reference level with 0.01 dB settability. Use its 10,396 Hz frequency (0.03% accuracy) and Bessel null techniques for precise deviation setting.

BROAD TESTING CAPABILITIES: High-quality audio testers sell for $6,000 to $12,000. At that price, they should test everything in the station--VTRs, ATRs, consoles, processors, distribution amplifiers, routing switchers, full station proofs. They should measure IMD, wow and flutter, phase, frequency, THD + N, broadband and selective amplitude and noise. Audio Precision's System One does.

PERFORMANCE LEVELS: In 5 to 10 years, much of your audio chain will be digital. That puts tough demands on test equipment. Today, some VTRs have PCM audio channel distortion below 0.01%. Your audio test set distortion should approach 0.001%. System One guarantees <0.001%.

AUTOMATION: Automated testing is the economical alternate to increasing staff. System One saves setups, graphs and stores data, prints output. You concentrate on results instead of how to make the measurement.

PROPER PROOFS: Recommended practices call for proofs at constant deviation percentage. That requires data flow from analyzer to oscillator, software that adjusts oscillator amplitude for constant deviation, then measures and graphs oscillator output. Standard with Audio Precision System One.

DAILY PROOFS: Skeleton proofs (even split site) run in 60 seconds at normal operating settings of stereo generator and mod monitor. Daily proofs at sign-on or sign-off help you exercise tight control over audio quality.

If an audio test set doesn't meet these requirements, it's not a complete BTSC tester regardless of its name. System One is used by the leading manufacturers of BTSC stereo generators.

For more information on our complete BTSC testing package consisting of filters and software, call or write Audio Precision today.

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People

Paul D. Gerlach has been appointed to the position of vice president and general manager at Lenco Electronics Division, Jackson, MO. He is responsible for providing administrative and supervisory leadership; overseeing the production of the electronics product line; and implementing corporate goals, policies and directives.

Steve Smith has been appointed marketing manager of audiotape products for Ampex Magnetic Tape Division, Redwood City, CA. He is responsible for the development and implementation of all audiotape marketing programs. He also will oversee and coordinate the activities of all audio product managers.

Jeff Blackden and **Betsy Edwards** have been appointed to positions with Pinnacle Systems, Santa Clara, CA. Blackden is manufacturing manager and is responsible for materials requirements planning, purchasing, inventory control, vendor relations, quality control and factory service. Edwards is marketing communications manager. She is responsible for advertising, public relations, direct mail programs, collateral materials and trade shows.

Mary Zaller has joined Ultimatte, Reseda, CA, as sales manager. She will take over the sales and dealer liaison portion from Pat Smith, vice president, who is going into semi-retirement.

Jamal Hamdani has been appointed manager of systems engineering and international marketing for Moseley Associates, Santa Barbara, CA. He has been with the company for two years.

Daniel F. Maase has been appointed operations manager for commercial products at Varian Associates, Microwave Equipment Division, Santa Clara, CA. He is responsible for managing all commercial equipment operations, including engineering, manufacturing and program management.

Eugene O. Edwards, Greg Best, Jim Pickard and **George Reis** have been appointed to positions with Harris Broadcast Division, Quincy, IL. Edwards is vice president of sales and service. Best is engineering director, responsible for TV transmitter product development. Pickard is engineering director for sustaining engineering activities, including antenna design, manufacturing, testing and sales support, engineering records; and engineering equipment maintenance. He also is in charge of special equipment design for customers. Reis is engineering director for radio product engineering.

Nigel W. Spratling, Debra Underwood and **Don Survilas** have accepted positions with Fortel, Norcross, GA. Spratling is the first European sales manager. Underwood is marketing support manager. Survilas is manufacturing manager.

Dean A. Miller, Ray G. Privette, William B. Rosenzweig and **Jett B. Logan III** have been appointed to positions with Nakamichi America, Torrance, CA, previously Nakamichi USA Corporation. Miller is executive vice president and general manager. He is responsible for home, mobile and professional audio equipment business in the United States. Privette is the vice president of operations. Rosenzweig is president of marketing. Logan is vice president of sales.

William C. Benison has been named president and chief executive officer of Modulation Associates, Mountain View, CA.

John McClimont has been appointed sales manager for broadcasting industry products at Conrac, Covina, CA. He is responsible for all sales and product planning activities for studio monitors and other broadcast video display products, and will work with the major TV network offices in New York and Los Angeles.

Gary L. Hudson has been appointed marketing and sales manager at Meyer Sound Laboratories, Berkeley, CA.

Charles J. Gaydos has been appointed national sales manager for Panasonic Broadcast Systems Company, Secaucus, NJ. Gaydos is responsible for organizing and managing the national sales group in the sales of M-II equipment to the broadcast and post-production markets. He also is in charge of sales for the education and industrial areas through Panasonic representatives.

Aaron Z. Snyder has been named northeastern district sales manager at Magni Systems, Portland, OR. He is responsible for all sales in the northeastern United States.

John McPherson, Jerry E. Smith, Carlo Severo and **George Kuchmas** have been appointed to positions with Sony, New York. McPherson and Severo have joined the Sony Communications Products Company. McPherson is vice president of marketing and will be responsible for marketing professional industrial TV production and distribution equipment and will head a 9-member national marketing group. Severo is vice president of customer service and will direct all service operations for the professional audio, video, broadcast and information systems products. He also will plan and control service and administrative policies. Smith is division vice president at Sony Professional Audio, with responsibility for sales and marketing to the recording studio and film and video production markets. Kuchmas is general manager of manufacturing for Sony Professional Products Company.

A.J. Menozzi has been promoted to president and general manager of dbx North America. He joined the company in October 1986 as vice president of marketing and sales.

Simon G. Shaw and **Richard Sirinsky** have been appointed to positions with CMX, Santa Ana, CA. Shaw has been appointed manager, Euroservice. He is responsible for sales and marketing functions, including customer service for Europe, Africa and the Middle East. Sirinsky is vice president and director of sales. He is responsible for worldwide sales.

James S. Nichols has joined Garner Industries, Lincoln, NE, as national sales manager for the electronics division. He is responsible for the coordination of sales and distribution of all magnetic media degaussers.

Art Kramer has been appointed president of Miller Fluid Heads, Burbank, CA. He recently opened a sales and distribution office in the United States.

