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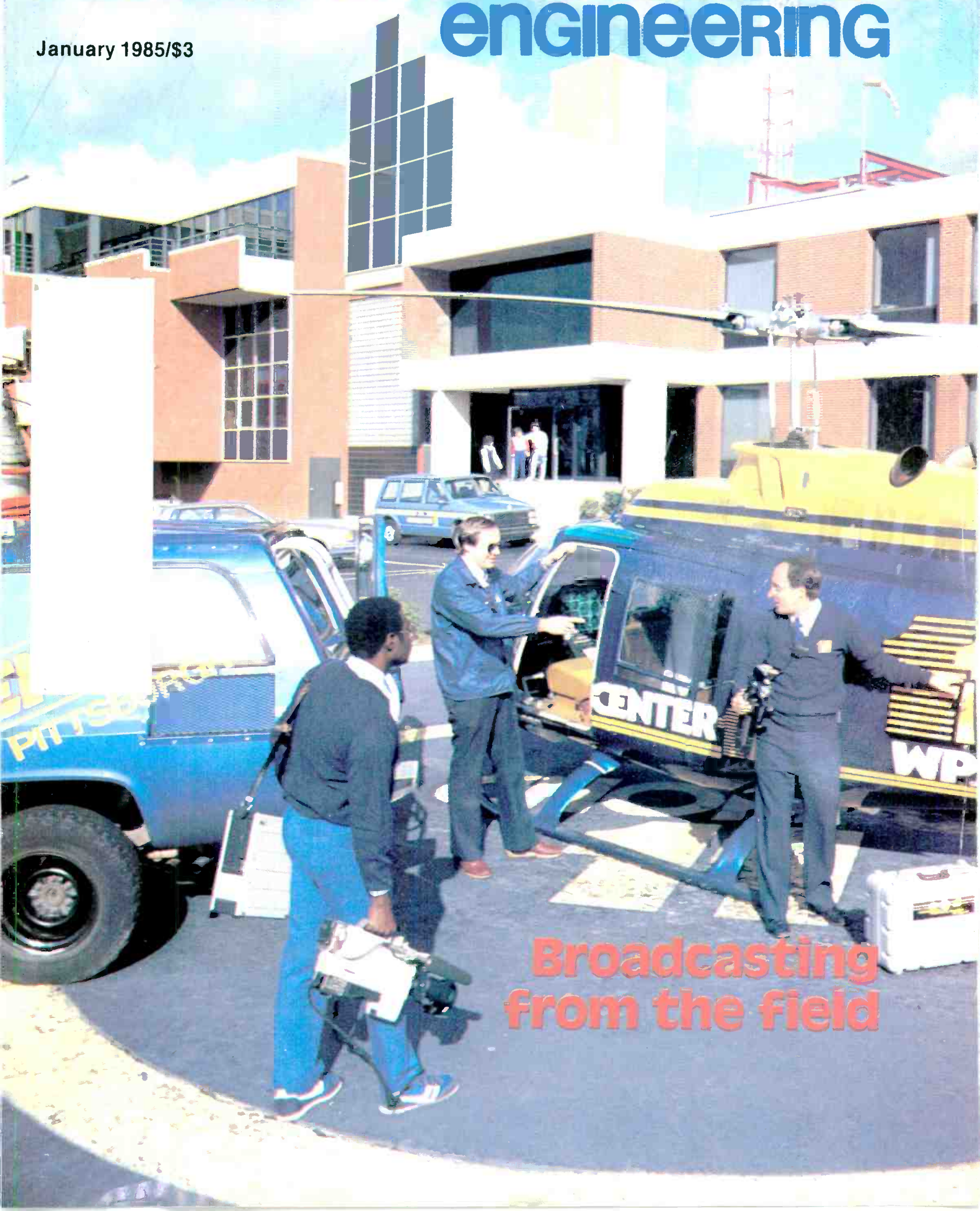
January 1985/$3



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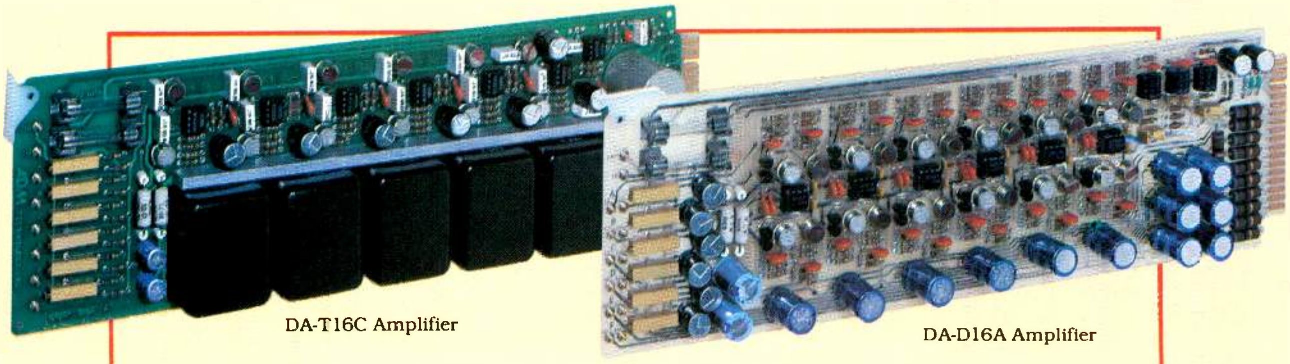

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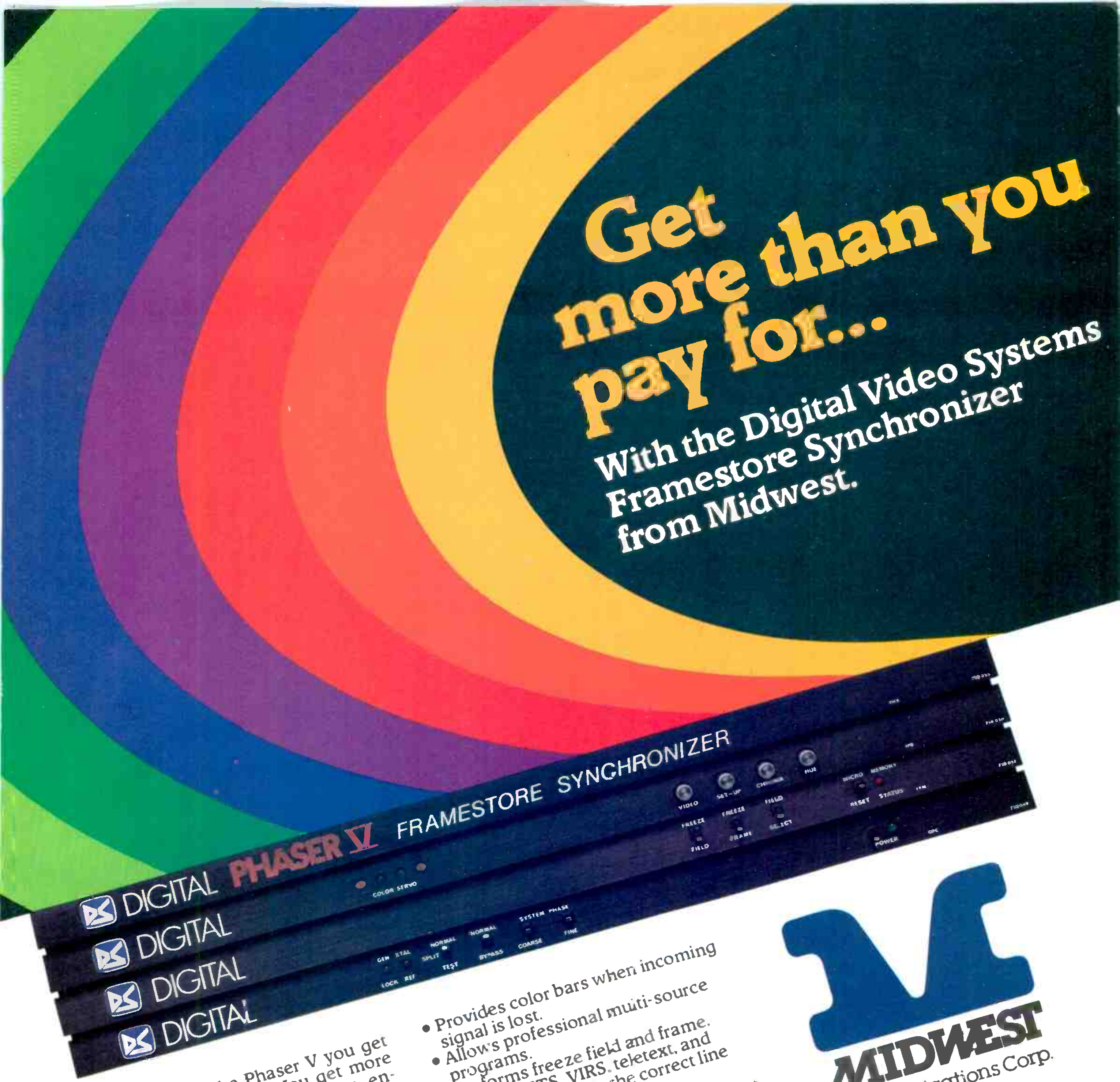

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BROADCAST engineering

The journal of broadcast technology

January 1985 • Volume 27 • No. 1

BROADCASTING FROM THE FIELD: ENG/RENG/EFP SPECIAL

The art of gathering outside program material and returning it to the station has advanced significantly in recent years. New technology has removed the barriers of the studio and is taking viewers and listeners to virtually any location.

22 **RENG: New Technology For New Requirements**
By Jerry Whitaker, radio editor
A well-designed radio ENG system can meet your present needs and will be ready to handle future challenges.

44 **Field Report: Electro-Voice ELX-1 Remote Mixer**
By Brad Dick, director of engineering, KANU/KFKU, University of Kansas, Lawrence
How this new remote location audio mixer performed during field use.

52 **Full Fidelity Remote Broadcasts**
By Dennis Ciapura, technology consultant
You can produce high quality radio remote broadcasts on a modest budget.

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By Carl Bentz, television editor
Setting up a maintenance program will keep ENG equipment where it belongs—on the road.

62 **Planning An ENG/EFP Unit?**
There is more to choosing a remote unit than writing the check.

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With practice and planning, you can set up a live shot in less than three minutes.

OTHER FEATURES

80 **The Effects of ac Line Disturbances, Part 5**
By Jerry Whitaker, radio editor
Transient suppression technology has moved beyond the days of spark gaps and R-C snubbers.

86 **AES Replay**
By Jerry Whitaker, radio editor, and Blair Benson, TV technology consultant
The 76th convention dispelled lingering doubts about the arrival of the digital era.

90 **Focusing On The Future Of Image Technology: SMPTE '84**
Analog systems proliferated, but they did not win universal acceptance.

94 **Building An STL system**
By John Leonard
How to design, build and maintain an aural STL system.

108 **Plant Tour: Broadcast Electronics**
By Jerry Whitaker, radio editor
Founded as a cart machine maker, the company's product lines have expanded to include transmitters, audio consoles and turntables.

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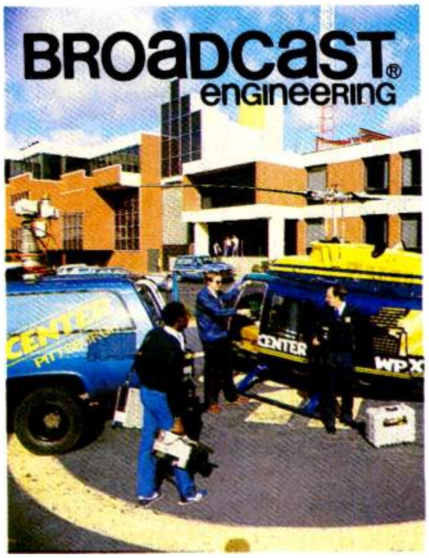

THE COVER this month shows the fast pace of today's ENG operation. Camera operator Tony Mock and senior technician John Getz, of WPXI/TV-11, Pittsburgh, transfer equipment from an ENG van to a helicopter. In television and radio, ENG technology allows newsgathering to be faster than ever. *(Photo by Rick Evans.)*

DEPARTMENTS

In the August **BE**, an article by Bebe McClain, "¼-inch—An '84 Reality," implied the SMPTE was about to adopt a ¼-inch standard format. No standard was released at the October SMPTE convention, and work on the standard is expected to begin in February. (Coverage of the convention begins on page 94.)

NEXT MONTH
- Audio time base corrector developments
- Video time base corrector systems
- Audio and video special effects


HITACHI
HR-230

1985 calendar

Jan. 5-8
Association of Independent Television Stations, Los Angeles

Jan. 10-14
National Association of Television Program Executives, Hilton, San Francisco

Jan. 13-16
PTC '85, Honolulu

Feb. 3-6
National Religious Broadcasters Convention, Sheraton Washington, Washington, DC

Feb. 11-15
Video Expo/San Francisco, Civic Auditorium, San Francisco

Feb. 15-16
SMPTE, St. Francis Hotel, San Francisco

March 5-8
AES, Hamburg, West Germany

April 14-17
NAB '85, Convention Center, Las Vegas, NV

May 7-11
American Women in Radio & Television, Hilton, New York

May 12-15
Broadcast Financial Management, Chicago

May 14-15
LPTV, Western Bonaventure, Los Angeles

May 15-18
Public Broadcasting Service/National Association of Public Television Stations, St. Francis Hotel, San Francisco

May 19-23
National Public Radio, Mariott City Center, Denver

May 29-June 1
ITVA Conference, Marriott, New Orleans

June 2-5
National Cable Television Association, Convention Center, Las Vegas, NV

June 5-9
Broadcast Promotion Association/Broadcast Designers Association, Hyatt Regency, Chicago

June 6-12
14th International Television Symposium and Technical Exhibition, Montreaux, Switzerland

June 27-29
Third Seoul International Broadcasting & Communications Equipment Exhibition, Kosami Exhibition Hall (Yeoi-Do), Seoul, South Korea

July 23-25
WOSU-Broadcast Engineering Conference, Fawcett Center For Tomorrow, Columbus, OH

Aug. 8-Sept. 14
World Administrative Radio Conference, Geneva, Switzerland

Sept. 11-14
Radio Convention and Programming Conference, Loew's Anatole Hotel, Dallas

Sept. 12-14
RTNDA Fall, Opryland Hotel, Nashville, TN

Sept. 30-Oct. 4
Video Expo/New York, New York

Oct. 8-11
AES, New York

Oct. 27-Nov. 1
SMPTE, Conference Center, Los Angeles

BROADCAST ENGINEERING

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Strictly TV

by Carl Bentz, television editor

Transmission standards: a reign of confusion

Television is a communications medium in almost every country around the world. A recent TV usage map shows only eight small areas with limited or no TV service. Also, while most of the world enjoys color television, three Asian and 11 African countries are limited to monochrome broadcasts. The variations in color television throughout the world, however, lead to a state of confusion.

3+ standards

For the most part, there are three color TV transmission standards. There is a tendency for a country's selected standard to follow lines of political affiliation, past or present.

NTSC is found throughout North America. Greenland, Central America and the western side of South America, as well as Japan, South Korea, Taiwan, the Philippines and Burma, use the NTSC system.

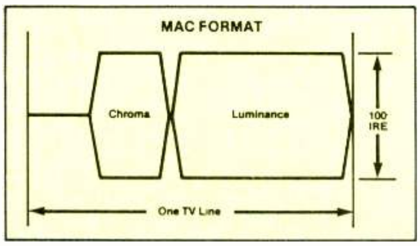

Figure 1. Chrominance and luminance are time compressed and transmitted in a sequential format on each TV line.

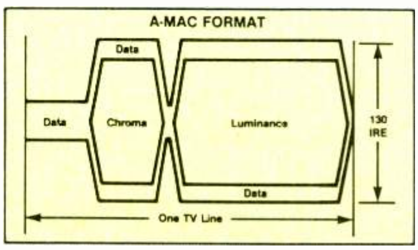

Figure 2. A-MAC provides a baseband frequency multiplex of the audio and data on a subcarrier.

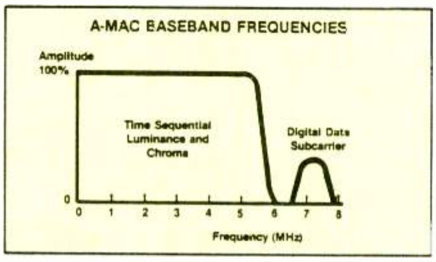

Figure 3. Luminance and chroma occupy approximately 6MHz with a digital data subcarrier at 7.16MHz.

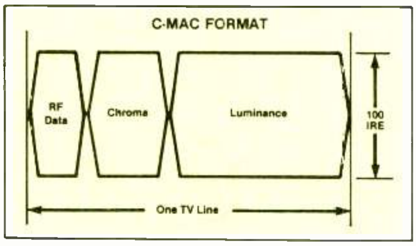

Figure 4. C-MAC time multiplexes the data at RF with the baseband chroma and luminance on each TV line.

PAL is far more scattered, with significant use in all continents except North America.

SECAM is the French standard and is found in the Soviet Union, Eastern Europe, most of the Middle East, scattered countries in Africa and limited areas around the Caribbean.

All three standards have variations. (See Table 1.) NTSC, for the most part, is CCIR type M, 525 lines per frame and 59.94 fields per second, with a color subcarrier of 3.579545MHz (3.58MHz for short). There is some use of modified NTSC (NTSC-4.33), which uses a subcarrier of 4.43361875MHz.

PAL comes in seven variations, CCIR B, G, H, I, M and N. N is divided by two subcarrier frequencies. All PAL forms are based on 625 lines with 25 frames (50 fields).

SECAM includes CCIR B, D, G, H, K, K1 and L, each of which uses 625 lines with 50 fields. The color subcarrier for most SECAM systems is 4.406250MHz. The variations of SECAM center on various parameters. Color synchronization may be line or field ID types.

PAL uses phase switching of the reference with each TV line. SECAM transmits a line of one color difference signal, then a line of the second difference, with a memory system allowing the two to be combined for display.

Between the three, there is some compatibility between NTSC and PAL, as well as between PAL and SECAM. However, it is limited.

Introducing components

A number of video component formats have been introduced in the last several years. Aimed primarily at satellite transmission applications, these multiplexed analog component

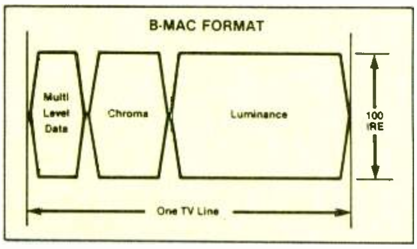

Figure 5. B-MAC uses a multilevel code for data and time multiplexes this baseband signal with chroma and luminance.

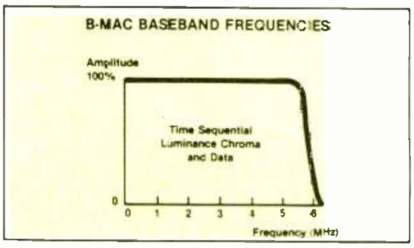

Figure 6. The baseband bandwidth of B-MAC is held to more than 6MHz for data, chrominance and luminance, yet provides 1.8Mb/s.

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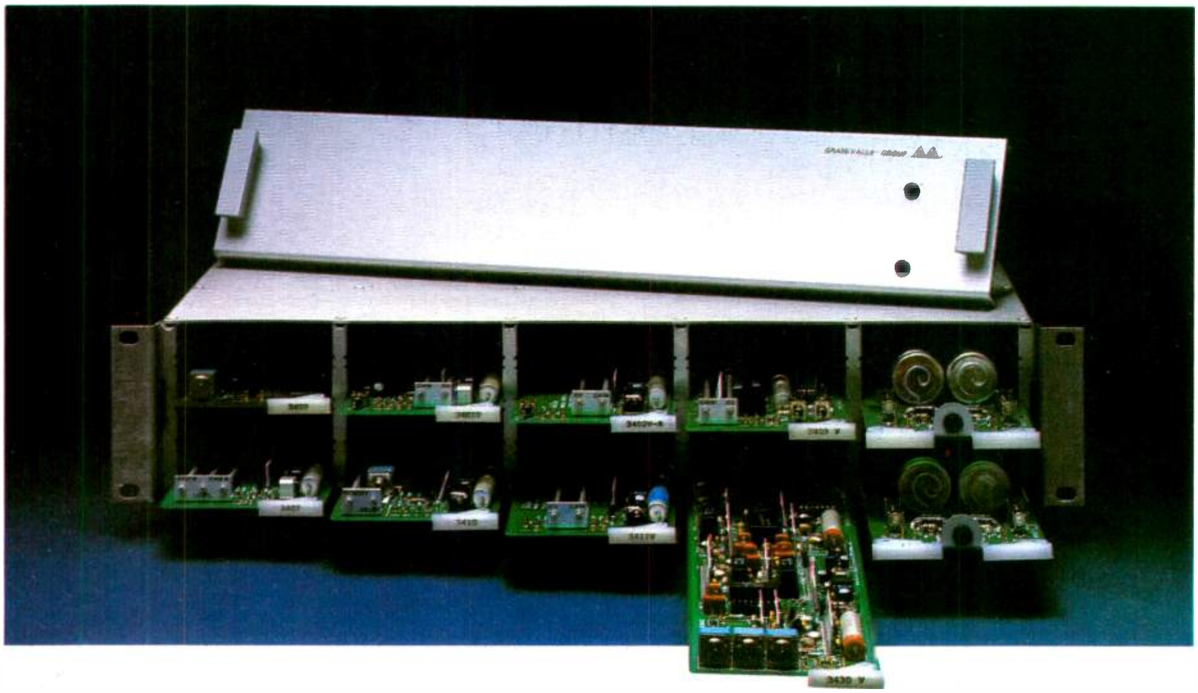

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(MAC) systems allow digital transmission techniques for audio and data, combined with analog color difference video components.

The version C-MAC was suggested by the Independent Broadcasting Authority (IBA) in England, and has subsequently been considered a possible standard for the European countries. However, no decisions have been made yet.

In addition to C-MAC, A-, B-, and D-MAC formats have been suggested. To date B-MAC, developed by Digital Video Systems, a division of Scientific Atlanta, is the only one to be scheduled for early use. An announcement in late September indicated that Australia will use the B-MAC format for its nationwide satellite transmission, with plans for implementation by the middle of this year. Contracts have already been signed for the equipment.

The MAC systems

The general MAC signal uses a form of time multiplex to include separate packets of luminance and chroma information within the time of one TV line. Luminance and color difference are sampled digitally, compressed in time and transmitted in a sequential format, as shown in Figure 1.

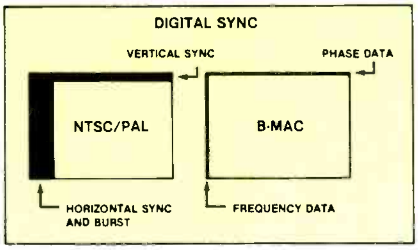


Figure 7. The absence of subcarriers for chroma, audio or data allows simple expansion of bandwidths for extended definition TV systems in the future.

Special encoding and decoding equipment is required, but transmission equipment for the visual information is similar to that needed for the terrestrial transmission formats. At this point, similarities decrease.

MAC systems provide the capabilities of carrying information beyond typical audio and video signals. Through digital techniques, improved audio and multiple channel audio is possible. The B-MAC system allows up to six separate audio signals, which may be configured in three stereo pairs. Alternatively, the extra audio channels of B-MAC can be used for additional data capabilities.

Because MAC systems are intended for satellite transmission to widely separated receiving locations, the data capabilities offer receiver addressability, for pay-TV uses; screen displays of text, for subscriber information or teletext; and esoteric applications, such as transmission of computer programs or computer data. One of the greatest differences between the four MAC systems is how data are handled.

MAC data

A-MAC uses a baseband frequency multiplex approach to place audio and data on a 7MHz subcarrier (Figures 2, 3). This approach is suggested to be highly reliable for the data, but places limitation on the use of threshold extension (for recovery of lower signal levels). Bandwidth constraints are also posed in regard to eventual use of extended definition video.

D-MAC also uses frequency multiplexing, but at RF frequencies. Video will be centered on a nominal 70MHz, with data on a separate carrier at perhaps 85MHz. Separate uplink locations for audio and video are possible. Although high data rates may be used, separate receivers are needed, and interference is highly probable.

C-MAC uses time multiplex of data at RF frequencies, as shown in Figure 4. Nine microseconds of time that would typically be used for horizontal sync is used instead for the data at rates to 20Mb/s. Direct demodulation from RF to digital data can provide up to eight audio channels, but the separate demod equipment is expensive.

The transmission channel required for the entire C-MAC signal is in excess of 10MHz, which poses incompatibility with CATV, SMATV and broadcast retransmission services without signal modification.

B-MAC also time multiplexes data into the 9μs horizontal blanking period, as shown in Figures 5 and 6. Video is nearly the same as C-MAC, although it is limited to a little more than 6MHz, making it compatible with typical terrestrial transmission systems. A digital sync system is used, which places all required synchronization information on one line of the

Continued on page 124

TABLE I

	NTSC	PAL	SECAM
Lines/frame	525	625	625
Field rate	59.94/second	50/second	50/second
Color Subcarrier	3.579545MHz 4.43361875MHz*	4.43361875MHz 3.58105625MHz* 3.579545MHz*	4.406250MHz
Color Components¹	I, Q	U, V	R, B
TV Channel Bandwidth	6MHz	8MHz 7MHz*	8MHz 7MHz*
Vestigial Sidebands	0.75MHz	1.25MHz 0.75MHz*	0.75MHz 1.25MHz*
Visual Modulation Type	Amplitude negative	Amplitude negative	Amplitude negative Amplitude positive*
Aural Modulation	FM	FM	FM AM*
Aural Carrier Separation	4.5MHz	5.996MHz	6.5MHz
Aural Pre-emphasis	75μs	50μs	50μs

*Variations from most commonly used standard form.

[1] $I = -0.27(E'_B - E'_Y) + 0.74('E_R - 6'_Y)$

$Q = 0.41(E'_Y) + 0.48(E'_R - E'_Y)$

$U = 0.493\ (E'_B - E'_Y)$ $\quad V = 0.877(E'_R - E'_Y)$

$R = -1.902(E'_R - E'_Y)$ $\quad B = 1.505(E'_B - E'_Y)$

where $E'_Y = 0.299E'_R + 0.57E'_G + 0.114E'_B$

and E'_R, E'_G and E'_B are gamma pre-corrected primary signals.

Table 1. Comparison of major TV color standards.

SUPER 2

SUPER CAM

Satellite update

By John Kinik, satellite correspondent

Fire is a broadcaster's nightmare. But a bigger threat can be the water used to extinguish a fire, especially in this age of computer circuitry.

PBS faced this situation on Oct. 15, when its technical center in Washington, DC, suffered heavy water damage in a fire. The network has not only continued to operate, but the crisis showed the flexibility of a satellite-based network.

The technical center was housed in the basement of the U.S. Postal Service headquarters. Although the fire was contained in the upper floors, the water that collected in the basement ruined PBS's computer and broadcast equipment.

Despite this, PBS has maintained its on-air schedule with little interruption, which can be attributed to quick thinking during the fire, donated equipment, staff cooperation and an adaptable satellite network.

When the fire was first detected, the PBS staff kept operations going for as long as possible by switching to automatic mode. They then took the next two day's videotapes out of the building, buying the network time while it established a new operating base.

Operations resumed at public stations WNVT/WNVC in Fairfax, VA. about 15 miles east of Washington. On Oct. 16, the day after the fire, PBS hooked up a single feed between WNVT and the main origination termination (MOT) satellite uplink facility at nearby Bren Mar, VA.

Public stations from around the country provided feeds to keep the programming going. Emergency equipment, including a mobile videotape trailer loaned by ABC and a rented mobile broadcast center truck, were brought to Bren Mar.

Suddenly, a quiet link in the PBS chain became the network's heart. Since the fire, operations have continued at this stable, although temporary, location.

Two terminals at the PBS MOT at Bren Mar, VA, link to Westar IV for program distribution to the network stations.

Since water damage destroyed equipment at the PBS technical center in Washington, DC, an ABC mobile videotape trailer and a Video Rentals truck help relay three feeds to the satellite.

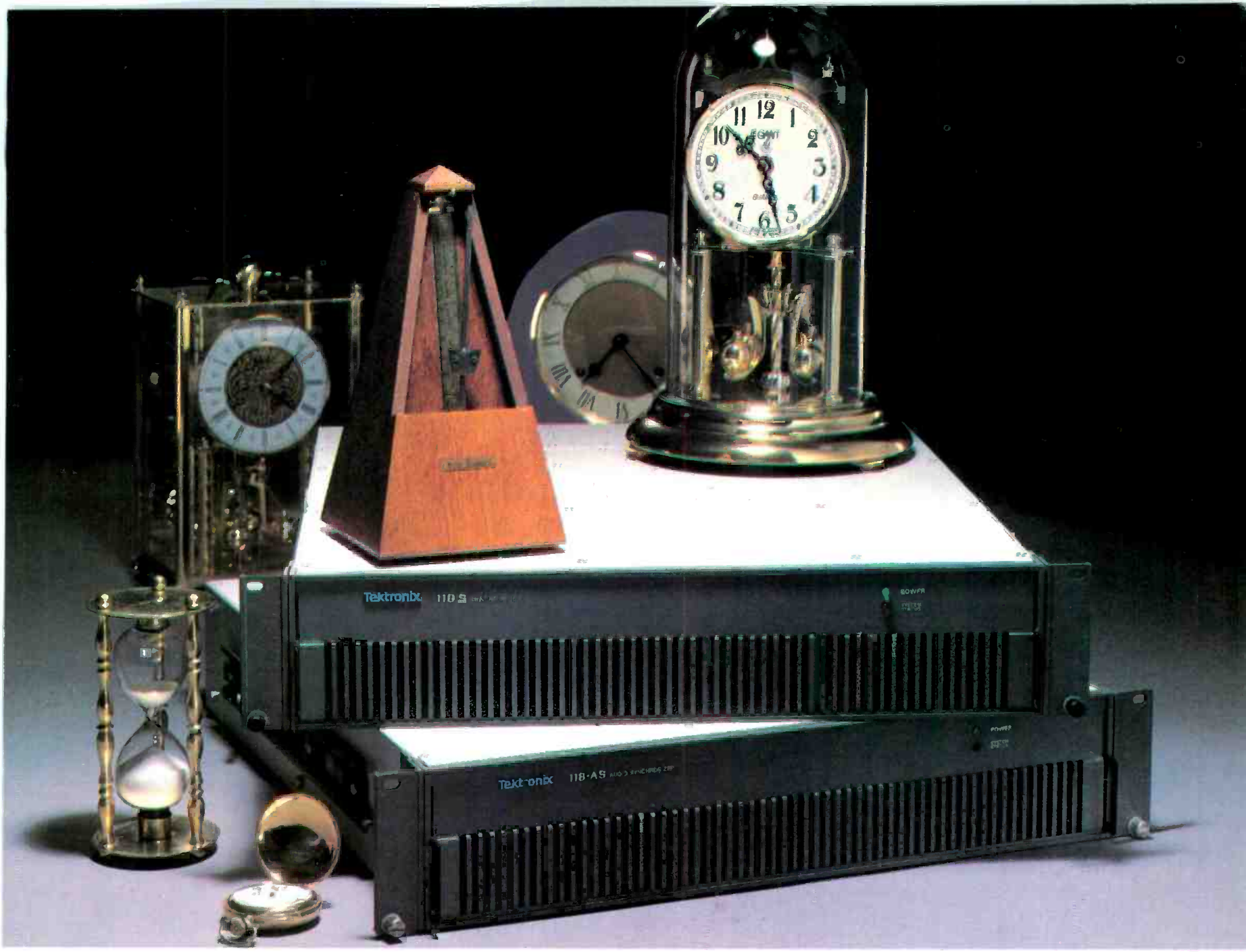
Key PBS personnel in the crisis include Cary Wight, manager of technical operations; Bill Kinsella, manager of satellite operations; and Larry Jefferson, manager of technical maintenance.

Wight and Kinsella praised the many organizations that have helped the network by providing equipment, facilities and services. Also essential, they said, was the cooperation between PBS departments.

The fire's silver lining is that a fresh approach can be taken to designing and implementing replacement facilities. The technical maintenance staff will have a bigger role than in normal planning.

But the hovering cloud is PBS's financial uncertainty. PBS funding is in doubt, as President Reagan vetoed two bills in as many months authorizing funding from fiscal years 1987 to 1989.

Although fire insurance covers the loss, the lack of funding for future programming places additional burdens on PBS when it needs it least.



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Anytime your video and audio signals go into our synchronizers, they come out in perfect time. It makes for a difference your viewers can't see!

Start with the Tek 110-S for transparency no other frame synchronizer can match. Our high noise immunity genlock circuitry and adaptive clamping ensure the 110-S will track noisy signals longer and at the same time minimize streaking in the picture.

Add optional four-field memory and you get accurate color framing with no decoder artifacts or 140 ns picture shifts. Your picture is virtually camera clear.

Now! You can include time base correction for heterodyne color VTRs in your 110-S package. This option features auto VTR signal recognition and infinite window correction range. It provides time base correction without feedback to the VTR. Ideal for remote location feeds.

The new Tek 118-AS Audio Synchronizer works in tandem with the 110-S to eliminate lip sync errors. The 118-AS solves the audio-to-video problems introduced by four-field memory video synchronizers and other large-memory digital devices. The 118-AS features automatic and manual delay correction, wide dynamic range and low distortion. And with 18-bit floating point code and 93.75 kHz sampling, the 118-AS sets the same high performance standards as the 110-S.

Don't settle for less than perfect timing! Call your Tektronix Television Sales Engineer for a demonstration today. Or call Tek toll-free at 1-800-547-1512 for complete details. (In Oregon, 1-800-452-1877.)

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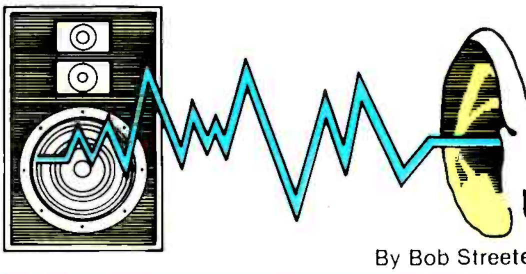
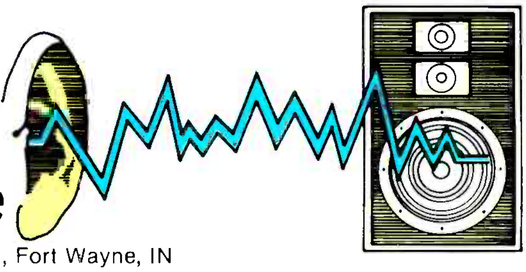


AM stereo update



By Bob Streeter, AM Stereo, Inc., Fort Wayne, IN

Preparing production and air studios for AM stereo is a major undertaking that demands careful planning and a financial commitment to 2-channel operation. In all likelihood, the source equipment—reel-to-reel tape decks, cartridge machines and turntables—will have to be replaced or modified to provide for stereo operation. The audio control boards may also have to be replaced and monitoring equipment updated.

Many far-sighted broadcasters have been updating their facilities to stereo in anticipation of an eventual move to full 2-channel operation on the air. Stations that have not already planned for AM stereo should consider an improvement program that could be phased in over several years.

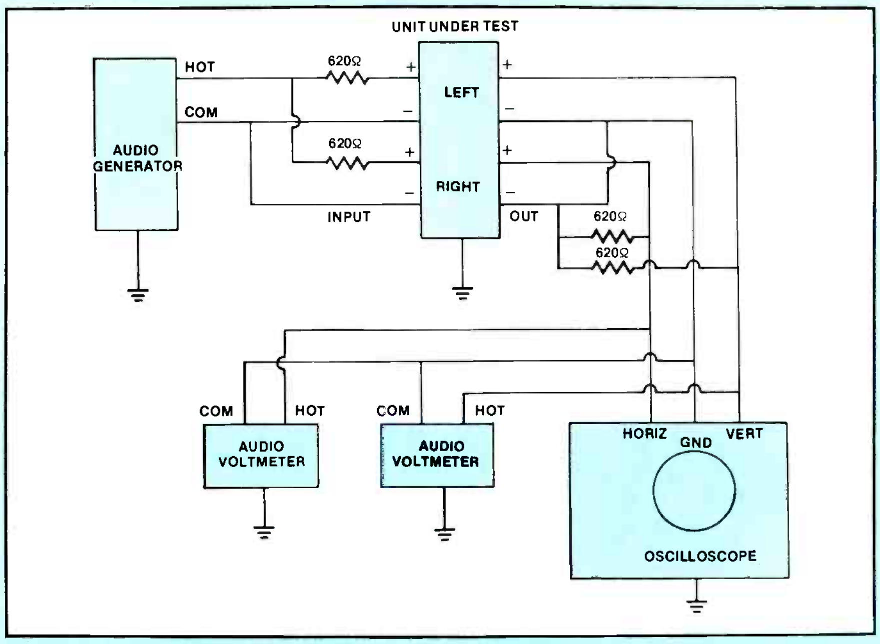
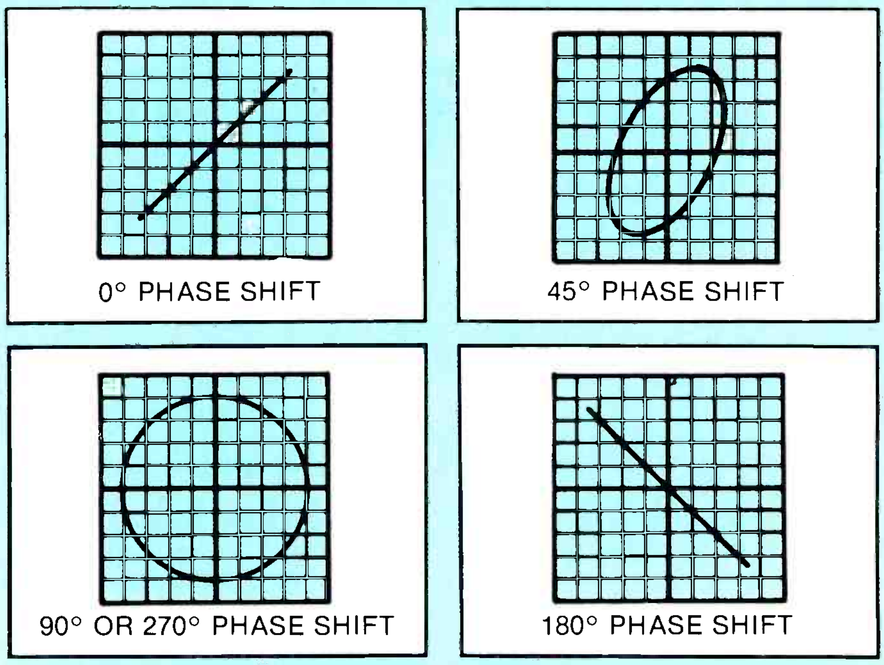


Figure 1. A typical test setup for checking the phasing, phase stability and frequency response of an audio recording (or transmission) system.



0° PHASE SHIFT

45° PHASE SHIFT

90° OR 270° PHASE SHIFT

180° PHASE SHIFT

Figure 2. Oscilloscope photo displays for various phasing conditions. (The same displays will occur at multiples of 360°.)

Source equipment maintenance

The phasing and phase stability of the source equipment in the studios of an AM stereo station are critically important to both stereophonic *and* monophonic performance. If the polarity of either the left or right channel audio signals is reversed (180° out of phase), the primary signal energy of the programming will appear in the L-R stereophonic (difference) subchannel, rather than in the L+R monophonic (sum) main channel.

Program material exhibiting reversed-phase characteristics is most often found in tapes from outside sources. Therefore, develop a procedure to examine the content of the L + R and L − R audio channels for proper phasing whenever material from outside the station is to be used. The primary signal energy should be contained in the L+R channel, not the L − R channel. Phase offsets caused by tape machine misalignment can also cause frequency response variations in the L + R signal.

Check the recording equipment used to transcribe music programs for proper phasing before any program material is recorded for AM stereo use. Similarly, check all remote sources—such as satellite or Telco feeds—for proper phasing into the control board.

Test all the source equipment at the station on a regular basis for proper phase coherence, frequency response, distortion, noise, wow and flutter.

The first step in maintaining source equipment is to have the proper tools. For cartridge machines and reel-to-reel tape decks, two audio voltmeters, a low distortion audio generator and

Continued on page 125

MAXIMUM COVERAGE

CRL Audio processors are improving the fidelity and coverage of hundreds and hundreds of radio stations. From Seattle to South Africa . . .from Saipan to Rome . . . and from New York to Peru, radio stations world-wide have discovered that CRL processing gives them the best signal possible.

CRL has a complete line of audio processors and limiters, including unique split-band automatic gain control units; multi-band compression amplifiers that allow precise control of the on air signal; and absolute peak control units for FM and AM Stereo. The latest product is a stereo generator with unsurpassed specifications and a very modest price.

Take the time to send for complete details and user information. You will discover why America's choice should be your choice.

SG800 Stereo Generator
Distortion: .01% or less
Separation: 65 db or better
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Provides mono compatible signal with maximum loudness. Exclusive stereo enhance control.

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Patented non-overshooting filters and multiplex clipper for maximum loudness with low distortion.

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Circle (9) on Reply Card

FCC update

January 1985

By Harry C. Martin, partner, Reddy, Begley & Martin, Washington, DC

Data transmission on VBI authorized

The FCC has authorized TV stations to use the vertical blanking interval (VBI) to offer data transmission, computer software delivery and paging services. Licensees will be permitted to transmit any type of communication in either the digital or analog mode.

Because teletext would qualify as a permissible service under the new VBI authority, the rules for the new service will replace the existing teletext rules.

VBI services will be considered secondary to regular TV programs, and will not be subject to the Fairness Doctrine, political broadcasting requirements or other public service obligations. Nor will the commission entertain competing applications for VBI facilities or require licensees to obtain additional approval for a station's technical facilities if it desires to provide private carrier or common carrier service.

However, stations wishing to provide common carrier service still will be required to seek FCC authority to provide the particular type of service proposed. Those wishing to provide private carrier VBI services will not be required to apply for a separate authorization. They would, however, be required to certify that their facilities will be used only for the services permitted by Parts 90 and 97 of the rules.

Non-commercial TV stations will be allowed to use the VBI in the same way as commercial stations and may charge a fee for such services.