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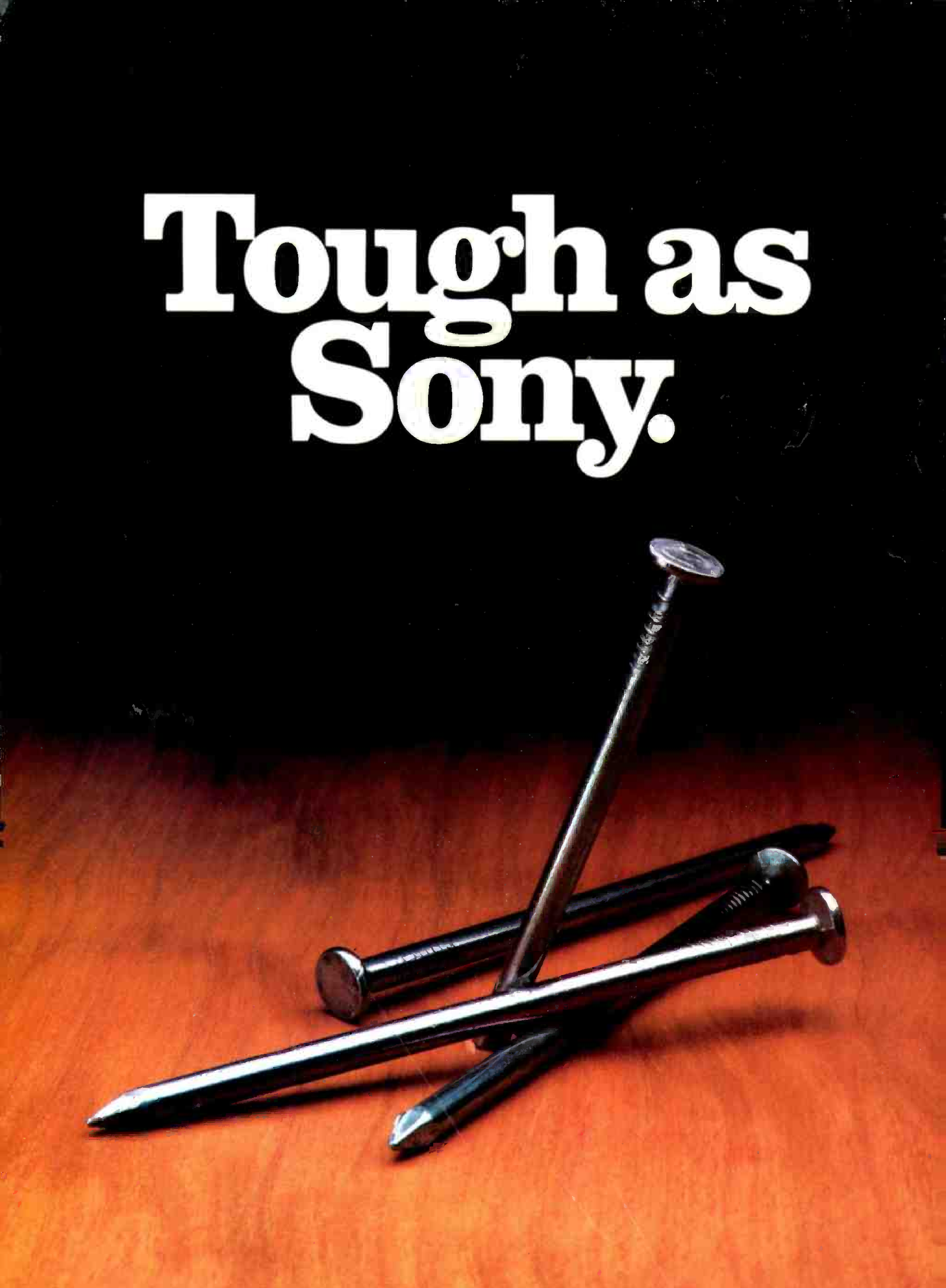
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What we wanted.

One word sums up everything we tried to achieve in the production of V1-K videotape: durability.

Why? Because for us, and you, it's not enough for a videotape to deliver the prettiest picture. It has to be able to do it over and over and over again.

Because the real world for professional videotape is constant jogging, shuttling, still frame editing... and deadlines. So rugged dependability counts every bit as much as dazzling picture quality.

How we got it.

Sony V1-K one-inch videotape was built to be uniquely durable, from the base film up. We developed a truly tough cross-linked binder system and coupled it with the strongest adhesive base film available.

This durable foundation protects an ultra-fine Vivax™ magnetic particle formulation, which delivers astonishing picture quality, higher stability and optimum S/N ratio.

The finishing touch is our carbon black anti-static back coating, which dramatically minimizes dropouts.

Pound for pound, Sony videotape is the toughest you can buy.

What you gained.

Amazingly enough, despite being so durable, V1-K has the lowest headwear rate of any major one-inch tape you can buy.

It also has smoother runability and better winding properties. And, oh yes, it delivers an extraordinary picture, too.

What else got better.

Our efforts to provide you with the most durable videotape have also benefitted BCT Betacam® and BRK U-matic® videocassettes. They both provide you with trouble-free still frame editing, totally reliable repeated playback and worry-free long-term storage.

We made the cassette shells and components tough, too, through precision engineering to quality control standards as tough as our tape.

Treat it like a Sony.

Sony professional videotape has the same properties as any Sony: standard-setting video and audio with a "tough as nails" reputation. That's why it's the only videotape you can treat like a Sony.

And we think that hits the nail right on the head.

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Ampex supplies paint system

Boston Post Production, Boston, has purchased an AVA-3 video graphics system with SpeedTrace and Perspective options, two CVR-40 Betacam studio recorder/player VTRs and an ADO 2000 digital effects system from *Ampex*, Redwood City, CA.

Fuji relocates Dallas office

Fuji's Dallas office has been moved into a new facility. The address is: Fuji Photo Film USA, 1628 West Crosby Road, Suite 100, Carrollton, TX 75006; telephone 214-466-9200 (800-527-0804 outside Texas; 800-441-0528 in Texas).

Colorado Video relocates headquarters

Colorado Video has moved into new facilities at 5490 Spine Road, Boulder, CO; telephone 303-530-9580. The company's mailing address will remain the same: P.O. Box 928, Boulder, CO 80306.