New frequencies for aural STLs and ICRs

To accommodate demand for new aural broadcast studio transmitter links (STLs) and intercity relay stations (ICRs), the FCC has allocated frequencies from 944MHz to 947MHz for such facilities. It also has provided for grandfathering of existing STL/ICR stations from 942MHz to 944MHz.

Current rules for the 947MHz-to-952MHz band provide nine channels for STL/ICR use, representing the only portion of the spectrum below 1GHz available to accommodate the rapidly increasing number of new FM stations.

In many metropolitan areas, no more channels are available in this frequency range. The new allocation provides six new channels exclusively for aural STL/ICR use.

In a concurrent action, the commission allocated 941MHz to 944MHz for government and non-government use, providing for point-to-point operation in a band previously allocated for land mobile.

Existing STL and ICR stations operating from 942MHz to 944MHz will be grandfathered, but the approximately 50 stations that operate in the band on special temporary authorizations will have to cease operations within five years.

In Puerto Rico, where STL/ICR users are not expected to affect other service operations, the entire 942MHz-to-947MHz band will continue to be available for STL/ICR use on a shared basis.

MMDS lottery selection

The FCC has decided to use lotteries to select permittees for its new multichannel, multipoint distribution service (MMDS). There are nearly 16,500 applications on file for the approximately 1000 available MMDS channels. A preference system favoring minorities and those without other media interests will be incorporated into the lottery selection process.

In establishing lottery procedures for MMDS applications, the FCC said it would hold two lotteries for each service area—one for the "E" group of channels and one for the "F" group. Applications that are not exclusive will be processed and acted upon quickly. Those that are exclusive will be screened for acceptability for inclusion in a lottery.

Applications found acceptable will be placed on a public notice specifying the market, date and time of the lottery and the selection probability.

After the lottery, a public notice announcing the tentative selectee will be issued. Petitions to deny will be accepted within 30 days after the public notice is issued. If a petition raises substantial and material questions of fact, the application will be designated for hearing. If the selectee is found to be unqualified, another lottery for that market would then be conducted.

The commission said it would afford settling applicants the cumulative number of chances in a lottery that they would have had if no settlement agreement had been reached. However, each applicant must have filed an individually acceptable application to be eligible for a cumulative chance.

The commission also said that all MMDS construction permits would be subject to its anti-trafficking policy, which prohibits sale of an unbuilt station for a profit. Licensed facilities will be freely transferable except those authorized through a lottery in which the successful applicant benefited from a minority or diversification preference. In such cases, stations must be operated for at least one year before they can be sold for a profit.

Common rule violations

In a public notice issued in early November, the FCC listed five areas where many violations of its technical rules continue to occur. These problem areas are:

- Frequency tolerance. Many stations do not keep their frequencies within allowable tolerances. These are 20Hz for AM stations, 2000Hz for FM stations and 1000Hz for the video carrier of a TV station. Tolerances are 0.01% through 0.0005% for remote pickup stations and 0.02/0.002% for low power TV and TV translators.
- EBS tests. Many stations are not completing and logging required EBS tests as required by Sections 73.961(c) and 73.1820 of the rules. All broadcast stations are required to conduct and log EBS tests once a week on random days and times between 8:30 a.m. and local sunset. The tests should be made using the methods shown in the EBS checklist provided to all stations.

Continued on page 126

LOOK INTO YOUR FUTURE: KY-21OU

If you see a feature-filled, reliable, moderately-priced camera in your future, then look at the latest members of JVC's KY family: KY-21OU series cameras. In both field and studio configurations, they offer value just not available from any other camera in their class. They even have full RS-170A color framing.

EXCEPTIONALLY NATURAL COLOR

A linear matrix masking circuit makes the KY-21OU's "eye" nearly identical to the human eye, and results in the most natural color possible.

OUTSTANDING LOW-LIGHT PERFORMANCE

A 2H vertical enhancement circuit PLUS a level depend circuit. At + 18 dB boost, 40 lux (3.8 fc) is all the illumination that's required

BRIGHT LIGHT, TOO.

A slope circuit that compresses video level from 300% to 100%; an automatic black level circuit; and a servo iris circuit.

CRISP IMAGES IN A COMPACT PACKAGE

Three SATICON™ pick-up tubes. Fast, f 1.4 prism optics. 650 lines horizontal resolution. 57dB or better S/N ratio. 12½ pounds. Compact, light-weight, and built to take it.

ELECTRONIC VIEWFINDER

Adjustability of a cable-connect type with the hassle-free convenience of a hot-shoe system. Has both a flip-up eyepiece and a diopter.

CIRCUITS, CIRCUITS

For auto shift registration, white balance, black balance, beam control, genlock. Digital H/V blanking circuits. Split-field color bar generator, too, that meets the RS-189A standard.

The KY-21OU accepts all the options and accessories available for the KY Series, and can be equipped for remote control operation utilizing time-division multiplexing. It's the ideal camera for EFP, ENG and simple studio use.

For a demonstration of the KY-21OU, a Spec Sheet, or JVC's complete catalog, call, toll free:

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BE-China trip

Broadcast Engineering, in association with the China Broadcast Ministry, is hosting a *China Broadcast*, March 10-19 to three major cities in China. Eligible delegates are international broadcast industry executives who wish to determine the market potential for their products in China or further their existing contacts.

For more information, contact Roman Associates, P.O. Box 1607, Lafayette, CA 94549; 415-284-9180.

NBC drops teletext

At the end of January, NBC will discontinue active participation in teletext services on network feeds. Some individual affiliates may continue local operations, but they will not receive any data input from the network.

The reason for the action is the lack of reasonably priced decoders for the consumer. Even when NBC entered the teletext market in May 1983, tests involved only specially prepared receivers that were placed in cooperating locations.

If products are produced to make the service a viable one, NBC will again take part in the vertical interval data transmission method.

SSE to study DBS for USIA

Satellite Systems Engineering, Bethesda, MD, under a contract from Martin Marietta, Denver, will study the technical feasibility and estimated cost of developing and operating a direct broadcast satellite system for the Voice of America and other government international broadcasters.

The study, which was commissioned by NASA's Lewis Research Center for the United States Information Agency, is part of a USIA program to explore long-range alternatives for its international sound broadcasting facilities and to expand its coverage.

Australia chooses B-MAC

A technically advanced transmission system for the Australian Broadcasting Corporation will extend the range of ABC services to outback Australians.

Michael Duffy, minister for communications, said that contracts would be be negotiated with an Australian-based company, backed by overseas technology, to use the B-MAC system to deliver ABC TV and radio services via AUSSAT.

Company service on subcarrier

An in-home data service is being developed that would allow KSL-AM, Salt Lake City, to broadcast its TeleText-5 data service to home computers in the station's coverage area.

The service is being developed and tested by Bonneville International, KSL's parent company, and Kahn Communications, Westbury, NY. KSL's AM subcarrier would be used to carry the information to a home computer, which would be connected to a subcarrier receiver.

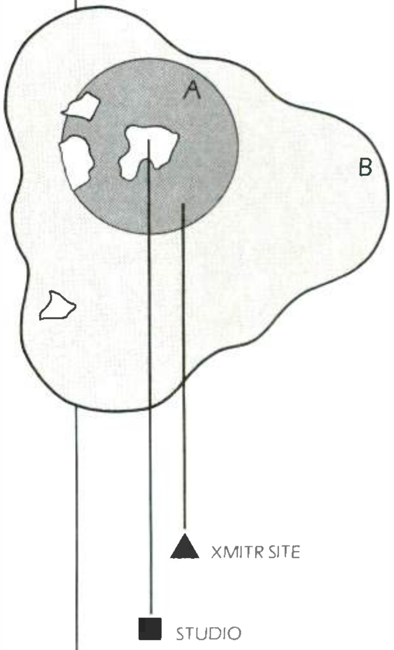
Digital system patented

The United States Patent Office has issued CompuSonics, Denver, a patent for its audio digital recording and playback system, announced David Schwartz, CompuSonics president.

The patent covers all 17 claims filed by the company for the floppy disk-based, digital audio recording and playback system. Foreign patents in 27 countries are still pending.

IF TRANSMITTER FAILURE HAS CAUSED YOU TO LOSE REVENUE, LET US INTRODUCE OUR INEXPENSIVE EMERGENCY TRANSMITTER.

What happens at your station when your FM transmitter goes down? Or your studio transmission link is disrupted? Or a power loss at the transmitter site occurs?



A — Coverage using QEI studio location transmitter

B — Coverage using station's primary transmitter

QEI has an inexpensive solution. Our low-power FM transmitter designed for studio operation can handle all these emergencies and keep you on the air In many cases you'll retain the majority of your audience simply because your studio is usually located more central to your market than your transmitter site.

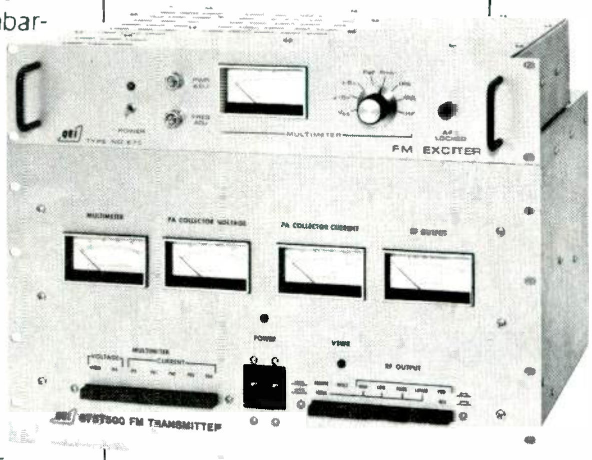
For a small investment your station will gain protection against lost revenues and the embarrassment of discontinued service.

QEI's low-power transmitters are all solid-state and are available in 150w, 300w or 500-watt power output levels. No warm-up is required. They are on the air in less than 10 seconds . . . and have hundreds of thousands of trouble-free hours. Virtually silent in operation, all our transmitters use QEI's famous 675 synthesized exciter.

So cover yourself with a QEI low-power FM transmitter located at your studio site . . .

Solve the problems caused by an STL or main transmitter failure . . . and do it on a modest budget.

For more information contact John Tiedeck at 609 728-2020. He will put a package together to meet your station's needs.



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Williamstown, NJ 08094
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Ampex Listened When You Described Your Ideal VTR.

CONSOLE WITH OVERHEAD PICTURE MONITOR—ONE OF 6 CONFIGURATIONS AVAILABLE

HI FI SPEAKERS LET YOU APPRECIATE SUPERIOR AUDIO QUALITY OF VPR-6 WITH EXCELLENT STEREO PHASE RESPONSE.

HANDLES SPOT TO 2 HOUR REELS WITH EQUAL PRECISION AND GENTLENESS

BRUSHLESS DC SCANNER MOTOR AND INDIVIDUALLY REPLACEABLE HEADS

LOGICAL, EFFICIENT CONTROL PANEL—ALL OPERATOR CONTROLS UP FRONT

DUAL NUMERIC READOUTS—ONE FOR TAPE TIME/TIME CODE; ONE FOR CUE POINTS, DIAGNOSTIC CODES, TAPE SPEED, SETUP CODES

TBC-6 WITH 32 LINE MEMORY AND 28 LINE CORRECTION WINDOW; PERFORMANCE MATCHED TO VPR-6.

Now, Here It Is. The New VPR-6.

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

Smart, yes. Complicated, no.

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

You insisted on fast but gentle tape handling . . . the VPR-6 shuttles tape at speeds approaching 500 ips and handles all reel sizes from spot to 2 hours with equal precision and gentleness. The servo microprocessor senses when the end of the tape is near and slows down the reels and scanner and unthreads the tape gently.

You asked for power-down memory . . . so we built in a long-life battery to protect setups, edit and cue points and all editor configuration parameters.

"Make it easier to troubleshoot," you said, and we built in an extensive diagnostics system that constantly monitors many system conditions and warns you if a fault occurs. You can even run from the control panel a diagnostic routine using a logic probe to test every IC in direct communication with the two microprocessors.

A tried and true transport

You demanded reliability. Not wanting to tamper with success, we borrowed the tape transport and mechanical design of our reliable and proven VPR-80. We also eliminated most wire harnesses in favor of more reliable printed wiring boards and backplane connectors throughout. The modular package allows convenient access to any part of the VTR for easy maintenance.

A TBC to Match

Because you wanted play speeds from – 1 to 3X normal and picture in shuttle, we also developed the new TBC-6 digital time base corrector, performance-matched to the VPR-6. Its 32-line memory and 28-line correction window are the largest in any TBC appropriate for a VTR of this type.

State of the art editing

So much for recording and playback, how about editing? The VPR-6 has all the capabilities you asked for, including split audio-video auto edit and auto tag. RS-422 serial communications capability lets VPR-6 function efficiently in a state-of-the-art editing system with the Ampex ACE and other edit controllers.

First-rate audio

"Make audio better," you said, and we did. The VPR-6 has audio (as well as video) confidence playback. The audio system also offers high quality stereo phase and an optional fourth audio channel for EBU systems.

Selection of styles

Most users may agree on capabilities, but you prefer a variety of configurations to choose from. So, we offer the VPR-6/TBC-6 in four console styles as well as tabletop and rackmount versions. Many Ampex video accessories work with it, including some you may now own.

In production now

The VPR-6 is too good to wait for, so it's already in factory production. Ask your Ampex video sales engineer to quote price and delivery for any model in any world standard, and watch his face light up!

AMPEX

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Canada, Toronto 416/821-8840

Attendance makes the art grow stronger

Are you a member of a trade organization—such as AES, EIA, IEEE, ITVA, NAB, NRBA, SBE and SMPTE? Assuming you are, when did you last attend a group function? That is the reason, after all, to be affiliated with such organizations—to interact with others in your field, to share ideas, problems and solutions. You're not one of those who joined for status or political reasons, are you?

Oh, you're not a member? Why not? Your opinions aren't important to others? If that's the way you feel, you're wrong.

If you work in communications electronics, your opinion and your expertise is of interest and of value. After all, the membership of these groups are much like you; individuals with different points of view.

By working together, you can find answers to common problems. But without your ideas, say for a new control system or a different approach to monitoring, perhaps all possibilities have not been heard.

At the recent 126th SMPTE conference an intriguing dichotomy existed. At one point, we spoke to several broadcasters (and members of SMPTE) who observed the new generation of broadcast products and praised the advanced concepts.

In the next breath, they damned those who they saw responsible for making the decisions of operation and interfacing of these new products. They admitted to advantages of component video and to the digital audio experience. Yet they questioned why they should bow to the wills of those who have set the standards for the advances.

Later, we encountered another SMPTE member from the manufacturing point of view. Speaking as part of the educational arm of SMPTE, he asked how SMPTE could get more interest and input from the grassroots broadcasters, the equipment users.

Because they will be expected to implement the recommendations developed by SMPTE, he asked, should they not also take part in developing those recommendations?

What a droll situation. One side argues that no one asks the user. The other is looking to ask a user. Yet, two sides that want to communicate so badly can't find one another. Why?

The purpose of trade organizations is to guide and to interconnect broadcasting and the allied, diverse disciplines of communications electronics. They exist to benefit the industry overall, and, indirectly, our individual involvements in the industry.

Associations are broad in their interests. NAB, for example, is concerned with all aspects of radio and television, representing 4500 radio and 700 TV stations. But the Science and Technology Division and the Advanced TV Systems Committee (ATSC) are concerned with present and future technical station operations.

The bailiwick of AES and SMPTE is in developing engineering compatibility between the industry's parts. Station KAAA needs to be technically similar to WZZZ. Without a compatible framework in which to work, chaos results. Without standards, there is little possible cooperative interchange.

We think the industry needs trade associations and investigative societies. But we are distressed by regular criticisms—that the organizations do not serve their members; that they are ruled more by manufacturers trying to peddle their wares than by those who must use the products; that new technologies are being forced upon users against their wishes. Typically, the loudest critics are the non-active or the non-members.

We see the problem having several facets. First, within communications organizations, communications is the least abundant asset. Second, getting involved requires that you dedicate some of your time, a commodity in our lives that is seemingly too precious to waste on our profession. Third, the aura of the august body of intellectualism, SMPTE, overwhelms the nuts-and-bolts technician that must maintain an outdated VTR.

An ENG camera operator, whose 8-hour tour of duty chases news stories

Continued on page 126

Tascam Recording Consoles. Mix With The Professionals.

Creative choice is what TASCAM's broad line of professional mixing consoles is all about.

Starting with our M-30, we've packed more artistic choice into a modestly-priced package than any console in the industry. This versatile 8x4 is ideal for everything from basic recording to video production and comprehensive small studio applications.

Increased flexibility highlights the M-30's big brother, our M-35. This durable 8x4 combines wide-ranging function capabilities with operating ease. The M-35 features 4 separate sub groups, solo, independent monitoring, built-in effects loop, and much more.

For more elaborate production demands, our rugged new M-520 console gives exceptional precision and complete control of your 8 and 16 track recording, over-dubbing and mix down. The M-520's creative options include multiple inputs per channel, 8 independent subgroups, stereo solo-in-place, PFL, balanced and unbalanced inputs and outputs, multiple auxiliary mixes, and long-throw faders.

And if you're recording needs are met by 8 tracks, our M-512 console gives you the sophisticated functions, easy operation, and technical quality of the M-520, with fewer input channels.

See your TASCAM dealer today. He'll tell you about these and a wide range of other professional TASCAM mixers, and get you hands-on with the console that was built for you. Or write for more information to TASCAM, TEAC Professional Division, 7733 Telegraph Road, Montebello, CA 90640, (213) 726-0303.

Circle (13) on Reply Card

No matter how complex your audio production requirements, TASCAM has the right console to do the job.

RENG: New technology for

By Jerry Whitaker, radio editor

Radio stations have used the remote location broadcast for decades to bring the listener an added sense of realism and excitement. Although the concept of the *remote*—as it is better known—has not changed substantially, the means to accomplish the task has been quantum leaps in performance, ease of operation and reliability.

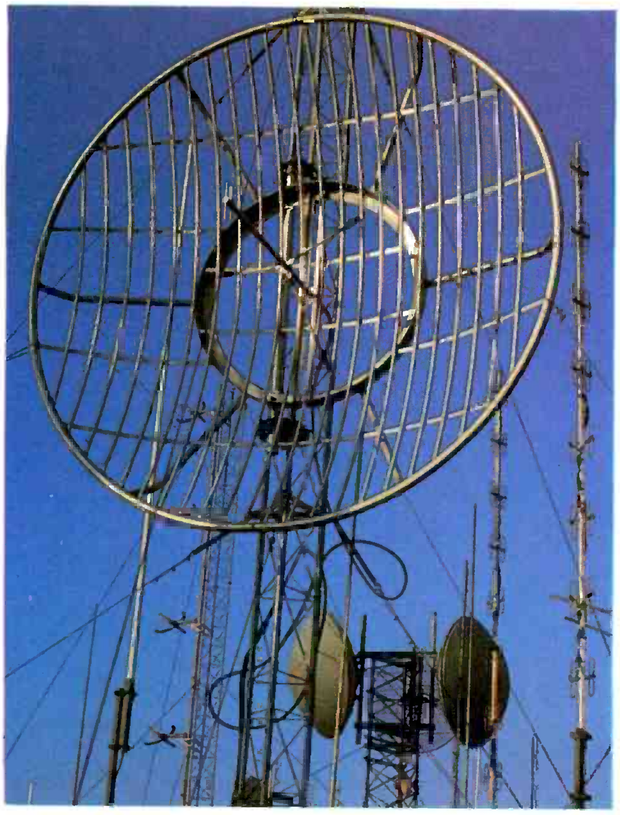
Today's radio ENG systems can be configured to provide virtually any degree of sophistication required by the station. As with any other area of broadcasting, the key to a successful RENG system is thoughtful planning.

Planning the network

The importance of careful planning of an RENG system cannot be overemphasized. You should configure the network based on the precise needs of the station. Everyone who will use the system should be consulted to determine just what type of arrangement will be needed. Whether a station's format is *all news* or *AOR*, all people in the news, production and engineering departments should sit down and define the network requirements.

Many—perhaps most—RENG systems were built on a piecemeal basis,

Radio remote broadcasting has come a long way from the narrowband *walkie-talkie* days when a 5W "portable" transmitter weighed 25 pounds and was the size of a briefcase. Today's gear is small, lightweight and reliable. RENG equipment has given stations the ability to take virtually any show on the road.



new requirements

as needs dictated and economics allowed. The lack of a unified plan has often led to configurations that are cumbersome to operate and, in the long run, are more expensive than necessary to build for a given level of performance.

The size and layout of the station's market will have a substantial effect on how you design the RENG network. A system intended to cover a sprawling urban area of 10,000 square miles will be configured much differently than a tightly clustered urban center covering 2000 square miles.

The number of stations in the market that are involved in RENG activity will also affect how you design a system, and what types of equipment you use. Stations in major metropolitan areas may find few, if any, vacant frequencies for RENG use.

Program material can be returned from the field to the studio through either of two common routes—wired telephone lines or wireless transmission systems of various types. The route taken back to the studio will depend upon a number of factors, including the event's location, telephone line availability, setup time and broadcast duration. (See "Wired vs. Wireless," page 26.)

Building a RPU system

In view of the serious spectrum congestion problems that exist in many areas of the country, any RPU/RENG system should be designed to be as spectrum-efficient as possible and—equally important—to be as immune to undesired transmissions as possible. Even if you will be operating the system in an area that does not have a spectrum congestion problem, there is no guard against such a problem surfacing in the future. In any event, a well-engineered system is also a spectrum-efficient system.

The first rule of spectrum-efficiency is to use only the effective radiated power (ERP) necessary to do the job. There is no justification for putting 15W into the air when 5W will provide the desired (or acceptable) S/N figure from the receiver.

Ideally, all transmitters in an RENG system would be equipped with continuously variable power output stages. The operator at the remote site would then run the transmitter with only enough power output to reach the required S/N figure at the receive (studio) point.

Unfortunately, continuously variable power output transmitters are not generally available. Modification of existing equipment is not an acceptable solution, as such work would most likely invalidate the transmitter's FCC type acceptance.

A more logical solution is to purchase RENG transmitters with several different power outputs levels operating on the same frequency (or frequencies). All of the popular RENG broadcast equipment manufacturers offer units with a variety of power output levels. With some equipment, a low-power transmitter is used and a power amplifier module is added between the transmitter and the antenna to give the needed RF output.

Directional receive and transmit antennas are a good idea from both an efficiency and coordination standpoint. Using a pair of high gain antennas makes it possible to achieve a much greater ERP for the same transmitter power. Of equal benefit in a crowded urban area is the elimination of any non-essential radiation. Through the use of directional transmit and receive antennas, stations can establish more secure channels by placing the radiated energy where it will do the most good (at the transmit end), and rejecting unwanted signals from other directions (at the receive end).

Wired systems: The alternative method

Wired communication systems for news, sports or programming can take a number of different forms, from basic Telco equalized loops to sophisticated single- or multiline frequency extension systems using the dial-up network.

An equalized line offers the user a simple, reliable link to the studio. The drawbacks include inflexibility, installation lead time and installation/rental costs.

Although the dial-up network gives the user a greater degree of flexibility than standard equalized loops, the level of performance (when a bandwidth extension system is *not* used) leaves a great deal to be desired. The most popular way around this problem is to use a 2-line frequency extender system.

There are a wide variety of extension methods, each with a different way of accomplishing the task. Basically, audio from the remote source is split into two frequency bands by a filtering network. The higher frequency components are shifted lower by a conversion circuit for application to the telephone company dial-up network. The lower frequency components are shifted upward by a second conversion circuit and applied to a second telephone line.

At the studio demodulator, the two signals are frequency-shifted back to their original values, filtered and recombined to form the output of the system. Variations on this method include the use of single- or multiband compressors, variable equalization and compandor circuits. The use of audio compression at the transmitting (remote) point, and reciprocal expansion at the receiving (studio) end, can provide a substantial reduction in apparent line noise.

Photo by Ben Weiss

The use of a frequency extender system on standard dial-up telephone company lines can produce some impressive results. The equipment setup shown was used by KLSI-FM, Kansas City, MO, during a week-long remote broadcast from Disney World in Florida. A Comrex 2-line extender system was used to feed program material back to the studio during the morning and afternoon drive-time periods.

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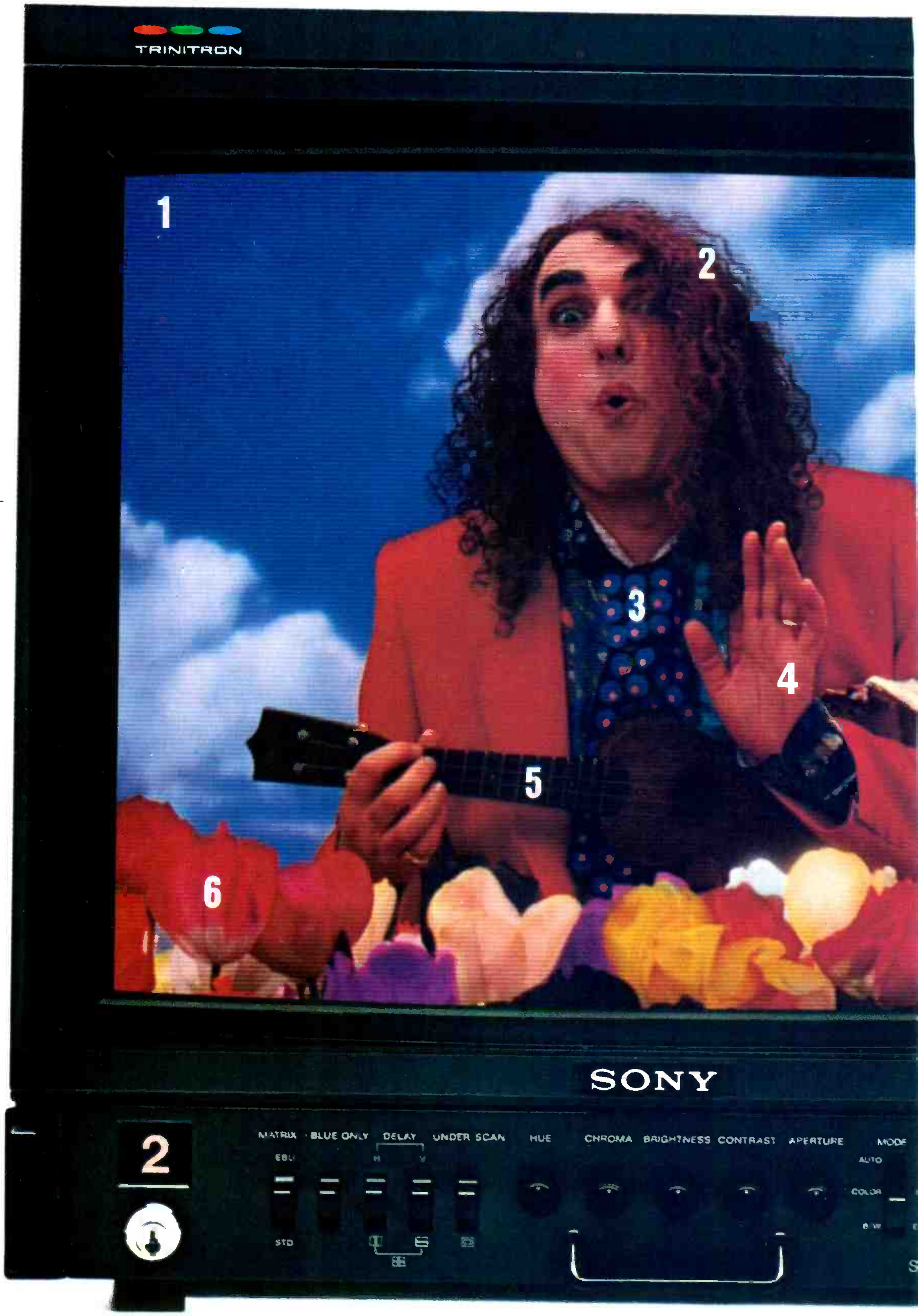

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Wired vs. wireless

Until the 1960s, the word "remote" was rarely spoken without referring in the same sentence to "the telephone company." Wired systems, either using the dial-up network or leased broadcast loops, provided the vast majority of interconnections from remote broadcast sites to a station's studio facilities.

Since that time, however, radio systems have assumed an important role in remote activities because they inherently offer greater flexibility and generally provide the user with a higher-quality audio link.

Radio systems are ideally suited for broadcasts of relatively short duration from a variety of locations. Meetings, speeches and sporting events, on the other hand, are probably best handled by a wired arrangement.

The amount of frequency congestion in the origination area will also have an effect on which method a station will choose for the greatest reliability. Urban areas in which secure RPU channels are difficult to find may be best suited to a wired link.

The amount of lead time given the station before various events that need to be covered will also have a significant effect on the route taken by the program audio from the remote site to the studio. Broadcasts that are scheduled weeks in advance are obvious candidates for the use of a telephone company loop. Spot news events, on the other hand, do not lend themselves to planning days in advance, let alone weeks in advance. In such applications a radio system is more practical.

The cost of Telco facilities must also be considered. Unless the loop is to be left in place for a long time, installation charges can become prohibitive, especially if high-performance equalized lines are needed for the application. Many stations are able to justify the cost of an RENG radio system based on the anticipated Telco savings.

This does not mean to imply that stations should choose between *either* a wired or a wireless link. Large systems are often built using *both* interconnection methods, either as various links in the chain or as back-up protection in the event of a partial system failure.

A simple and sometimes effective coordination tool is cross-polarization. Two stations on adjacent frequencies may achieve as much as 25dB isolation through the use of different polarizations of transmit antennas, matched by the same polarization at their respective receive antennas. Cross-polarization results in varying degrees of success, depending upon the frequency of operation and surrounding terrain.

Line-of-sight paths usually will provide good results, but urban centers with their reflective buildings generally cause polarity shifts in the transmitted signal that may significantly reduce this technique's benefits.

System configuration

Users' requirements will vary greatly from one station to the next and from one market to the next. There are, however, several standard system configurations that can be modified to fit the requirements of most users. These range from the simple point-to-point program relay system common in many small-scale operations, to complicated multipoint relay installations with automatic signal quality voting circuits.

Figure 1 shows the basic RENG program relay system in which one or more transmitters on a particular frequency are used in the field, and a single receiver is located at the studio. All antennas used in the system are omnidirectional.

Although there is much to be said for system simplicity, an arrangement such as this is not practical in an increasing number of urban areas because of spectrum congestion problems and the need to cover large geographical areas.

The system configuration shown in Figure 2 overcomes the geographical coverage area problem through the use of an automatic relay station (ARS). The range of an RENG system can be greatly extended by using an ARS. Such systems also make it possible to use lower power transmitters in the field, because the transmitter at the program origination point only needs to be powerful enough to reach the ARS site. This often allows the use of smaller and lighter remote transmitters, usually hand- or pack-carried units.

The arrangement in Figure 2 will satisfy the requirements for wide area coverage and is sufficient for radio markets where spectrum congestion is not a problem. Because all antennas in the system are omnidirectional, however, the configuration is not suitable in large urban areas that experience frequency allocation problems. For such applications, you need a more sophisticated approach.

Figure 3 shows a high-performance, 2-point RENG system designed for operation in spectrum-congested

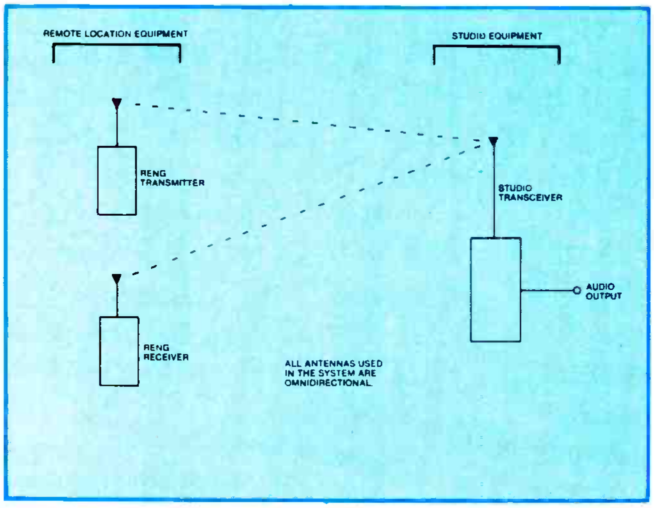


Figure 1. The basic RENG program relay system using a single hop from the remote location to the studio.

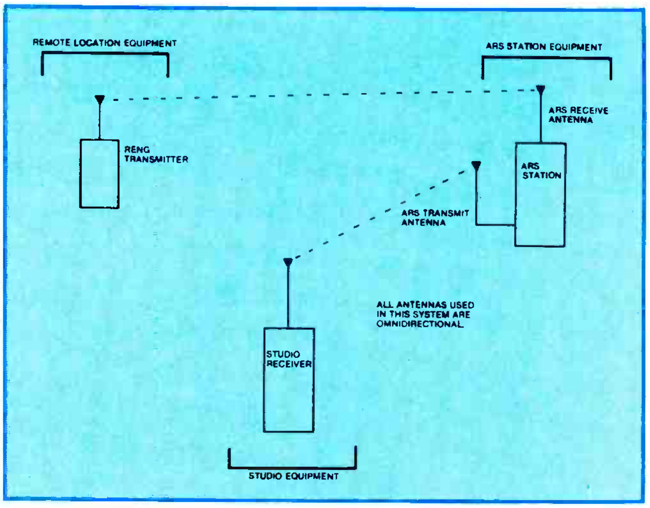
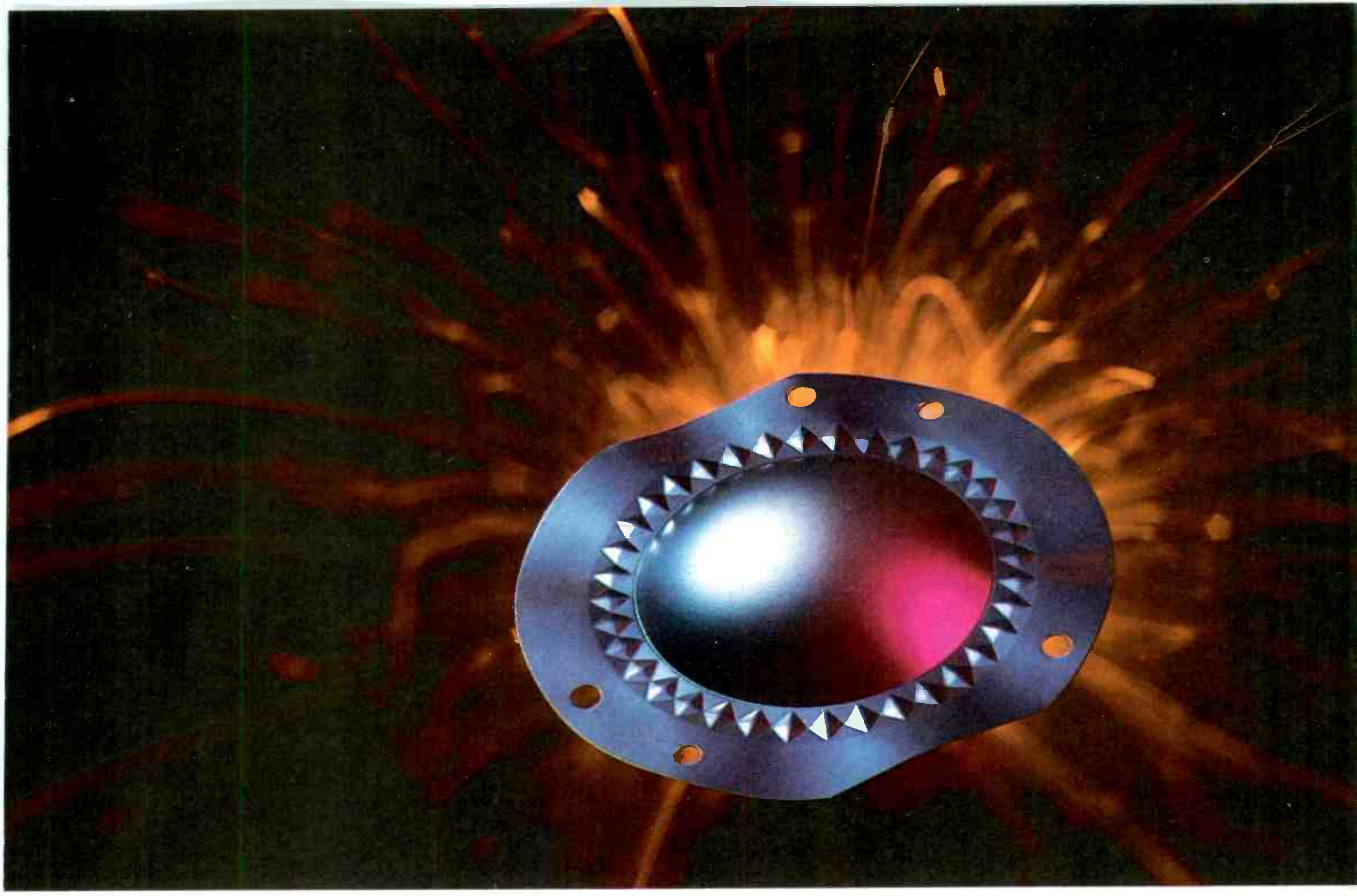


Figure 2. The basic RENG program relay configuration using an ARS station between the remote location and the studio.



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Selecting an antenna for RENG use

Selecting an antenna for use in an RENG system is an important decision because of the effect the antenna has on system performance and spectrum usage.

The usual RENG antenna has, until recently, been the omnidirectional vertical whip with a small amount of gain. Many system planners, however, are now being forced by interference concerns to use directional antennas with moderate amounts of gain. The low power levels commonly used with RENG equipment and the RPU band frequencies make it possible to economically achieve increased effective radiated power (ERP) through the use of high gain transmit antennas.

High gain antennas also concentrate the radiated signal where it will do the most good, and minimize radiation in directions that may adversely affect the RENG activities of stations operating nearby.

Omnidirectional vertically polarized base station antennas commonly used in the 150MHz and 450MHz bands give the user a gain of 4dB to 6dB. Electrical beam tilt is sometimes available. Depending upon the manufacturer, up to 20° downtilt can be provided on 150MHz antennas, and up to 11° is common on 450MHz omnidirectional units.

A high degree of beamtilt is normally used when the antenna will be mounted on a structure that is substantially above the surrounding terrain. The beamtilt will improve the antenna's close-in coverage.

A typical *directional* RENG antenna is the medium gain 5-element Yagi. It provides about 9dB to 10dB gain over a reference dipole, with a front-to-back ratio of approximately 14dB to 18dB. Figure 6 shows the radiation pattern for a commonly used 5-element 150MHz Yagi. This particular antenna measures 40" X 40" X 4 " and weighs 8 pounds. It is small and light enough to be used on remote broadcasts.

It is also suitable for permanent installation using either horizontal or vertical polarization. This type of antenna may be stacked in two or four bay arrays (with suitable phasing harnesses) for additional gain and directivity.

Most Yagi antennas are made to match the specific frequency requirements of the user. Multiple frequency operation using a single antenna is possible with a reasonable VSWR, though, as long as the operating frequencies are not removed from the *cut center frequency* by more than 1% to 2%.

A recent addition to the RENG user's bag of electronic tricks is the broadband log periodic antenna, which can be used on any channel within a wide band of frequencies. These antennas provide a smooth pattern with minimal sidelobe radiation and a high front-to-back ratio (typically 25dB in the 150MHz band). Nominal gain for 150MHz operation is 7dB. Units can also be stacked to provide more gain and directivity.

Log periodic antennas are usually larger and heavier than the familiar Yagi. However, they allow use of the antenna for virtually any frequency within the specified band at a low VSWR (a maximum of 1.5 to 1 is typical).

Figure 7 shows the radiation pattern of a log periodic antenna designed for use in the 450MHz band. Horizontal or vertical polarization is available. This antenna has a gain of 8dB and a front-to-back ratio of *35dB*. This unit is ideally suited for areas with high spectrum congestion.

Just as a TV or FM broadcast antenna must be protected against icing problems, so should antennas used in RENG applications. Although antenna de-icers are not used in RENG installations, a radome is often available for the antenna to protect it from damage or degradation in performance because of snow, ice or salt spray.

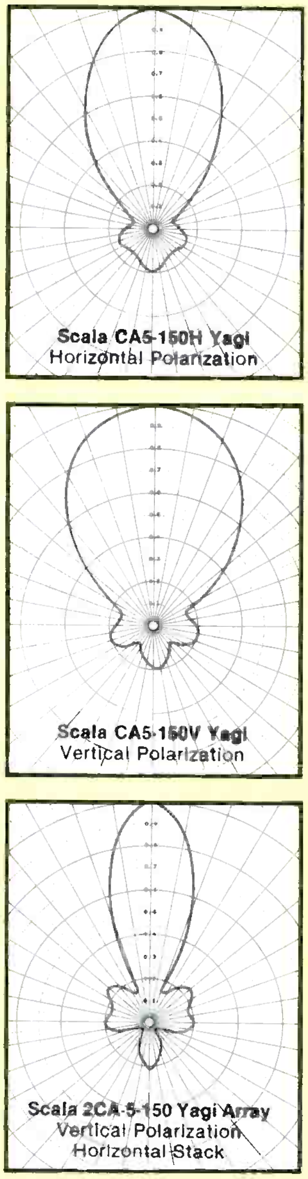
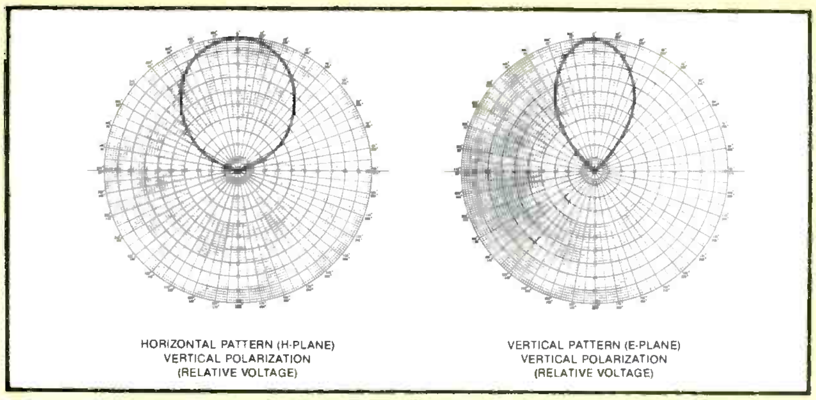


Figure 6. Radiation patterns for the CA5-150 5-element Yagi antenna made by Scala Electronics for the 150MHz frequency band.



HORIZONTAL PATTERN (H-PLANE)
VERTICAL POLARIZATION
(RELATIVE VOLTAGE)

VERTICAL PATTERN (E-PLANE)
VERTICAL POLARIZATION
(RELATIVE VOLTAGE)

Figure 7. The radiation patterns for the Scala CL-400 broadband log periodic antenna, designed for use in the 450MHz RPU frequency band.

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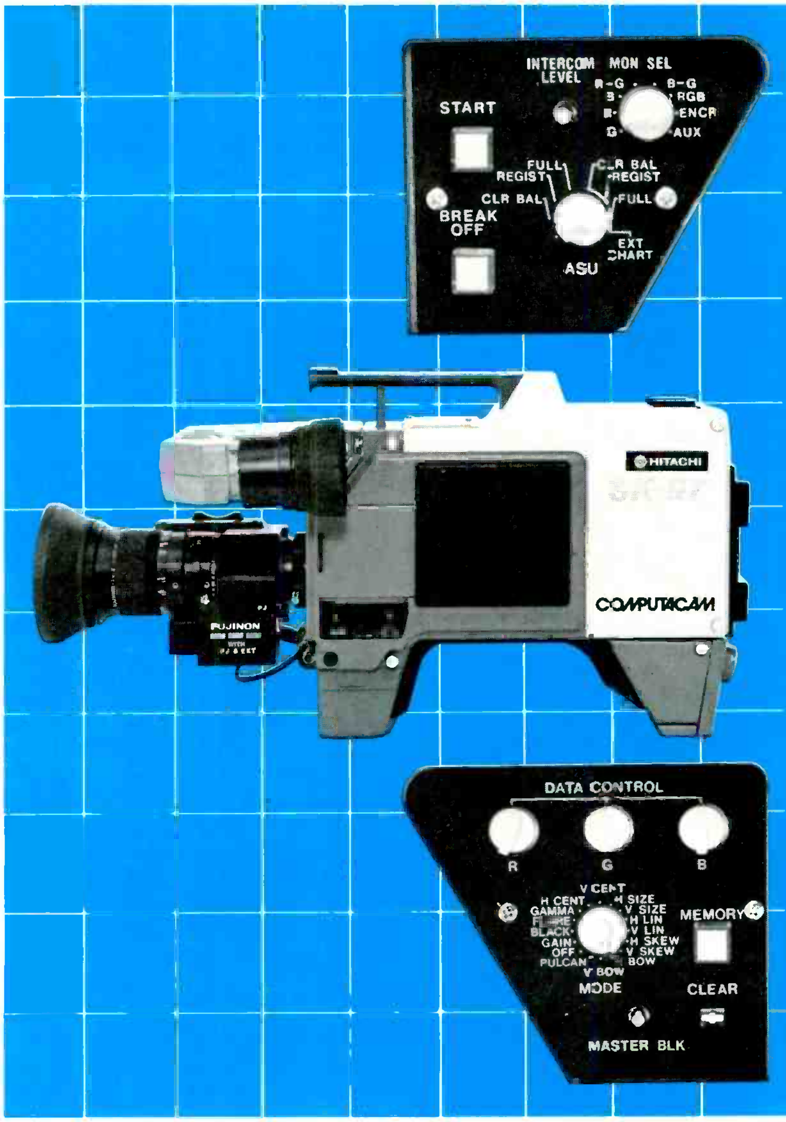

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HITACHI

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RENG equipment licensing

RENG work is done on two primary bands of frequencies set aside by the FCC for remote pickup unit (RPU) operation. A number of frequency groups are allocated near 150MHz and 450MHz. Some assignments are also made on frequencies in the 25MHz region. A particular broadcast station is not restricted to a maximum number of RPU systems that it may put into operation. The needs of the station and the budget available for equipment purchase are, instead, the major controlling factors.

Most RENG activity is centered in the 150MHz and 450MHz bands. In these slices of spectrum, three license classifications exist: Automatic Relay Station (ARS), Base Station and Remote Pickup Mobile Station.

ARS systems are designed to receive program material on one frequency and retransmit it on another. In this way, the coverage area of the RENG system can be extended considerably.

Base stations, as might be expected, are fixed-position transmitters used for communication between a central point and one or more remote points. Base stations may, in the event of emergency conditions, be used as a program relay channel for Emergency Broadcast System information.

Remote Pickup Mobile Stations consist of vehicle-mounted and hand-carried transmitters. They are usually licensed as a system in conjunction with a principal base station, or stations. Remote Pickup Mobile Station licenses generally specify a minimum and maximum number of mobile transmitters allowed in the RPU system. Standard divisions include from one to four stations, four to 12 stations, 10 to 20 stations and 20 to 50 stations.

The commission's rules require that the transmitter power for an RPU station be limited to a level necessary for satisfactory coverage of the service area. In any event, not more than 100W transmitter power output will be licensed. RPU transmitting equipment operating on board an aircraft is normally limited to a maximum transmitter power of 15W. A mobile station consisting of a hand- or pack-carried transmitter is restricted to not more than 2.5W power output.

All RPU transmitting equipment must be type accepted by the commission and checked each year (for units with more than 3W output) for frequency accuracy, deviation and RF power output. FCC rules also require that RPU transmitters rated for 3W or greater be equipped with a circuit that will automatically prevent modulation in excess of the authorized limits. In other words, an audio limiter must be built into the unit.

There are virtually no operator requirements for the use of a unit in the RPU service. Any person designated by and under the control of the licensee of the station may operate the equipment. An operator's licence, as detailed in Part 13 of the commission's rules, is not required.

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areas. At the remote site, two transmitters and two antennas are used. The communications transceiver is used to set up the program audio link and to relay cues and coordinating information. The low-power transmitter and its associated directional transmit antenna are used to relay the program signal to the studio.

At the studio site, a communications transceiver, feeding an omnidirectional antenna, is used for setup information, cues and coordination work. The multi-antenna receiver system picks up program audio.

The *cues and orders* radio system shown in Figure 3 is used for general purpose communciations not requiring wide frequency response and a high S/N ratio. The lower power program relay transmitter and directional receive and transmitter antennas provide a secure and quiet channel, without causing interference to other RPU band users in the area.

When the remote broadcast is not on the air, the omnidirectional antenna is patched into the broadcast-quality RPU band receiver at the studio through the coaxial switch, K1. Once contact has been established with the remote crew, one of the directional antennas—which are mounted on a common mast driven by a remote-controlled antenna rotor—is switched into the studio receiver.

The polarization of the transmission from the remote site is planned before the remote crew leaves the studio. Selection of either horizontal or vertical polarization is made during the frequency coordination process, or at the discretion of the user. Engineers may find that a particular polarization yields better results from certain geographical areas, and in such cases, that polarization would be chosen.

Once the proper antenna has been selected, the antenna rotor is adjusted for maximum received signal strength. The studio operator then talks the remote crew into the best position for its Yagi transmit antenna. At this point, the antennas are locked down, and the link is ready for the remote broadcast.

If a variable power output transmit-

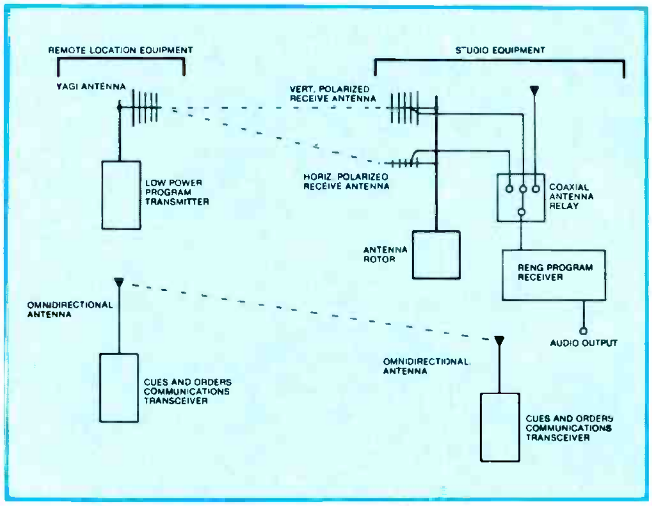

Figure 3. A high-performance 2-point RENG system designed for operation in frequency-congested areas.

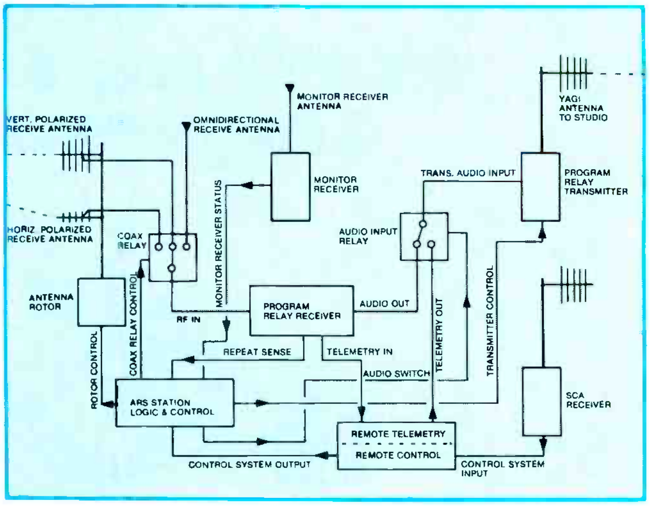

Figure 4. A high-performance, secure-channel ARS station with remote control of system functions.

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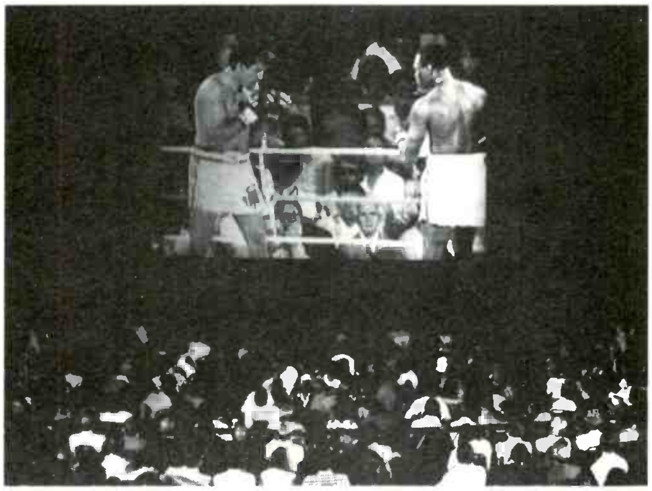
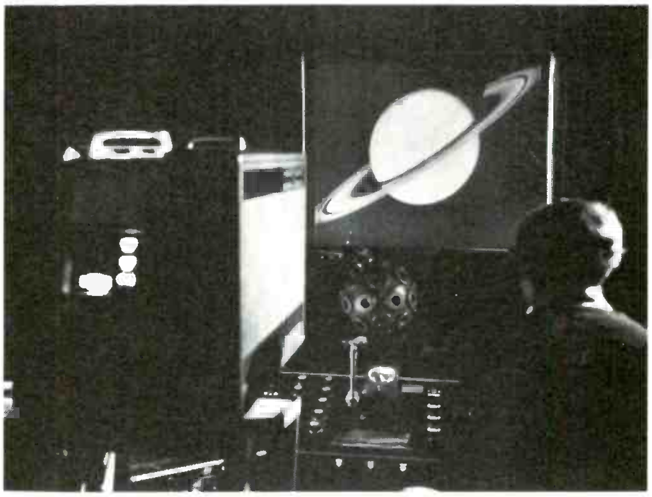


View from ringside transmitted live to guests in Caesar's Palace lounge.



View from spacecraft transmitted live from NASA to sell-out planetarium crowd.

View from finish-line projected in racetrack lounge is preferred over grand stand by many patrons.

View from armchair at home is duplicated between races to draw extra admission fee at racetrack lounge.

GENERAL ELECTRIC

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ter is used at the remote site, or transmitters of various power levels are available, the transmitter power is next adjusted to give the desired S/N performance from the studio receiver. After power output has been set, the antennas on both the receive and transmit ends are checked again for correct positioning.

Although this process may be time consuming and require the purchase of additional equipment, it will assure a high quality, secure, RF link from the field to the studio. This system will also result in a minimum amount of unwanted radiation to other RPU band users.

Figure 4 shows a high-performance, secure-channel ARS. The same antenna selection and positioning procedure is used in the ARS installation that was used in the 2-point system of Figure 3, except that the antenna switching and positioning work is done by remote control.

The link for this remote control system can be a subcarrier on the main station broadcast signal, a separate dedicated radio link, a dial-up telephone patch or a leased Telco data or voice loop.

A standard broadcast transmitter remote control system is used at the ARS station, with the various channel on-off/up-down functions performing the necessary switching and positioning work at the ARS site. For stations with multiple-site capability on the main transmitter remote control system, the ARS remote point can be simply treated as another *transmitter site* and controlled as such from the master unit.

A monitor receiver is included at each ARS installation to inhibit activation of the ARS transmitter if a transmission is already in progress on that frequency. As shown in Figure 4, the control commands are received over a subcarrier receiver from the main station transmitter. The relay station logic interfaces the remote control unit with the receive antenna coaxial switch and the antenna rotor control box.

During setup, the telemetry section of the remote control unit provides an audio FSK signal that is sent back to the studio control unit via a Telco line or the relay (ARS) transmitter, as shown.

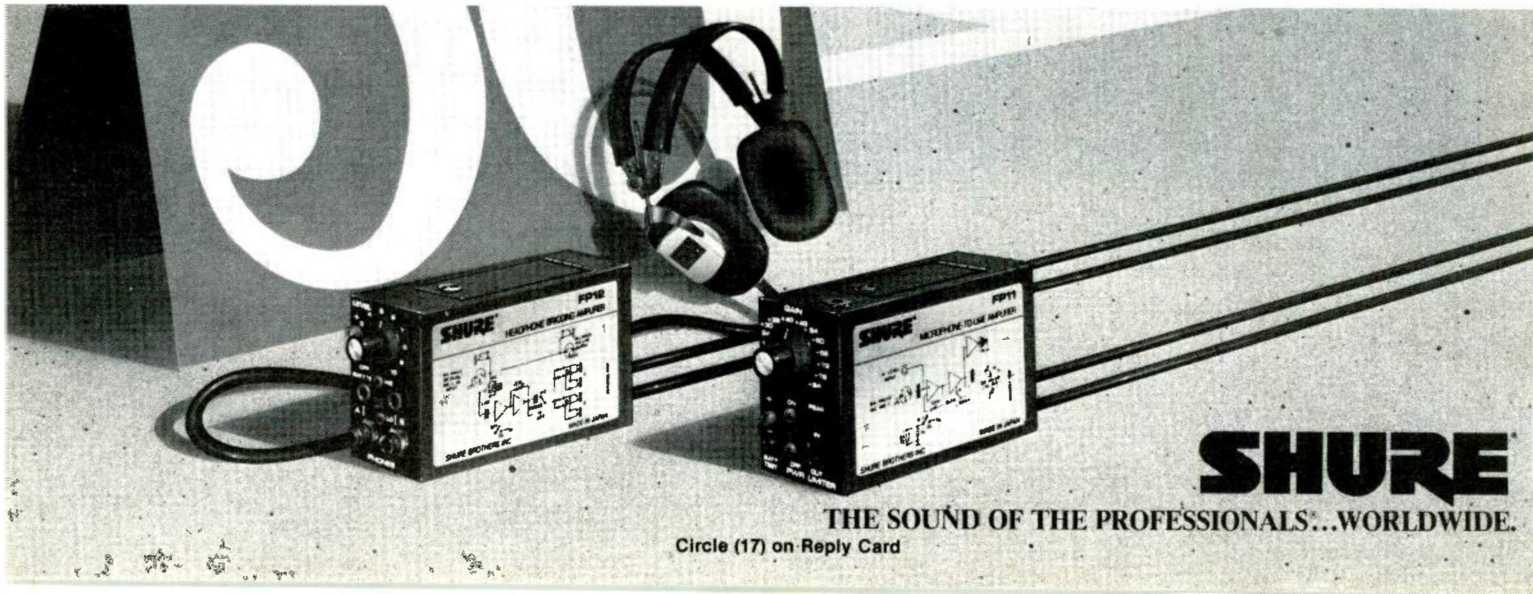
The SCA, omnidirectional program, monitor and relay transmit antennas are all fixed in position. Only the directional receive antennas, one set for horizontal polarization and the other for vertical polarization, are movable. This arrangement provides maximum flexibility and minimum risk of program audio disruption.

A sub-audible tone or identification tone burst may be transmitted to unlock the ARS repeater transmitter. This prevents undesired traffic from activating the repeater.

The selection process can also be used to prevent miscellaneous traffic from appearing at the audio output of the studio receiver. Without such provisions, unwanted traffic or noise bursts may be heard at the listening position. A source identification tone can be used to enable the receiver audio, assuring that any transmissions heard out of the RENG monitor speaker at the studio are desired.

One of the problems you might experience with ARS equipment is the possibility of a desired signal opening the system, and an undesired signal keeping it open after the desired traffic has ended. This can occur if you use the *tone burst* method of repeater keying.

For example, a valid tone burst signal unlocks the ARS system and then undesired noise or traffic holds the channel open after the desired traffic has ended by prohibiting a loss-of-carrier indication from the receiver. The ARS will be *struck open* until the level of the interfering signal drops to a point that allows the receiver to squelch and generate a *loss-of-carrier command* to the ARS system logic. To



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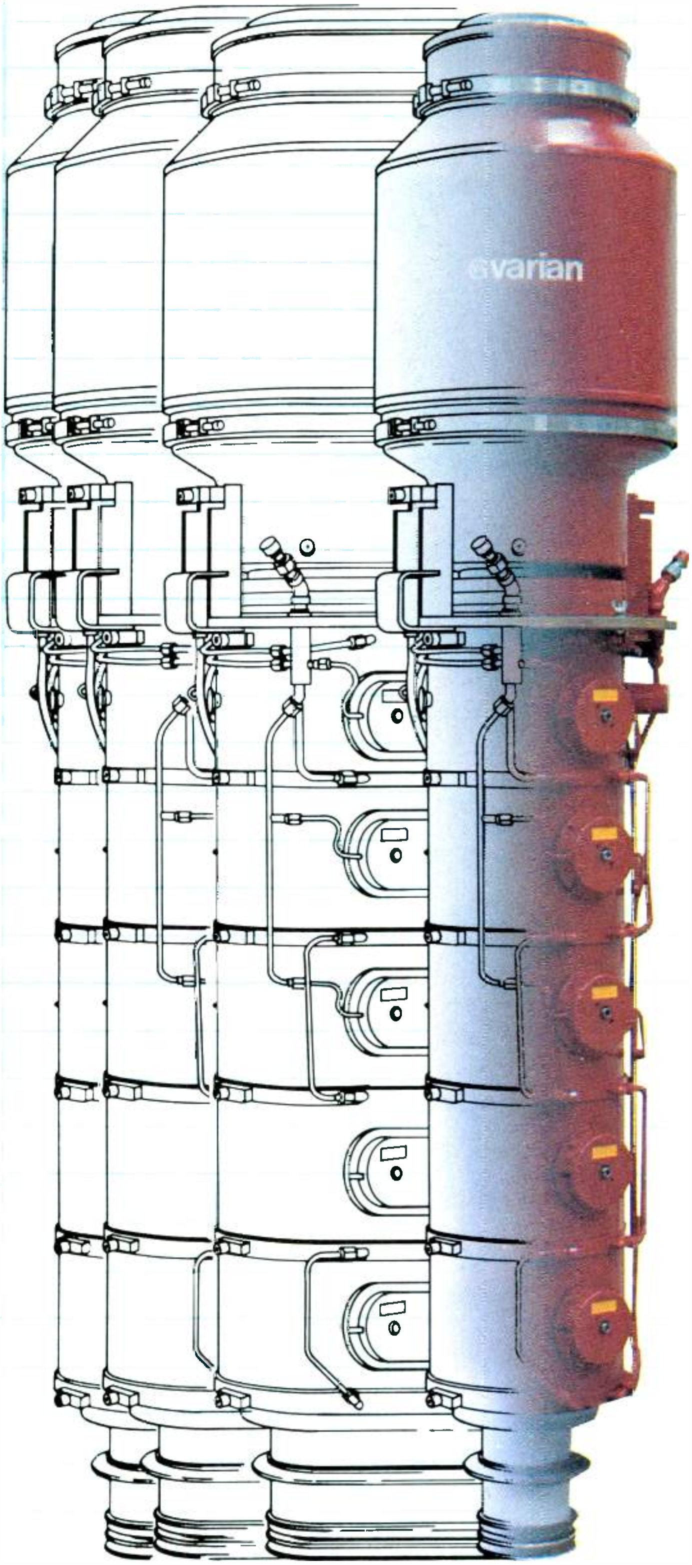

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- Ikegami 9-Series Color Monitors, reknowned for superb resolution and amazing life-like colors.

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- Two Ikegami HL-79EAL Cameras with Canon 13:1 Lenses.
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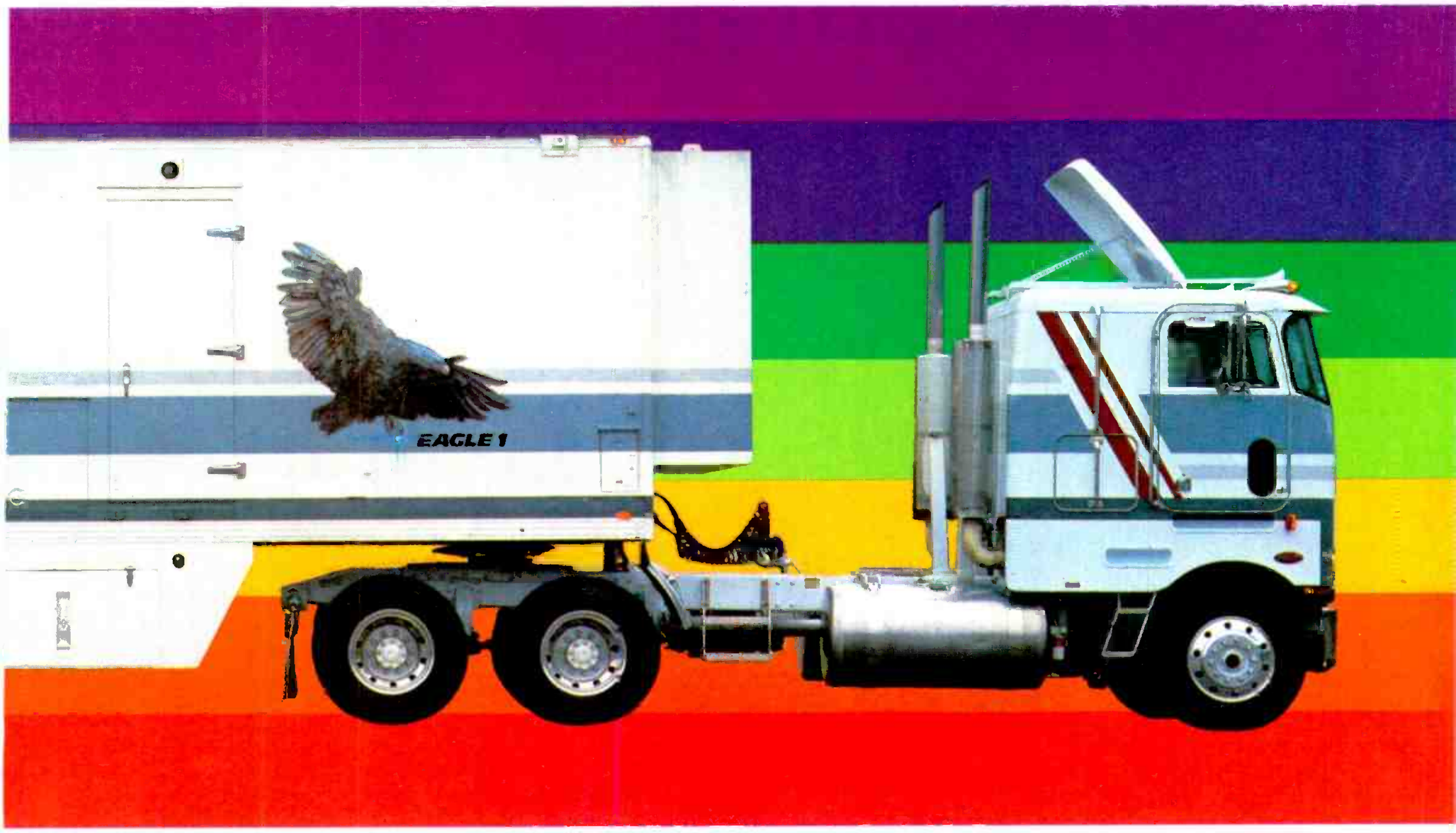

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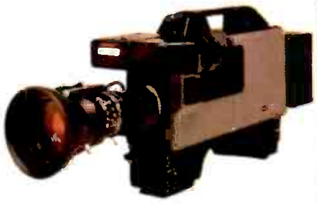

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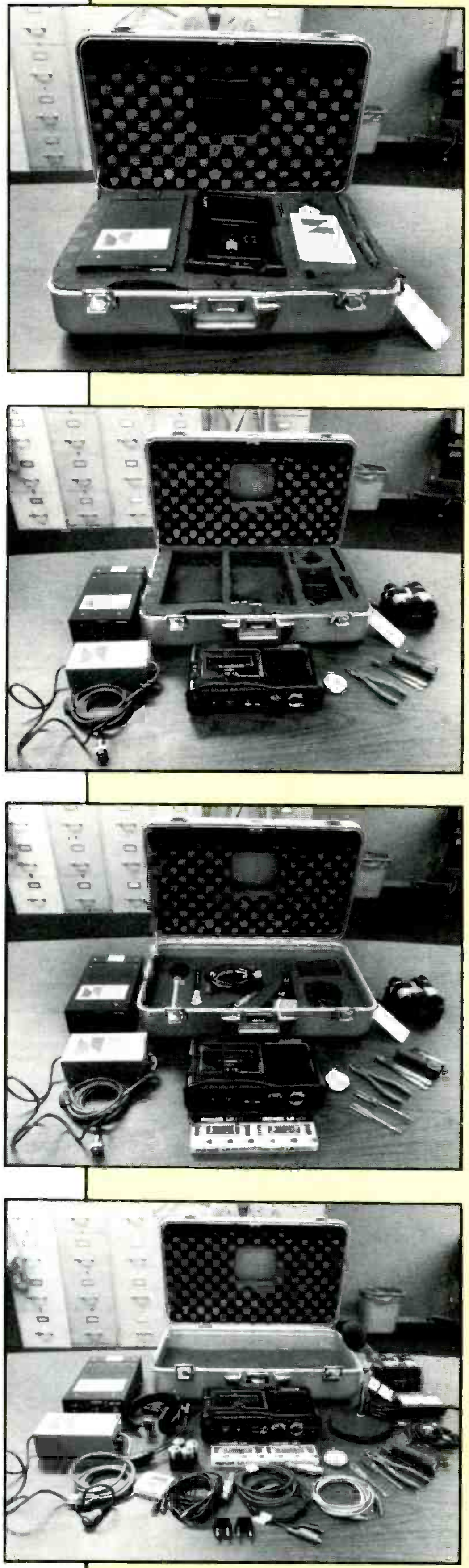
The RRAT-pak



The impressive array of items that can be transported in Alan Walden's RRAT-pak equipment case.

Photos courtesy of NBC Radio

One of the biggest problems many radio news reporters have in covering an event is not necessarily getting the story, but getting the equipment to do the story.

There must be some unwritten law of broadcasting that states no matter how much gear you bring to an event, it is not enough. You will always leave something back at the station.

This problem is serious enough when the station is a few blocks away. Imagine leaving something back at the office when you're a network news reporter and your story assignment is somewhere in Central America!

The ideal solution would be a medium-sized carrying case that could hold all the supplies that you could possibly need on any assignment. But can it be done?

Alan Walden of NBC News—after frustration over the grab-bag approach to transporting the tools of his trade—proved that it can be done. He put together something he calls the RRAT-pak, an acronym that stands for remote record and transmit.

The accompanying photos show the wide variety of items that Walden managed to fit neatly into a 12" x 18" x 5" aluminum camera case. The whole package weighs only 35 pounds and can be carried using the built-in handle or a shoulder strap. Best of all, it will fit underneath an airline seat. The case can be packed or unpacked in less than five minutes.

In case you're wondering what can fit into Walden's RRAT-pak, here is a list:

- A Comrex PLX low frequency extender and power pack.
- A Sony TC-5000 cassette recorder, including a case and carrying strap. (The recorder also functions as a 2-channel audio mixer.)
- An Aiwa TP-26 cassette recorder.
- A Shure SM-63L microphone.
- An Atlas desk stand—the heavyweight kind that can't be knocked over.
- A Sony headset/lip microphone combination.
- An induction coil acoustic coupler.
- A set of telephone clip heads.
- An assortment of tools.
- A 110V to 220V voltage converter.
- An assortment of cables and connectors.
- Spare cassettes and batteries.
- And several miscellaneous items, such as a small flashlight, stop watch, pad, pencils and set of mini binoculars.

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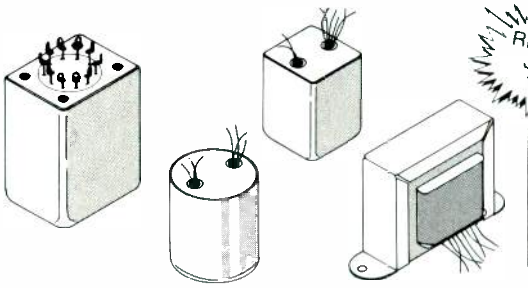

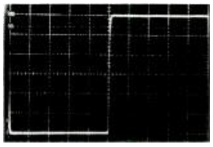

JE-16A
2 kHz Square Wave

INPUT TRANSFORMERS AND SPECIAL TYPES

Model	Application	Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20Hz Max Input Level[1]	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width[2] –3 dB @(kHz)	20 kHz Phase Response (degrees)	Over-Shoot (%)	Noise Figure (dB)	Magnetic Shield[4] (dB)	Number of Faraday[4] Shields	Package[5]	PRICES		
														1-19	100-249	1000
MICROPHONE INPUT																
† JE-16-A JE-16-B	Mic in for 990 opamp	150-600	1:2	+8	0.036/0.003	–0.08/–0.05	200	–8	<1	1.7	–30	1	A = 1 B = 2	64.21 68.86	42.89 45.99	29.60 31.74
† JE-13K7-A JE-13K7-B	Mic in for 990 or I.C.	150-3750	1:5	+8	0.036/0.003	–0.09/–0.21	85	–19	<2	2.3	–30	1	A = 1 B = 2	64.21 68.86	42.89 45.99	29.60 31.74
JE-115K-E	Mic in for I.C. opamp	150-15K	1:10	–6	0.170/0.010	–0.50/+0.10	115	–5	<7	1.5	–30	1	3	42.03	28.07	21.92
LINE INPUT																
JE-11P-9	Line in	15K-15K	1:1	+26	0.025/0.003	–0.03/–0.30	52	–28	<3		–30	1	1	103.47	69.13	47.69
JE-11P-1	Line in	15K-15K	1:1	+17	0.045/0.003	–0.03/–0.25	85	–23	<1		–30	1	3	40.05	26.76	20.90
† JE-6110K-B JE-6110K-BB	Line in bridging	36K-2200 (10K-600)	4:1	+24	0.005/0.002	–0.02/–0.09	125	–12	<1		–30	1	B = 1 BB = 2	62.86 71.52	42.01 47.79	30.83 32.97
* JE-10KB-C	Line in bridging	30K-1800 (10K-600)	4:1	+19	0.033/0.003	–0.11/–0.08	160	–9	<2		–30	1	3	41.56	27.76	19.16
JE-11SSP-8M	Line in/repeat coil	600/150-600/150	1:1 split	+22	0.035/0.003	–0.03/–0.00	120	–9	<3.5		–30	1	4	151.90	101.47	70.01
JE-11SSP-6M	Line in/repeat coil	600/150-600/150	1:1 split	+17	0.035/0.003	–0.25/–0.00	160	–5	<3		–30	1	5	79.22	52.91	36.51
SPECIAL TYPES																
† JE-MB-C	2-way[3] mic split	150-150	1:1	+1	0.050/0.003	–0.16/–0.13	100	–12	<1		–30	2	3	34.60	23.13	18.06
† JE-MB-D	3-way[3] mic split	150-150-150	1:1:1	+2	0.044/0.003	–0.14/–0.16	100	–12	<1		–30	3	3	60.09	40.15	31.35
JE-MB-E	4-way[3] mic split	150-150-150-150	1:1:1:1	+10	0.050/0.002	–0.10/–1.00	40	–18	<1		–30	4	1	96.90	64.73	44.66
JE-DB-E	Direct box for guitar	20K-150	12:1	+19	0.096/0.005	–0.20/–0.20	80	–18	<1		–30	2	6	43.57	29.11	22.73

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

PACKAGE DIMENSIONS:

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

NICKEL CORE OUTPUT TRANSFORMERS[6]

Model	Construction	Nominal Impedance Ratio Pri-Sec	Turns Ratio Pri:Sec	20 Hz Max Output Level[7]		600 Ω Load Loss (dB)	DC Resistance per Winding	Typical THD Below Saturation (%) 20 Hz / 1 kHz	Frequency Response (dB ref. 1 kHz) 20 Hz / 20 kHz	Band-Width –3 dB @ (kHz)	20 kHz Phase Response (degrees)	Over-Shoot[8] (%)	Package[9]	PRICES		
				(dBu)	across (n) windings									1-19	100-249	1000
* JE-123-BMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+28	2	–1.1	20Ω	0.002/0.002	–0.02/–0.02	>450 160	–21 –41	<1	7	87.41	44.17	30.47
* JE-123-DMCF	Quadfilar 80% nickel	600-600 150-600	1:1 1:2	+21	2	–1.0	19Ω	0.004/0.002	–0.02/–0.00	>450 230	–12 –25	<1	8	50.71	33.88	23.38
JE-123-BLCF	Quadfilar	600-600 150-600	1:1 1:2	+32	2	–1.1	20Ω	0.041/0.003	–0.02/–0.01	>450 170	–19 –40	<1	7	61.30	35.79	24.70
* JE-123-DLCF	Quadfilar	600-600 150-600	1:1 1:2	+27	2	–1.0	19Ω	0.065/0.003	–0.02/–0.01	>450 245	–12 –25	<1	8	39.61	26.45	19.42
JE-123-SLCF	Quadfilar	600-600 150-600	1:1 1:2	+23.5	2	–1.1	20Ω	0.088/0.003	–0.03/–0.01	>450 245	–12 –28	<1	9	33.48	22.35	15.43
JE-112-LCF	Quadfilar	600-600 150-600	1:1 1:2	+20.4	2	–1.6	29Ω	0.114/0.003	–0.03/–0.01	>450 205	–12 –32	<1	10	25.48	17.01	12.49
JE-123-ALCF	Quadfilar	66.7-600	1:3	+26.5	3	–1.3	8Ω	0.125/0.003	–0.04/+0.06	190	–46	<6	8	42.14	28.15	19.42
JE-11S-LCF	Bifilar w/split pri.	600-600 150-600	1:1 1:2	+30	1 (sec)	–1.7	63Ω	0.058/0.002	–0.02/+0.01 –0.02/–0.05	>10MHz 155	+11 –41	<1	8	42.14	28.15	19.42

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

† IMPROVED PERFORMANCE * NEW MODELS

PACKAGE DIMENSIONS:

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

Prices shown are effective 6/1/84 and are subject to change without notice. Packing, shipping, and applicable sales taxes additional.

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

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Circle (21) on Reply Card

The crowded skies

Radio channels typically used for RENG work are assigned on a shared basis, so receipt of a license is no guarantee of unlimited interference-free operation. Indeed, an unused channel is the exception—not the rule—in most larger urban areas in the United States.

Frequency coordination is a complicated procedure that requires careful thought, planning and generally a large amount of lead-time. Broadcasters rarely have to decide *whether they wish* to become involved in frequency coordination efforts. The *need* for coordination is usually painfully obvious to all people involved in RENG.

The main driving force behind coordination efforts has been the Society of Broadcast Engineers, which has set up a National Frequency Coordinating Committee to encourage and to assist in local coordination efforts.

Spectrum congestion is a sad fact of life for many stations engaged in RENG today. Users must recognize that coordination is vital to the reliable operation of remote broadcast systems. Spectrum congestion will, in all likelihood, become worse in the future, not better.

Interference survey

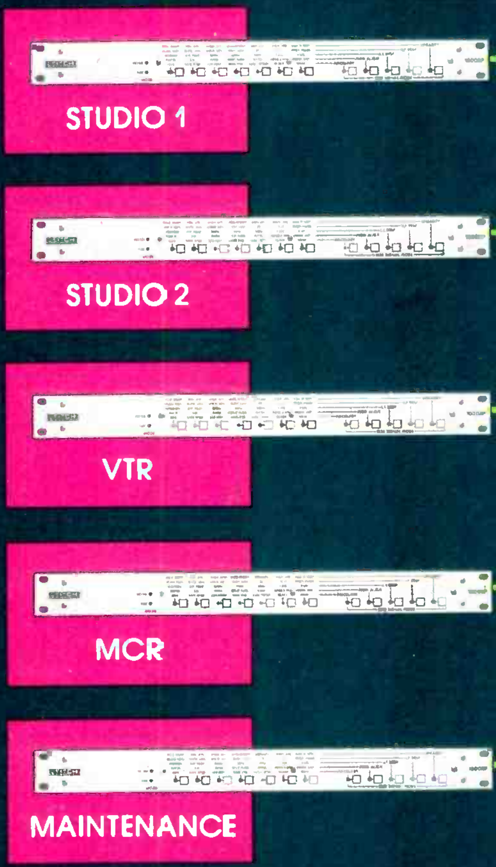
The July **BE** contained a post card questionnaire dealing with the interference problems broadcasters experience because of the operation of land mobile transmission equipment.

Most of the respondents, 87%, said that land mobile base station transmitters were located near their ENG/RENG receive antennas. The major problem experienced with these transmitters, according to the respondents, was the generation of intermodulation products at *shared sites.* The method used most often by stations to eliminate this interference was the installation of cavity, notch or bandpass filters on the input of receiving equipment.

Respondents indicated that the best way the industry as a whole could reduce the interference problems would be to implement strict frequency coordination policies for broadcast and land mobile operations. The survey results are summarized in Table 1.

We also asked respondents to comment on the interference problems they have personally experienced with land mobile operators or other broadcasters. A sampling follows:

"We have lost on-air RENG programming and spent large



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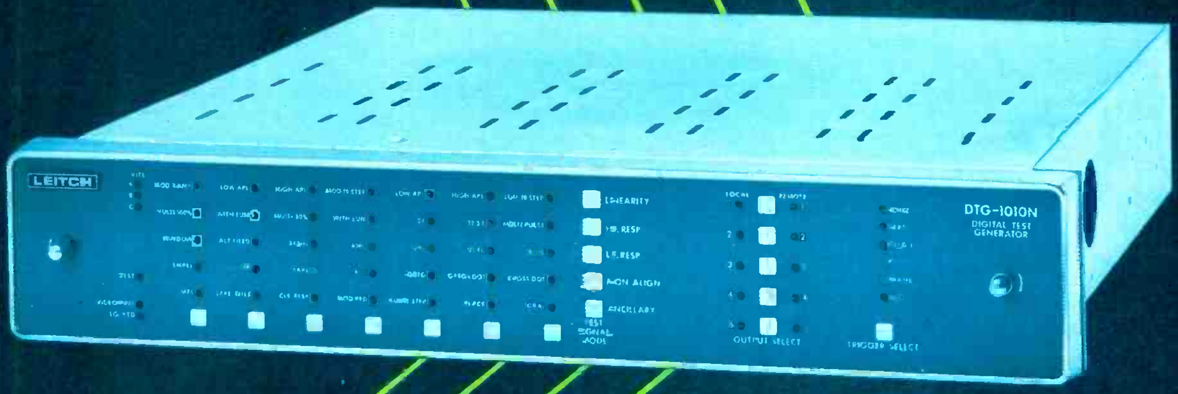

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Circle (24) on Reply Card

amounts of time on interference tracking. I have been spending money on my system because land mobile people have not been spending money on their systems."

The major problem experienced with land mobile transmission equipment:
1. Intermodulation products.
2. Out-of-band radiation.
3. Desensitization of receiving equipment.

The method used to eliminate interference:
1. Installation of cavity, notch or bandpass filters.
2. Relocation of receive antennas for greater horizontal or vertical separation from land mobile transmit antennas.
3. Installation of more selective receive antennas.
4. Placement of receivers farther away from land mobile transmitters.
5. Use of special encoding/decoding techniques.

The best way the industry could reduce interference between services:
1. Strict frequency coordination policies for broadcast and land mobile operations.
2. Better enforcement of the last in interference policy.
3. Assignment of land mobile reserve bands for use by broadcasters.
4. Implementation of new transmission technologies, such as amplitude compandored sideband (ACBS) systems.
5. Use of vacant UHF TV channels for broadcast and land mobile communications.

Table 1. Results of the interference questionnaire that was published in the July **BE.**

"Because most land mobile transmitters use vertically polarized antennas, we have noticed a significant reduction in interference by using horizontal polarization for remote pickup use. This technique is difficult to use for vehicles and aircraft, but it is effective on point-to-point work with directional antennas."

"We have experienced many problems of a lack of coordination with out-of-town broadcasters, much more so than with land mobile users."

"A big problem is the network crews that come into an area and use ENG/RENG frequencies without contacting the local stations."

Editor's note:
For additional information on the SBE's frequency coordination program, write the society at P.O. Box 50844, Indianapolis, IN 46250.