EFX Systems adds Sony consoles and recorders

Sony Professional Audio, Park Ridge, NJ, has announced the sale of two MXP-3036 recording consoles and ADS-3000 SMPTE-based hard-disk automation systems to EFX Systems, a post-production studio in Burbank, CA. EFX also has purchased two Sony PCM-3324 24-track digital recorders, along with two PCM-3202 2-track recorders.

Faroudja Labs delivers 100th encoder to NBC

Faroudja Laboratories, Palo Alto, CA, has delivered its 100th NTSC encoder to NBC-Burbank for use in its newly constructed graphics center, the Magic Room. The encoders employ bidimensional comb filtering to eliminate the NTSC effects of cross color and cross luminance.

Cubicomp offers training videotapes

Cubicomp, Hayward, CA, has developed a series of videotapes to complement its in-person training classes and tests for the PictureMaker 3-D computer graphics system. The tapes were conceived and developed by Steven Tainer, manager of training and documentation. The tapes are an example of the capabilities of the PictureMaker system. Graphics for the series were created on PictureMaker/30 systems. The training course is divided into 18 tapes categorized in three sections: theory, applications and configurations.

Tainer developed the training series in conjunction with The CPU Group, a partnership of three PictureMaker-based animation and graphics companies established in 1986 to produce the tapes. Members include Bill Hite and Rick Hite of Marshall Productions, Nashville, TN; Scott Grey of Solid Ideas, Dallas; and Jay Sullivan and Lou Giacalone of Advanced Entertainment Associates, San Francisco and New York City.

KPIX adds five CMX 3100 editors

CMX, Santa Clara, CA, has sold five 3100 computer-assisted videotape editing systems to KPIX, the Group W CBS outlet for the San Francisco Bay area. The editors are operating in the station's five post-production suites.

Cromemco becomes a Dynatech Company

Cromemco, Mountain View, CA, has been acquired by Dynatech Corporation, Burlington, MA. Cromemco will retain its name and continue to operate out of Mountain View. Company management will stay the same.

Barco Electronics opens U.S. office

Barco Electronics, Kortrijk, Belgium, has made a commitment to the U.S. market with the establishment of its first U.S. office. Located in Atlanta, this facility will allow the company to directly manage sales and service for its products in the United States. Barco's debut in the United States was marked by its participation in COMMTEX International in Atlanta, Feb. 26-28.

TV stations receive Bogner antennas

Bogner Broadcast Equipment, Westbury, NY, has shipped two high-power antennas to: KDOR-TV Channel 17, Bartlesville, OK, part of the Trinity Broadcasting Network; and WFLI-TV Channel 53, Chattanooga, TN. Both antennas are 32-bay Bogner series BUI. The Channel 17 antenna includes heavy null fill for coverage close to the tower site.

Bonneville announces Ku-band uplink

Bonneville Satellite Corporation, Los Angeles, has announced a full-service Ku-band satellite uplink in Los Angeles. The earth station, which became operational Nov. 1, is available for recurring, occasional-use and dedicated services. The 4-port, 6.1m Ku-band uplink/downlink is frequency-agile and features full-arc capability with redundant HPAs and 300W transmitters. It is located atop the Dollar Building at 6430 Sunset Boulevard.

KARK-TV acquires NEC CCD cameras

KARK-TV, Channel 4, the NBC affiliate in Little Rock, AR, has opted to standardize its news-gathering operation on SP-3A CCD cameras with electronic shutters, from *NEC America*, Wood Dale, IL. The station wanted to replace its equipment with cameras that would be compatible with all tape formats.

NBC also has entered a long-term agreement with NEC involving the purchase of the SP-3A CCD camera systems for use by NBC news and NBC's owned-and-operated stations, primarily with Panasonic's M-II VTR format.

Marconi ships telecines to Australia

Australian TV company, Channel 10, from Sydney, has purchased its second B3410 digital line array telecine from *Marconi*, Chelmsford, England, after working with its first system for six months. The order was placed with Marconi Communication Systems in conjunction with GEC Australia.

Strand Lighting expands in Italy

Strand Lighting, Rancho Dominguez, CA, has acquired Quartzcolor Ianiro SpA, Rome, a manufacturer of TV and film studio lighting products. Strand has been the worldwide distributor of Quartzcolor Ianiro products for several years, and this acquisition will ensure that Strand Lighting will continue to provide the studio lighting market with products and after sales service.

Ikegami opens West Coast facility

Ikegami, Maywood, NJ, has opened a West Coast, 60,000-square-foot regional facility in Torrance, CA. The facility will serve as a major distribution and warehousing center for the 12 western states. After-sales service, customer training and on-premise repairs, and a full stock of spare parts for the company's broadcast TV cameras, monitors and CCTV products will be handled at the facility.

Video Post installs graphics system

Video Post & Transfer, Dallas, has installed its second Dubner Texta advanced character generator and graphics system. The generator becomes the standard text and background graphics system in its post-production suite. With the addition of the generator there is compatibility between all of the post-production suites at Video Post.

Sachtler relocates

Sachtler has relocated its U.S. headquarters to 55 North Main St., Freeport, NY 11520; telephone 516-867-4900.

Rank Cintel sells telecines

Rank Cintel, West Nyack, NY, has sold two ADS 1 telecines to the Gaylord Broadcasting chain, which is implementing an automation upgrade at its Milwaukee and Cleveland stations. The telecines will transfer movies and syndicated programming to ½-inch Sony Betacart, which combines with the Connelly automation system for on-air transmission. The telecines will eliminate the station's need for film editors as well as the storage of 16mm films.

Bext opens office

Bext has opened its office at 739 5th Ave., San Diego, CA 92101. The telephone number is 619-239-8462.

Micro Communications sells combiner

Micro Communications, Manchester, NH, has designed, manufactured and installed a high-power, dual-channel combiner for UHF television on the Sears Tower in Chicago. The MCI model uses two waveguide bandpass filters and two constant-impedance hybrids. The combiner allows two high-power UHF-TV transmitters of 120kW power level, operating on different channels, to use a common feedline and antenna system without causing interference to each other.