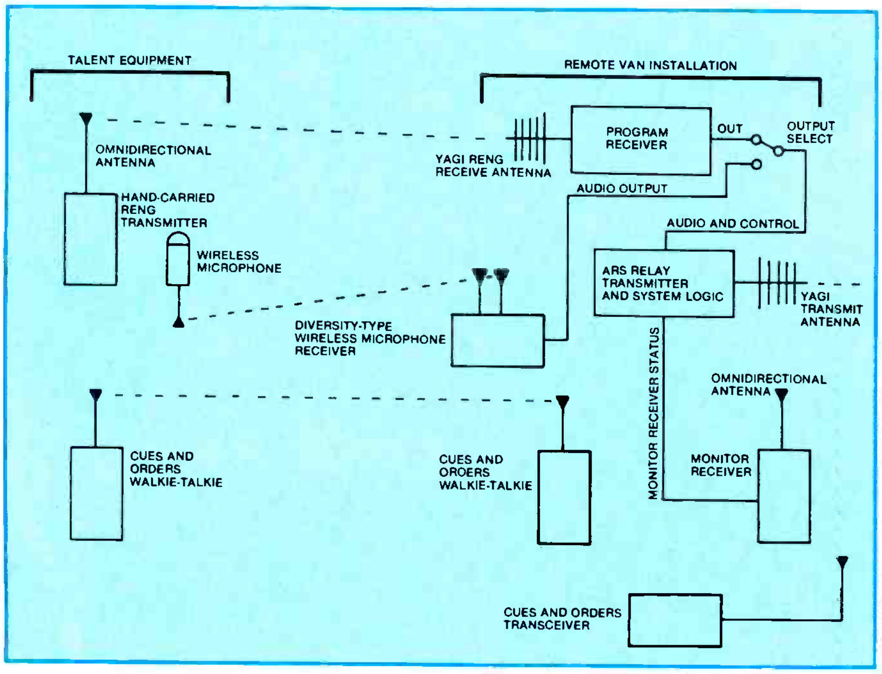

Figure 5. The use of an ARS system at the event site for added range and talent flexibility.

maintain positive control over the system, you should have the option to override the ARS logic by remote control from the studio.

Figure 5 shows some of the ways the remote location program audio can be transmitted. As mentioned previously, the communications transceiver is used for cues and orders from the studio location. The program channel link can consist of a hand- or pack-carried transmitter, which directly feeds the studio receiver or one or more ARS systems.

Figure 5 also shows a repeater station configuration that can be used when a high-power transmitter is required to reach either the studio or the ARS relay point. The use of a repeater—configured as a standard ARS station—in a car or van outside the remote location gives the talent at the event greater flexibility, because a small hand-carried transmitter can be used, rather than a larger unit with antenna and power cables attached. This arrangement is also ideally suited for use with a wireless microphone, which gives the talent an even greater degree of flexibility. The receiver antenna at the remote van can be either an omnidirectional unit, or a Yagi.

The system shown in Figure 5 includes a monitor receiver to prevent ARS transmission over traffic already in progress.

There is a limit, of course, to the number of times a signal can be repeated and still maintain good audio specifications. Moreover, each added hop in the path between the remote site and the studio increases the chances of a spurious signal interrupting the remote feed. Each additional hop also increases the complexity of the system and the vulnerability of the total link to equipment failure. The goal for any RENG system should be to keep the arrangement as simple and direct as possible, while providing talent flexibility, backup protection and high performance.

In conclusion

You should plan and construct an RENG network long-term service and frequency coordination requirements in mind. Areas that currently do not experience spectrum congestion problems may encounter them in the near future. It pays, therefore, to design a system that is spectrum-efficient and relatively immune to interfering signals. It is always easier—and cheaper—to do the job right the first time.

This article was adapted from a chapter on RENG technology written for the soon-to-be published 7th edition of the *NAB Engineering Handbook.*

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Circle (25) on Reply Card

Field report:
Electro-Voice ELX-I remote mixer

By Brad Dick, director engineering,
KANU/KFKU radio,
University of Kansas, Lawrence

The Electro-Voice ELX-1 broadcast remote audio mixer is similar to other small 4-channel portable units, but with some unique and useful features.

The ELX-1 is contained in a sturdy black metal case. It weighs about 5½ pounds with batteries and cord and may be carried with a shoulder strap, if desired.

The internal construction is straightforward and well laid out. The mixer uses three main circuit boards and most components mount directly on those boards. The rear PCB contains the input circuitry and RF filtering. The front board holds the solid-state components, faders, output amplifiers and oscillator. A small circuit board mounted on top of the front board contains the bar graph and its associated driver components. Interconnection between the various boards is made through Molex-style connectors.

Mixer inputs/outputs

The mixer has four inputs, each switchable to either line or microphone level. It is important to note that these inputs are not transformer-isolated. However, the unit is provided with choke and bypass filtering on the input stages to eliminate the potential of RF interference. To further enhance RF rejection, a pair of high performance transistors are used in the first stage of amplification, instead of the differential-input IC common in many studio consoles.

The ELX-1 was used at KANU/KFKU in a variety of locations without any noticeable RF interference problems. A subjective RFI test was conducted with a handi-talki and is described later.

Table 1

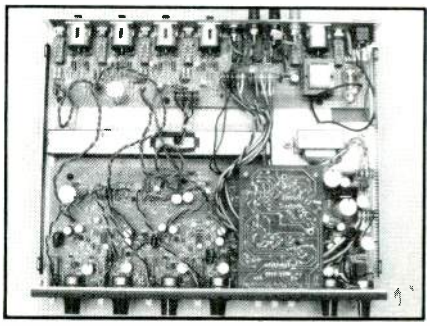
Frequency Response (line level input to line level output:
20Hz – 20kHz +0, –0.7dB

Total Harmonic Distortion:
20Hz at +4dBm output 0.14%
100Hz at +18dBm output 0.065%
1000Hz at +18dBm output 0.045%
10kHz at +18dBm output 0.105%
20kHz at +18dBm output 0.036%

Internal Oscillator:
Frequency: 998Hz
Distortion: 1.05%

Output Noise:

Inputs Down, Master Down	–75dBu
Inputs Down, Master at Nominal	–72dBu
Inputs Down, Master Up Full	–61.6dBu



The internal construction of the mixer, showing the input circuit board (top of the photo) and the mixer/amplifier board (bottom). The LED bargraph display PCB can be seen mounted on top of the mixer/amplifier board with the foil side facing up.

Table 1. The measured performance of the ELX-1 audio mixer.

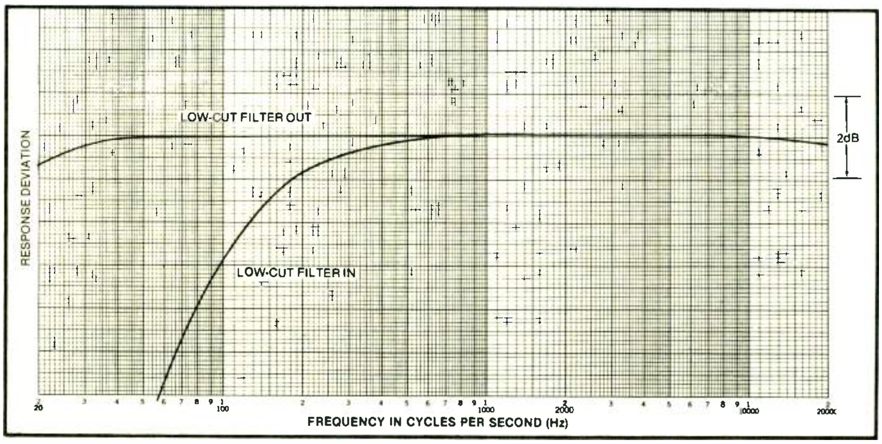


Figure 1. The frequency response below 2kHz with the low cut filter switched in and out of the circuit.

The mixer has low-cut filters on all inputs. Selectable by depressing a front panel switch next to each fader, the filters help reduce the effects of wind, handling and background noises. The corner frequency of the filter is 100Hz, with a slope of 6dB per octave. The effect of the low-cut filters on frequency response is shown in Figure 1.

All inputs have captive latches on the XLR connectors. Once plugged in to the ELX-1, mic cables are not going to be accidentally pulled out during a broadcast.

Next to each input fader is a small red *clip* LED. This LED monitors the output of its respective pre-amplifier for clipped audio. Upon detection of clipping, the LED light warns the operator to back down the level. Listening tests showed that the clip LEDs came on at about the same point that the audio was noticeably distorted.

The mixer also provides phantom powering for microphones. A 30Vdc supply is applied to each input through a switch on the back panel. As more condenser microphones find application in remote broadcasting, this feature will become even more important.

The ELX-1 has two transformer-balanced outputs. One output, available on a twin banana jack, is capable of holding a telephone line—if required—and provides a nominal 0dBm level. The second output, a rear panel male XLR connector, provides a selectable line or microphone level signal.

3-way power supply

Backup batteries are contained inside the mixer and are accessible through a removable panel on the bottom of the unit. Three 9V batteries are required, and no recharging circuit is provided.

This arrangement is typical of portable remote mixers, causing you to wonder why few manufacturers make provisions for rechargeable batteries. The lack of such an option is disappointing because most other remote equipment uses rechargeable batteries and operators are conditioned to having this feature.

A front panel Electro-Pulse Power Status LED glows green when using ac power, indicating proper operation. When batteries are used, the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Electro-Pulse LED will flash to indicate that the power supply is on. The flash rate corresponds to the supply voltage and ranges from one flash per second to one flash every five seconds. The slower flash rate indicates weak batteries.

Should the supply voltage fall below 18V, the LED will stop flashing. A rear panel jack allows the mixer to be powered from a 30Vdc supply.

Headphone amplifier

Without a doubt, the best feature of this mixer is the headphone circuit. The mixer has a true headphone amplifier capable of driving any type of load, stereo or mono. Many portable mixers suffer from inadequate level on the headphone feed, but this is not the case with the ELX-1. The headphone amplifier is capable of providing +18dBm output. The amplifier can also be used as a separate line level output channel, if needed.

The input to the headphone amplifier is derived from the mix bus, just prior to the master gain control input. This feature provides the operator with the ability to hear the total mix audio, even if it is necessary to dump the output with the master fader. This arrangement is not typical of most broadcast mixers and may seem confusing at first.

The feature is, however, typical of many large PA consoles. For those who work with live and taped broadcasts, the advantage of deriving the headphone signal separately from the main output signal will be obvious. It may take a little getting use to, but you will probably grow to like it.

Sine wave oscillator

The ELX-1 has a low distortion oscillator useful for level checks. The output is a clean sine wave, and the master level control is used to vary the oscillator level. The oscillator signal is also available on the rear panel at a fixed level of -10dBm.

Limiter

The limiter circuit provides gentle but positive control of audio levels. Selectable from the front panel, the circuit limits the output to a maximum of +14dBm. The circuit prevents clipping distortion and provides a front panel indication of when the circuit is operating. If required, the limiter threshold of +14dBm can be changed by following the simple instructions contained in the instruction manual.

Figure 2 shows the input-vs.-output level response of the limiter circuit. Performance tests showed the limiter to work smoothly and effectively in eliminating audio clipping due to excessive levels.

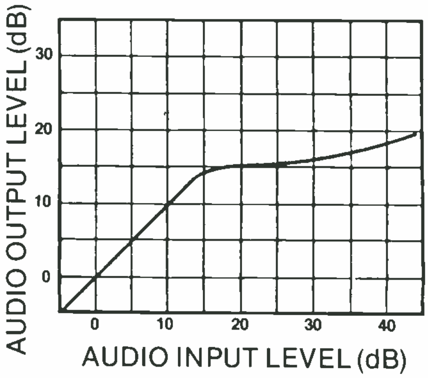


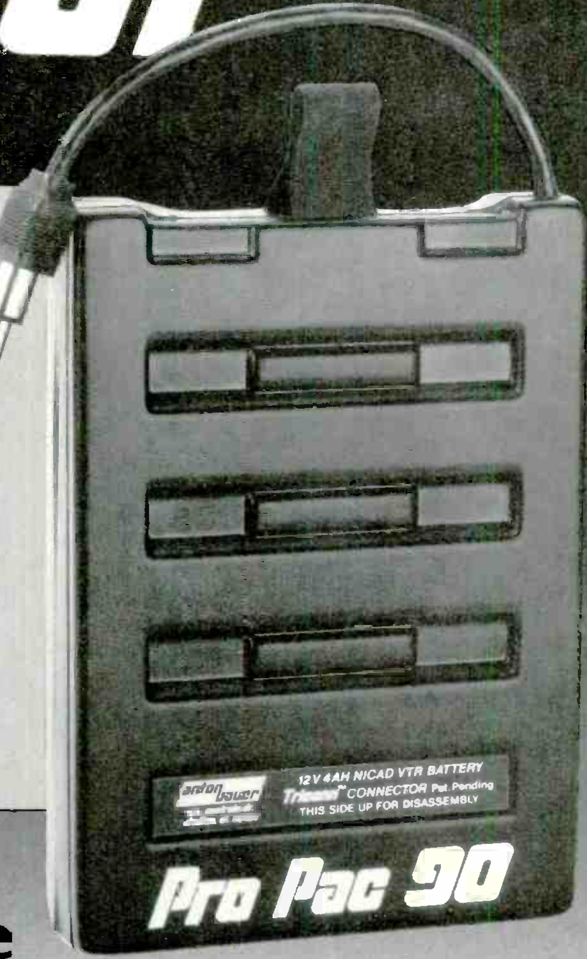
Figure 2. The limiting action of the mixer's built-in gain control circuit.

Bar graph VU meter

The front panel meter may surprise some old-timers. No more miniature VU meters with questionable ballistics or bent pointers. This mixer uses a 10-segment LED bar graph. The display contains five green and four yellow bar LEDs corresponding to levels from -12 to +12dB.

The 10th LED is red and provides an indication of clipping in either the mix amplifier output or the main amplifier output. If reducing the master volume control does not extin-

Survivor



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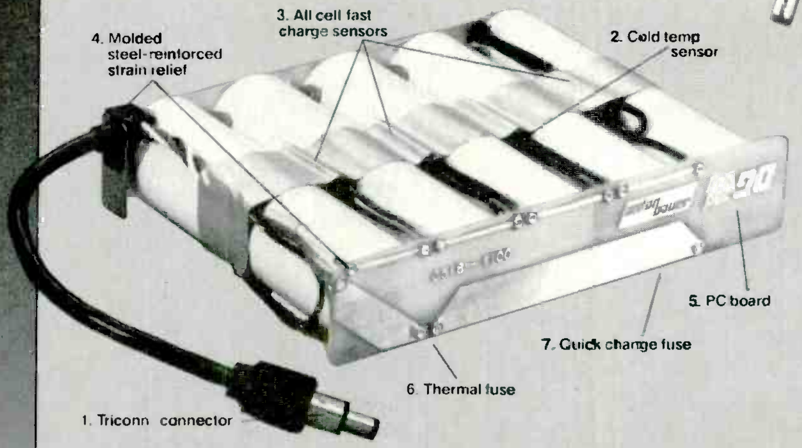
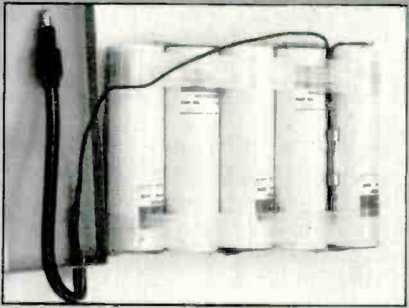
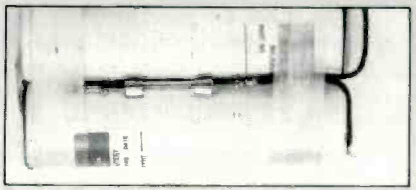


Typical BP-90 replacement battery: Failures waiting to happen.



Loose wiring. No fast charge sensors. No cold temp sensor.

No strain relief. Right angle wire stress. Splices.



Fuse replacement requires soldering and special pigtail fuse.

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Circle (28) on Reply Card

guish the LED, then the mixer amplifier is being overdriven and one of the input faders should be turned down.

The meter comes set up to display *peak levels* as described in PPM standard BS4297. The manual also provides instructions for changing the meter to VU ballistics for those operators who prefer the familiar VU characteristics.

To protect the audio signal from distorting as the battery supply voltage falls, the LED clip circuit trigger threshold is automatically reduced to compensate for the lower headroom caused by weak batteries. This action allows the operator to reduce levels as necessary and yet continue to operate without audio distortion.

To conserve battery life, the LED bar display switches to a dot mode when batteries are used. With dc operation, only one segment will light at a time instead of the normal bar graph display.

Operators' comments

In general, the operators who used this mixer liked it. The small size and light weight of the ELX-1 may have had something to do with those opinions. The mixer also looks sharp, especially with the bar graph meter.

The LED meter may take a bit of getting used to, especially in the peak configuration. Several operators liked the looks of the meter, but had to adjust their habits to get proper transmit levels. However, once accustomed to the display action, all seemed to like it.

There was particular appreciation for the clip LED. Quality conscious operators said that it helped them use the mixer more effectively.

The switches on the ELX-1 are all push-lock/push-release and easy to use, perhaps too easy. On two occasions, an operator found that while connecting cables to the mixer, one of the rear panel mic/line buttons was inadvertently depressed. This caused line level input signals to be applied to the pre-amplifier stage. No damage resulted, and the operator quickly learned to watch for such mistakes.

The same problem could also occur with the XLR output jack. If you were set up for microphone level out and then mistakenly depressed the output switch, about 40dB of additional level would be piped down the line.

One item that bothered a couple of engineers was the removable power cord. Canada requires certain types of electrical gear to be equipped with removable ac cords. Most of us in the United States are not used to such requirements, although some manufacturers do provide the feature.

An argument can be made whether it is better to have a cord firmly affixed to the mixer and run the risk of having it wear through at the point of exit, or whether the removable cord is simply an invitation for trouble, because it can be left behind at the studio by the remote crew. Concern about the cord is a minor point and anyone should be able to live with either situation.

Performance tests

One problem our engineers have faced on past remotes was the sensitivity of remote gear to RF interference. Although objective measurements in this area are complex and difficult to conduct, an effort was made to examine the performance of the ELX-1 in the presence of an RF field.

A 5W high frequency handi-talki transmitter was used as a signal source for the interference test. The handi-talki was placed 2 feet from the mixer, and the steady state and impulse noise levels were measured. The steady state noise did not change when the handi-talki was keyed. There was a brief 20dB spike in the output noise level, but once this impulse passed, the noise returned to a normal level.

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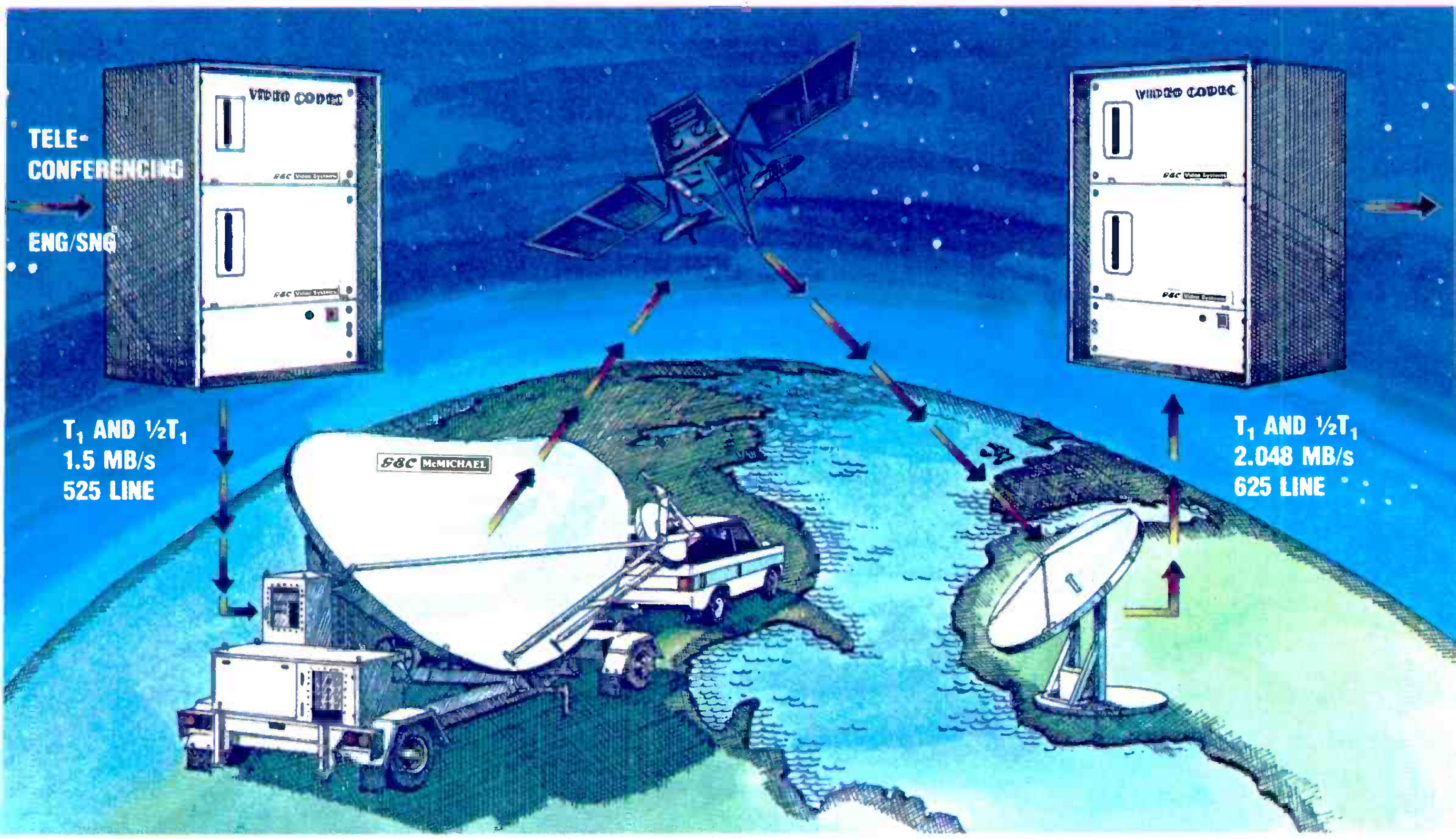

Video CODEC compresses bandwidth, provides low-cost solution to teleconferencing and ENG.

GEC McMichael has introduced a T_1 / $1/2T_1$ compression bandwidth unit that is compact and light enough to go anywhere. In fact, the quality of the GEC Video CODEC—at 1.5 MB/s—makes it ideal for news department broadcasts as well as teleconferencing.

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The ACE standards converter, a result of GEC's years of experience, is used by most major broadcast studios and is considered to be the standard of comparison throughout the world.

The broadcast experience and know-how that led to the development of ACE has also enabled GEC to design the highest quality compression bandwidth CODEC and KU band satellite systems.

GEC McMichael is a subsidiary of the General Electric Company of England.

For more information on any of the GEC McMichael broadcast products or systems, call 602/948-7255 or write GEC McMichael/Marconi Studio Systems at 8260 East Raintree, Scottsdale, Arizona 85260. TELEX 650-224-6202.

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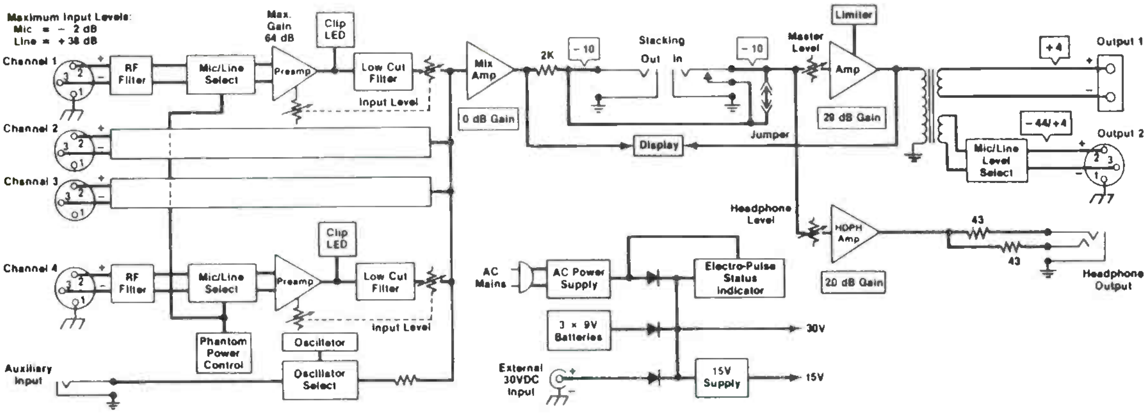


Figure 3. The block diagram of the ELX-1 mixer.

The same test was then conducted on a well known portable mixer with different results. That mixer showed a 40dB increase in noise level and a 60dB impulse spike. Although these tests are not scientific, the ELX-1 does seem to be less sensitive to RF interference than at least one similar model tested.

The mixer passed all the performance tests conducted except the noise specification measurement. In each of the three test cases, the noise level measured on this particular mixer was about 5dB higher than what is specified by the manufacturer. Whether the measured noise level is particular to only this unit is unknown. It was not possible to obtain another unit in time to meet scheduled deadlines. Table 1 shows the unit's measured audio performance in the field.

Conclusion

The mixer is easy to use, with all controls well laid out. Because of its low profile, most applications will require the use of some type of support to tilt the unit upward so the front panel can be easily seen. Several units can also be stacked on top of each other to provide a large number of audio channels in a small place.

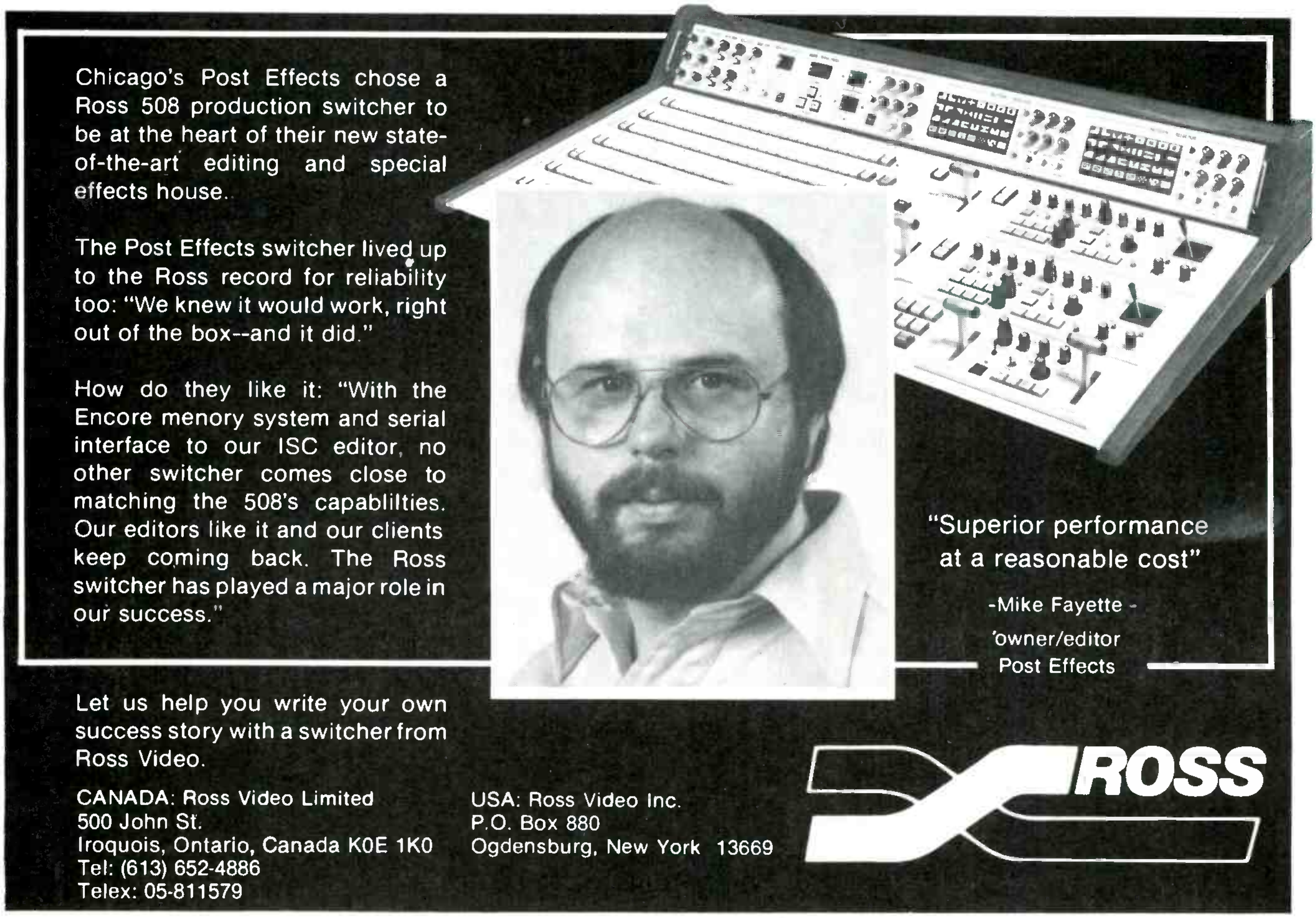
The features built into the ELX-1 make it a versatile unit for sports remotes, news conferences and other monaural sources. It is well constructed and designed to take a lot of abuse in the field.

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 field 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.**



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HARRIS

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Full fidelity live remotes

Fireworks burst over the San Diego Pops orchestra as KFSD begins another live broadcast in its concert series.

By Dennis Ciapura,
technology consultant

Years ago, live concert broadcasts were frequent events, and everyone took them for granted. Recording devices were crude, and stereo was still something that you read about in magazines.

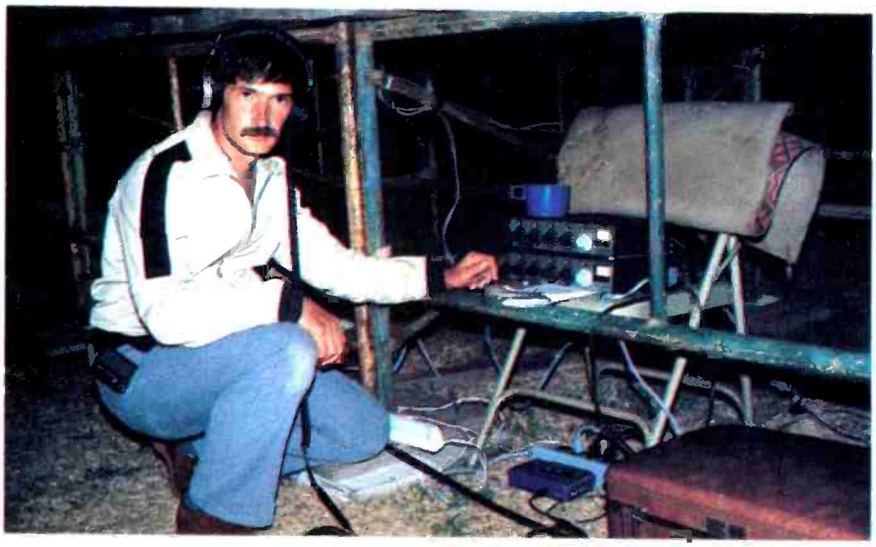
Unfortunately, wideband home receiving and reproducing equipment was rare, and the fidelity that the old live broadcasts offered was never appreciated by most listeners.

With the advent of the 33 rpm microgroove disk and improved magnetic tape recording, live broadcasting faded behind the brighter glow of enthusiasm for the new hi-fi recordings. Today, consumer equipment is so good—better than the LP record—that one of the few really unique audio "treats" that radio can offer is once again the ubiquitous live broadcast. An FM station that is properly engineered can air live concerts that surpass the fidelity of anything except digital compact disc recordings.

Quality on a budget

Although many engineers may feel that superb live broadcasts are necessarily an expensive proposition, KFSD in San Diego has proved that this is not the case. The fine arts station recently concluded broadcasting the entire San Diego Pops concert season from a local park with impressive results using modest equipment.

The system employed comes close to providing the station's listeners with a microphone-to-home amplifier link, permitting the maximum audio fidelity. After all, an intervening recording device could only impair the fidelity and nothing short of a digital recording will match FM



KSFD chief engineer Doug Schleutker rides the audio mixer gain during the station's broadcasts.

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There probably isn't a radio engineer on the planet who isn't familiar with the outstanding performance of our esteemed Tomcat cart machines. We've built and delivered more than 2,000 "Cat's" since we introduced them in 1981.

For those who want the quality, dependability and sonic performance of a Tomcat (and are willing to give-up a few of it's bells n' whistles), a serious evaluation of our new Micromax is in order.

MICROMAX IS MORE THAN THE "HIGH-TECH" LOOK.

With Micromax, our Maxtrax® heads come standard. Maxtrax is now widely accepted as THE performance standard because it delivers a half-track signal without quarter-track noise. With nearly twice as much track width, you get a quantum leap in sound quality, which, by our way of thinking, is the real bottom line. If your library is quarter-track (the NAB standard), no problem. Micromax can be ordered with an optional set of NAB stereo playback heads for immediate library use.

THE MECHANICS: TOUGH, LIKE A TOMCAT.

The D.C.-controlled capstan runs in sealed microfine bearings and is driven by a servo/belt system developed from computer disk drives. The result is superb wow & flutter specs. The conventional pinchroller solenoid was eliminated (and thus the damaging heat), and replaced with a simple, reliable D.C. servomotor which assures optimum, adjustable capstan-to-tape pressure and remarkably rapid starts and stops. Center-supported by a floating ball bearing race, the pinchroller self-aligns to prevent tape skew.

The cartridge guides guarantee accurate, repeatable positioning. The deckplate is thick alluminum alloy, precision milled and surfaced. Naturally, the heads are fully adjustable and mounted in beefy, precision cast assemblies.

THE ELECTRONICS: ADVANCED, LIKE A TOMCAT.

With Micromax you've got lot's of headroom, better transient response and +24 dBm active, balanced program outputs. We've even designed efficient low-noise CMOS control logic.

Micromax has the standard two auxiliary cue tones and high-speed recue (22.5 ips). You can set a replay inhibit, and assign a machine number to the front panel LED display (which also doubles as the power indicator).

IT SOUNDS AS GOOD AS IT LOOKS.

The superlative specs can't tell you the whole story of Micromax. You have to hear it. Micromax has a red-hot, crystal-clear top-end. And a clean, punchy low-end. Everything in-between jumps right out in front of your ears too. Micromax can instantly put much better sound on-air for you. Now. Regardless of your station's choice of carts.

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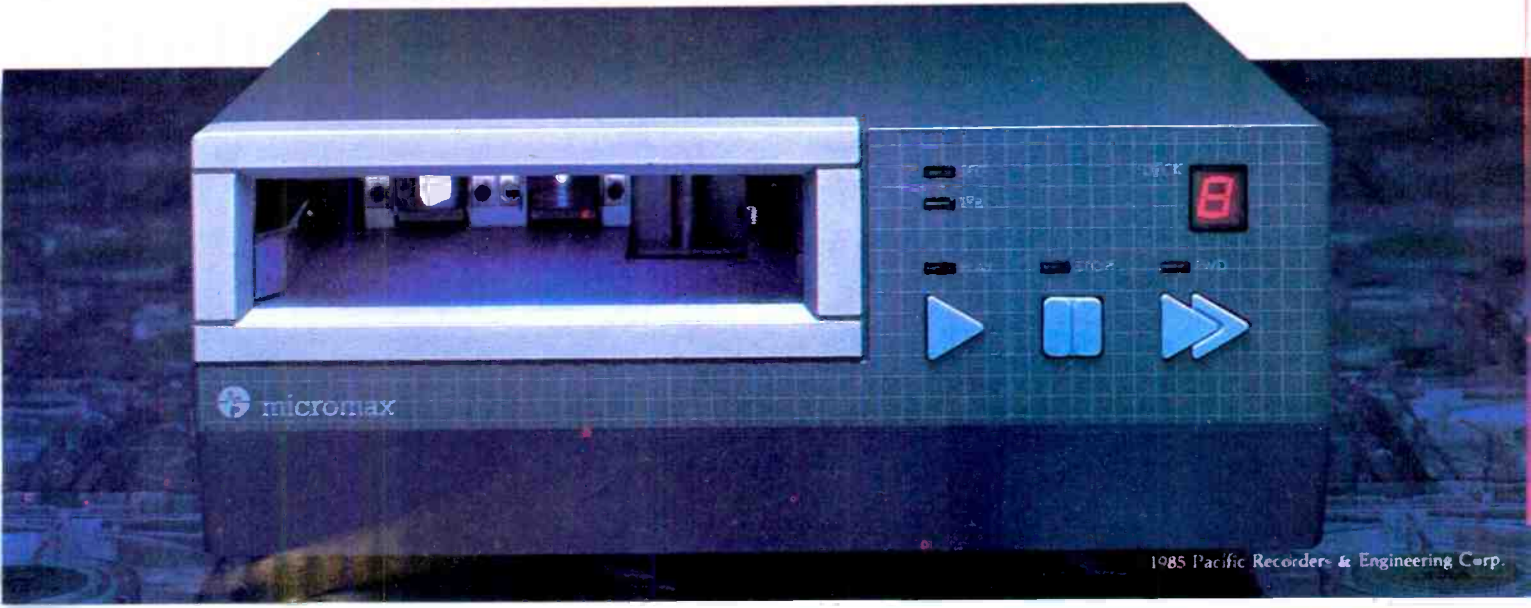


transmission quality if everything is optimized.

The KFSD equipment list starts with two Crown PZM microphones set up as a conventional stereo pair. They feed two Shure M67 mixers, which drive 15kHz Telco loops back to the studio. At the station, a Cetec console feeds dual mono STLs to the transmitter site, where two Moseley TFL-280 limiters are used to drive the RCA transmitter. The limiters are set up so that average program levels are 10dB below the threshold of limiting.

The most important component in the system, however, is the human element—chief engineer Doug Schleutker, who does his best to keep all of the last generation equipment maintained at peak performance.

He has kept all of the system clean and simple. Like many fine arts station engineers, Schleutker elected to minimize the amount of equipment in the audio chain. The same formula for success can also work for stations airing other formats.

How good is good?

The LP record still sets the standard for reproduction in the home, and FM broadcasts are actually heir to less losses than recorded material on disc. Although many audiophiles consider FM to be inherently inferior because of frequency selective limiting and "limited" bandwidth, records have even greater restrictions.

Although it is true that a disc may have frequency response in excess of the 15kHz to 17kHz that FM stereo stations can transmit, distortion products make up most of the audio signal that comes off a disc above 15kHz.

Furthermore, the RIAA recording characteristic embodies high frequency pre-emphasis similar to the FM curve, and so frequency selective limiting is almost always employed in generating the master disc. Records are also subject to certain mechanical limitations that restrict the best possible average distortion performance over the audio frequency range to about 0.7%.

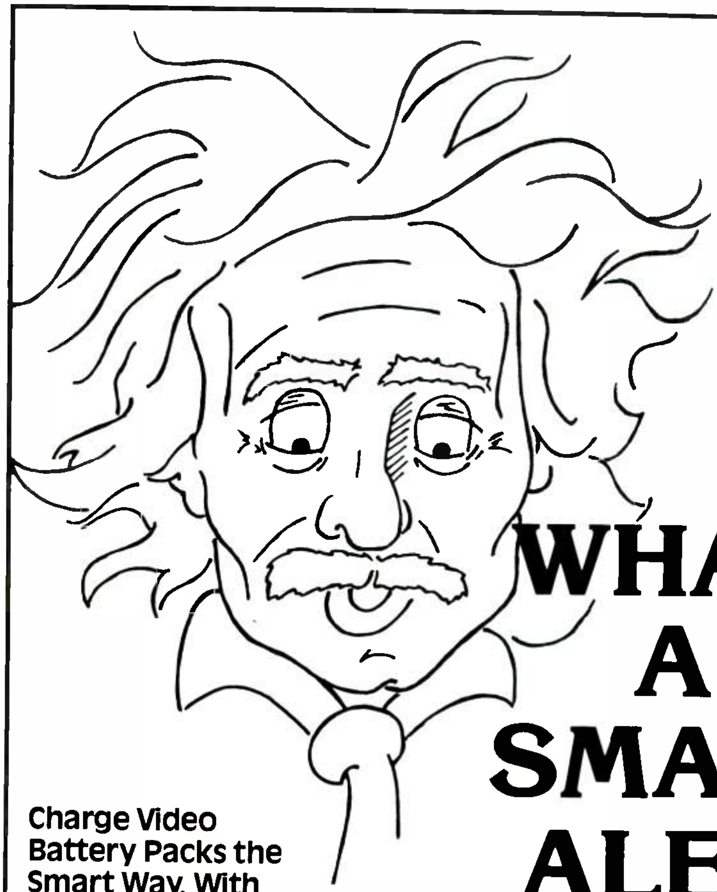
Distortion because of tracking error increases inversely as a function of the linear speed of the groove under the stylus and is, therefore, nearly four times as great near the end of an LP as it is near the beginning. This distortion increases with audio frequency and level. The distortion from a disc is mostly second harmonic and that is the only reason the darned things are listenable!

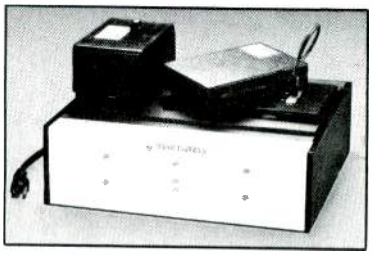
Anyone who has worked in a recording environment is familiar with the artificial crispness that a disc can impart to recorded music. In fact, an inexperienced listener often feels that master tapes lack high end, when in reality what is being heard is clean reproduction of the 3kHz to 8kHz region.

An FM station, on the other hand, can have extremely low distortion and no mechanical colorations. A properly microphoned live concert reproduced by a state-of-the-art FM receiver, driven by a solid multipath-free input signal, can actually provide much better realism than a typical record. When one considers disc surface imperfections, which cause extremely disruptive interference with the program material, FM looks even better.

Although CD provides numerical performance superior to FM capability, most of the improvement is in areas that seldom manifest themselves as audible differences. The biggest CD advantages are greater dynamic range than most programming requires, frequency response beyond what is needed for realistic reproduction and distortion that is several orders of magnitude lower than the microphones that are employed to make the recording.

Radio stations that are willing to take the time and effort to produce live broadcasts have a unique opportunity to provide an invaluable service to their listeners.





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For the ENG tech

By Carl Bentz, television editor

Since portable TV cameras made history in 1968 at the national political conventions, many changes have occurred in camera designs. Integrated circuits and smaller pickup tubes or CCDs have reduced the size, weight and power requirements.

In spite of the changes and improvements, keeping the ENG/EFP camera operating at its best requires a logical maintenance plan. Unlike the studio camera, which lives in a controlled environment, hand-held cameras are subjected to a variety of environments (hot, cold, wet, dry and dirty conditions) and general abuse. Without care, your camera and other ENG equipment may have a short life span. However, with proper attention, your ENG units with serve you well.

General care

Keeping equipment operating at its peak is a never-ending job. Far too often the job is to fix something that should never have failed. Using common sense while operating and maintaining the ENG units could actually save a good deal of repair time later.

Do not connect live power when the camera power switch is on. Although it is not always detrimental, attaching a hot power cord can result in intermittent surges. If the camera is on when power is connected, the surges may destroy, or at least shorten, the life of solid-state components.

Although manuals warn against operating cameras in excessively hot, cold or wet environments, it seems that most newsworthy events occur only when such hostile circumstances are prevalent. Because winter's ice and snow, summer's heat and spring or autumn rains will continue to make news, the most you can do is avoid unnecessary exposure of equipment to extremes.

In the extreme cold, heating the camera will put less stress on tubes and lenses. In the heat, be aware of where you set equipment down. Sometimes setting the camera on hot pavement or artificial turf even for a few minutes can subject the camera to temperatures that exceed safe operating conditions. Such temperatures can also warp the camera's plastic housing.

Do not point an uncapped camera directly at a strong light source. Although some tubes have high levels of tolerance, others may be irrevocably damaged by a short exposure to a large spotlight or the sun.

Keep the camera clean. Dust is highly abrasive to the intricate mechanics of a zoom lens. Dirt in the optics may appear in focus at some points of the system. To avoid scratching lens elements and the color or neutral density filters, use a can of compressed air and a soft brush for cleaning.

Transport your equipment in a traveling case. Protect your investment in the camera or recorder; spend a little more and get a case to transport it. Printed circuits may have eliminated much of the problems of wired systems, but excessive vibration will still weaken solder points.

Test equipment

An organized maintenance program for ENG equipment requires proper tools. The most versatile tool is a triggered oscilloscope. A good scope measures voltages, frequencies and pulse widths, and shows all simultaneously. The scope must be capable of handling the fast pulse rise times of TV camera circuits with a vertical amplifier frequency response of at least 15MHz.

Test equipment must give accurate readings. Scrimping on accuracy may result in problems developing without your knowing.

Because the scope may be used with other pulse or digital circuitry around the station, a response of at least 50MHz is best. Vertical channel sensitivity should be 10mV/div or better. Dual-channel capability and delayed sweeps help in diagnosing problems.

A digital voltmeter is invaluable for measuring critical voltage levels. The input impedance of the meter should be moderately high to avoid loading the circuit being measured. High megohm impedances may not show realistic measurements on impedance circuits of less than 5Ω, however. Inexpensive VOMs often have low input impedances that give inaccurate circuit readings. Don't scrimp on accurate measurements.

A vectorscope is required for adjusting encoder circuits for correct phases. A waveform monitor, instead of an oscilloscope, will simplify making many video level adjustments.

A frequency counter, good to 10MHz, helps to check oscillator circuits in the camera or recorder. An input sensitivity of 100mV or less is suggested, with a display of six digits. For other work in the station, a counting range including ENG microwave and STL assignments may be needed and should theoretically work for camera or recorder use, too.

Both monochrome and color monitors help in proper setup or maintenance by letting you see the results of adjustments. Underscanning and cross pulse displays are valuable features. Switchable time constants can help solve recorder playback problems.

An ac adapter or regulated dc supply is essential. A fixed 12Vdc unit with 2.5A to 3A rating is acceptable. On occasion, a variable supply, to simulate various battery conditions, can help to check voltage regulator circuits.

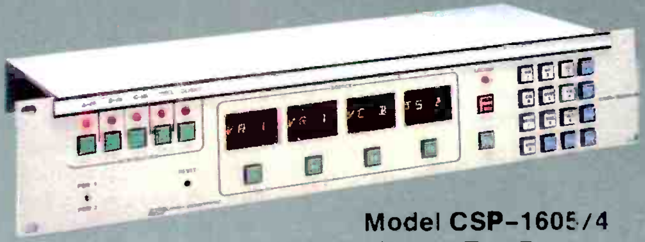
A video test generator with multiburst and other common signals may prove helpful in checking circuit frequency responses. Although not always specified by the manual, the generator will be helpful when dealing with ENG recorders.

Finally, resolution, registration and gray scale test charts are a must. You may also want linearity and depth of modulation charts for the major maintenance sessions. Two quartz-halide lights of 500W rating and 3200 K color temperatures should suffice for lighting the charts.

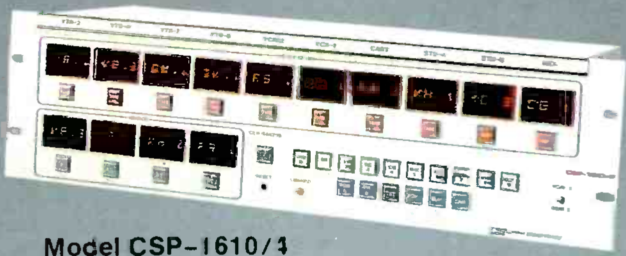
Tube troubles

No amount of care will prevent inevitable tube failures. Aging degrades performance. Optimum tube life can-

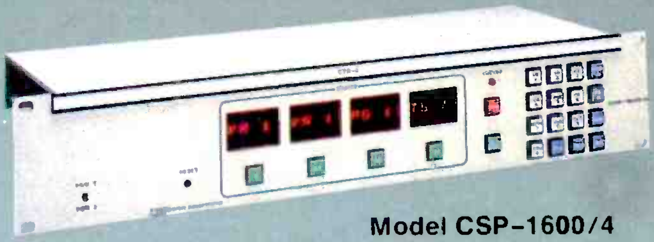
FOUR-LEVEL ROUTER CONTROLS
from
UTAH SCIENTIFIC



Model CSP-1605/4
Controls Five or Ten Busses



Model CSP-1610/4
Controls Ten or Twenty Busses



Model CSP-1600/4
Controls One or Two Busses

Model CSP-16160/4
Full Matrix Controller and Diagnostic Panel

This new series of microprocessor-based panels has been designed by Utah Scientific to meet the needs of the broadcast and teleproduction industries for individual control of source selection on multiple switching matrices (levels).

Each panel includes four alphanumeric displays to indicate either current *Status* (steady display) or a *Preset* source selection (flashing display) on each switching level. An alternate-action *Clear* button associated with each display plus an *All Clear* button permits toggling the displays between *Preset* and *Status* modes.

The touchpad features sixteen *group name* selections (beware of panels allowing for only ten) which, with either one or two *numeral* keystrokes, accommodates up to 1600 possible source names. Each panel can be provided with a *Program Select* switch that doubles the number of controlled busses at no extra charge.

Multi-bus panels provide instantaneous statusing of all four levels each time a new destination is identified. Instantaneous confirmation of changed status is also provided each time a new Take Command is entered.

The model CSP-16160/4 panel is specially programmed for maintenance/diagnostic duties as well as for full matrix control. It operates in either *alphanumeric* (source and destination names) or *numeric* (matrix input and output numbers) modes and can perform various diagnostic routines to permit rapid isolation of system faults.

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Circle (37) on Reply Card

not be achieved unless operating voltages are correct.

The target voltage of lead oxide tubes should be set between 35Vdc and 45Vdc, referenced to the cathode. A direct measurement between the two tube elements may not be possible. Your service manual will explain the correct measurement method.

A low voltage may cause highlight trails to burn into the target. Pointing the camera at a flat, lighted white surface for an extended period *may* reduce the extent of such burns. The chance of burns is increased as the lead oxide target voltage is reduced.

Higher voltages may cause white spots to appear. Exceeding 50Vdc on the target drastically shortens tube life and will void the warranty. So the preferred setting should be as low as possible for best image retention and sensitivity, while keeping above a 35Vdc minimum.

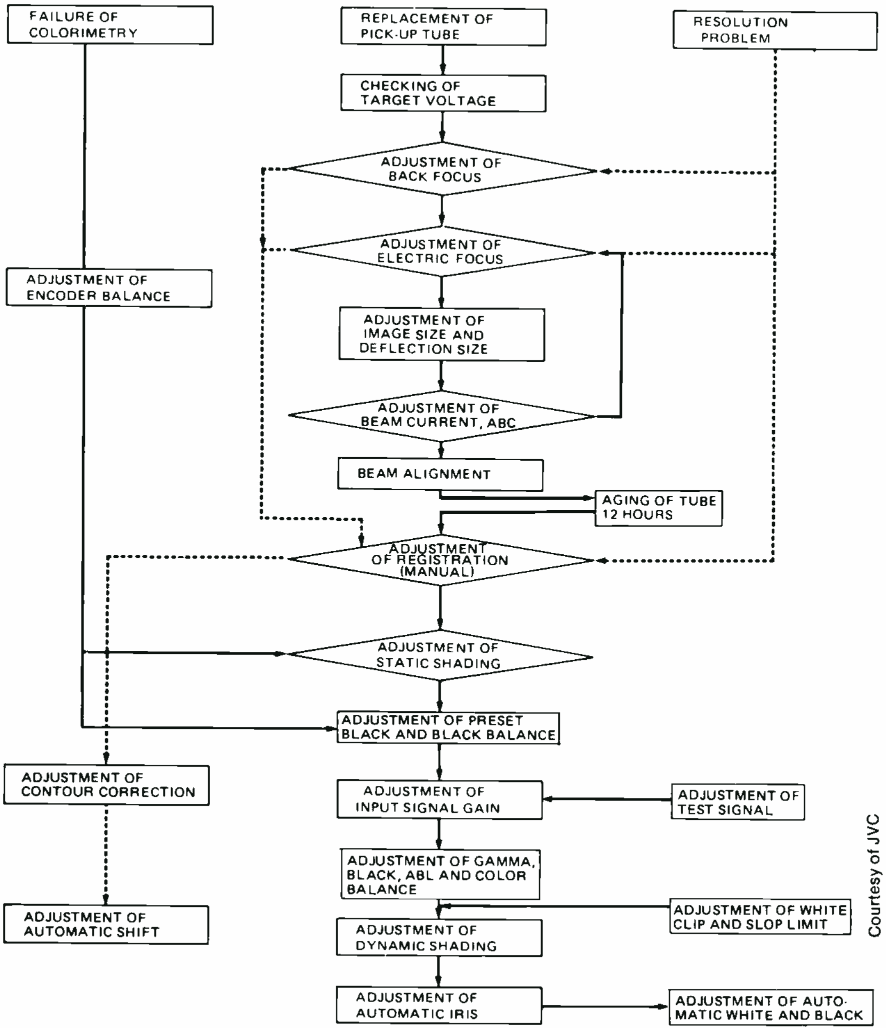
Saticon tubes have varying target requirements from 50Vdc to 75Vdc, depending upon the tube number. Check the manual for the correct voltage in your camera. The tolerance is small. A low voltage results in target deterioration; a high voltage significantly reduces tube life.

Bias lighting with PbO and SAT tubes reduces lag. Lag, the inability to respond to fast light level transitions, causes picture smear, color fringing and measurable resolution loss. A sudden increase in those factors suggests failure of the biasing lamp, often located in the tube socket.

All tubes produce a dark current output even with no light on the faceplate. Because the dark current is a small amount (nanoamperes), the beam may build up a negative charge on the target, in effect desensitizing it. Bias lighting floods the target with a low light level, increasing the dark current value and the sensitivity to rapid light transitions in the scene.

Filament and target voltages must be checked and set before you attempt to adjust the electrical and subsequent mechanical focus and image size. Focus, beam alignment and frequency response tests should be done before any registration procedures.

Signal levels in the color channels must be correct before making adjustments on the encoder board. Setting a 1V p-p output signal should follow checks to make sure that the RGB levels are applied to processing circuits that drives the encoder.



Courtesy of JVC

Table 1. Suggested camera adjustment procedures.

The green channel is usually the reference for adjustments to the red and blue channels, making it the most critical of the three. Unless obvious problems exist in green, or the green tube has been replaced, the green channel should be left alone. Unnecessary adjustments can cause more serious alignment problems than were originally present.

Using a logical attack

Table 1 shows some steps to take in troubleshooting typical ENG cameras. Following these procedures as well as steps in the maintenance section of your camera manual can speed adjustments and get the unit back into the field.

Most service manuals have been carefully prepared and represent the preferred method of setup and adjustment. Following the procedures closely is by far the best approach in any maintenance situation.

The ENG recorder

Just as your camera needs periodic care, so does your portable recorder. The signal path should be examined. RF, equalization and signal levels should be periodically checked. Assorted servo systems are also critical for proper recording and playback. Most problems will not occur in the electronics, however.

Mechanical problems are commonly caused by exposure to unfriendly elements and operator abuse. Because VCRs involve numerous moving parts, regular maintenance and preventative (cleaning) procedures are essential. Residue from the tape, for example, is a major source of recorder problems. Oxide particles are constantly displaced from the tape surface. As the tape moves through the mechanism, the particles desposit on the heads and tape guides.

A buildup of particles on the guides produces undesirable friction along the tape path. The result is uneven longitudinal motion of the tape path. The result is uneven longitudinal motion of the tape. If the buildup is bad enough, the tape may even be forced to move sideways from its designed path through the machine. Tracking on playback will be bad, and interchange with other machines may be impossible.

When a layer or residue on the head holds the medium away from the head gap, there may not be enough magnetic flux available to transfer the signal into the oxide. The only remedy is to clean the heads. There is no way to recover a recording flawed by clogged heads, except by rerecording the information.

Cleaning a recorder is the single most important maintenance procedure and should be performed dai-

Now you can change satellites the same way you change channels— with the touch of a button

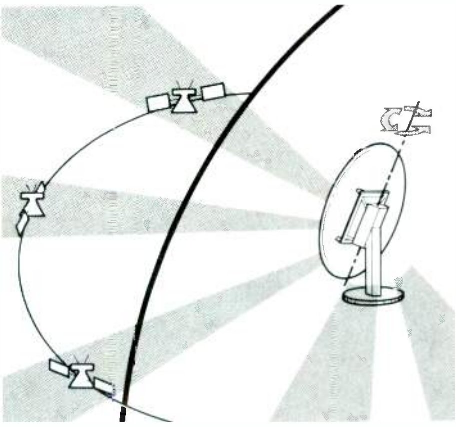
Our new motorized polar mount for our 5- and 7-meter antennas lets broadcasters and cable system operators switch from one satellite to another at the touch of a button.

Enhances pay-per-view capabilities

The polar mount's programmable position controller lets you store up to 16 satellite positions, including presetable polarization. So you can take advantage of all the special programming that's becoming available on a pay-per-view basis. You can offer baseball one night, a championship fight the next, a blockbuster Broadway show or movie the night after that. If a program you want is up there, you can get it with our system. That means more options for your viewers and more profits for you.

Operationally stable in winds up to 75 mph

Our motorized polar mount has been designed to keep a 7-meter antenna operationally stable in winds up to 75 mph—even at Ku-band frequencies where even a little movement can't be tolerated. And it is survival rated for winds up to 200 mph.



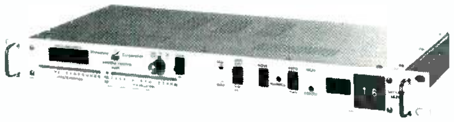
A polar mount needs only to rotate about a single axis to align itself with any satellite in the geosynchronous arc. Our polar mount is built to withstand 200 mph winds and is repeatable to within ± .1°

Spans entire arc in 1.5 minutes

It takes our polar mount just 1.5 minutes to span the entire geosynchronous arc. That's about 2 degrees per second, so you can go from Satcom 2R at 72° West to Satcom 5 at 143° in just 35.5 seconds. And with an accuracy of ± .1 degree.

LED readout displays antenna position

Our rack-mounted control unit features an LED readout to display the antenna position so you can confirm that you're where you ought to be at the time you're supposed to be there. And you can control the antenna locally, or remotely.



Our programmable position controller stores up to 16 satellite positions. It can be controlled locally or remotely, and has an LED display for the antenna position.

The latest addition to the Microdyne line

The motorized polar mount for our 5- and 7-meter antennas joins the line of polar mounts for our 10′ and 12′ antennas. It is the latest addition to our full line of satellite communications equipment for uplink and downlink in the C-, S-, and Ku-bands. For more facts on how our polar mount can help expand your programming options, call our Marketing Department at (904) 687-4633. Or write to us at the address below.

Microdyne Corporation

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Circle (36) on Reply Card

ly. Use cotton swabs and denatured alcohol or special cleaning solutions.

Avoid scented rubbing alcohol, which contains a high percentage of water and may leave undesired residues. Also avoid cleaning fluids that may soften plastics. Regularly clean all surfaces the tape contacts.

Video heads require delicate care because of their fragile structure. Cleaning swab motion should follow the length of the video head with a minimum of pressure. Motion across a head itself should be avoided.

The fibers of a cotton swab are small enough to become caught in the head structure. The fibers are also strong enough that trying to dislodge them may crack the head, impairing performance or requiring an expensive head replacement. Some manufacturers suggest chamois-based cleaning products for heads.

Proper tape tension is important for successful recording and playback. The manual will explain how to measure the tension at various points along the path.

Voltage controlled servo are frequently used for tension control on newer machines. Older models, however, may depend upon mechanical methods. You may need to bend parts to get the right pull on a spring. Excessive bending does cause metal fatigue and failure. Normal wear will cause some bending of parts that will need correction, so avoid reshaping of the parts more than is necessary.

Keep a good supply of brake bands on hand. Each time a recorder is in the shop, look closely at the brakes. If they show excessive wear, and if excessive flagging or time base error is apparent in the video, change the bands.

Videocassettes

Videocassettes may be the most vulnerable item in the ENG system. They can become troublesome if improperly handled. Progress has been made in backings, binders and oxide formulations for tape materials, but no solution has yet been found for the abuse and stress the ENG conditions place on tape.

The cassette housing provides some protection to the tape. But once dirt has ingressed the housing, it is trapped. It may become embedded in the material, causing dropouts.

Or, as a tape is used, embedded dirt may be displaced into the machine mechanics, adding to abrasion and wear. The fast pace of ENG as cassettes may be tossed around in a remote vehicle, dropped on the floor, then picked up and reused, makes dirt an even worse culprit.

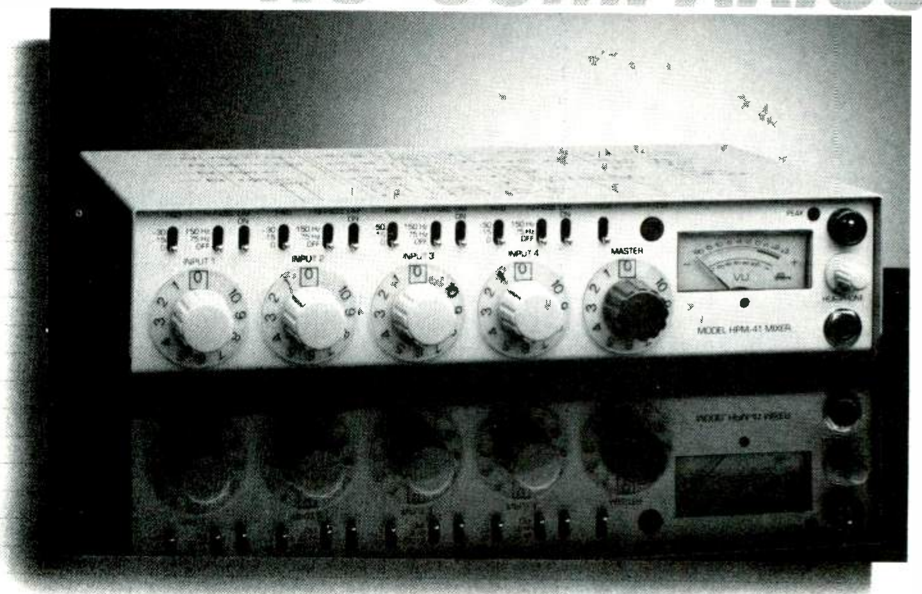
Just using a cassette leads to tension problems within the housing. Unless a constant tension is kept on the reels, changes in packing occur. Improved drive mechanisms try to correct for the packing, but older VCRs do not. Far too often the machine has been blamed for problems that a cassette caused. In fact, machines sometimes fall victims to the tape, when tension errors and dirt result in mechanical bending of critical tape path parts.

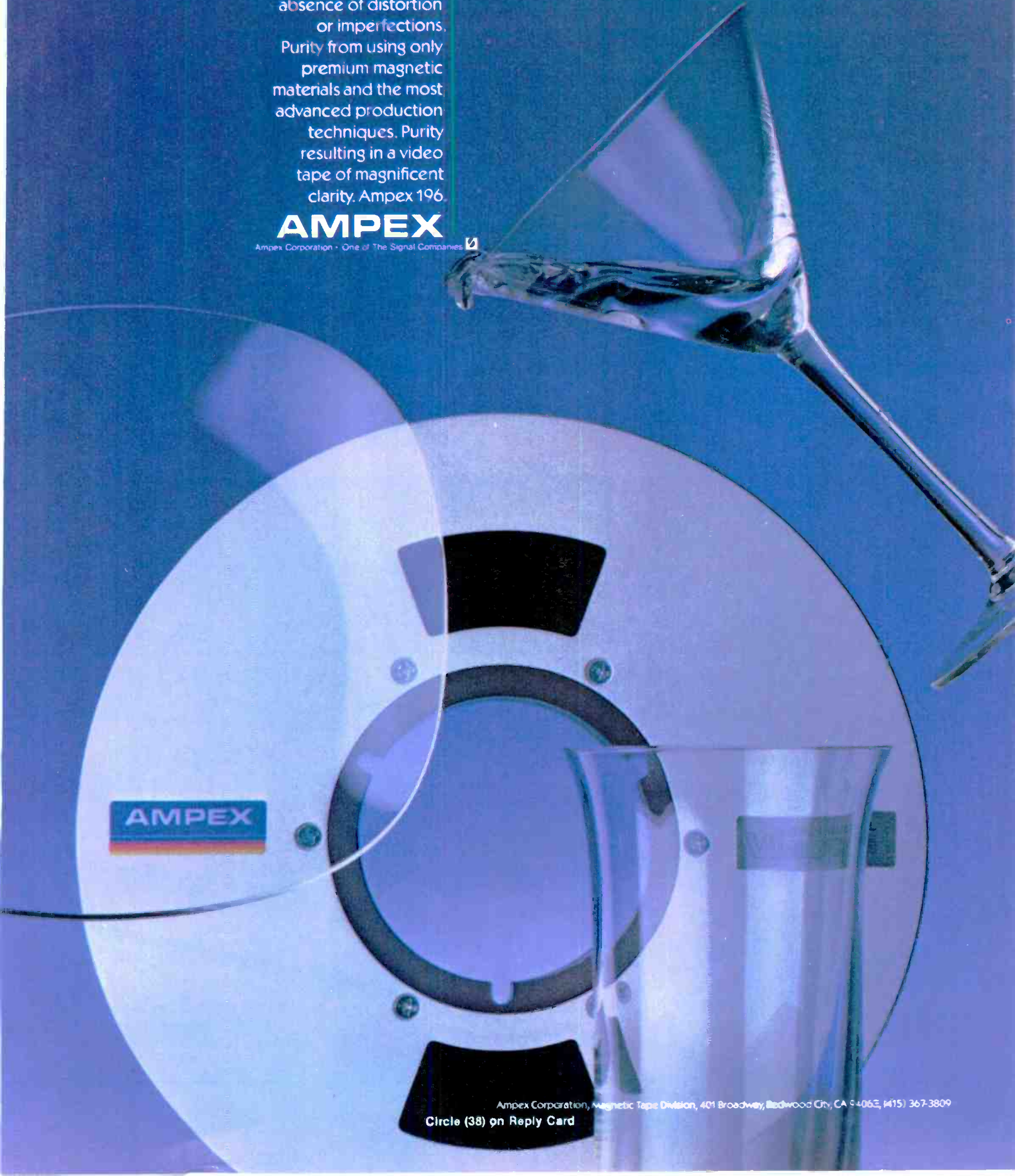
Delaying wear and tear

Keeping the ENG equipment in top-notch shape is a battle between normal wear and tear and operator abuse. A regular schedule of preventive procedures should be followed for each part of the system.

When appropriate, instruct the operators on the proper handling of the unit. Unfortunately, most ENG operations allow little time to inspect equipment or conduct training.

When the chance occurs to check the equipment thoroughly, a logical series of steps should be taken to correct problems, followed by a general checkup of the entire unit. A diary of problems, repairs and replacement dates for each unit in the ENG system is one way to keep track of equipment status, and will help keep each system on the road.




AMPEX

Planning an ENG/EFP unit?

By Carl Bentz, television editor

So you're committed to remote productions and need a remote vehicle. If it's your first unit, many questions need to be answered. If it's not your first, the following provides a review of topics that need consideration before any checks are written.

The station has decided to prepare for remote productions. The production department already has big ideas on what they want to do. Management wants the most for the dollars. Accounting wants to know how it will be paid for. Promotions is already dreaming up a media blitz. And engineering has to provide a functional remote production unit that will be easy to operate, easy to maintain and financially feasible.

Economic questions

Before any real progress is possible on this project, one difficult but important question must be answered. What is the intended use of the mobile unit? Strictly ENG? Limited production, such as commercials and documentaries? Major productions, such as sports events, made-for-TV drama, politics? How you plan to use the remote vehicle will make a difference in the kind you choose.

Initial cost is a major factor. For a simple ENG, the costs will be little above the expense of the equipment, including the van, a camera, a video recorder, cables, mics, batteries and perhaps a microwave transmitter with an antenna on a telescoping mast.

You will need a 2-way radio, for communication with the station, if you plan live segments for the news. Convenient storage containers provide protection for equipment. Space should accommodate several passengers, the microwave engineer, the

Selecting ENG microwave

By D. J. McCarthy, M/A-COM Microwave Video Systems. Burlington, MA

Microwave bands for broadcast auxiliary service in remote pickup applications are the same as for fixed links. Three bands exist:

- 2GHz—1990MHz to 2110MHz and 2450MHz to 2550MHz.
- 7GHz—6875MHz to 7125MHz and 6450MHz to 6550MHz.
- 13GHz—12,700MHz to 13,250MHz.

The 2GHz band has been predominant for ENG operation because of overall path performance, antenna design, transmitter powers and receiver selectivity. In comparison, the 7GHz spectrum presents propagation problems. Adverse path conditions, such as trees and other obstacles, as well as antennas with narrow beamwidths, make path alignment more difficult. At 13GHz, propagation becomes proportionally more difficult than at 7GHz.

In selecting microwave for ENG, other aspects should be considered, including what band is in service for studio-transmitter-link and inter-city relay operation in the area; how far from the station you plan to go with your remote system; what STL/ICR activity is present in the proposed remote region; and what mode of operation is expected, i.e., ENG or planned EFP.

Mutual interference with other users of shared frequency bands may be expected. In particular, channels 8, 9 and 10 of the 2GHz band could exhibit interference from microwave ovens, industrial heating sytems and medical diathermy installations. In the portion of the 7GHz band, from 6450MHz to 6550MHz, sharing is coordinated with common carrier users. Broadcasters should realize that if interference is encountered in these regions, the FCC cannot take action to alleviate the problems.

This information is extracted from material provided by McCarthy for the 7th edition of the *NAB Engineering Handbook.*

camera operator and the talent.

Increasing the capability to limited production adds to the cost. Several cameras, a switcher, an audio mixer, one or two VTRs, picture and signal monitoring and a character generator are realistic plans for a limited production vehicle. The primary purpose is to get material on tape, then return to the studio to edit and add effects. Time base correction and a still-store would be desirable.

The initial cost of a basic custom turnkey system in a super-van configuration might range between $100,000 and $250,000, if it is contracted to one of the remote vehicle manufacturers.

A step-van or straight truck configuration increases space. The price range also increases, to $200,000 to $300,000, depending upon features and equipment specifications.

The 40-foot semi-van system contains a production unit that equals, perhaps surpasses, many in-house production studios. At least six cameras, multiple recorders, digital effects, a still-store and video switcher fullfill the major requirements. An audio mixer and recorders, complete with necessary monitoring, cabling, communications, an attractively finished interior and all ancilliary items easily carries a price tag of $3 million to $3.5 million.

Build it or buy it?

If the costs seem high, perhaps building a system is more realistic. Certainly an ENG van would not be difficult to assemble. The microwave operates off a secondary battery that is kept charged by the operating vehicle. Padded storage containers can be built in the scene shop. Insulation and air conditioning should be included.

For a limited production unit, the station staff could design, engineer and assemble a functional system. But the custom system should include extra frame members for a sturdier vehicle, insulation, attractive finishing and air conditioning to handle the heat rise of the equipment and operations personnel.

ENG microwave equipment and 2-way radio may be included as well, along with a power generator system capable of operating the entire production system. It takes time to design and construct such a vehicle. Expertise in systems design, mechanical engineering and environmental control are also essential, if the remote truck is to be reliable. Are these talents and the time available from the station engineering staff?

The station could also eventually complete a 40-foot van system. But again, the custom, turnkey vehicle will start from a basic chassis. The structural framework will include extra bracing and heliarc welds throughout. Separated compartments for audio, video, technical, transmission and production areas can be acoustically isolated from one another. All will be thermally insulated for the long, hot summer afternoon baseball game or the below freezing football game.

Air conditioning designed for the planned equipment and personnel load is built in. The electronic products, as you specify, will be installed, cabled and tested for 100% operation before you take possession. In short, it's a major production studio on wheels, delivered to you ready to drive.

Own or lease?

How much do you expect this remote system to be in use? If it's a simple ENG system, it will probably be on the road constantly. The cost is in a range that can be reasonably amortized according to the station's financial plan. If you need ENG, then ownership is practical.

The question of ownership of a limited production vehicles is not as easily answered. If microwave equipment is included in the package, it can double for ENG. If a heavy schedule of commercial production is likely, making the payments will be easier.

If the equipment package is inviting to other users, leasing it will help you pay for it. But, if the plan is limited production and on a limited basis, with no other expected use, ownership might present an undesirable financial burden. Look into leasing.

If your eyes are on the 40-foot system, maintain a heavy production schedule. Supporting a large produc-

ABC drivers are in the big leagues

The ABC Sports presentations are dependent upon a fleet of 18 tractor-drawn production vans. Each of the model 362 Peterbilt tractors is over-maintained, admits Tom Ferranti, fleet manager, the annual expense totaling about $200,000 for the fleet.

Peterbilt is Ferranti's choice based on cost and reliability. His own maintenance program gives him an edge on Murphy's Law failures. Each of the tractors, capable of pulling an 80,000-pound load, easily handles the 68,000-pound production vans.

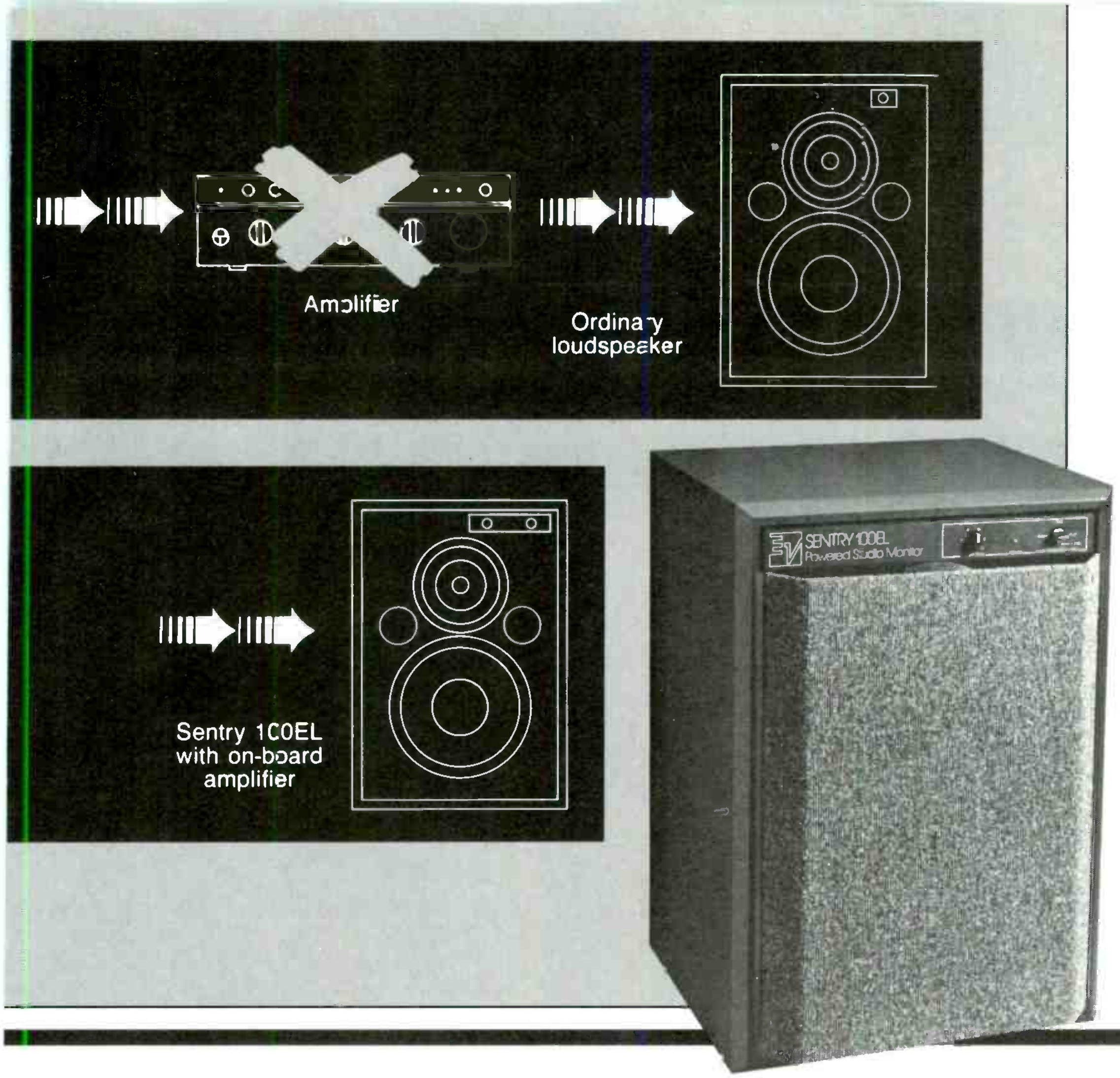
Drivers are an important part of the operation, Ferranti says. "There are thousands of drivers in the world," he says, "but there are only a few professionals."

Before he will even bring an applicant into his office for an interview, he requires proof of 250,000 miles driving experience through all four seasons and perferably in all areas of the country. The individual's driving record must be spotless.

The driver will be responsible for a $4 million rig, but failure to arrive at the specified location at the scheduled time could cost the network organization even more.

For that reason, ability, aptitude and attitude are extremely important. Once hired, the driver is well paid. Ferranti does not solicit new people through newspaper advertisements, but prefers to work through word-of-mouth with his current staff.

Continued on page 68



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

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

If you can imagine all that, you've just pictured the **Sentry 100EL powered monitor system** from Electro-Voice. Designed and created for your monitoring convenience, the 100EL combines the superb audio reproduction of the Sentry 100A with an integral, 50-watt amplifier.

With speaker and amplifier in one compact, rack-mountable package, this monitor system solves problems like limited rack space, equipment transport on remotes or cramped spaces in video editing booths.

Also, by requiring less hardware—fewer cables and connectors—the 100EL keeps setup simple and reduces potential interconnect problems. And there's no possibility of power loss caused by resistance from a lengthy speaker cable.

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

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

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

Electro-Voice®
SOUND IN ACTION™

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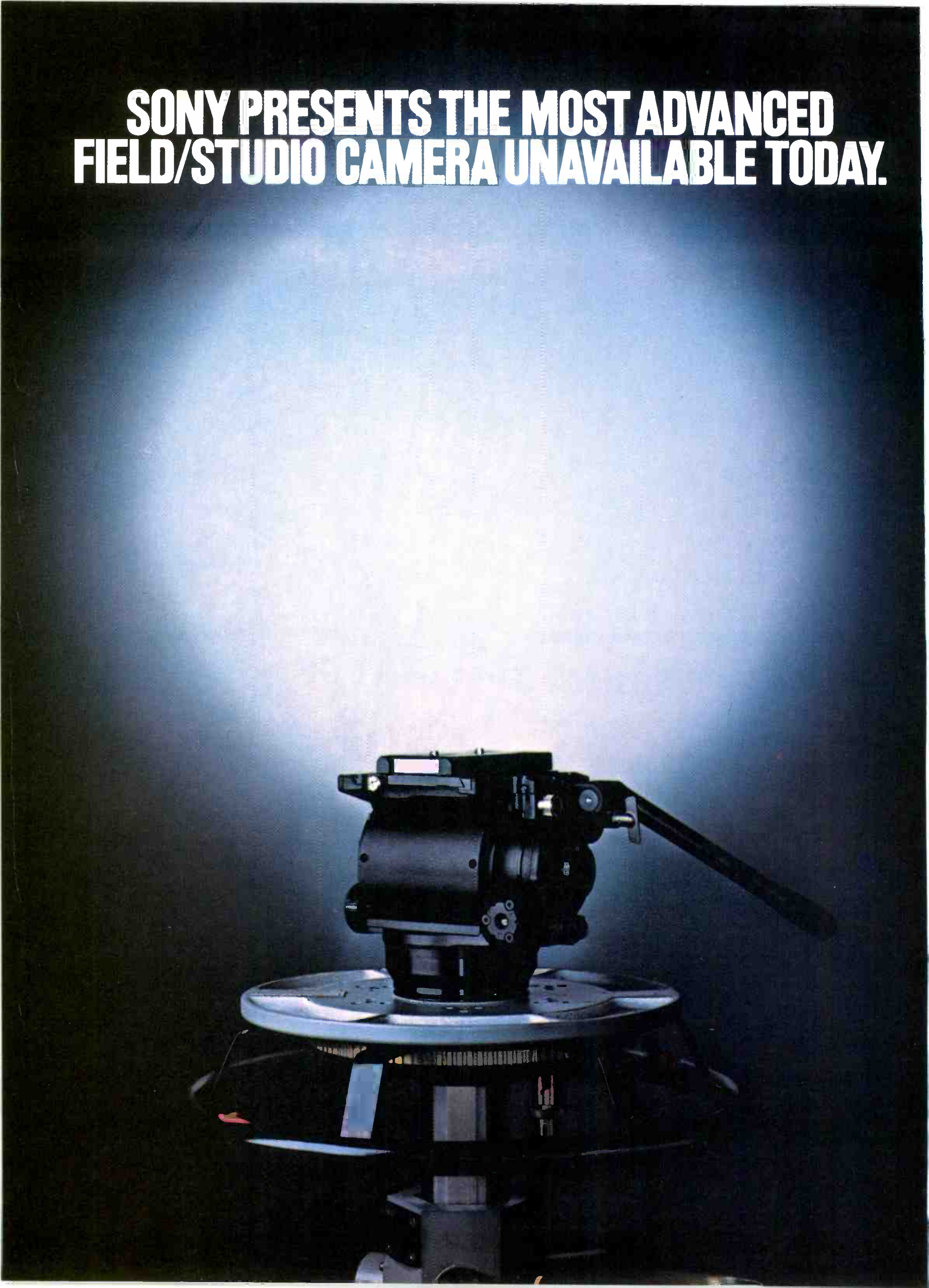
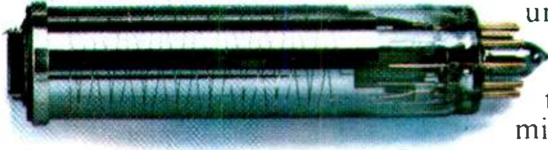

SONY PRESENTS THE MOST ADVANCED
FIELD/STUDIO CAMERA UNAVAILABLE TODAY.

INTRODUCING THE SONY BVP-360. ON MAY 1, 1985, THE REMARKABLE BECOMES AVAILABLE.

When we previewed this camera at NAB, the response was tremendous. Which, considering Sony's considerable reputation for high performance broadcast portables, wouldn't normally seem so surprising. Except for one detail.

The BVP-360 isn't a broadcast portable. (Although at 50 pounds it's certainly the most portable camera in its class.)

What the BVP-360 represents, however, is the culmination of Sony's work in tube technology, in innovative mechanical design and in High Definition Video Systems. A highly sophisticated, automated camera that promises to usher in a new era in price/performance for cameras in the Field/Studio category.



Sony-developed 2/3-inch Mixed Field Saticon™ (Plumbicon™ tubes also available.)

THE ⅔-INCH IMAGE FORMAT COMES OF AGE.

For those of you unable to get through the crowds for a close look at the BVP-360, there are two explanations for the exceptional image quality you saw on the monitors overhead.

First, the BVP-360 employs the remarkable, Sony-developed ⅔″ Mixed Field* tubes. The first real challenge to big tube performance. Because they deliver twice the registration and geometric accuracy of conventional ⅔″ tubes. Plus greater depth of modulation. And thanks to the special Sony-developed FET that is built into the tube and yoke, an extraordinary signal-to-noise ratio. (MF Plumbicon™ or MF Saticon™ tubes are available.)

Secondly, the Sony BVP-360 is equipped with a breakthrough F1.2 prism design that single-handedly results in sensitivity and depth-of-field comparable with 25mm image formats. And vastly superior to any current ⅔″ Field/Studio camera at any price.

And, naturally, when you combine these factors with the extensive signal processing technology Sony has engineered into the BVP-360, you get specs which could only be described as spectacular.

A SUPERHUMAN FEAT OF HUMAN ENGINEERING.

Many of the experts who were able to get their hands on the camera at NAB were even more impressed by how it performs from a human standpoint.

Some were moved to comment by how easy the BVP-360 is to move around. Its smoothly integrated handles. Low weight. The highly maneuverable viewfinder. And the shortest lens-front-to-viewfinder distance in the industry.