Wavefront purchases software division

Wavefront Technologies, Santa Barbara, CA, and *Abel Image Research* have reached an agreement for Wavefront Technologies' purchase of Abel's AIR 3-D software division. Wavefront will continue to develop and market its multipurpose graphics software and will evaluate the Abel code with the goal of combining the best features of each into a new generation of graphics software. Abel Image Research will concentrate on producing high-end computer imagery and will pursue new markets in CD-ROM, CD-I and interactive laser disc productions. Abel also will continue to develop high-end, application-specific software that will not be competitive with Wavefront products. To foster the relationship, Abel will join the technical advisory board of Wavefront.

Nakamichi sells dupe system

Nakamichi, Torrance, CA, has supplied 50 MR-1 professional cassette decks to Mark Custom Recording Services, a division of Mark Records, Clarence, NY. The installation, performed by VSM Leasing Corporation, represents the largest MR-1 real-time tape-duplication system to date. Mark is expanding a system of more than 50 Nakamichi LX-5s that have been in operation for three years.

SWA acquires Audio & Design

Straight Wire Audio, Arlington, VA, and *Audio & Design Recording* have announced a joint venture for the distribution and manufacture of Audio & Design products in the United States. Audio & Design has been acquired by SWA and will move into SWA's manufacturing premises in Arlington, VA. SWA will import and service the entire Audio & Design line. The companies are pursuing joint development of proprietary digital technology for broadcasting and recording production.

Harris and Allied announce agreement

Harris Corporation, Broadcast Division, Quincy, IL, and *Allied Broadcast Equipment*, Richmond, IN, have announced a sales and marketing arrangement. Under the arrangement, each company will retain its separate identity with no changes in ownership and will retain its own dedicated sales force. Allied also will assist Harris in the marketing of Harris radio transmission products, and has been designated as an exclusive authorized representative, permitting Allied sales personnel to present Harris' line of radio transmitters while Harris' direct sales force retains responsibility for the sale of the products. Allied also will be a distributor of selected Harris radio products, which the company will market, sell, install and service.

Allied Broadcast Equipment's Satellite Division, headquartered in Richmond, IN, also will be the 1987 exclusive distributor for the DART 384 digital receiver and its accessories from Fairchild Data Corporation, Phoenix, AZ.

Varian discusses broadcast unit purchase

Varian Associates, Palo Alto, CA, has concluded discussions with Philips Electronics concerning the purchase of Pye TVT Limited, Philips' broadcast transmission subsidiary in the United Kingdom. Pye TVT Limited, Cambridge, UK, designs and manufactures a wide range of broadcast transmission equipment and specializes in the supply of transmission equipment for TV frequencies.

Otari supplies recorders

Masterfonics Recording Studio, Nashville, TN, is the first studio in the United States to purchase the DTR-900 PD format, digital, multitrack recorder from *Otari*, Belmont, CA. The company chose the recorder for its remote-control features.

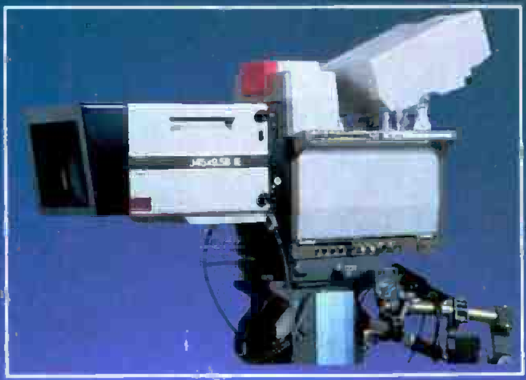
Mitsubishi delivers recorders

The Mitsubishi Pro Audio Group, San Fernando, CA, has announced several shipments of its digital multichannel tape recorders. Six X-850 32-channel digital recorders have been delivered to A&M Records, Gear Studios, Ivan Rene Moore Studios and Enterprise Studios, all in Los Angeles; Clinton Studios, New York; and Audio Media Studios, Nashville, TN. The first X-400/8 8-channel digital recorder has been shipped to the Burbank Studios in Southern California, for use at its film rerecording facilities.

BE))))

Limitless!

IKEGAMI'S NEW HK-323P IS THE IDEAL PORTABLE COMPANION FOR YOUR HK-323 FIELD/STUDIO CAMERA.



The HK-323 Field/Studio Camera

Ikegami's HK-323 1" and ⅔" field/studio cameras are big news...so is the smaller HK-323P companion camera. This lightweight hand-held model provides the user with limitless potential, flexibility and performance that meets and exceeds industry standards for excellence.

Featuring a built-in micro-processor for various software based control functions and fully automatic setup, the HK-323P operates from the same base station as the HK-323 and offers high performance prism optics, auto-knee circuitry to handle high contrast, scene files with extensive memory, for the sharpest picture quality regardless of scene color content or special color lighting. This, plus selectable gamma values; 0.45, 0.4, 0.35, two memorized servo filter wheels each with four positions, a back-up memory system and various adaptors for total system flexibility.

Go the limit with the HK-323 and HK-323P companion camera system.

For a complete demonstration of the Ikegami HK-323 and HK-323P, contact us or visit your local Ikegami dealer.

Ikegami

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Fluid heads and tripods

Miller Fluid Heads has introduced the following products:

- The Miller 20 for CCD camera payloads up to 20 pounds features sliding counterbalance plate, continuously variable fluid tension, 75mm claw-ball leveling and positive locks on pan and tilt.
- The Miller 30 for camera payloads up to 30 pounds features integrated variable counterbalancing, preset fluid tension settings in pan and tilt, quick-release plate and 100mm claw-ball leveling.
- The Miller 50 for camera payloads up to 50 pounds features integrated variable counterbalancing, preset fluid tension settings in pan and tilt, quick-release plate and 100mm claw-ball leveling.
- The Miller 80 for camera payloads up to 80 pounds features integrated adjustable counterbalancing and a sliding camera platform with quick-release plate, preset fluid tension settings in pan and tilt, a full positive-locking system with additional safety lock and 150mm claw-ball leveling.
- The Miller compact tripod is a lightweight, black-anodized tubular tripod with locks that feature overtightening protection and a raised spreader system.
- The Miller midi tripod is a midrange, 4-element tubular tripod, with black-anodized finish, locks and raised spreader system.
- The Miller maxi tripod has a heavy-duty, 4-element tubular construction, with black-anodized finish, raised spreader and locks.

Circle (350) on Reply Card

Audio mixer

Precision Design has introduced the ROAM-8, a remote on-location audio mixer. The unit is housed in a poly case and operates on ac or dc voltages. The mixer operates on dc through an internal extended-life battery pack. Input consists of eight mic or line channels with full low, mid and high EQ. Two independent headphone jacks with individual level adjust are provided along with a limiter, telephone logic and pink-noise generator. Output is sent via studio line feed or an internal telephone transmission network.

Circle (351) on Reply Card

Time-code generator/reader

For-A has introduced the TGR-3300 compact, self-contained time-code generator/reader. It generates and reads longitudinal time code (LTC) for high shuttle speeds and vertical interval time code (VITC) for slower speeds and pause. Both LTC and VITC can be selected either manually or automatically with line selection also possible for VITC. The system reads control track in the event of time-code loss. Other functions include EBU and SMPTE time code; slave-lock to correct or replace time code lost through tape deterioration; color frame lock to synchronize time code to color phase; drop-frame compensation; error bypass; and time-code display.

Circle (352) on Reply Card

Microphones

HM Electronics has introduced the following microphones:

- The HM58 unidirectional dynamic hand-held microphone with mic-mute switch comes with a 3-pin XLR cable, mic clamp and vinyl bag. It has a non-glare finish.
- The RM77 digital reverb unidirectional electret microphone has reverb built in. An adjustable control permits varying the amount of reverb and a 3-position switch provides the capability to mute or add echo. The mic also comes with a 3-pin XLR cable, mic clamp and vinyl bag. A built-in pop filter minimizes external interference.
- The EM43 omnidirectional electret lavalier microphone comes with mic clip, windscreen and case. It is designed to work in RF environments.

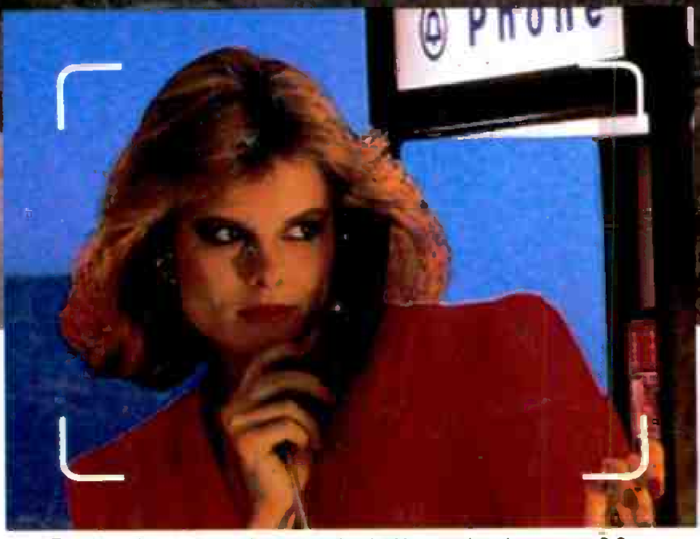
Circle (353) on Reply Card

Character generator add-on features

Laird Telemedia has introduced three add-on features for the model 1500 character generator:

- The model 1524 Data Tablet is used in conjunction with the Font Developer. It allows the user to edit and create new fonts and logos. The tablet provides a user-friendly, icon-driven menu. Fonts and logos can be drawn in freehand on the screen or traced on the tablet surface.
- The model 1526 Camera Entry is used in conjunction with the Font Developer, and allows the user to digitize any character, logo or picture and use it as a character in a font.
- The model 1528 Font Developer allows the user to create fonts and logos. Fonts the user already has may be resized to as small as six scans and as large as 256 tall. In single scan

FUJINON'S NEW A8.5x5.5ERM — THE WIDEST ZOOM IN THE WORLD



The Fujinon advantage — deploying the 1.7X extender gives you a 9.3mm wide angle instead of 12mm.

- **With extender — 9.3mm**
- **Without extender — 5.5mm**
- **Best maximum aperture of any wide angle lens**

You told us what you wanted in an ultra wide angle zoom. The added range and flexibility of an extender without settling for a wide angle any ENG can offer. You wanted a zoom that could cope with lower light level operation.

We've delivered. Designed and manufactured with your input, Fujinon's new A8.5x5.5ERM is the widest zoom made. Instead of a conventional 2X extender, it has a 1.7X extender. When it's in position, you still get an extra-wide 9.3mm. And, at the full tele positions (1X - 47mm, 1.7X - 80mm), it gives you a half F-stop speed advantage.

In fact, the F1.7 maximum aperture remains flat from 5.5mm out to 37mm and drops only to F1.9 at the full tele position. Throughout its dual ranges, you get distortion-free zooms with all the brightness, contrast, and color accuracy that has made Fujinon famous. Naturally, the new A8.5x5.5ERM provides the high MTF and low longitudinal chromatic aberration you expect from Fujinon.

You also wanted absolute production control. To accommodate your needs, the lens accepts a full range of Fujinon studio conversion accessories including shot boxes that deliver push-button operation with accuracy to a single millimeter and zooms at the precise speed you want. It's even available with a built-in test pattern projector.

To learn more about all of Fujinon's wide angle zooms — the A3.5x6.5RM, A7x7RM, the new A8.5x5.5ERM, and the A18x8.5ERM — you'll get more information or a demonstration by calling the Fujinon location nearest you.

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steps this will provide the owner with 250 different sizes of any font. New font and logo creations can be done as well, using the character generator and entering in the new character manually. The Font Developer contains software to run both the Camera Entry and Data Tablet options.

Circle (354) on Reply Card

SMPTE time-code window generator

HORITA Company has introduced the WG-50 time-code window generator. The Micro-Window provides a means of making burned-in time-code window-dub copies of SMPTE time-coded videotapes. The generator reads play speed SMPTE time code and converts it into a digital clock type of display that is surrounded by a black mask. This time display is then inserted into the video signal for recording along with the picture. The generator also can be used to burn-in a time-code window on an edit master tape when stripping it with black or color bars.