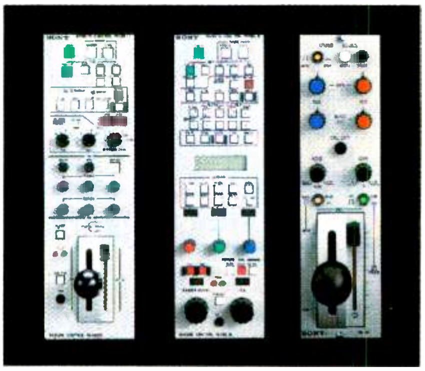
Others cited the uniquely pragmatic approach to automation. An approach that concentrates the camera's considerable microprocessor-based intelligence on the most difficult setup operations; functions such as digital registration, B/W balance, flare and gamma.

And still others referred to the BVP-360's extensive camera head memory, which can store up to sixty-four scene files, eight setup files, sixteen lens files and three reference files.

Plus the advantages of being able to choose from three remote operational panels.

NOT JUST A CAMERA. A CAMERA SYSTEM.

But perhaps the most striking aspect of the BVP-360 is its "building block" design concept. An arrangement that makes it particularly easy to customize the camera for various production situations.



BVP-360 Remote Control Panels: (left to right) a flexible Field unit, a highly sophisticated Creative Production panel and a simple Studio unit.

It starts with a camera head able to transmit component signals via Triax or Multicore. Or function as a stand-alone camera.

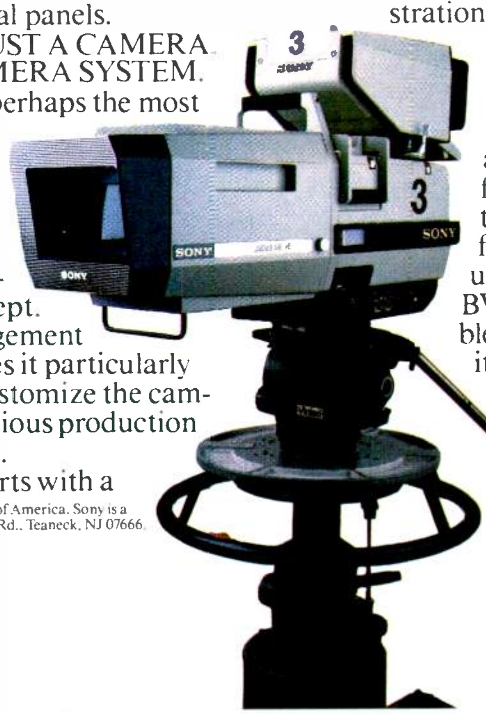
Then, on the technical front, alignments are handled at the Camera Control Unit. With each camera able to be tweaked individually. Or addressed as part of up to an eight-camera chain linked to one Master Setup Unit.

And finally, on the operational front, all control during production may be directed from one of three types of Remote Control Panels—a simple Studio model, a flexible Field unit, or a highly evolved Creative panel with extensive memory and scene-painting facilities.

ADOPT A WAIT-AND-SEE ATTITUDE.

Of course, as we said at the outset, the BVP-360 isn't ready for delivery tomorrow. But that doesn't mean you have to wait until May to see it. There are units here right now for demonstrations and evaluations.

And of course, by the time you're finished testing it, raving about it and getting a budget for it (although that last part may go faster than you're used to thanks to the BVP-360's incredible price/performance), it won't be tomorrow. It'll be closer to May 1.



SONY
Broadcast

*Sony Mixed Field tubes use electrostatic deflection and magnetic focus. Sony Broadcast Products Company, 1600 Queen Anne Rd., Teaneck, NJ 07666.

Continued from page 64

tion vehicle outside a major market could be difficult, unless you can contract for a great deal of sports, made-for-TV programming, big-name commercials, etc.

Not only are you looking at the initial cost of the trailer unit and its maintenance, you are also dealing with operating personnel, a tractor to tow it from location to location, tractor maintenance and tractor operating costs.

At present, you can expect to pay from $60,000 to $75,000 for a cab-over semi-tractor with sleeper berth, an essential item for long trips. As usual, cost is determined by features of the tractor, but for long trips, drivers will appreciate the added comforts of the higher priced unit.

Alternatively, a good used tractor will run from $30,000 to $45,000. In either case, diesel fuel costs should be based on mileage rates of 4.2mpg to 6mpg. Fuel tanks with a 200-gallon capacity are standard. And as an owner, you are liable for taxes, licensing and driver payroll. Leasing the tractor might run around $116 per day on an occasional use basis. For long-term tractor leases, negotiable rates are available, which also include taxes, repairs and licensing.

The question is, then, can your area and your proposed segment of the remote production business support ownership of a large production truck? Status doesn't pay the bills, so perhaps the practical solution is to lease when the equipment is needed, if you can get on the schedule in time to have the system when you need it.

Leasing large production vehicles, equipped with top-of-the-line products, is based upon the equipment items needed. Averaging at about $600 per day per equipment item (still-stores may run slightly more), the suggested lease price, based on a 10-hour day for a 7-camera system, comes to about $13,000. The amount may vary with geographic region, season and availability.

That includes three VTRs with slow motion capability, a character gen-

From van to station

Transmitter systems for the 2GHz ENG service take a number of approaches, all aimed at providing the maximum 12W allowed by the FCC at the antenna input. Figure 5 shows a typical configuration, when allowed full power to the antenna on the van mast.

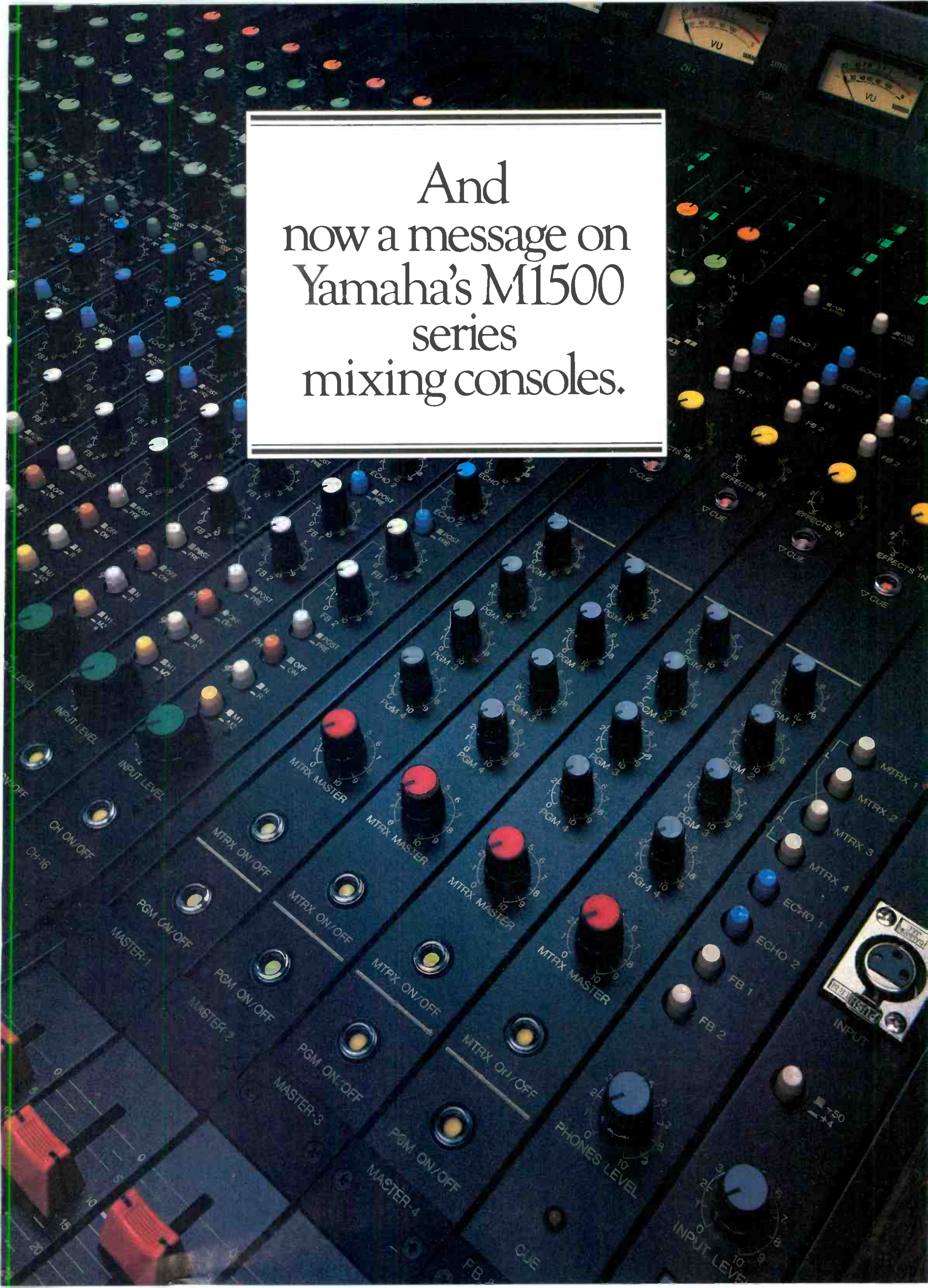
In this configuration, the transmitter may easily be removed from the van for use with a separate roof-mounted antenna for a more direct shot to the receive site. In this type of installation, either a coiled or retractable RF cable is used to transfer the signal from the antenna to the antenna.

A second approach to van installation is shown in Figure 6. In this format, the transmitter is expected to be dedicated to the van, with only rare use as a separate system.

Control and composite baseband information are routed through separate conductors from the control head inputs to the transmitter/antenna unit at the top of the mast. Little RF cabling is needed in this situation.

In either format, all basic transmitter or transmitter/amplifier systems cover the standard seven channels of the 2GMz band along with the offsets (at ½-channel frequency up or down). Operation is typical from +12Vdc automotive batteries and may be extended to 30Vdc systems as well as 115Vac.

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



M1516A

GENERAL SPECIFICATIONS

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

TOTAL HARMONIC DISTORTION (THD)*
Less than 0.5% @ + 10dB, 20Hz to 20kHz. Less than 0.1% @ +20dB, 50Hz to 20kHz.

HUM AND NOISE* (20Hz to 20kHz, 150Ω source, Input Selector set at "−60")
- −128dBm Equivalent Input Noise (EIN);
- −95dB residual output noise with all Faders down.
- −73dB PROGRAM OUT (77dB S/N); Master Fader at nominal level & all Input Faders down.
- −64dB PROGRAM OUT (68dB S/N); Master Fader and one Input Fader at nominal level.
- −73dB MATRIX OUT; Matrix Mix and Master controls at maximum, one PGM Master Fader at nominal level, and all Input Faders down.
- −64dB MATRIX OUT (68dB S/N); Matrix Mix and Master controls at maximum, one PGM Master Fader and one Input Fader at nominal level.
- −70dB FB or ECHO OUT; Master level control at nominal level and all FB or ECHO mix controls at minimum level. (Pre/Post Sw. @ PRE.)
- −64dB FB or ECHO OUT (68dB S/N); Master level control and one FB or ECHO mix control at nominal level. (Pre/Post Sw. @ PRE.)

MAXIMUM VOLTAGE GAIN (Input Selectors set at "−60" where applicable)
PROGRAM & MATRIX 84dB; Channel In to the corresponding output. EFFECTS 20dB; Effects In to PGM Out.
FB & ECHO 94dB; Channel In to FB/ECHO Out. SUB IN 10dB; Sub In to PGM Out.

EQUALIZATION (±15dB maximum)
LOW: 50, 100, 200, 350, 500Hz, shelving. HIGH MID: 1.2, 2, 3.5, 5.7kHz, peaking.
LOW MID: 250, 350, 500, 700, 1000Hz, peaking. HIGH: 10kHz, shelving.

HIGH PASS FILTER 18dB/octave rolloff below 80Hz.

PHANTOM POWER For remote powering of condenser microphones, +40V DC can be switched on via a rear panel Master phantom power switch. When an individual Input Phantom switch is also On, voltage is applied to pins 2 and 3 of that input's balanced XLR connector.

DIMENSIONS/WEIGHT M1516A 34" W x 36 1/2" D x 14 1/2" H 147 lbs. M1524 55 3/4" W x 36 3/4" D x 14 1/2" H 213 lbs. M1532 55 3/4" W x 36 3/4" D x 14 1/2" H 231 lbs.

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

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

Of course, all three M1500 consoles have legendary Yamaha quality, reliability and craftsmanship. Which explains why you see Yamaha mixers wherever you look. Studios. Concert halls. Clubs. Theatres. Churches. We could go on, but you get the message.

For more information, write: Yamaha International Corporation, Combo Products Division, P.O. Box 6600, Buena Park, CA 90622. In Canada, Yamaha Canada Music Ltd., 135 Milner Ave., Scarborough, Ont. M1S 3R1.

YAMAHA

Circle (43) on Reply Card

erator, digital video effects unit, still-store, a 24-input video switcher with three mix/effects amps, routing switching, a 32-input audio production console with cartridge, cassette and reel-to-reel audiorecording and a complete assortment of cables, headphones and intercom systems. A portion of the $13,000 also covers the crew of 18 to 20 technicians needed for operating the semi-tractor system.

Building your own

Other things must be considered in putting a truck together. Obviously

The book of plans

The Summer Olympics played to a record audience of 5.7 million people. But they were only a small fraction of the U.S. TV audience of more than 180 million and an estimated global TV audience of 2.5 billion.

For the domestic and international TV audience, ABC left no stone unturned to bring every detail to home screens. It was, as ABC billed it, "the greatest show in the history of television," and it took hundreds of color TV cameras and mountains of support equipment to cover it. ABC calculated that it had 238 cameras in service, including 102 studio/field units and 136 hand-held types.

Few of the events that the average engineer works on will dare to rival the complexity of the Summer Games. However, many of the steps needed for an award-winning production such as the Olympics may be followed.

The key to competent and efficient coverage is *planning*. This planning may culminate in the form of an operations manual. Whether a complete manual with detailed table of contents or a single sheet of paper with the plan of action, certain preparations should be made before attempting to cover an event.

At least 10 areas of consideration should be included in the overall plan, according to Gordon Mehlman, engineer-in-charge of remote productions at WGBH, Boston. Although there can be others, preparing for these 10 should reduce the number of last-minute surprises and contribute to a smooth and efficient shoot. The areas are:

- **Schedule order, timing.** The schedule indicates dates of the event, including setup and teardown of the production. Preparatory meetings associated with the event should be included. Program order lists all planned segments from the opening video to the end of closing credits. For prepared "rehearsed" programming, timings allotted for each segment will keep the event on schedule.
- **Contact list.** A comprehensive list of personnel, with their phone numbers (at home and at work) lets everyone know who's working the production. It should also include any alternates in case staff members cannot make their assignments.
- **Equipment requirements.** A "grocery list" of the necessary pieces of equipment for the production lists the source of the units, any special contacts at that source and backup arrangements in case of failure.
- **Camera positioning.** A chart indicates the placement of all camera and camera-related products. Locating cameras for the Olympics was more complex than for the average production, but the concept is the same.
- **Transmission plans.** Particularly for the live remote, or when any involvement with the studio is required, links with the studio should be noted. If microwave is used, note primary frequencies and equipment to be used. If secondary units and channels are available, they should also be listed. This would also be a good place to note the interconnection to the network (uplink location, satellite and transponder), when live feeds via satellite are planned.
- **Communications.** All operators and engineers involved in the production should have an efficient method of communicating with other locations. Headset units on walkie talkies with vox would be desirable for any operators whose hands will be busy.
- **Special facilities.** Include the helicopter or any other ancilliary units. Instructions and cues for operators on these extra units should be clearly mapped out. List any special requirements or restrictions that the pilot should know about.
- **Who is where?** At all times there should be a clear understanding of where all personnel are expected. Any changes in operating locations should be spelled out with expected transit times noted.
- **Food.** This is perhaps an unusual item to include in a planning manual. Include any catering plans.
- **Transportation/accommodations.** Depending upon the duration and location of the production, transportation and arrangements for accommodations should be indicated for all personnel.

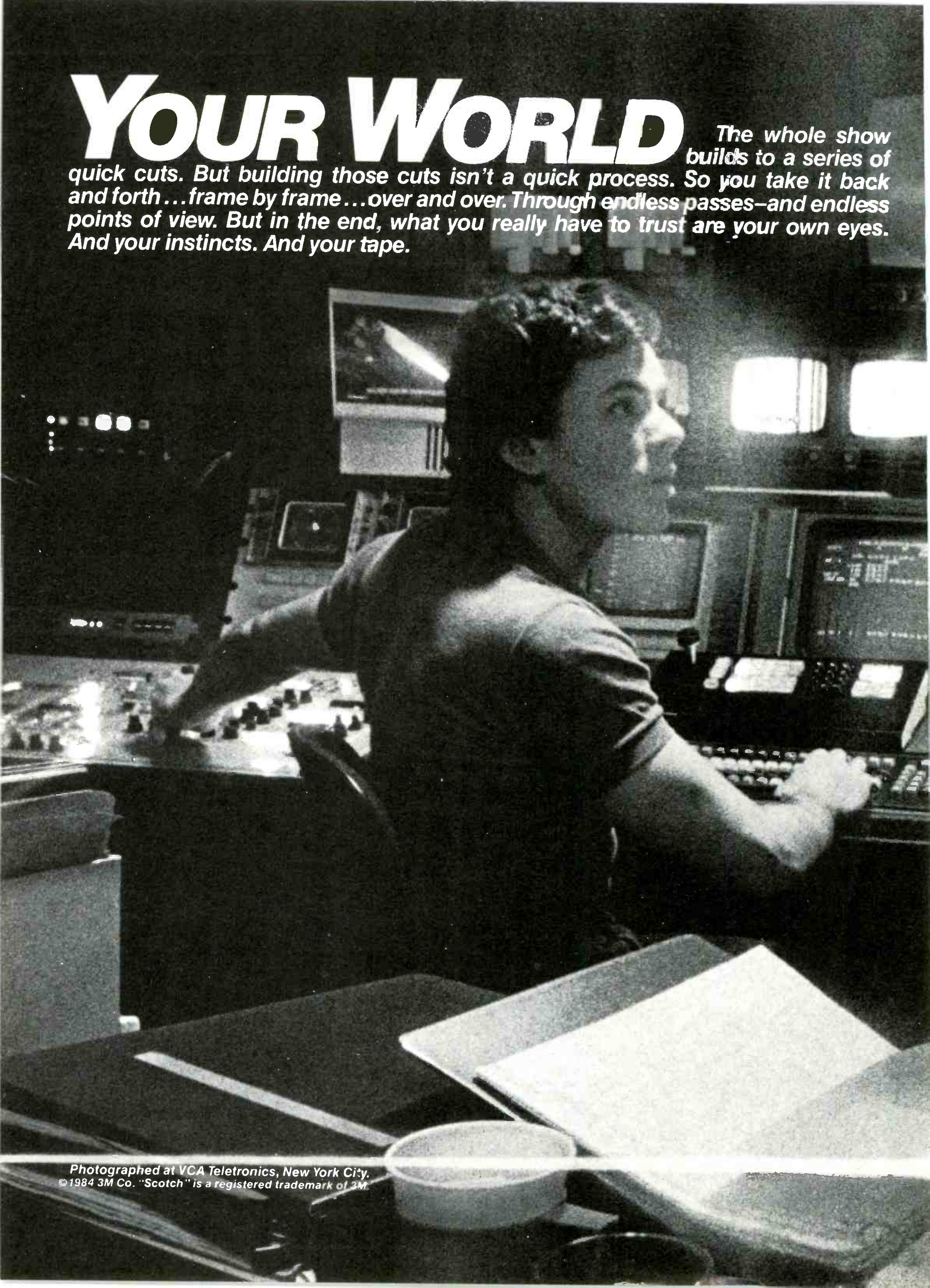
The operations manual will not make for a perfect shoot, but it will reduce many of the possible complications that result when one person thinks someone else is handling an assignment. From this plan of attack, you can also perfect future productions. With the written table of contents, review the production after the actual event and make notes of any particular problems. If you think of the award-winning coverage of the Olympics as a model, you can see that thorough planning can help even the smallest production go more smoothly.

Photos courtesy of Ikegami

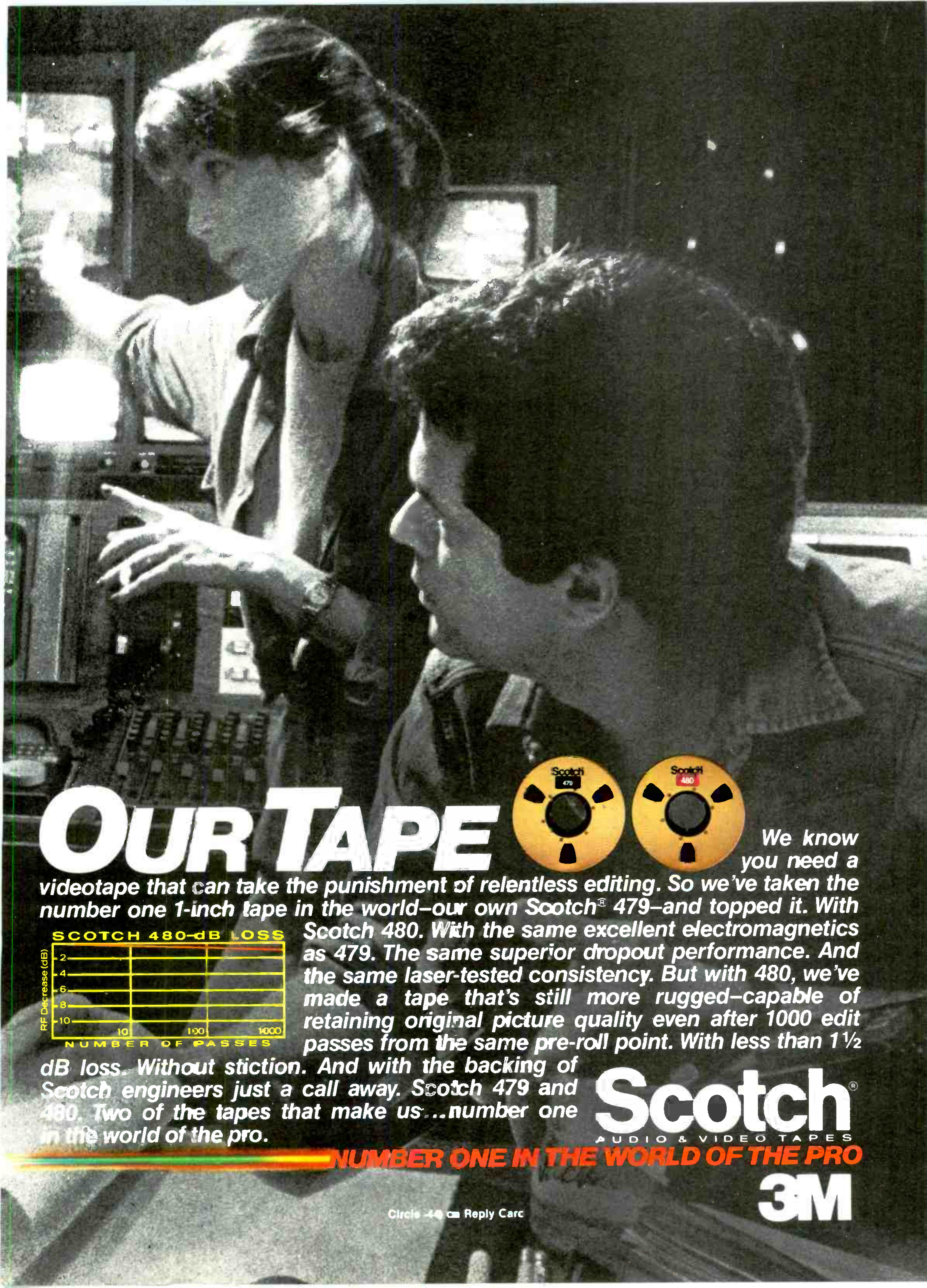
Thorough planning of camera locations and personnel assignments contribute to a smooth, efficient shoot. At the Olympics, camera operators throughout the Los Angeles Coliseum had specifically outlined duties.

YOUR WORLD

The whole show builds to a series of quick cuts. But building those cuts isn't a quick process. So you take it back and forth . . . frame by frame . . . over and over. Through endless passes–and endless points of view. But in the end, what you really have to trust are your own eyes. And your instincts. And your tape.



Photographed at VCA Teletronics, New York City.


Scotch
479
Scotch
480
SCOTCH 480–dB LOSS
RF Decrease (dB)
2
4
6
8
10
10
100
1000
NUMBER OF PASSES

From camera to van

Getting camera signals from inaccessible locations back to the mobile production switcher often involves small microwave systems. Roving cameras at sports events are another application for radio linking. In the remote vehicle, frame synchronizers process the camera signals to allow fades and effects with the camera. In most cases, the system works well; in others, problems may cause picture impairments.

For WGBH-TV2, Boston, microwave worked well during the annual 4th of July Boston Pops concert, broadcast on PBS. Shots from a helicopter, a boat and the roof of the Prudential Building added dimension to the live program, thanks to technicians who kept antennas aimed for the best reception from the remote cameras.

A large amount of WGBH's successful production came from extensive planning, including frequency coordination with other Boston stations. Equipment and frequency allocations were loaned by WBZ-TV14, WCVB-TV5, WNEV-TV7 and WLVI-TV56.

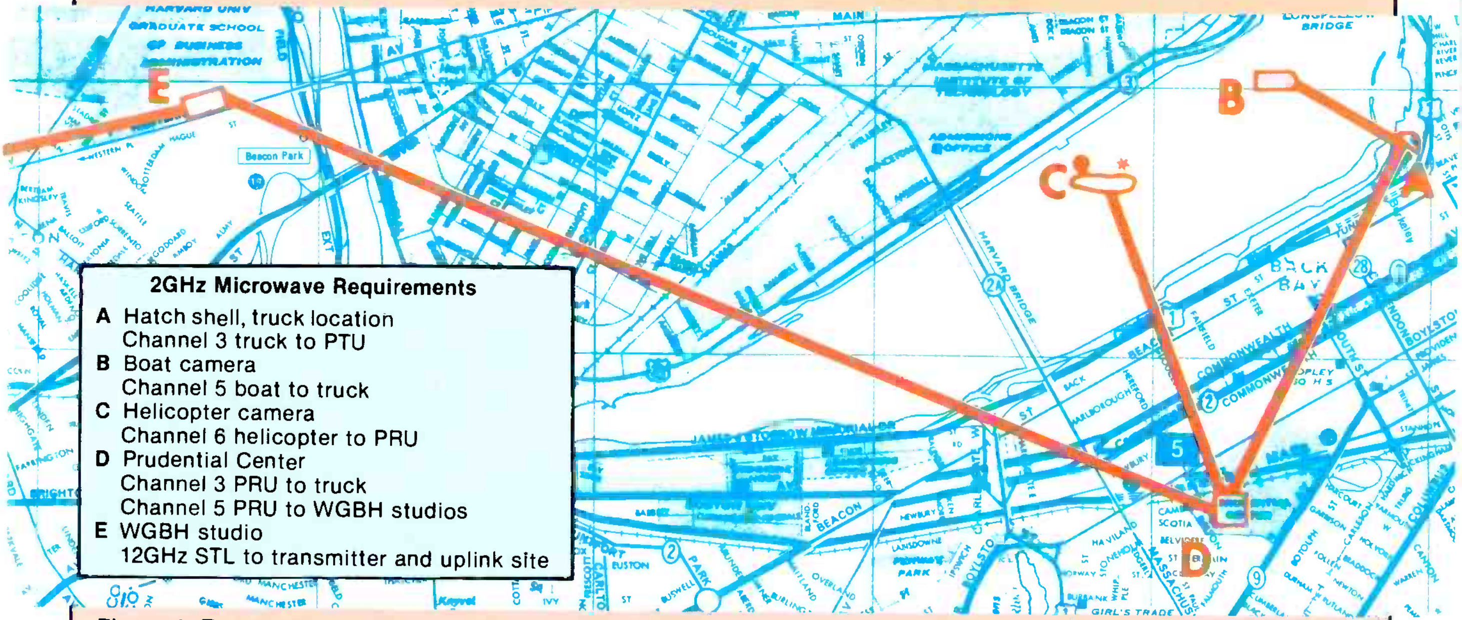
With only seven 2GHz channels allotted for all the Boston stations, it was important that no one transmitted unauthorized signals from the concert site. Figure 4 shows how the links were used for the nationally broadcast production. Such a drawing is a valuable part of the operations manual prepared for any remote telecast.

In covering the International Air Show, WHIO-TV7, Dayton, OH, made extensive use of microwave for a 5-hour live event coverage. Remote cameras provide different viewpoints from aboard a helicopter and from two roving operators.

In addition, two operators, secured by parachute-type harnesses to airplanes with pontoon-type landing gear, sent aerial coverage back to the production van via microwave.

Coordination with other Dayton TV stations that covered the event avoided interference between the stations, but WHIO battled other RF sources throughout much of its telecast. Rerouting of communications paths eased much of the interference, but the abundance of radio communications needed for the air show was a culprit. Adding to the rest were radar installations, which injected their own peculiar pulse-type of signal.

Careful site planning must consider radio links specifically needed for the production. The survey of the site must also determine any other type of RF sources in the area that serve non-broadcast segments of the event. Check with other aspects of the overall production. Perhaps additional RF usage will require coordination as well.



2GHz Microwave Requirements

A Hatch shell, truck location
Channel 3 truck to PTU

B Boat camera
Channel 5 boat to truck

C Helicopter camera
Channel 6 helicopter to PRU

D Prudential Center
Channel 3 PRU to truck
Channel 5 PRU to WGBH studios

E WGBH studio
12GHz STL to transmitter and uplink site

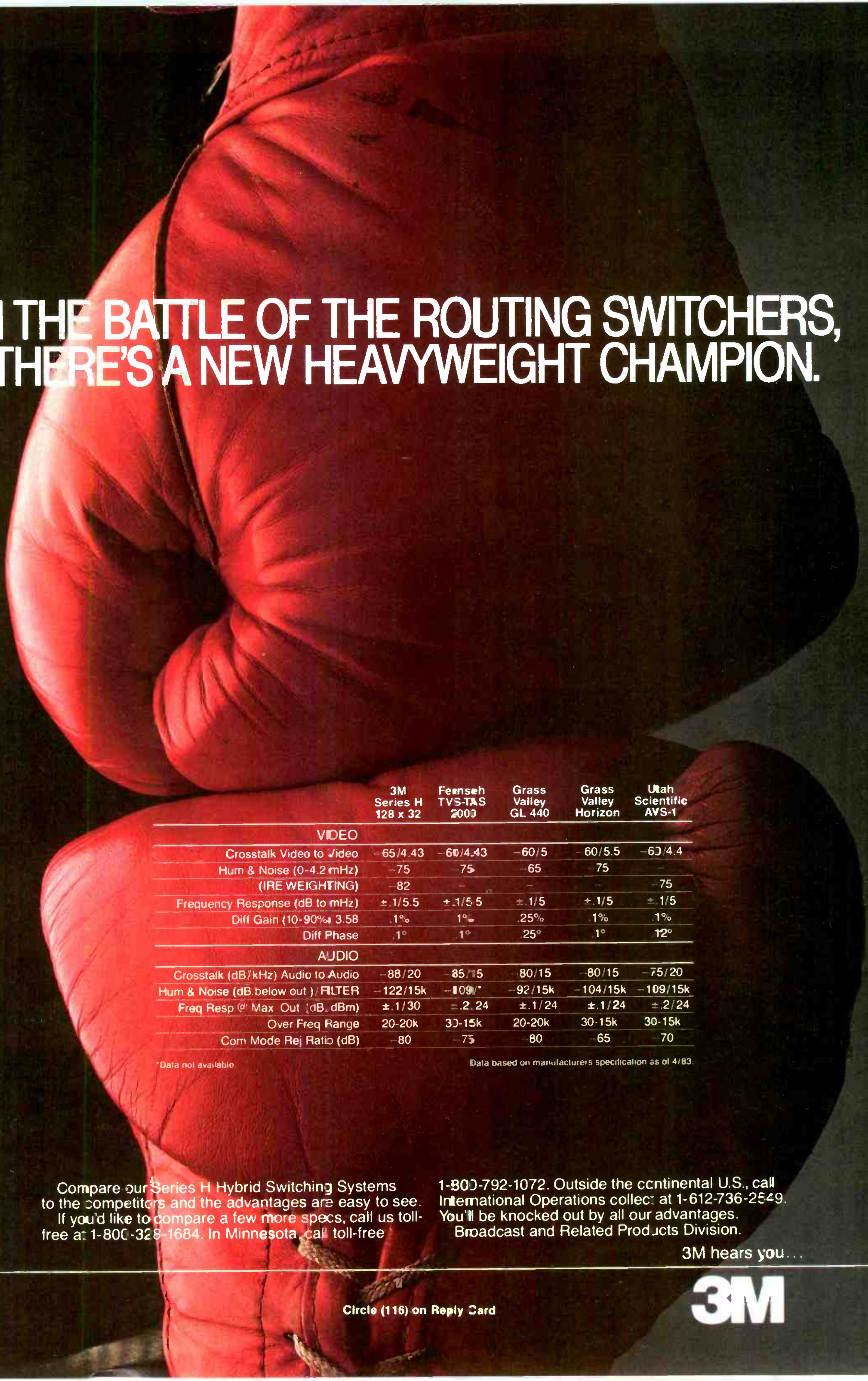
Figure 1. The microwave requirements for WGBH's broadcast of the Boston Pops 4th of July concert.

the TV equipment is required. If you're acquainted with specifying a production sytem, gathering equipment is the easier part of the mobile unit project. Cameras, recorders, audio, effects, routing and ancilliaries like sync generation, signal distribution and interconnection panels would be standard items that you'd expect for an indoor studio.

The real difficulty for most people in designing a production truck will involve:

- Getting rigidity into the chassis and structural framework.
- Planning power distribution throughout the unit.
- Specifying air conditioning loading, based on 20A/rack equipment dissipation and 750W per person for the crew.
- Designing air flow.
- Planning input power arrangements, transformers, voltage regulators and/or portable power generators.
- Selection and placement of thermal and acoustic insulating materials.
- Planning the arrangement of storage areas, including materials used for belly boxes under the main trailer or truck bed.
- Location of entrances/exits to separated or connected compartments within the system.
- Operator seating plans.
- Selecting interior finishing.

If specifying a mobile vehicle sounds like a big job, be assured that it is. And for that reason, the majority of systems larger than simple ENG units, for individual stations and for the networks, are usually custom projects, with delivery from one to six months, depending upon complexity. Delivered to you in a completely operating condition, the turnkey system makes good sense.



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VIDEO					
Crosstalk Video to Video	-65/4.43	-60/4.43	-60/5	-60/5.5	-60/4.4
Hum & Noise (0-4.2 mHz)	-75	-75	-65	-75	-
(IRE WEIGHTING)	-82	-	-	-	-75
Frequency Response (dB to mHz)	±.1/5.5	±.1/5.5	±.1/5	±.1/5	±.1/5
Diff Gain (10-90%) 3.58	.1%	1%	.25%	.1%	.1%
Diff Phase	.1°	.1°	.25°	.1°	.12°
AUDIO					
Crosstalk (dB/kHz) Audio to Audio	-88/20	-85/15	-80/15	-80/15	-75/20
Hum & Noise (dB below out)/FILTER	-122/15k	-109/*	-92/15k	-104/15k	-109/15k
Freq Resp @ Max Out (dB/dBm)	±.1/30	±.2/24	±.1/24	±.1/24	±.2/24
Over Freq Range	20-20k	30-15k	20-20k	30-15k	30-15k
Com Mode Rej Ratio (dB)	-80	-75	-80	-65	-70

*Data not available

Data based on manufacturers specification as of 4/83.

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Rapid response with live ENG

By John Getz, WPXI/TV-11, Pittsburgh

WPXI camera operator Tony Mock prepares his camera for a live shot from the station's helicopter.

Photos by Rick Evans

The author checks a live shot signal with the news department's ENG control room.

The first live truck that I worked out of was a disaster when it came to setting up for a live shot.

Everything was scattered throughout the truck. One IFB radio was kept in the glove box, another under the seat. The earpieces were usually wrapped around the rear view mirror, but the needed adapter cable could be anywhere. The tripod was secured behind the spare tire, with bungi cords and tie wraps. A quick release camera bracket was quick only if you had the right size wrench. And the talent's air monitor required ac power.

At the station, "live" required repatching, lots of talk on the 2-way radio to set up, and general confusion among all parties involved. And I won't even mention what happened when the event required a 13GHz link.

There had to be a better way to do live remotes. Over time, a fine-tuned, streamlined system has emerged.

The truck

A live truck needs to be easy to work out of. There should be no hidden switches or patches. What you see on the monitor and hear in the speaker is what should be going to the transmitter, scope and VTR. Everything in the truck always needs to be stored in its proper place.

When you design your next live truck, ask the people who will be using the truck what they don't like about the old unit. Try to correct those problems in the new unit. Simple things, such as the convenient placement of the 2-way radio mic, can be a big help.

The remote box

One of the simplest improvements is the addition of the remote box. This padded suitcase contains everything needed for the camera end of a live shot: portable radio, IFBs, earpieces, battery-operated TV receiver, mics and batteries.

When you set up for the live operation, one person unloads the camera, tripod and lights as needed. The second person starts pumping air into the mast, and while the mast is going up, he takes the remote box and the end of the siamese audio/video cable to the camera location.

At this point, everything for the live coverage of the event should be in place. The camera operator makes the

---

Getz is senior technician of WPXI's news department.

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connections, while the technician returns to the truck to send the signal back to the station.

Setting up the signal

When the ENG truck pulls onto the scene, it should be parked so the microwave antenna is pointing toward the receiving site. There's little point in fighting with any stops at the ends of the antenna's rotation. Going 360° just to get 5° past the stop wastes a good deal of time.

Tell the operator at the receive site where you are, so he can position the receiving antenna. A fast way to pan in the link is to have the receive site operator key the mic on the 2-way radio, holding the mic next to the microwave receiver audio speaker. Starting with tone applied to the link transmitter, get the general direction set. Once the link is established, kill the tone and tune the microwave transmit antenna direction for maximum quietness as a final adjustment.

After the control room makes a check of the microphone audio, camera video and IFB, the live remote is ready to go on the air.

Portable transmitter

If the shot requires a relay, it is necessary to set up a portable transmitter at the scene. The padded suitcase concept also works well for this equipment. Include batteries, cables and other special equipment with the transmitter. Having all the needed transmitter equipment in one case makes it a fast, streamlined operation. While the camera operator prepares the portable transmitter, the technician can be moving the truck to a higher location for the relay.

Chopper relays

For stories in outlying areas, the chopper aids in rapid response. In addition to the normal camera equipment, grab the remote box and transmitter box before heading to the scene in the helicopter. On a recent train derailment, in an almost impossible-to-reach terrain about 50 miles from the WPXI facilities, we left the station an hour before newstime (stories always seem to break an hour before newstime), landed almost a mile from the scene, packed the gear through the woods and across a stream, set up, were live at the top of the show and relayed the microwave through our chopper.

The secret to the rapid response was having all the gear in the suitcases. The microwave equipment for chopper relays stays on board and hooked up at all times.

When a plane crash occurred recently, we managed to the live truck within 100 yards of the wreckage. We knew the station wanted to break into programming as soon as we were set up, so we hustled. As the mast was going up, we grabbed the camera, remote box and cable ends and ran across the field to the wreckage.

The camera operator assembled his equipment, while I dashed back to the truck and panned in the microwave link. We were ready to go in less than three minutes.

The ironic part of the operation is that we had to ask the control room for a minute or two extra delay. The reporter was so winded from the run across the field that he needed time to catch his breath!

By fine-tuning the procedures for setting up live shots and streamlining communications between the station and the crews in the field, setups can be surprisingly quick.

With organization and practice, you, too, can break the three minute barrier. At WPXI, we've had quite a bit of practice, including live events from moving trains, boats and trucks; two camera live shots from the helicopter; numerous chopper relays; and multiple truck relays.

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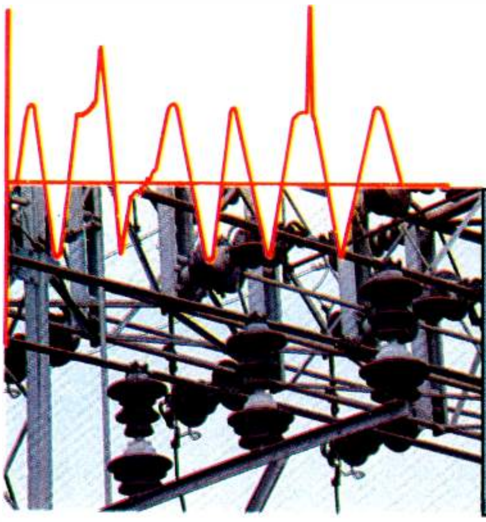

The effects of ac line disturbances

Part 5

The fifth part of our special series on ac line disturbances examines discrete suppression devices and applications.

By Jerry Whitaker, radio editor

The performance of discrete transient suppression devices available to the broadcast engineer has greatly improved in the last 10 years. Transient suppression technology has come a long way from the days of spark gaps and resistor-capacitor (RC) snubbers.

The wide variety of new devices available at reasonable prices make tight control over unwanted voltage excursions possible, and allow the complicated electronic equipment being manufactured today to work as intended. Much of the credit for transient suppression work goes to the computer industry, which has been dealing with the problem for more than two decades.

Types of devices

Transient suppression hardware can be divided into three general categories: ac filters, crowbar devices and voltage-clamping components.

The simplest type of ac power line filter is a capacitor placed across the voltage source. The impedance of the capacitor forms a voltage divider with the impedance of the source, resulting in the attenuation of high-frequency transients. This simple approach has definite limitations in spike suppression capability, and may introduce unwanted resonances with inductive components in the ac power distribution system.

The addition of a series resistance will reduce the undesirable resonant effects, but will also reduce the capacitor's effectiveness in attenuating a transient disturbance.

Crowbar devices include gas tubes (also known as spark-gaps or *gas-gaps*) and semiconductor-based active crowbar protection circuits. Although these devices and circuits have the capability of shunting a substantial amount of transient energy, they are subject to *power-follow* problems.

Once a gas tube or active crowbar protection circuit has fired, the normal line voltage, as well as the transient voltage, will be shunted to ground. This power-follow current may open protective fuses or circuit breakers if a means of extinguishing the crowbar clamp is not provided.

Voltage-clamping devices are not subject to the power-follow problems common in crowbar systems. Clamping devices include selenium cells, zener diodes and varistors of various types.

Zener diodes, using improved silicon rectifier technology, provide an effective voltage clamp for the protection of sensitive electronic circuitry from transient disturbances. Power dissipation for zener units is usually, however, somewhat limited (compared with other suppression methods).

Selenium cells and varistors—although different in construction—act in similar ways on a circuit exposed to a transient overvoltage. Figure 1 illustrates the *variable nonlinear impedance* exhibited by a voltage-clamping device, and shows how these components are capable of reducing transient overvoltages in a particular circuit.

The voltage divider network established by the source impedance (Z_S), and the clamping device impedance (Z_C), acts to attenuate voltage excursions at the load. It should be understood that the transient suppressor depends upon the source impedance to aid the clamping effect. A protection device cannot be effective in the circuit that exhibits a low source impedance, because the voltage divider ratio is proportionately reduced.

A typical voltage-vs.-current curve for a voltage clamping device is shown in Figure 2. When the device is exposed to a high voltage transient, the impedance of the component changes from a high standby value to a low conduction value, thereby clamping the voltage at a specified level.

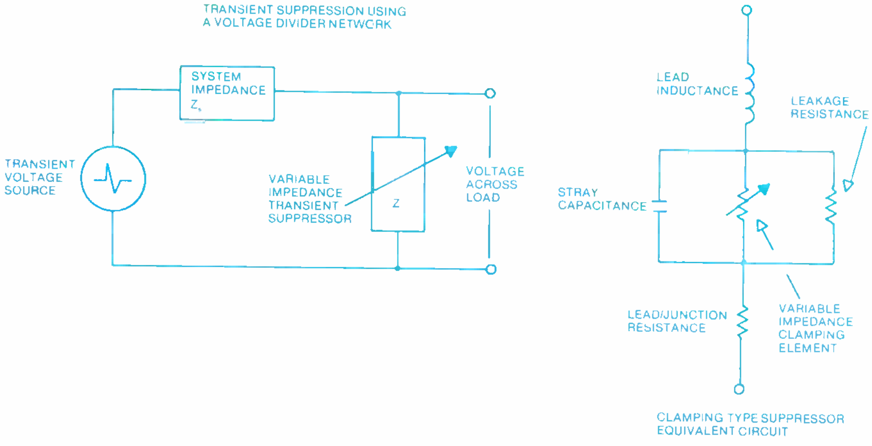

Figure 1. The mechanics of transient suppression using a voltage clamping device.

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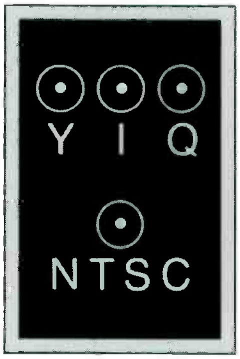

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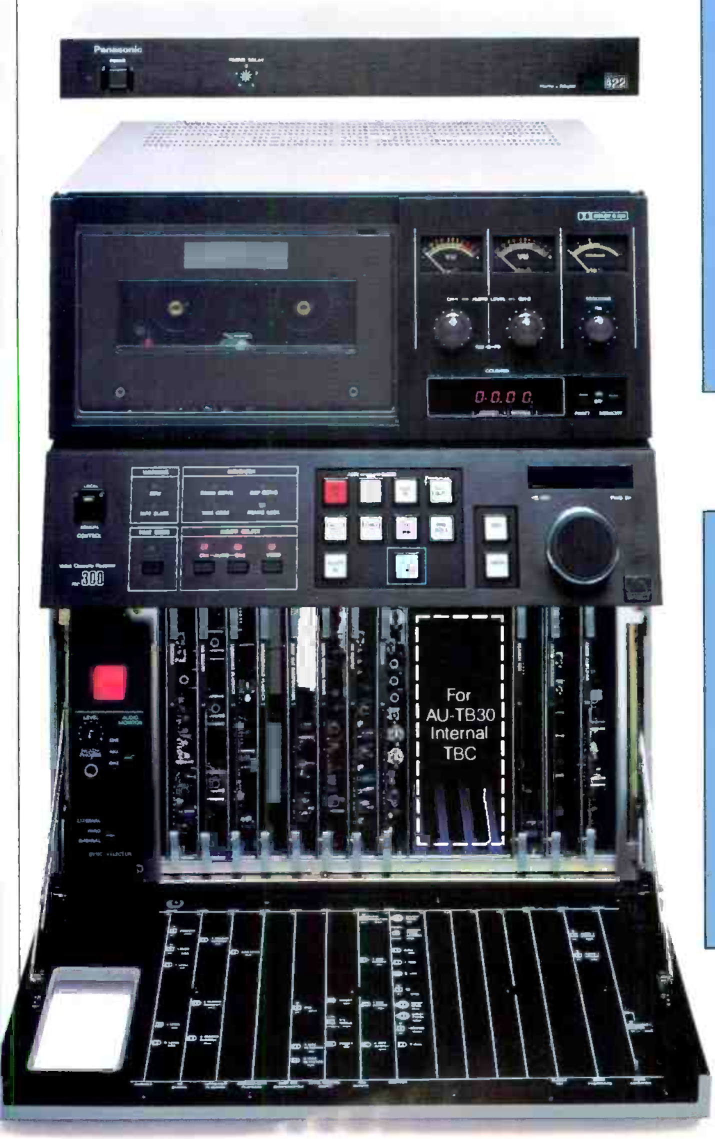
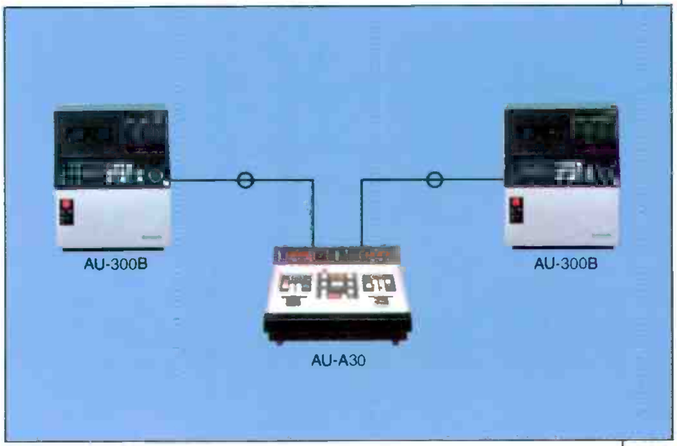


SIMPLE EDITING



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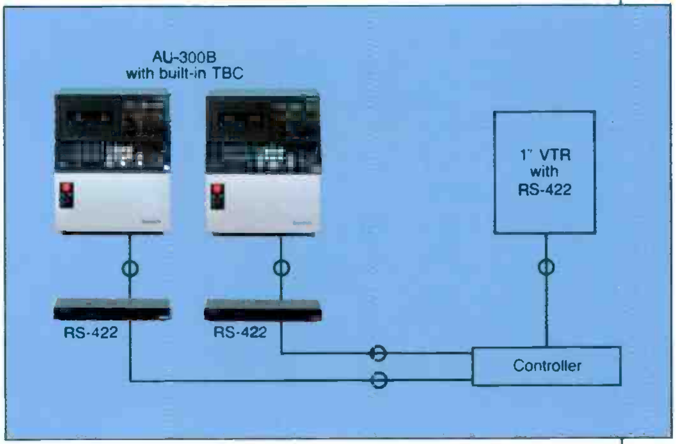
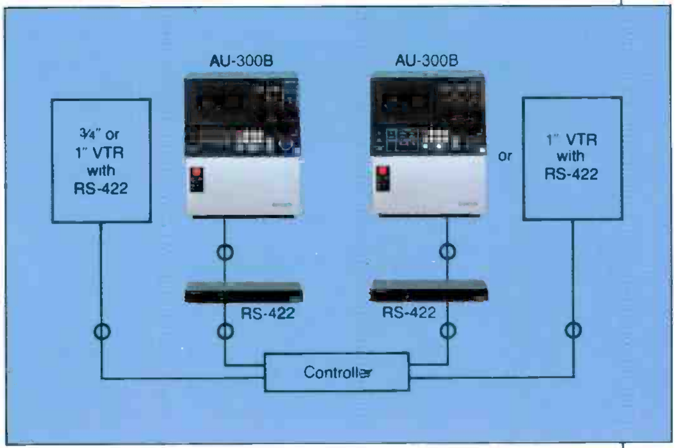


INTER-FORMAT EDITING



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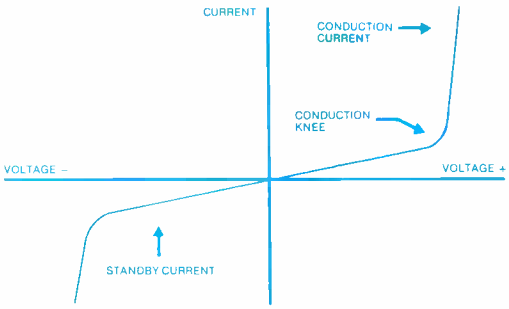

Figure 2. The voltage-vs.-current curve for a typical bipolar voltage clamping device. These components are designed to be essentially invisible in the circuit until the applied positive or negative potential reaches or exceeds the *conduction knee*. The device then effectively clamps the voltage excursion at a specified level.

Selecting a protection device

Selecting a transient suppression device for a particular application is a complicated procedure that must take into account the following items:

- The steady-state working voltage, including normal tolerances.
- The transient energy to which the device is likely to be exposed.
- The voltage clamping characteristics required in the application.
- Circuit protection devices (such as fuses or circuit breakers) present in the system.
- The consequences of protection device failure in a short-circuit mode.
- The sensitivity of the load equipment to transient disturbances.

Most transient suppression equipment manufacturers offer detailed application handbooks that should be consulted whenever you plan to use a protection device. The specifications and ratings of suppression components are not necessarily interchangeable from one manufacturer to another. Pay careful attention to the selection process.

The addition of transient suppression devices to a piece of equipment or ac power distribution system should be weighed carefully. Make allowances for operation of the circuit under all anticipated conditions.

Power protection

Transient protection methods for a broadcast facility vary considerably depending upon the size and complexity of the plant, the sensitivity of equipment at the facility and the extent of transient activity on the primary power lines.

Figure 3 shows one possible approach to transient suppression for a broadcast facility. Lightning arresters are built into the 12kV to 208V 3-phase pole-mounted transformer. The service drop comes into the meter panel and is connected to a *primary lightning arrester* (General Electric Company No. 9L15CB002) and a primary *varistor* (GE No.V151DA40).

The circuit shown in Figure 3 is duplicated three times for a 3-wire wye (208V phase-to-phase, 120V phase-to-neutral) power system.

The primary arrester and varistor are placed at the service drop input point to protect the main circuit breaker and power system wiring from high voltage transients that are not clipped by the lightning arrester at the pole or by varistors later in the circuit path.

The primary varistor has a higher *maximum clamp voltage* than the varistors located after the main breaker, causing the devices downstream to carry most of the *clamp-mode current* when a transient occurs. If the main circuit breaker should open during a transient disturbance, the varistor at the service drop entrance will keep the voltage of the spike below a point that could damage the breaker or system wiring.

Placing overvoltage protection before the main service breaker is recommended only when the pole-mounted transformer feeds a single load and when the transformer has transient protection of its own, including primary-side fuses. Consult the local power company before any spike suppression devices are placed ahead of the main breaker.

Transient protection immediately after the main breaker consists of a varistor (GE No. 131DA40) and a capacitor (0.1μF at 5kV) between each leg and neutral. A 47Ω 10W series resistor protects the circuit in the event of capacitor failure. It also reduces the resonant effects of the capacitor and ac distribution system inductance.

The varistor clips overvoltages as previously described and the resistor-capacitor network aids in eliminating high frequency transients on the line. The capacitor also places a somewhat higher capacitive loading on the secondary of the utility company step-down transformer, reducing the effects of *turn-on spikes* because of capacitive coupling between the primary and the secondary of the pole- or surface-mounted transformer.

As an extra measure of protection, another varistor (GE No.V130HE150) and R-C snubber are placed at the primary power input to the transmitter. Transient suppressors are placed as needed at the ac power distribution and circuit breaker box.

The transient suppression system shown in Figure 3 uses a technique known as *staging* of protection components. An equivalent circuit of the basic system is shown in Figure 4. You can take advantage of the series resistance and impedance found in the ac wiring system of a facility to aid in transient suppression.

The protection components located at the utility company service drop entrance (the *primary suppressors*) will carry most of the suppressed-surge current in the event of a lightning strike or major transient disturbance. The varistors and R-C networks downstream (the *secondary* and *supplemental suppressors*) are rated for clamp voltages lower than the primary protection devices, and with the assistance of the ac circuit series resistance and impedance, exercise tight control over voltage excursions.

Staged suppression design also protects the system from *exposure* because of a transient suppression device that may—for whatever reason—become ineffective. The performance of an individual suppression component is more critical in a system that is protected at only one point than it is in a system that is pro-

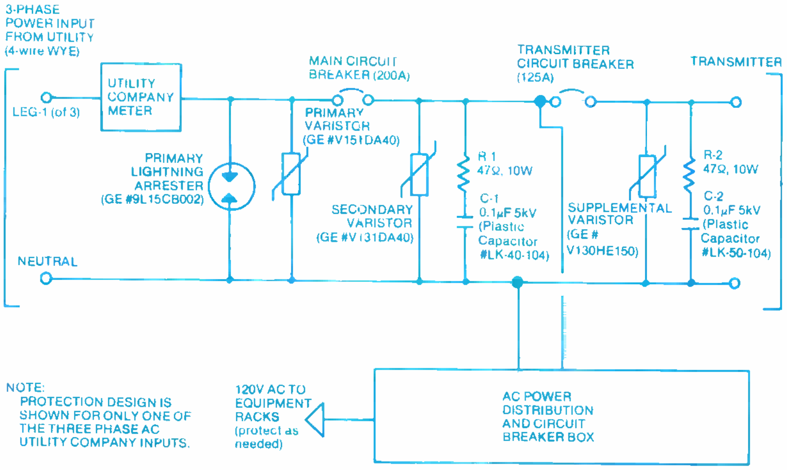

Figure 3. The application of transient suppression devices to a system-wide protection plan. Install such hardware with extreme care, and only after consultation with the local utility company and an electrical contractor.

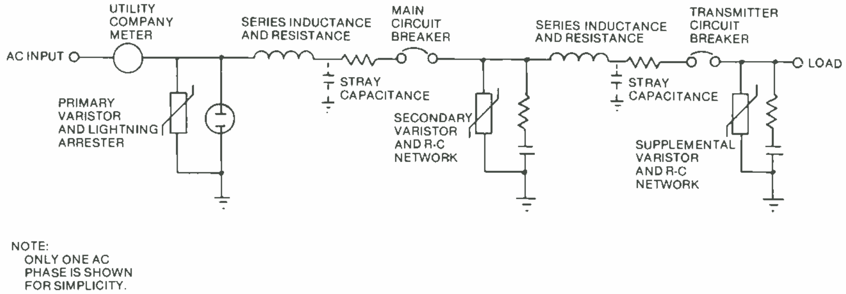

Figure 4. The use of ac system series inductance and resistance to aid transient suppressors in controlling line disturbances. This technique is known as *staging.*

tected at several different points. The use of staged suppression also helps prevent transients generated by load equipment from being transmitted to other sections of a facility, because suppressors can be located near offending loads.

Transient suppressors generally should not be placed in parallel to gain additional power handling capability. Even suppressors that are identical in type number have specified tolerances, and consequently, devices placed in parallel will not share the suppressed-spike current evenly.

Design cautions

Install transient suppressors at the utility service entrance with extreme care and only after consulting with the utility company's engineering department.

Although the addition of transient protection to an ac feed is vital to the long-term survival of the equipment downstream, the action of surge-suppression devices can cause one or more of the fuses at the service drop transformer to open, thereby creating a *single-phasing* condition.

Positive protection against continued operation under such a condition is necessary when transient protection devices are installed at the service entrance of a facility.

Although protection device failure is rare, it can occur, causing damage to the system unless the consequences of such a failure are taken into account. Before installing a surge-limiting device, examine what would happen if the device failed in a short circuit (which is generally the case).

Check for proper fusing on the protected lines, and locate transient limiting devices in sealed enclosures that will prevent damage to other equipment, or injury to people nearby, should device failure occur.

Spike-suppression components fail when subjected to transients beyond their peak current/energy ratings. They can also fail when operated at steady-state voltages beyond their recommended values.

Part 6

In the sixth and final part of our examination of ac line disturbances, we will discuss the importance of proper grounding of broadcast equipment to the control of *noise currents* on the power line.

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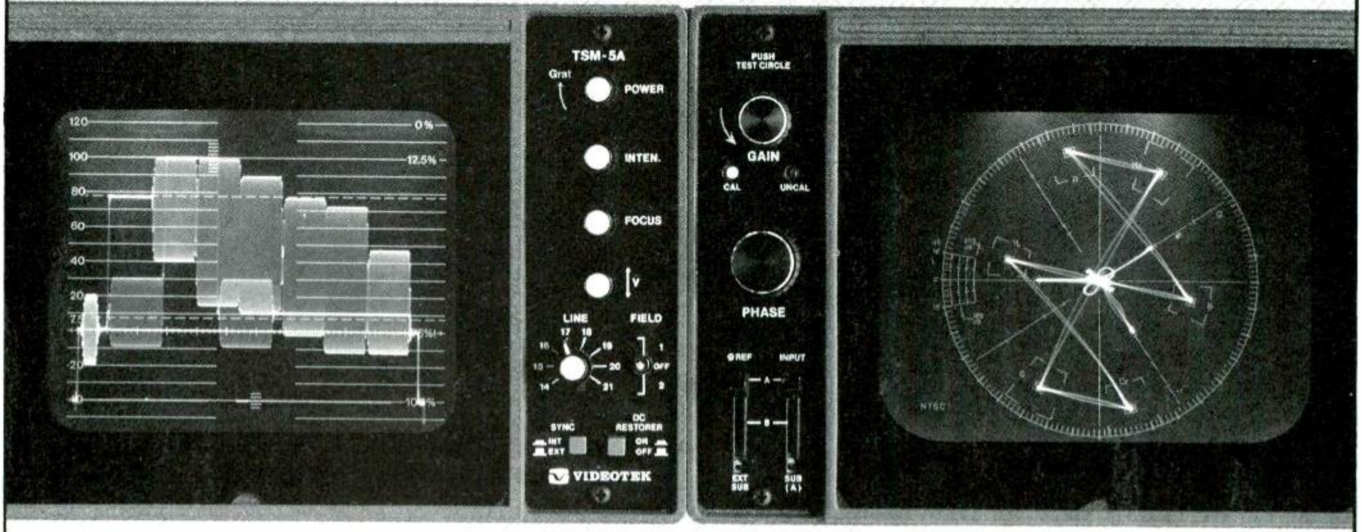

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AES convention replay

By Jerry Whitaker, radio editor

The 76th Audio Engineering Society convention, held Oct. 8-11 in New York, provided a window on the future of broadcast and professional audio. That view showed a new level of digital sophistication in tape recorders, special effects, audio consoles and interconnection systems.

It is no longer a question of *when* the digital era will arrive. It is here.

Equipment featured at the convention demonstrated that digital systems are no longer islands in a sea of analog hardware. Technology has progressed to where digital-based machines can communicate with each other, and the outside world, to form a totally digital audio production plant.

An all-digital system has several performance advantages, but one interesting aspect brought out in conversations with various manufacturers was that a digital plant can also offer cost advantages to the user.

Consider the construction of a major audio/video production studio. When the plant is all-digital, interconnection of audio consoles, tape machines and special effects can be accomplished with fiber-optic cables instead of bundles of shielded audio wire. Fiber-optic interconnection eliminates troublesome RFI problems many broadcasters experience. Light cables also consume less space and are less expensive to install than conventional audio lines, resulting in substantial labor savings when a large facility is built. A digital plant may provide a cost-effective alternative to an analog facility.

More than 8000 persons jammed the New York Hilton for the 76th AES convention. More than 180 exhibitors were on hand to show off the latest in audio equipment, many of which were digital systems.

As digital equipment continues to improve, analog technology is also moving forward. Analog equipment displayed at the show featured improved performance and greater versatility than previous models. The trend toward merging analog and digital hardware into a single system is also gaining momentum.

Full or partial automation of many analog systems has made the distinction between analog and digital equipment difficult in some cases. Microprocessors have been incorporated into a wide variety of analog hardware, from audio consoles to tape recorders.

The 76th AES convention featured a record 184 exhibitors, bringing more than one-half million pounds of equipment to the exhibition floors and demonstration rooms. The British contingent made a strong showing again this year, with 27 companies taking part. Attendance was estimated overall at more than 8000 for the 4-day show.

The offering of technical papers was the largest of any AES convention. Of special interest to broadcasters were papers on digital interconnection methods, FM stereo coverage area improvement and telephone network bandwidth extension systems. Multichannel TV sound was given special attention at the AES session on broadcasting and transmission, detailed in "AES Engineering Sessions," on this page.

In what should be welcome news to many manufacturers, the AES Board of Governors voted during the show to change the organization's convention and exhibition policy. Beginning in

AES engineering sessions

By Blair Benson, TV technology consultant

The broadcasting and transmission session at the AES, held Oct. 8-10 in New York, was well-attended, pointing out the high level of interest in stereo TV broadcasting by station engineers and equipment manufacturers. The papers ranged from a tutorial introduction to stereo technology to the design and operation of stereo TV facilities.

Center image

In a discussion on the basics of TV stereo, Richard Burden of Burden Associates, Canoga Park, CA, emphasized the need for a stable *center image,* because of the viewers' concentration on the TV screen, and a proper *depth perspective.* This requirement demands an accurate relationship between the sum (L + R) and difference (L – R) signals.

Unlike stereo radio and recording, the TV picture presents an accurate and stable perspective to the viewer. This perspective will not be maintained if amplitude and phase differences exist between and L and R transmission channels. The stereophonic effect will be preserved, but only at the expense of a wobbling or blurred center channel. Unfortunately, such variations are a common

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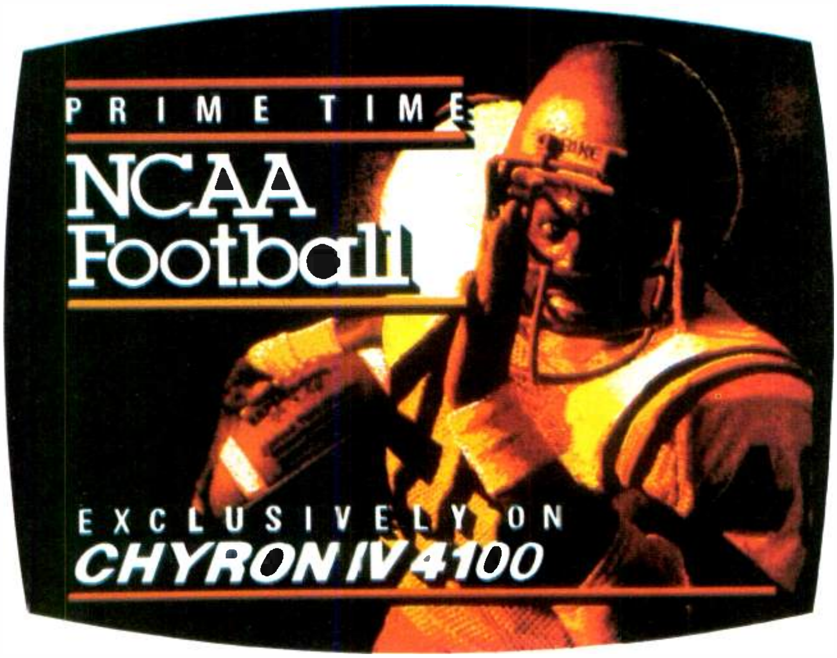

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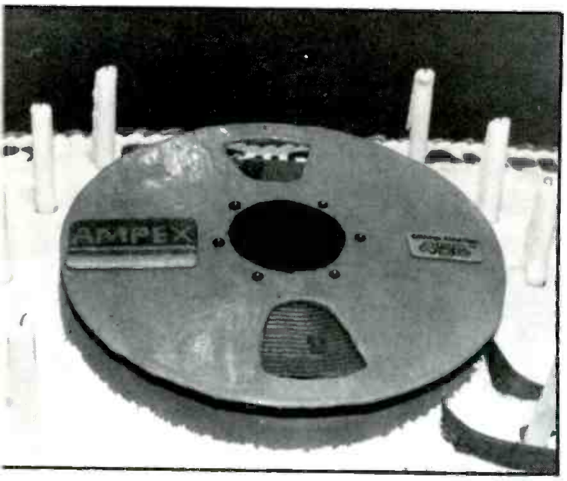


Ampex celebrated the 10th birthday of its Grand Master 456 series of mastering tape with a huge cake made to resemble a reel of 2-inch audio tape. The 456 series was introduced to the industry at an AES convention in 1974.

1986, there will be just one AES convention/exhibition per year, held in the fall. The show will alternate between the East Coast and West Coast, and the location will synchronize with the annual SMPTE convention.

Because of previous commitments, however, two conventions—one in the spring and one on the fall—will be held as planned this year.

Continued from page 90

consequence of conventional audio processing.

Burden pointed out, however, that in the matrix (L + R/L – R) transmission format, channel variations will not affect the center image, but instead will cause the stereophonic effect to vary in width and balance. This, he contended, is a more acceptable modification of perspective for TV applications.

When using either the L and R or L + R and L – R mode of transmission, it is important that any phase and amplitude differences between the 2 channels be kept to a minimum.

Because of the importance of producing a stable center image, Burden recommended that broadcasters seriously consider operating in the matrix format *within* the TV plant. This mode has the additional advantage of being compatible with many existing plant systems and procedures.

It is also compatible with videotape equipment, with monophonic capability retained on audio channel 1 without the need for matrixing. Using the L + R/L – R format, Burden said, would permit an orderly and gradual changeover of facilities to stereo.

Not everyone in the audience agreed. Several people questioned the feasibility of maintaining the phase and amplitude tolerances necessary for good stereo performance in all of the matrix encoders and decoders that would be needed in a typical TV plant. Modifying existing equipment to accept the matrix format was also cited as a potential problem.

Production techniques

As if the problems within the TV facility were not enough, other papers reviewed the production techniques required for stereo pickup, with special attention given to monophonic compatibility. TV broadcasters converting to stereo operation will rely initially upon network and recorded material for programming. Eventually, however, as the number of viewers with stereo receivers becomes a significant proportion of the audience, stations will be faced with the decision of which local programming should be multichannel, and how it should be accomplished.

Skip Pizzi of National Public Radio provided some of the answers to the second half of this question with a detailed discussion of the M-S (mid-side) intensity-stereo microphone technique. M-S uses a coincident

pair of microphones with side-pickup directional patterns at right angles. The excellent monophonic compatibility of the M-S technique and stability of the center image make it ideal for on-location TV broadcasting.

Pizzi described several applications of the M-S technique, including instances when it was supplemented for on-location production with X-Y (left-right) pairs for ambient sound gathering. A spacing of 20 feet to 30 feet for a X-Y pair in a large orchestral pickup was recommended to improve the monophonic signal by minimizing cancellation effects.

Although stereo production for sports programming has been largely ignored to date, Pizzi briefed the audience on some of the problems that have been encountered. First, true stereo perspective for the viewer is difficult to achieve because of the frequent changes in camera angle and subject distance common in TV sports coverage. A simple (but not very elegant) solution to this problem is to provide one or two X-Y microphone pairs for overall ambient sound, and separate highly directional monophonic *action microphones.* The announcers would be covered by normal mono pickups.

In the long term, audiences will demand a more exact match between the video image and the stereophonic audio. This will require a sophisticated production system that would likely include stereo submasters feeding an audio-follow-video switcher. Each submaster would provide a stereo mix corresponding to the related camera position. EFP wireless cameras would be equipped with stereo microphone pairs of the M-S type, either on the camera or positioned near the sound source.

The variable-zoom camera lens will pose an even more difficult problem, perhaps dictating the use of dynamic audio panning to track the change in the visual perspective.

Studio productions of news and interviews involving two people can provide a pleasing stereo image without a *ping-pong* effect by using a single M-S microphone pair centered on the two subjects. This approach may not be worth the effort in a typical acoustically dead studio, where two mono center-panned microphones may suffice. On location, however, a single M-S microphone pair may provide an effective solution to the pickup problem.

Pizzi recommended that all monitoring of audio signals at on-location events be done on loudspeakers sufficiently isolated from the sound source. He said headphones should be used only for continuity and cue monitoring, not for program or mix adjustments because of the image distribution and placement errors that can result.

Pizzi said that near-field monitor loudspeakers with carefully controlled dispersion should be used at remote location events. Such loudspeakers will minimize the effects of room reflections on the sound heard by the mixing engineer.

Final thoughts

The speakers at the broadcasting and transmission session of the AES convention presented the audience with a number of complex problems and some, but not all, of the solutions. For the TV broadcasters who have been concerned only with single-channel monophonic sound pickup and transmission, the session provided insight into what must appear to be a new technology.

The bright side of the inevitable transition to stereophonic television is that broadcasters will have adequate time to acquire the new facilities and operating techniques needed for this important service.

Focusing on the future of image technology: SMPTE '84

By Carl Bentz, television editor

After a spacious Los Angeles Convention Center exhibition in 1983, the 126th SMPTE Technical Conference returned to the New York hotel environment for the film and TV industry's major meeting of 1984.

A total of 169 exhibitors showed their wares at the New York Hilton and Sheraton Centre hotels between Oct. 30 and Nov. 1. Suites in the hotels provided extra space for an overflow of exhibiting companies.

Technical sessions overlapped the equipment show, starting on Monday, Oct. 29, and continuing through Friday, Nov. 2. The schedule of 160 papers represented 11 countries. The success of tutorial sessions at Montreal in February prompted 12 tutorial papers to be included within the 16 sessions.

Subjects of particular interest for TV were the sessions on image technology; small format video; image sensors; post-production; graphics and digital techniques; TV systems and broadcast technology; and future trends in imaging technology.

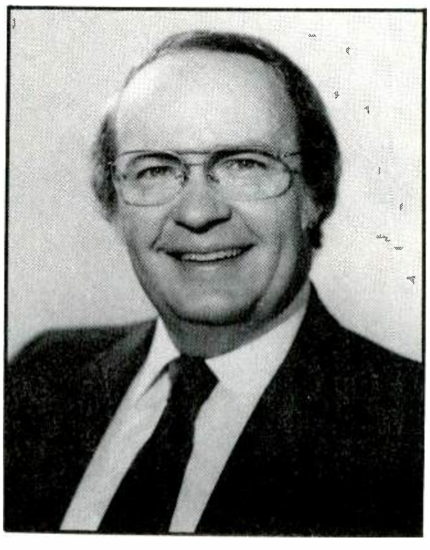
Thirty-three of the SMPTE study and working groups held meetings during the period, although no major statements on standards were released. For those interested in ¼-inch format work, no recommendation has yet been released and no work is expected before February.

Awards

Appreciation to a number of dedicated industry personnel was shown at the annual honors and awards luncheon. SMPTE president Leonard Coleman presented the following awards:

- Richard S. O'Brien (retired, CBS), the David Sarnoff Gold Medal, for leadership in planning and implementing advanced TV production facilities and contributions to TV technical literature.
- Allen J. Trost (principal engineer, Ampex), the Alexander M. Poniatoff Gold Medal, for contributions to recording technology.
- Edward H. Reichard (retired, Consolidated Film Industries), the Presidential Proclamation, for support of SMPTE and contributions to motion picture engineering.
- David W. Samuelson (Samuelson Film Service Ltd.), the Presidental Proclamation, for industry support on an international level.
- Ronald E. Uhlig (senior photographic engineer, Eastman Kodak), the Samuel L. Warner Memorial, for development of stereo photographic soundtracks, improved sound negative film and improved quality control techniques.
- Christoph Geyer (technical director, Geyerwerke GmbH), the Herbert T. Kalmus Gold Medal, for total immersion wet printing gates and liquid support systems.
- Jay Leyda, the Eastman Kodak Gold Medal, as an internationally recognized figure in film education and scholarship.
- Kenneth I. Richter (Kenneth Richter Productions & Cine Equipment), the John Grierson International Gold Medal, for specialized equipment to improve quality in documentary and travel films.
- Linwood G. Dunn, Honorary Membership, for contributions to special effects in motion pictures and the Acme-Dunn Optical Printer.
- Charles R. Fordyce (retired, Eastman Kodak), Honorary Membership, for pioneering work of safety cellulose triacetate motion picture film.
- Joseph A. Flaherty (vice president, engineering & development, CBS), the Progress Medal, for development and implementation of new TV technology, including ENG, off-line editing systems, electronic cinematography, HDTV and establishing a world-compatible standard for digital coding of TV signals.
- Bengt K. Modin (Swedish TV), the Agfa-Gevaert Gold Medal, for improved interfacing between motion picture film and TV imaging systems.
- Wilfred Liekens (Agfa-Gevaert), the Journal Award for Motion Pictures, for "Psychophysical Relationship of Image Quality Characteristics of Motion Picture Color Films."
- John L. E. Baldwin (engineer, IBA), the Journal Award for Television, for "Analog Components, Multiplexed Components and Digital Components—Friends or Foes?"


Richard S. O'Brien was awarded the David Sarnoff Gold Medal for his contributions in advanced TV production facilities.


Joseph A. Flaherty received the Progress Medal, for his work in new technologies, including ENG, HDTV and off-line editing systems.

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- Ivan Barclay (chief, radio-TV broadcasting, House of Commons, Ottawa section).
- Grant Dearnaley (chief, lab & video services, National Film Board of Canada, Montreal/Quebec section).
- Ted H. Horn (Karas Film, Detroit section).
- Charles D. Kircher (director of engineering, Foto-Industries, Hollywood section).

Although a number of interesting items were introduced, no single new product took the conference by storm. Analog video component systems continued to proliferate, from cameras to production effects to switcher systems.

One interesting demonstration involved S-MAC, the multiplexed analog component approach being studied by SMPTE committees for transport of video in the studio. In the demonstration were comparisons of the comonent approach vs. NTSC, particularly aimed to show artifacts that result from the NTSC color subcarrier. S-MAC remains in the experimental stage.

B-MAC was also demonstrated, showing the imaging quality under adverse conditions, multichannel digital audio quality, screen text displays, individual receiver addressability and computer program and data service.

The system has been selected by Australia for the Homestead and Community Broadcasting Satellite Service, through AUSSAT satellites. A confirmed order for at least 200 decoders by mid-1985 brings MAC into the realm of realistic technology.

C-MAC, introduced several years ago, has yet to be implemented.

Continued priority for digital control and processing of video was apparent. A number of new production effects systems, time base correction units, production switcher and master control switcher products dotted the exhibits.

New disc-based products included camera and video mixer setup memory systems as well as storage for graphics generators and real time digital recording and playback.

Heavy involvement of computer technology was obvious in the film-style editing systems that remove an editor's concern about time code data. Enhanced software facilities were offered for the more typical time code systems, however.

Many fine audio products were exhibited this year, but not to the extent seen at the 1983 conference. Assignable mixing desks designed with stereo TV in mind, processing systems and audio recorders indicated that digital remains a preferred switching control mode. For mixing and general signal handling of audio analog methods continue to be important.

The 126th SMPTE conference returned to the hotels this year, making quarters tight for exhibitors and observers. Yet, there is no doubt that the more than 12,000 attendees found plenty to keep them occupied. The suites, exhibit halls and lecture sessions provided many interesting things to see, hear and discuss.

Although analog component video is here to stay, not everyone is pleased. Several engineers from small stations indicated that they felt the new technology was being thrust upon them. They admitted to improvements in imaging through the use of components, yet they were concerned about the importance being given, in their minds, to component techniques.

At the same time, SMPTE expressed an interest in finding more participation from the grassroots and small-station sector of the broadcast community. It is the opinion of SMPTE that, while SMPTE recommendations are intended to be helpful, they realize that many prospective users do not have a voice in the procedures. By participating more, engineers could possibly dispel these fears.

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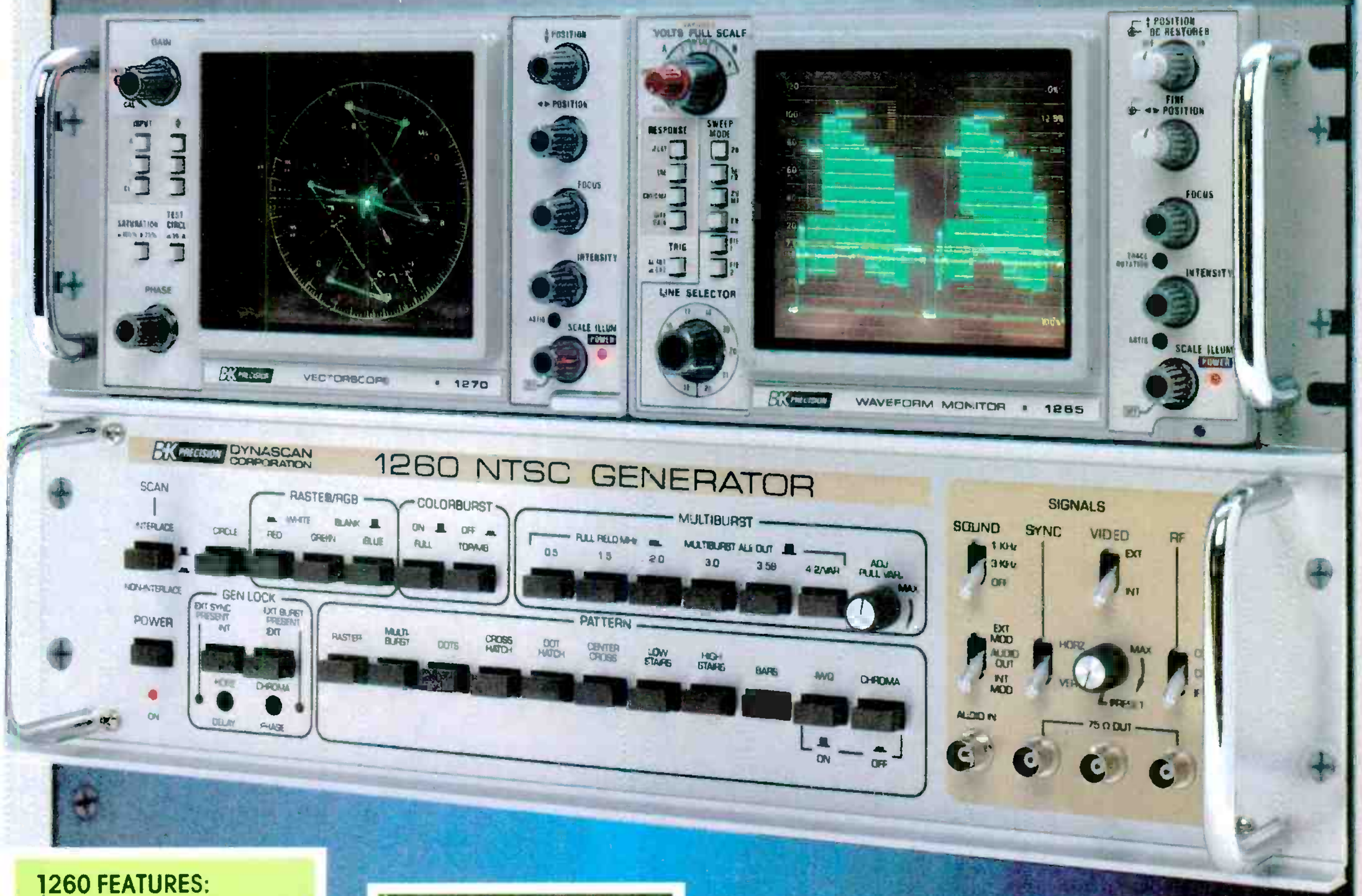

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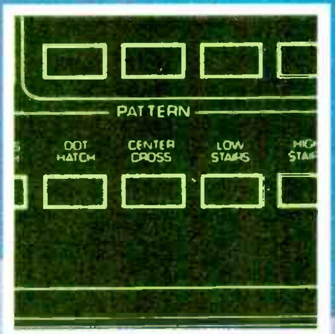

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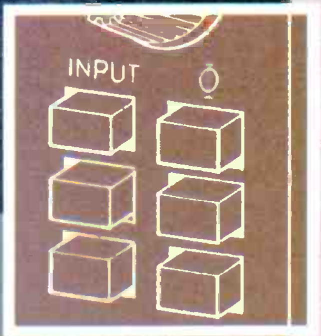

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Building an STL system

By John Leonard Jr.

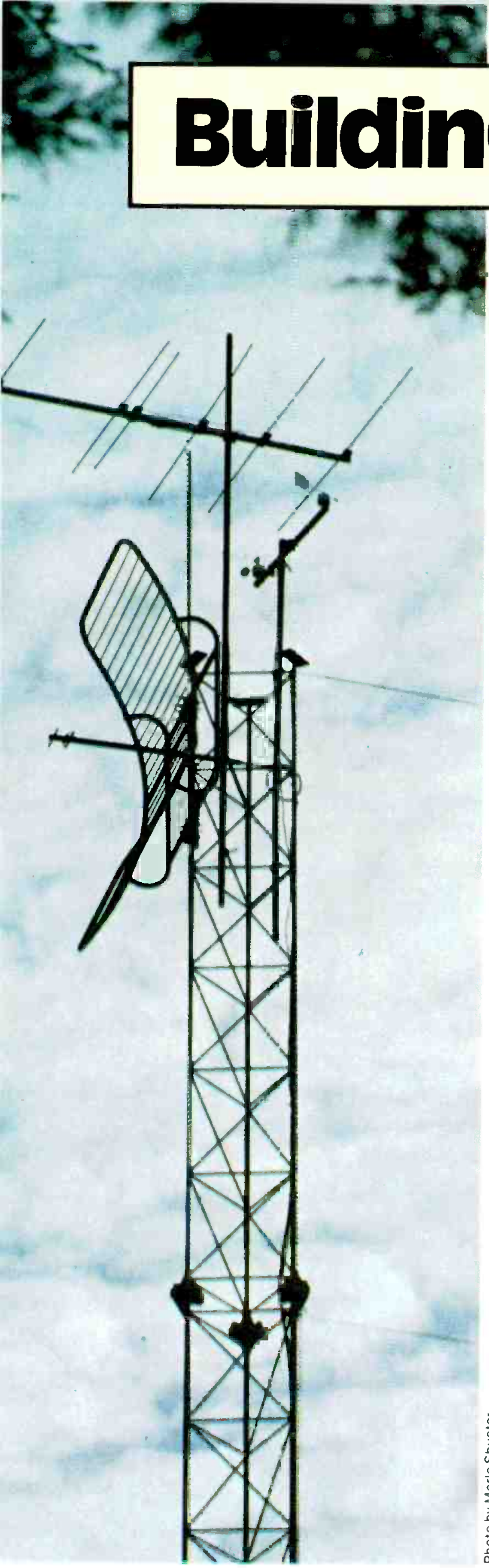

Photo by Merle Shuster

Studio-to-transmitter link (STL) manufacturers are making new generations of systems that are designed to provide transparent reproduction of complex program material in the congested RF environments that are becoming common in many urban centers.