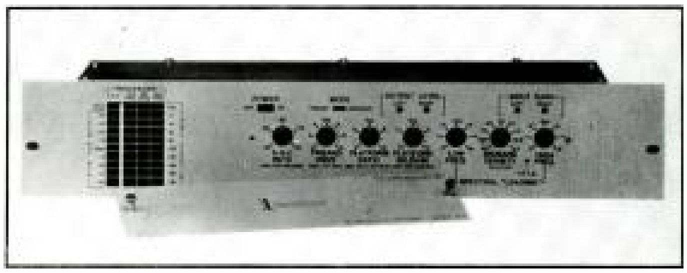
Circle (355) on Reply Card

Portable microwave spectrum analyzers

Hewlett-Packard has announced two portable, programmable microwave spectrum analyzers. The HP 8562A and 8562B analyzers meet MIL-T-28800C, Type III, Class 3, Style C requirements for ruggedness and feature 5-minute warmup time; synthesized tuning; AM/FM demodulators and speaker; and a continuously self-adjusting IF section. The 8562A has tracking preselection from 2.75GHz to 22GHz, while the 8562B is a non-preselected version for applications that don't require microwave preselection. Except for preselection, both versions are identical. A built-in frequency counter has 10Hz resolution and a delta-frequency mode that measures the frequency difference between a birdie and the recovery pilot. The analyzers also have a 1dB/division scale factor.

Circle (356) on Reply Card

Audio processor



Inovonics has announced the model 255 stereo audio processor with Triband/PWM, which incorporates the triple function of gated, gain-riding AGC, 3-band dynamic compression and program peak limiting. Wide range control over subjective results is afforded by a variety of calibrated user-adjustments with emphasis on assignment of program spectral distribution and density. The unit uses pulse-width modulation in a system of soft-knee feedforward gain reduction. The upper crossover frequency is selectable to accommodate 50ms or 75ms or flat transmission characteristics.

Circle (357) on Reply Card

Tape analyzer system

Jasoni Electronics has introduced the TAS-1000 compact, self-contained tape analyzer. It plugs into audiotape equipment for checks and alignment of mono and stereo tape recorders and reproducers. Features include: noise generator for phase error alignment; sine oscillator; distortion less than 1%; frequency response of 1dB; built-in monitor speaker, switch selectable left, L+R, and right channels; stereo termination switch for 10kΩ and 600Ω sources; balanced inputs and outputs; and transformer powered.

Circle (358) on Reply Card

BTSC stereo generator

Learning Industries has introduced the MTS-2 BTSC stereo generator. The unit encodes satellite or local programming into the BTSC (stereo television) format using dbx companding. Two pairs of left and right inputs may be selected by remote or local control and input switching can also be used for local ad insertion. The built-in stereo synthesizer may be used with mono services. A test-tone generator, separate video and 4.5MHz loop-throughs are provided.

Circle (359) on Reply Card

DMM/storage oscilloscope

Leader Instruments has introduced the model LCD-5840 combination digital multimeter/storage oscilloscope. The oscilloscope section is equipped with a 200kHz bandwidth, 10mV sensitivity and an auto range mode that automatically sets the time base. An on-screen display of setting conditions includes sensitivity, time base, triggering, slope and sync. Other features include roll mode, pretrigger mode and a battery-backed memory that allows storage of three waveforms with their setting conditions. The DMM section offers automatic ranging, automatic polarity indicator, ac and dc measurement functions and a low-ohm mode.

Circle (360) on Reply Card

Lighting equipment

LTM Corporation of America has introduced a range of lighting equipment:

- A camera light features on-board dichroic and scrim and a focusing knob.
- The HMI Sun Gun uses the 270W HMI single-ended lamp. Input voltage is 24V or 30V.
- The Mark III 575W and 1,200W softlights are compact and can be operated in any position, vertical to horizontal, without restrictions.
- The HMI Multipar 8 uses eight Brite Beam 200W lamps offering a total of 1,600W with adjustable modular elements that can achieve a 180° spread. The lamp offers flat profile and can be ignited or cut off in pairs, and is focused by an individually rotatable set of four lenses offering different beam patterns.
- The microphone poles are made of carbon and fiber glass, and there is an access hole at the top of the pole if a wire needs to be run inside. The poles come in five sizes.

Circle (361) on Reply Card

Video test signal

Magni Systems has introduced the Dual Timing Pulse. It is a test signal that enables technicians to use existing NTSC monitors to test CAV equipment for delay timing and amplitude errors. For those applications where the CAV signals are encoded to NTSC format, the signal allows studios to use standard NTSC waveform monitors and vectorscopes to measure amplitude and delay errors between the CAV channels. The signal is available on the model 1515 test signal generator.

A bowtie signal on the model 1515 generator also has been introduced, with 10ns increments between the timing marks generated with the signal. The bowtie signal is displayed on an oscilloscope or CAV waveform monitor to determine timing and amplitude errors between channels on CAV equipment. The generator displays both the 20ns bowtie and the 10ns bowtie simultaneously.

Circle (362) on Reply Card

Amplifier

McKenzie Acoustics has introduced the Q-MAX 600 stereo amplifier to complement its Q-MAX 7000 system PA loudspeaker enclosures. The amplifier is 300W per channel. The amp's input circuit eliminates hum loops without disconnecting the mains safety ground, and a relay-controlled delay banishes power surges and speaker thump during switch-on. A matte black design incorporates LED bar graph protection on the front panel. At the back of the amplifier, connection is offered via male and female sockets.

Circle (363) on Reply Card

Automation system

Rational Broadcast Systems has announced the total automation system. It provides real-time updates and ad hoc inquiry, with fingertip control of critical information. It integrates traffic, programming and billing, provides tape inventory with bar-code validation and writes reports. Existing PCs may be used as on-line terminals as well as for networking and file transfer. Total installation, documentation and training are all provided by Rational. The automation system is centered on a 32-bit minicomputer. Its database is self-reorganizing.

Circle (364) on Reply Card

Digital video effects system

Microtime has introduced the Genesis 1 Act 1 digital video effects system, which features continuous variable filtering and interpolation cards that result in compressed images with enhanced resolution and antialiased picture edges. The unit can operate with composite or component video. The filtering and interpolation cards are available to existing users as an upgrade.

Circle (365) on Reply Card

Uninterruptible power sources

Networx has introduced a line of uninterruptible power sources: the Networx Power Backers 330 and 450. They respond within 2ms and 4ms, respectively, furnishing uninterruptible power during blackouts, brownouts and power sags, and maintain power for up to 30 minutes. The power sources also have fast-response circuitry that guards broadcast equipment, computers, computer data and other hardware against surges, spikes, RFI and EMI. The power sources are applicable to non-linear-type loads, operate from 120Vac, 60Hz single-phase input, and come with 6-foot, 3-wire power cords.

Circle (366) on Reply Card

Spatial image enlarger

Modulation Sciences has announced the Stereomaxx spatial image enlarger, which operates in the spatial domain. The unit is totally mono-compatible and is fully compatible with audio-processing gear. The unit is recommended as the next-to-last device in the audio chain, before the limiter.

Circle (367) on Reply Card

Solid-state 30kW UHF transmitter

NEC has introduced the PCU-930SSW high-power UHF 30kW transmitter that is 100% solid-state (both visual and aural). The transmitter is multichannel TV sound compatible, and can be used with any of the stereo generators without modification to the transmitter. The transmitter also features a solid-state, high-performance exciter with 30% fewer circuit components. Built-in remote-control/telemetry facilities allow unattended operation.

Circle (368) on Reply Card

Production cart

Nalpak Video Sales has introduced the TK-500 heavy-duty production cart featuring a 75-pound capacity; expandable/removable top shelf to accommodate monitor/recorders; and a large-capacity, adjustable bottom platform. The unit can be modified by lifting off the top shelf and adjusting the lower platform to create a 300-pound capacity luggage cart with mud guards, stair slides and a set of outrigger back wheels. The unit may be converted into a compact package that fits under an airline seat by flipping up the bottom shelf, folding in the back wheels and collapsing the handle.

Circle (369) on Reply Card

Static transfer switch

Powermark has announced microcomputer-controlled static transfer switches for providing 4ms bidirectional transfer between any primary and secondary power sources. When used in an off-line mode, the switches' microcomputer continually monitors the primary power source and transfers to an alternate source if power drops below a usable level. When primary power is restored the switch transfers the load back to the primary source. The switch also offers 4ms reverse transfer for on-line applications, switching to the ac line or other primary source if the secondary power fails. The switch is available in power ratings of 2.5kVA and 5kVA. Other features include transfer and line-loss alarms and rack-mounting capability.

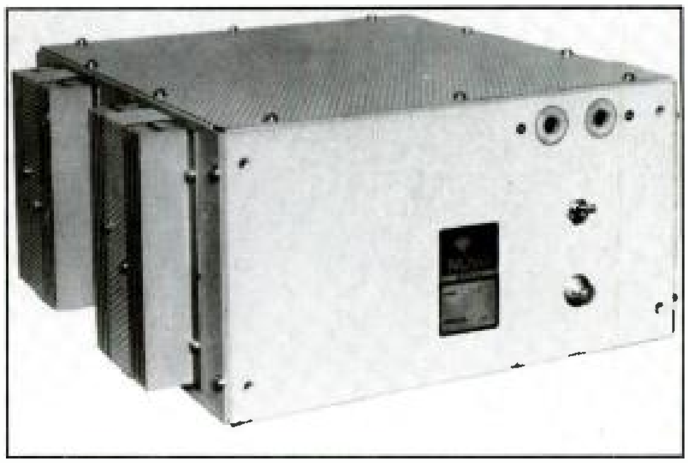
Circle (370) on Reply Card

Digital tape transfer console

Rupert Neve has introduced the DTC-I totally digital tape transfer console. It provides digital mixing and processing capabilities. All console parameters can be instantly reset under SMPTE time-code control. The console also permits the user to select or mix either of two stereo digital inputs and one stereo analog input with manual or auto crossfade from AES/EBU or 1610/1630 inputs to compatible outputs. Other features include: choice of signal path via EQ and DRC; motorized digital faders that provide left and right balance; stereo balance and stereo level—all on one fader for each input; capability to retain multiple stores of console settings on floppy disk; RS-232 printerport to provide a complete printout of all console-stored settings; and separate analog and digital metering.

Circle (371) on Reply Card

Sine wave inverter



Nova Electric Manufacturing Company has announced the model 5060-12 sine wave inverter. It features transistorized circuitry in a pulse-width-modulated design, enabling the maintenance of close voltage regulation over a broad input voltage range. An LC filter at the output filters objectionable harmonics and results in a sine wave output with less than 5% total harmonic distortion. The output waveform enables the inverter to drive loads that are sensitive to deviations in the sine wave. The inverter will operate from automobile or truck alternators, from batteries and from power supplies producing any voltage between 11Vdc to 16Vdc and the output remains stable over the entire input voltage range.

Circle (373) on Reply Card

Positioner assembly

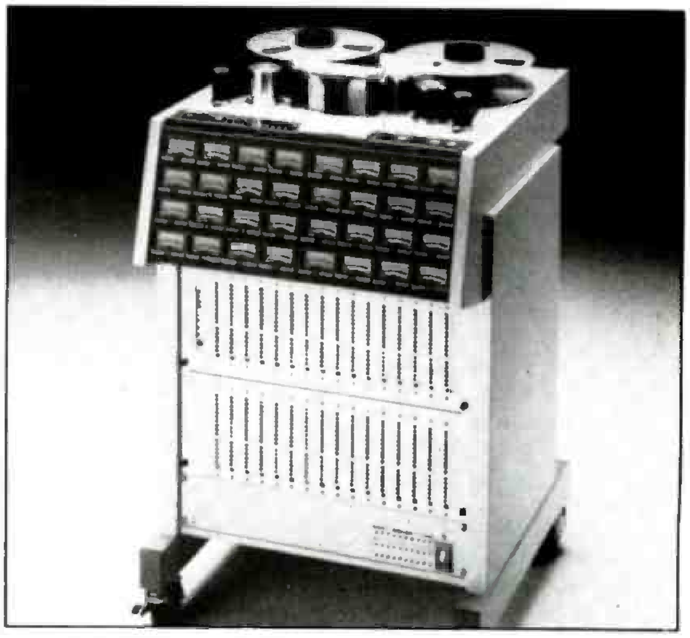
Precision Specialties has announced the Positioner Assembly model series P2000. The system is an elevation-over-azimuth axis positioner for 8- to 16-foot diameter reflectors, multi-antenna arrays, point-to-point communications, satellite communications, electronic news-gathering single antennas and other devices that require full hemispherical motion. The design geometry uses a linear actuator acting with a lever arm for elevation axis positioning and a close-coupled motor/gear box assembly for azimuth positioning.

Circle (374) on Reply Card

Digital and analog audio recorders

Otari has announced the following products:

- The DTR-900 multichannel digital audio recorder. It is a 1-inch, 32-channel mastering recorder. The PD format assures the tapes made on a PD machine will record and play back on any other PD machine. The tape transport is based on the pinchrollerless transport, and will accept a wide range of external time base references including 50/60Hz, 59.94Hz, 9.6kHz, and composite video. The error-correction of the PD format allows mechanical razor-blade editing on digital tape and is capable of rerecording over a splice from a previously recorded tape.
- The MX-80 analog tape recorder is available in 2-inch, 32-channel, 24-channel and a 24-channel prewired for 32. It features a microprocessor-controlled, constant tension tape transport with dc-servoed reel motors. The machine is user-convertible between 30/15ips and 15/7.5ips speed pairs that allow the machine to adapt to both music production and TV sweetening/post-production. The recorder offers a built-in mini-autolocator, including three cue-point memories; repeat function; and return to zero. The memories are front-panel selectable and can be activated on-the-fly. Other features include tape speed referenced seamless punch-in/gapless punch-out; HX-Pro bias optimization; and a full-function remote-session controller.



MX-80 analog tape recorder

Circle (375) on Reply Card

Lighting system

Lowel-Light Manufacturing has introduced the VIP system of lights.

- The V-light is a broad, 500W halogen source with a protective glass shield. It is small enough to fit in a large pocket.
- The i-light uses a 12V, 100W or 55W halogen lamp. Whether hand-held or camera-mounted, it can provide essential fill light, eye-light, highlight and contrast control, without overwhelming the available, natural light.
- The Pro-light uses various voltage lamps: 250W, 120V; 200W, 30V; 100W, 12V. It has interchangeable special-purpose reflectors, five swing-away accessories, plus a gel frame and brella.

Circle (376) on Reply Card

Rotary potentiometers

Penny & Giles has announced a line of precision rotary potentiometers. The units have twin precious-metal contact wipers and circular resistive elements of wire or hybrid conductive plastic. All models are supplied in heavy-duty sealed cases and are available with side or end terminals and flying leads. Wirewound track units are available in synchro sizes from 08 to 25, with resistance values from 30Ω to 100kΩ. Rotational life exceeds 50 million cycles. Units can be built in multicup formats with up to 10 cups per shaft.

Hybrid track potentiometers, in synchro sizes from 05 to 18, have a standard resistance of 5kΩ with options for 2.95Ω to 140.84Ω per degree. Standard linearity is ±0.15%. Resolution is infinite. Standard electrical angles are 340° and 350°.

Circle (377) on Reply Card

Betacam cassette tape

RAKS Corporation has announced a 30-minute Betacam cassette tape. The tape's surface, with ultrafine, cobalt-treated oxides, gives high recording density and low chroma noise levels.

Circle (378) on Reply Card

Cable assemblies

C.A.E. is manufacturing and repairing cable assemblies for Ikegami, Hitachi, Sony, Panasonic and Sharp studio cameras and camera-to-VTR systems, as well as cable harnesses for video duplication systems. Special cable assemblies per customer requirements also are manufactured by the company or it can design cables to fit customers' systems.

Circle (379) on Reply Card

Production switcher

Ross Video has announced the 210A 10-input production switcher. Features include: wipe to a downstream key; a key learn button and variable-width drop shadow on a downstream keyer. The unit also has a function button that allows access to diagnostics and allows users to tailor several operating parameters of the switcher to their own needs.

Circle (380) on Reply Card

News
Continued from page 4

NAB forms subsidiary to develop technologies

The National Association of Broadcasters has created NAB Technologies, a for-profit subsidiary. It will develop and bring to the market new production and transmission equipment to keep broadcasters in their traditional position of technological leadership.

Ted Snider, KARN/KKYK, Little Rock, AR, is NAB board chairman and chairman of the new subsidiary.

NAB Technologies will earn its profits from its share of royalties on products that it develops. Each newly elected NAB chairman will assume the chairmanship of the subsidiary. In addition to Snider, officers of NAB Technologies are: Edward O. Fritts, NAB president, as president; John Abel, NAB executive vice president/operations, as executive vice president; Henry L. Baumann, NAB senior vice president/general counsel, as general counsel; and Michael S. Harwood, NAB executive vice president/chief financial officer, as secretary-treasurer.

NAB Technologies has announced that its first project will be to participate in the final development and marketing of FMX.

Completion of FMX development will be conducted by a new company—Broadcast Technology Partners. Holding a majority interest in the company is a group of Detroit-area investors led by John F.X. Browne, consulting engineer. Other owners are: NAB Technologies; CBS, which NAB previously has been associated with in developing FMX; and the two inventors of FMX, Thomas Keller, NAB senior vice president, and Emil Torick, former CBS Labs vice president, Audio Systems Research. Work on FMX will be conducted in a space provided by CBS Publications, Greenwich, CT.

IBC to feature exhibits and technical program

The next International Broadcasting Convention, IBC 88, will be held in Brighton Sept. 23 to 27, 1988.

As in 1986, the convention will be held in the Metropole Conference and Exhibition Centre, the Grand Hotel and the Brighton Centre. The esplanade fronting that links the three locations will be used for outside exhibits.

As usual, there will be a technical program of papers by specialist authors, an exhibition of the latest broadcasting equipment and a social program that will include a special program for persons accompanying full-time convention delegates. The IBC Award also will be presented.

IBC is sponsored by the International Association of Broadcasting Manufacturers, Institution of Electrical Engineers, Institute of Electrical and Electronics Engineers, Institution of Electronic and Radio Engineers, Royal Television Society and the Society of Motion Picture and Television Engineers.

Further information can be obtained from the IBC Secretariat, Institution of Electrical Engineers, Savoy Place, London, United Kingdom, WC2R OBL. Telephone: 01-240 1871. Telex: 261176 IEE LDN G.

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HELP WANTED (CONT.)

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HELP WANTED (CONT.)

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Please apply in writing, detailing your career experience to:

Andy Wild, **Solid State Logic**, 6255 Sunset Blvd., Los Angeles, CA 90028.

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HELP WANTED (CONT.)

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A SUCCESS STORY

THE OBJECTIVE was no small task: design a radio console that would become the new standard.

THE METHOD involved listening to veteran broadcast engineers and installers. After all, they're the people who have seen and experienced all the ideas that came before. From this research we learned of the problems that had to be solved and the features that broadcasters required. We then added ten years of console building experience and innovation, and created the A-500a console.

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