In the United States, there are two types of facilities normally used to relay program audio from the studios of an AM or FM station to a remotely located transmitter plant. These are either leased telephone circuits or station-owned radio equipment. Station-owned facilities are classically comprised of an RF system called an aural studio-to-transmitter link—more simply, an STL.

U.S. aural STL service is permitted by Part 74, Subpart E, of the FCC rules and regulations, and is limited to 947MHz to 952MHz. In other parts of the world, a variety of different frequency bands are used for the service, primarily between 148MHz and 960MHz. The United Kingdom and Australia operate near 1500MHz, while Canada has incorporated service at 1700MHz. In the United States, additional frequencies are being considered to provide more spectrum to meet the needs of broadcasters.

This article will explore the design of aural STL systems at 950MHz, and discuss operating techniques and requirements for U.S. stations. The concepts presented, while applicable in theory to any frequency, should not be used below 300MHz, because techniques common to VHF, not UHF, are more appropriate.

Why select an STL?

There are several reasons to select an STL. In some parts of the country, the local telephone company is unable to provide simple 10kHz or 15kHz monaural circuits. The completion of such an audio loop may require special construction, and this work can be both time consuming and expensive—sometimes to the point where service is not available.

Other reasons include: lower distortion and noise in the program audio; broader frequency response and reduced phase shift in the audio; improved link reliability; increased flexibility and versatility; reductions in operating expense charges; and establishment of all station operations under common control.

Quality has become the key word at many stations. The audio response, distortion, S/N ratio and phase performance of an STL system almost always exceed that of a leased circuit.

One of the most often expressed comments following installation of an STL at a station where wire lines had previously been in service is the improved brilliance—or *presence*—of the on-air sound. This can be attributed to the transient response of the STL, particularly at lower audio frequencies.

With higher performance characteristics comes a higher degree of reliability. STLs are not subject to some of the common causes of telephone system failure, such as downed poles from traffic accidents and natural disasters.

This dependability is also related to another reason for selecting an STL instead of a wired telephone company link—the station controls all operations. This enables station personnel to routinely perform preventive maintenance, and emergency service when needed. The telephone company—not under control of the station—is no longer depended upon to properly test and maintain the interconnecting circuits between the studio and the transmitter.

Using an aural STL saves money by owning capital equipment, as opposed to incurring operating expenses through monthly telephone service charges. An STL system can cost less than one year's telephone line charges. More common payout periods are 3 to 5 years. With ever increasing telephone tariffs, an STL will continue to be an appropriate and economically viable investment.

Besides relaying program material, STLs can also combine other services, providing increased flexibility and versatility.

Because the construction of an STL is the responsibility of the station, installation practices and maintenance procedures are extremely important.

The STL path

Once you have decided to use an aural STL, the first step is to ensure that the topography between the studio and the transmitter site will permit reliable operation. With topographic maps, you can survey the proposed path and solve any obvious problems before construction begins.

Station engineering personnel (or a

This article was written while Leonard was vice president of the RF Products Division of Time and Frequency Technology, Santa Clara, CA.

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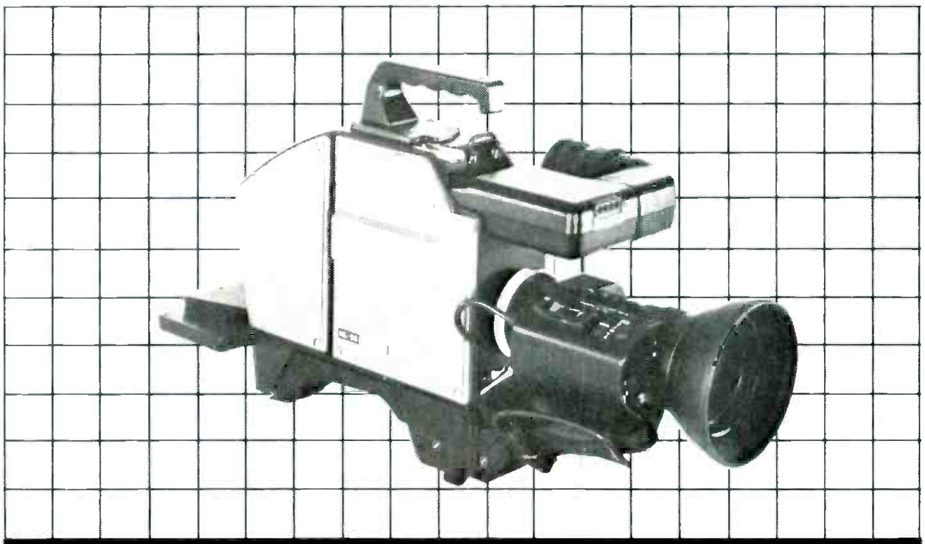

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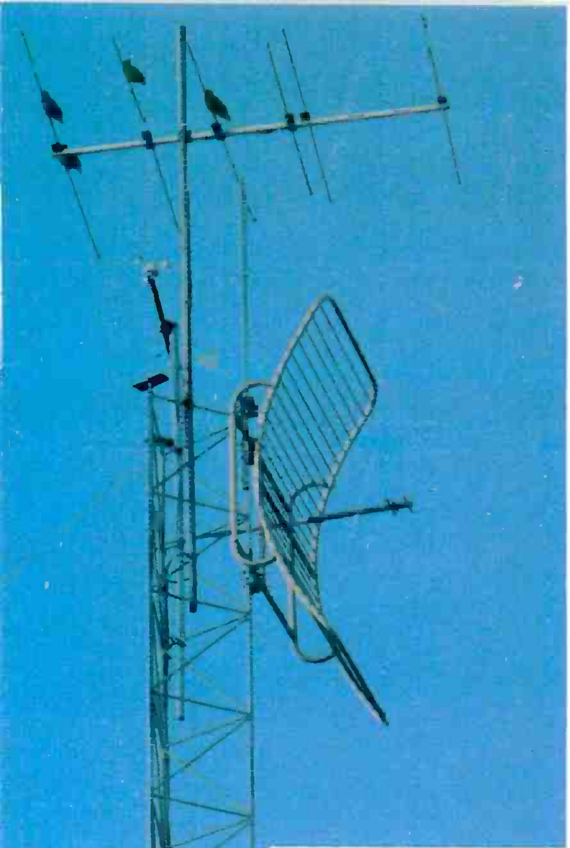
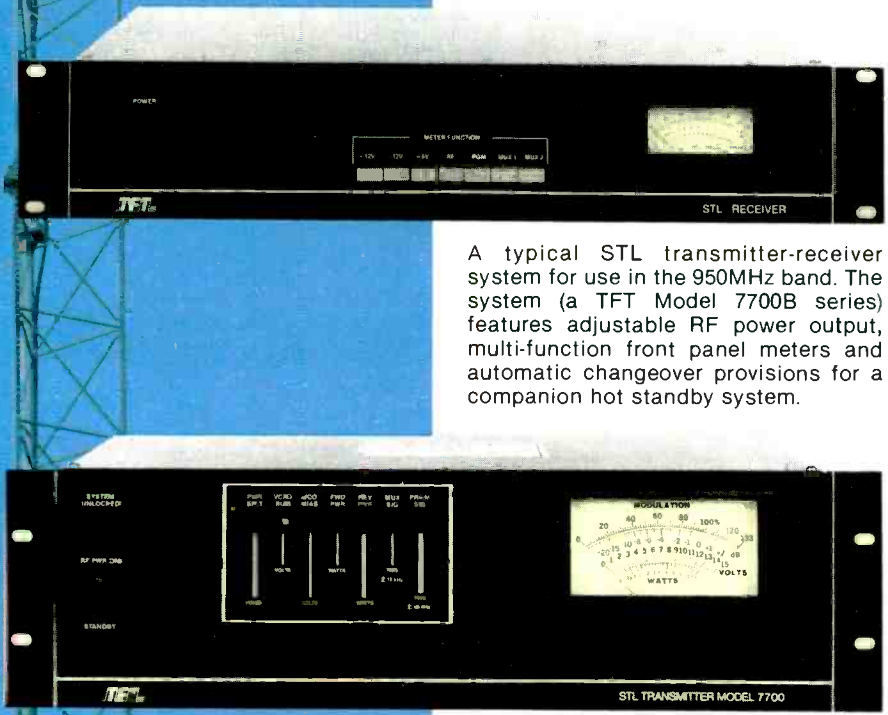


A typical STL system antenna. This particular model (a Scala Electronics PR-450U) features a gain of more than 18dB at 950MHz and a front-to-back ratio of 20dB. Identical antennas are normally used on both the transmit and receive ends of an STL path.

consulting engineer) can prepare a path study for a particular application with the assistance of one or more STL equipment manufacturers. The study generally consists of preparing a profile of the proposed radio path. Two types of graph paper are used for such profiles, each representing the earth's surface as an arc.

A graph whose arc represents 1.33% of the earth's radius, referred to as *4/3 earth* graph paper, is often used. Such an arc is usually optimistic and assumes that all forms of propagation, including refraction effects in a standard atmosphere, will occur.

In many instances, aural STL paths are evaluated with *true earth* radius graph paper. The true earth format has an arc that is representative of the actual curvature of the earth's surface, and is generally considered pessimistic. The reliability of the path should be maximized by proper planning of the receive and transmit points. Figure 1 shows an example of a path profile, and the methods used for assessing its performance.



A typical STL transmitter-receiver system for use in the 950MHz band. The system (a TFT Model 7700B series) features adjustable RF power output, multi-function front panel meters and automatic changeover provisions for a companion hot standby system.

If conditions permit, a first-hand observation is strongly suggested to confirm the information appearing on the charted profile. From the path profile, the length of the path and the heights of the received and transmit antennas are established.

With this information, antennas having the necessary gain and transmission line having known attenuation can be selected to obtain the best performance at a reasonable price. Free-space calculations are the classic method employed to verify the useability of the selected antennas and transmission line.

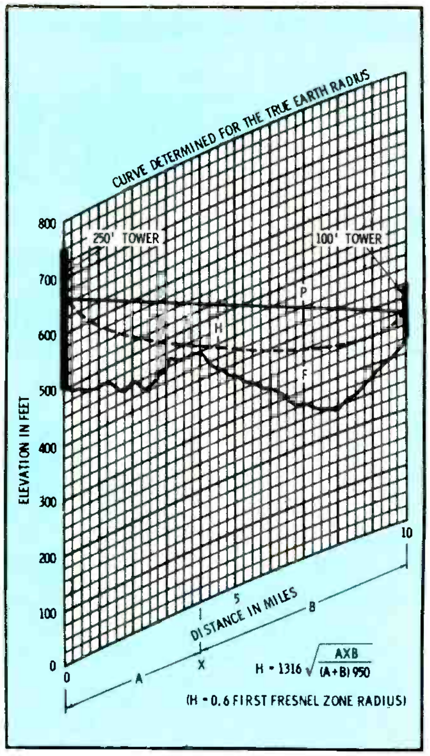


Figure 1. A typical aural STL path profile drawn on *true earth radius* graph paper. Line P between the studio and the transmitter site represents the center of radiation between the STL transmit and receive antennas. The dashed line (F) represents the 0.6 First Fresnel radius from the center of radiation, and is normally considered the minimum required clearance above any possible obstructions. This distance from the center of radiation can be easily calculated, as shown. In this example, a possible obstruction exists at point X. Using the formula shown, a minimum clearance of 66 feet is required at point X. Based upon this information, the minimum height above ground for both the transmitting and receiving antennas of the STL system can be determined.

Selecting STL equipment

The equipment a broadcaster selects depends on the required service. Aural STL gear has been specifically designed for both AM and FM applications and, with the variety of hardware available, most requirements can be satisfied.

As mentioned previously, most STL systems have capabilities besides relaying programming. The link provides radio stations a means of operating a transmitter remote control unit without leased circuits. Secondary program material (such as SCA) or cuing instructions can also be transmitted on the STL.

In using an aural STL, the system transmitter is a frequency modulated design in which varying amounts of pre-emphasis may be used. As with FM broadcast transmitters, 75μs pre-emphasis was common at one time.

More recently, STL equipment hav-

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ing a flat audio response, not employing pre-emphasis in the transmitter and de-emphasis in the receiver, has become available. Systems of this type are easier to set up and operate in AM service, because the pre-emphasis curve does not have to be considered in establishing actual program levels.

STL systems for FM service can be essentially the same as those for AM, if the FM programming is monaural (Figure 2). For FM stereo, two possible configurations exist. The first arrangement consists of two monaural STLs and is typically referred to as a *dual system*. Both radio links operate in a single STL channel with one conveying left channel program audio and the other right channel program audio.

The second possible system for relaying FM stereo programming is the single link *composite* STL. With this arrangement, the stereo generator is located at the studio and the composite stereo waveform is fed directly to the wideband input of the RF exciter in the FM broadcast transmitter (Figure 3).

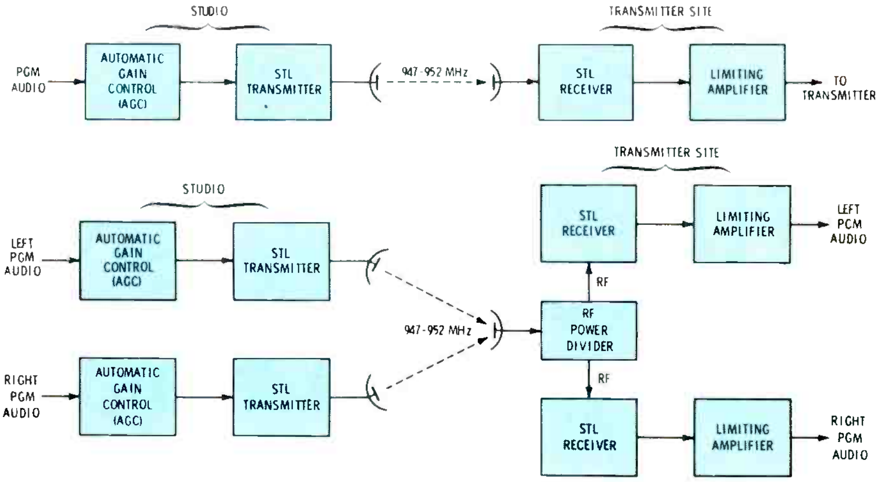

Figure 2. The basic monaural STL system and recommended audio processing equipment is shown in the top diagram. The dual STL arrangement, shown in the bottom drawing, utilizes separate monaural transmitters and receivers to relay left and right channel program audio. Separate STL transmit antennas are normally used with the dual system. An RF power divider can be used to operate the two STL receivers from one antenna, if desired.

An STL for AM stereo can, like the FM stereo systems previously discussed, be configured in one of two basic ways. The first (and most obvious) is the dual arrangement, where program audio for the left and right channels is relayed to the transmitter via two separate RF paths.

The other possible configuration is a modified composite system, using an FM-type stereo generator at the STL transmitter and a companion stereo demodulator at the receiver. The AM stereo composite STL thus provides separate left and right audio (as with the dual STL) to feed the AM stereo exciter at the transmitter, as shown in Figure 4.

Remote control

Remote control can be easily added to an STL system for totally wireless operation of an AM or FM transmitter, as illustrated in Figure 6. Command information for the remote control system is relayed over the STL by

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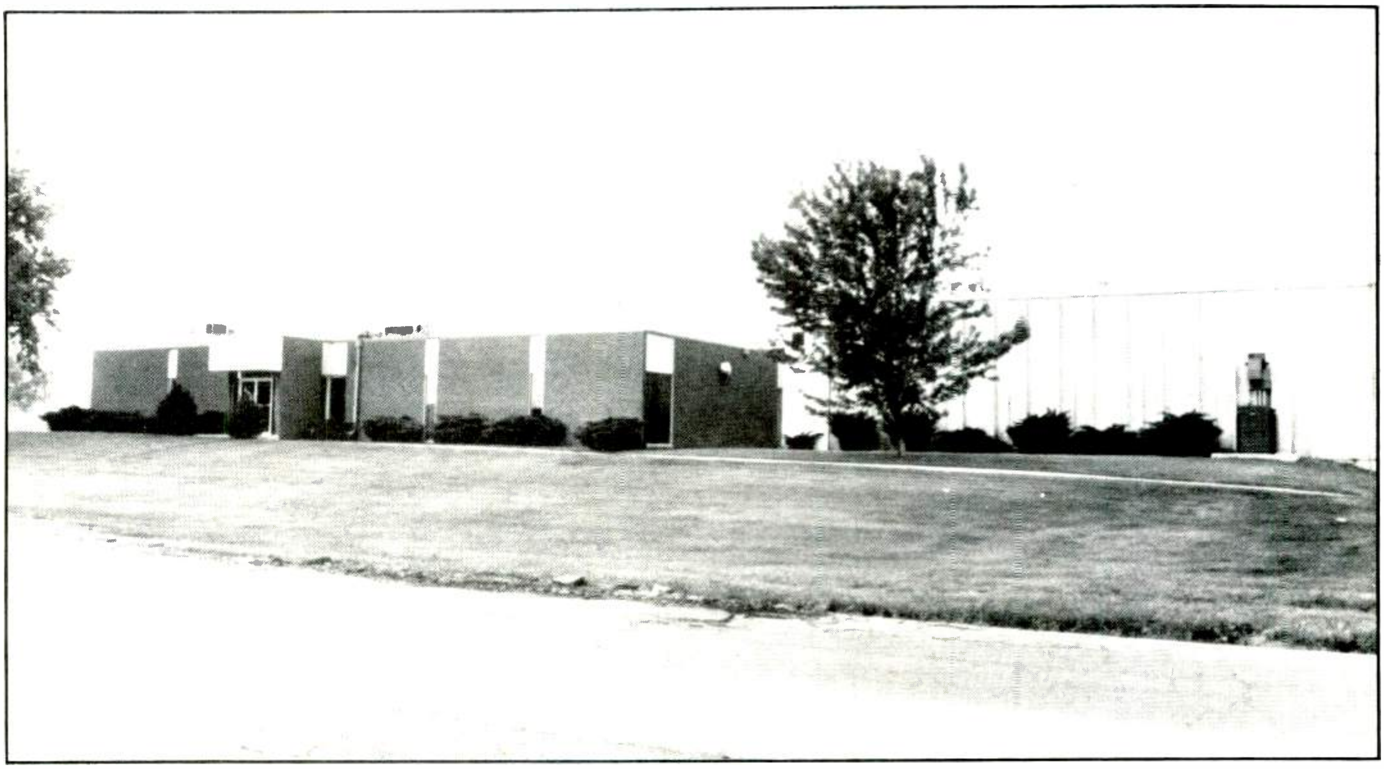

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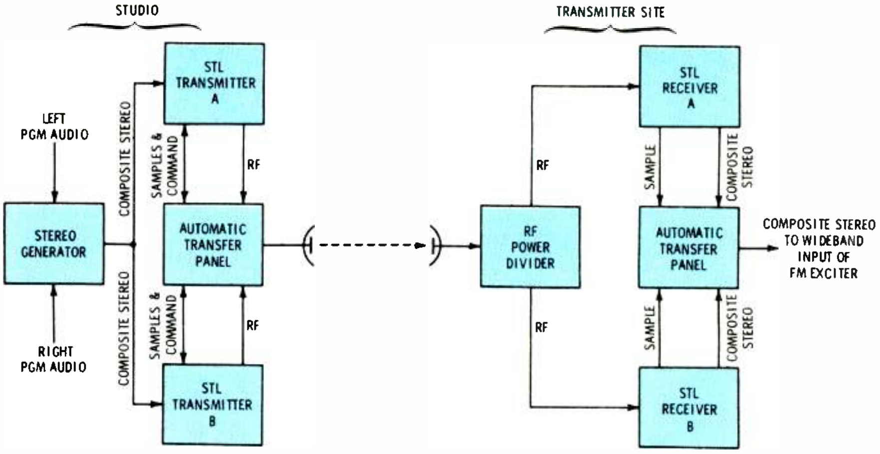

Figure 3. The configuration for a composite STL system with *hot standby* for automatic changeover to backup hardware in the event of equipment failure. The composite STL provides single-link service for FM stereo and allows the stereo generator to be located at the studio. The automatic changeover system shown is usually an optional equipment item.

an FM subcarier in the same manner that an SCA channel is used on an FM broadcast transmitter.

Metering (or telemetry) data returns to the studio via subaudible tones (in the case of an AM system), a subcarrier (in the case of an FM system) or a separate RF link referred to as a transmitter-to-studio link (TSL). TSL systems operate on 8 frequencies near 450MHz and 455MHz, and are referred to as Group P channels of the Aural Remote Pitching Service in the FCC rules.

Rules that establish aural STL service also establish another service—the intercity relay station (ICR). This service provides the transmission of aural program materials between broadcast stations or studios located in separate cities. Many stations are adapting this service to a variety of applications.

Educational radio stations have used another interesting application of the intercity relay link. A number of states operate state-wide FM broadcast facilities, and many of these systems utilize satellite-type FM transmitting stations to ensure total coverage. These satellites function as off-air repeaters and are interconnected by ICR systems where needed.

STL maintenance

Routine maintenance is an important part of STL system field use. Depending upon the STL equipment being used, this maintenance can be as simple as observing operating parameters. Test equipment should also be readily available in the event of a failure. The STL equipment selected will determine the exact requirements, but some basic instruments are worth noting.

A volt-ohm meter (VTVM or DVM) is normally used for basic measurements of dc operating parameters not metered on the equipment. Should the STL transmitter not have a built-in true VSWR bridge, an in-line wattmeter can be extremely useful in locating faults in RF connectors, transmission lines and antennas. Remember, the STL operates in the 950MHz region and any external wattmeter or VSWR bridge must be capable of accurately operating at these frequencies. Constant impedance *type* N connectors are a must.

An oscilloscope can greatly simplify many checks, particularly problems related to the audio and power supply sections of both the transmitter and the receiver. The upper response characteristics of the scope need not extend to 1GHz. While 100MHz capability can be useful, a 10MHz oscilloscope may be more within most budgets.

Because the frequency of the STL

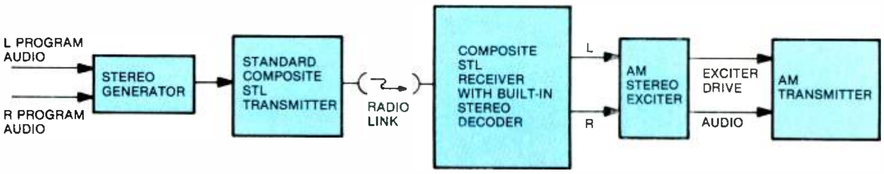

Figure 4. A basic AM stereo composite STL system. By converting the left and right audio channels into a composite waveform at the studio and then decoding them at the transmitter, differential frequency response and phase shift that could affect the L + R channel are eliminated.

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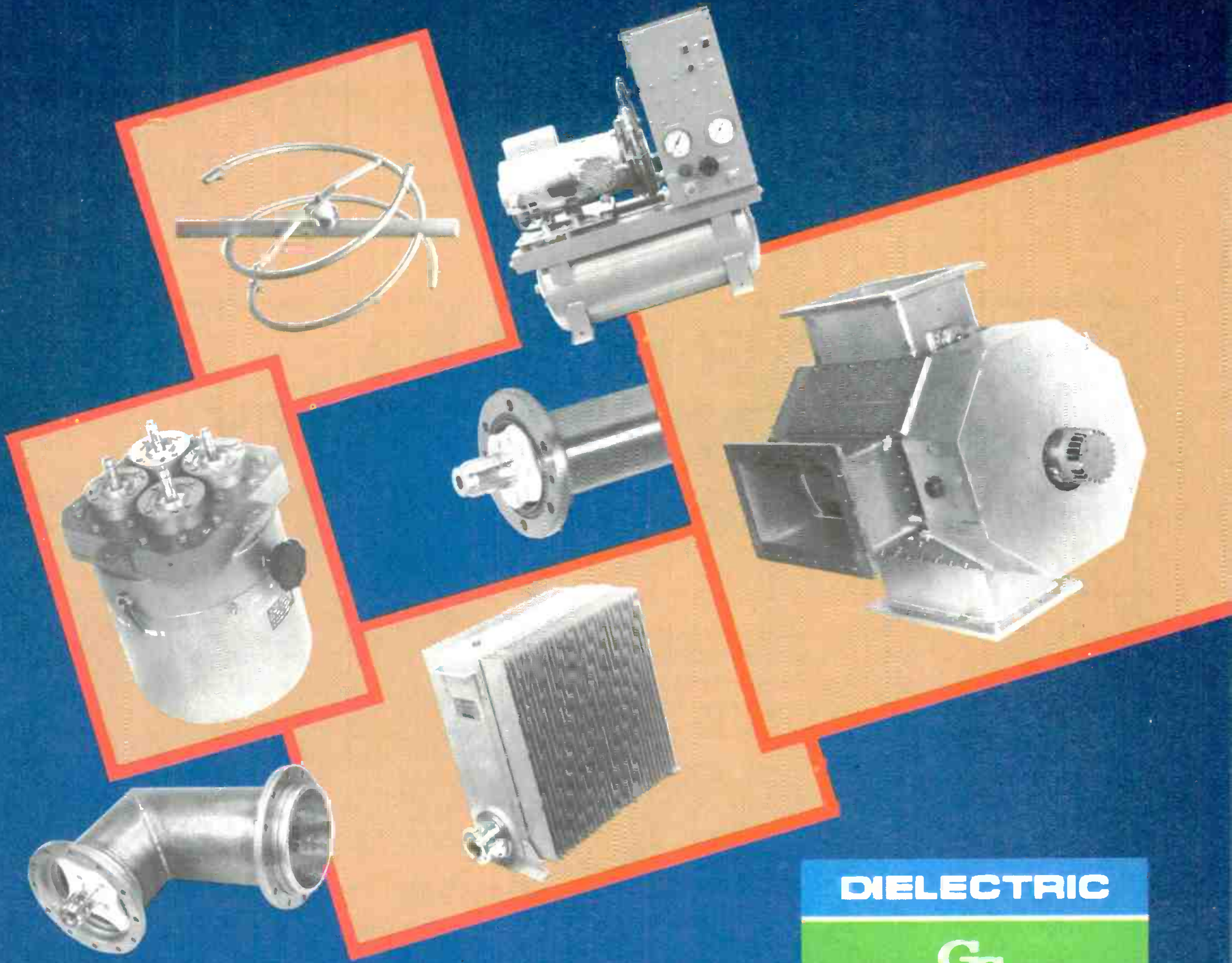

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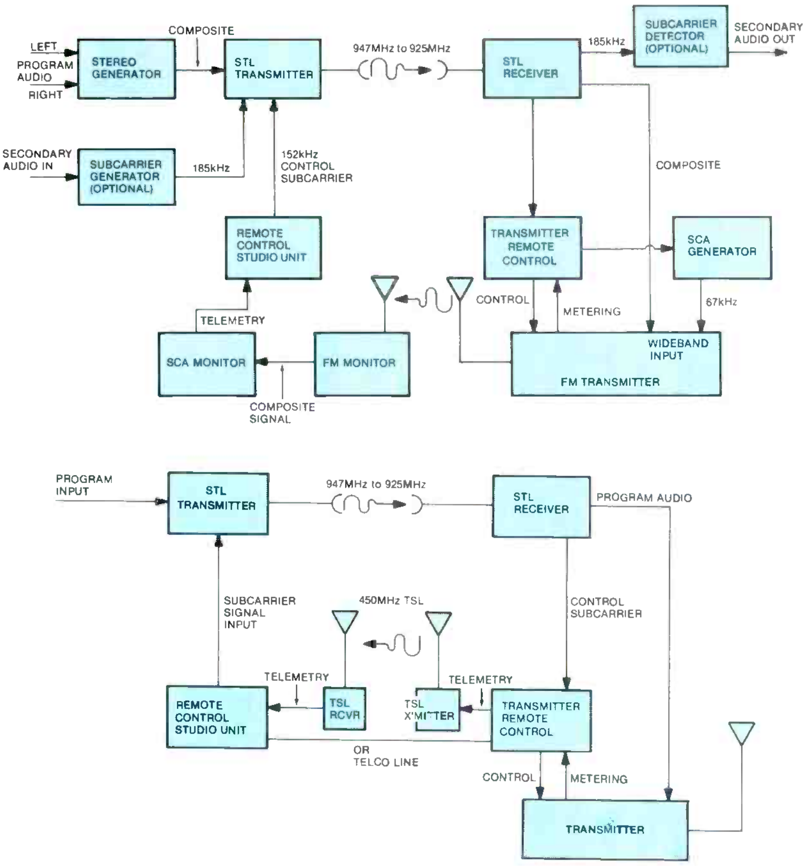

Figure 5. Some of the methods available for transmitter remote control and telemetry data return when an STL system is used. The top diagram shows a common application for an FM stereo system. The bottom drawing illustrates telemetry return that can be used in AM or FM applications.

transmitter must be periodically verified, an accurate frequency counter should be obtained. Counters capable of verifying the operating frequency are now economical and should be part of any station's inventory of test equipment.

In addition to the STL transmitter's carrier frequency, it is possible on some equipment to measure externally the frequency of the system's reference oscillator. The TFT Model 7700, for example, has all frequencies locked to a 10MHz temperature compensated crystal oscillator (TCXO) reference that is available for measurement purposes at a rear panel connector.

A frequency measurement service may, of course, also be used to check the operating frequency of an STL transmitter. It is not necessary to actually own all test equipment needed to troubleshoot a system if the gear can be easily rented or borrowed from a local source. The test equipment used for the transmitter will also be of great help with receiver testing.

Editor's note:

Broadcast Engineering carried three articles in the November 1983 issue on the planning, installation and operation of STL systems. The articles are:

- "The Propagation Path," pp. 19-28.
- "Aural STL Systems," pp. 31-48.
- "An STL Path Analysis Program," pp. 62-64.

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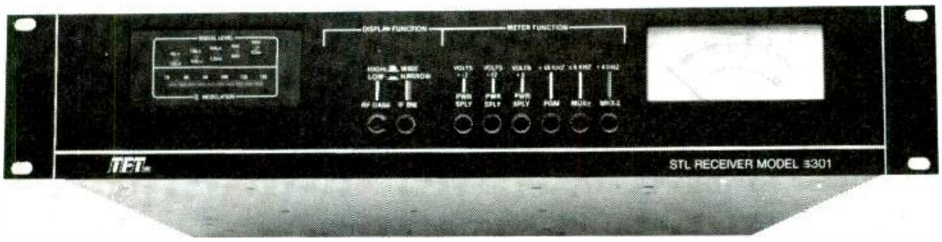

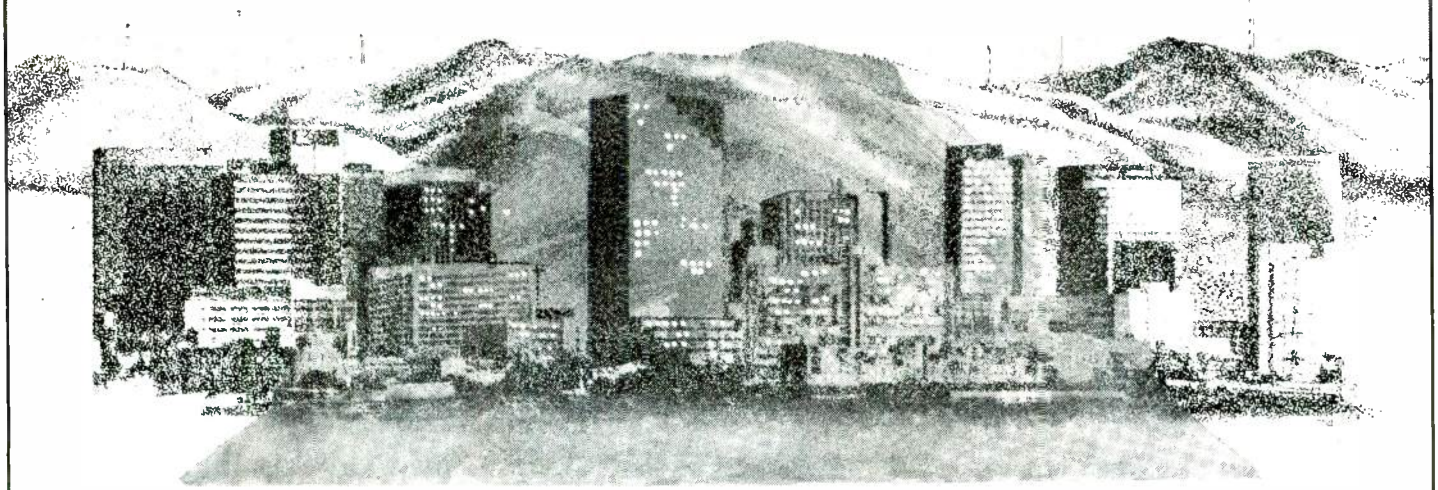

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Plant tour: Broadcast Electronics

By Jerry Whitaker, radio editor

Taking a stack of parts and sheet metal and weaving them into a working piece of broadcast equipment is truly an art form. Each company has its own way of producing the equipment that makes up its product line, and each has a particular philosophy regarding construction.

As a long-time user of broadcast equipment, I find it fascinating to see how companies build the hardware that we engineers take for granted. I recently visited the manufacturing facilities of Broadcast Electronics in Quincy, IL, and viewed first-hand its production methods and philosophy.

Broadcast Electronics was founded in 1959, manufacturing tape cartridge machines from a small factory in Silver Springs, MD. The original cart deck—which was developed by engineers at radio station WWDC, Silver Springs—was among the first magnetic tape cartridge machines manufactured for broadcast stations. In the 25 years since the company was founded, more than 35,000 cart machines of various designs have been built.

Today, Broadcast Electronics occupies a 70,000 square-foot manufacturing and engineering plant in Quincy. The product line includes cartridge tape machines, automation equipment, FM transmitters, audio consoles and turntables.

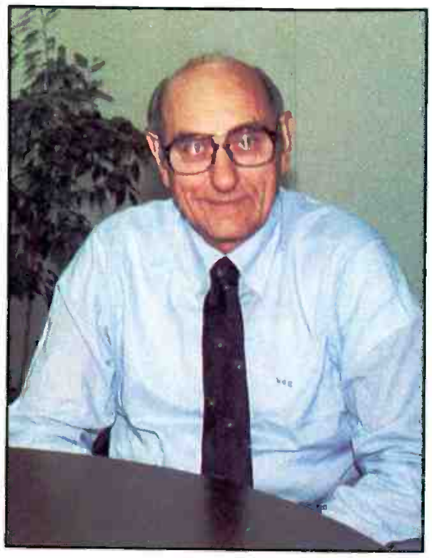
Product engineering

All electronic products the company manufactures start in the design engineering department, which is composed of four specialized groups—Audio Products, Digital Products, RF Products and Mechanical Engineering—each headed by a section manager. The work is divided into two separate areas—small signal development and transmitter development.

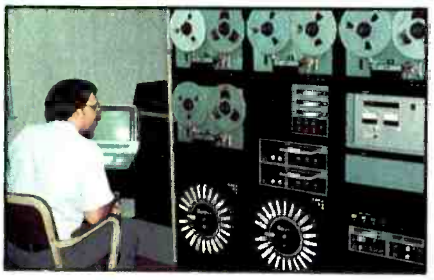
The small signal development area encompasses any product design task that is small enough to build on a work bench. Audio, low level RF, digital and cartridge equipment are developed and refined in this area. After an engineer designs a particular circuit, it is breadboarded and checked. A design may go through several refinement stages before it is ready for production.

The large assembly development lab—where transmitter work is done—is located separately from the small signal work area because of the space requirements of such equipment. Other reasons for this division include the special power and cooling needs of transmission gear and the dangers involved with exposed high-voltage areas.

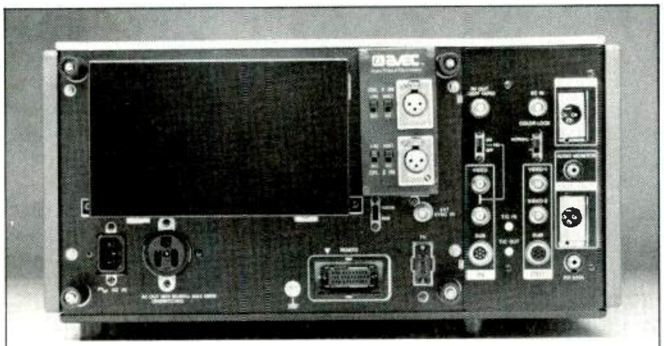
One of the recent developments from the company's engineering lab was a transmitter parameter video display and diagnostic system, shown at the 1984 NAB convention. The system includes a CRT monitor mounted on the front panel of the transmitter that provides the operator



(Above) Larry Cervon, president of Broadcast Electronics.



Broadcast Electronics (upper left), Quincy, IL, supplies studio and transmitter equipment to the radio industry. A *Control 16* automation system (bottom left) undergoes system performance tests in the factory demo room. The small signal development engineering lab works on prototypes of audio, digital and low level RF equipment (lower right).



or engineer with a visual readout of all important operating parameters in several different formats, including a *real-time* bar-graph display.

This feature allows the user to make a status assessment of the entire transmitter with a single glance at the CRT display. It also makes tuning adjustments on a particular stage easier, because the effects of the tuning on all stages of the transmitter can be observed simultaneously. The display eliminates the usual procedure where the engineer makes an adjustment and then runs through all of the front panel readings to see the effects.

The company's biggest change has been its introduction of a line of FM transmitters. The RF product series has evolved for several years. Work began on the first transmitter produced by the firm—the FM-30 (30kW)—in 1978. The unit was introduced to the industry in 1980.

Five transmitters of various power levels have been added, some building on the technology developed for the FM-30, such as the folded half-wave cavity PA stage. The company, following an industry-wide trend, is moving toward modular transmitter construction for production efficiency and design simplicity.

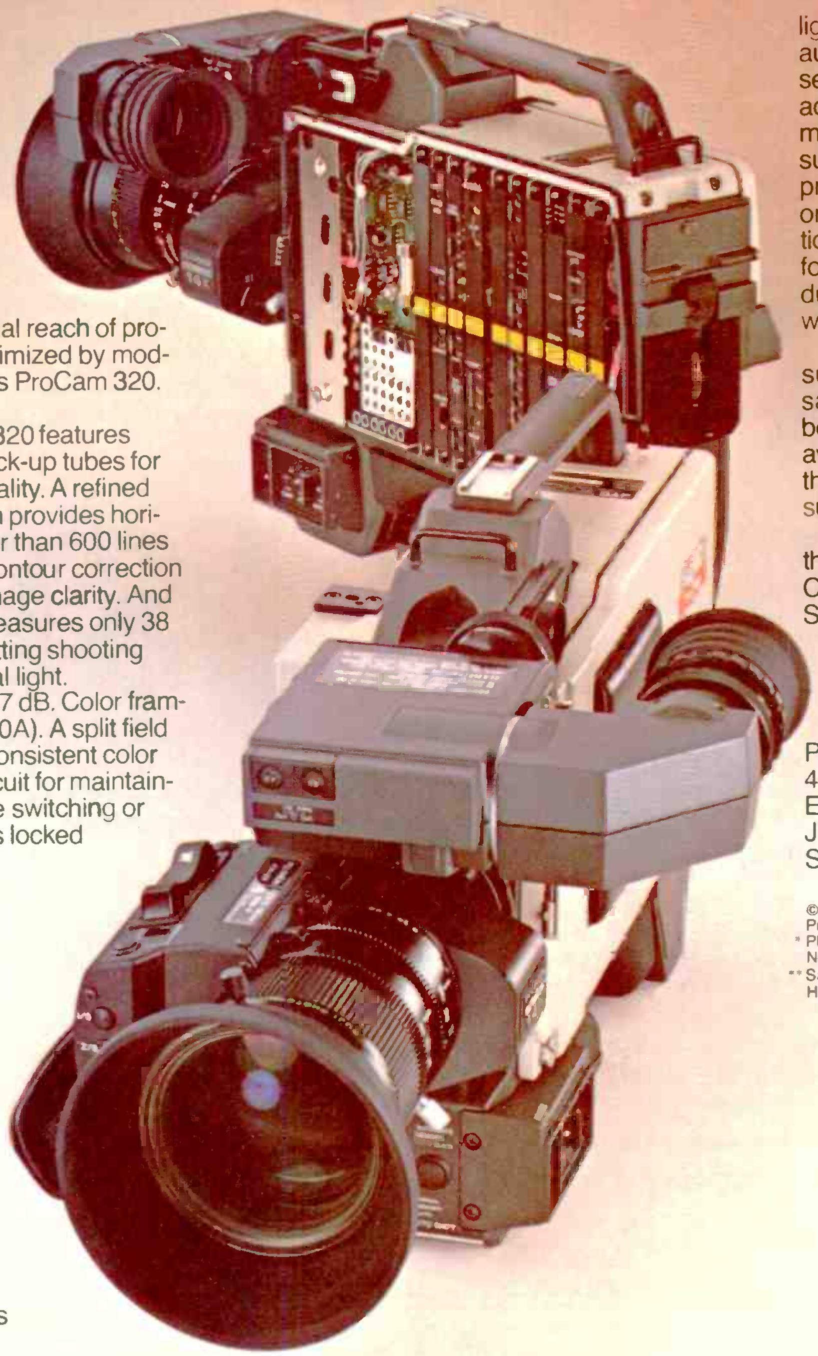
Another recent development is the design of an AM stereo exciter with several interesting features. A frequency synthesizer circuit has been

A technician tests the company's new transmitter status video display unit installed in a 3.5kW FM transmitter. The large assembly development lab, where transmitter work is done, is separated from the small signal lab.

Software development work takes place in a separate area of the engineering lab. Special prototype test fixtures simulate transmitter operating parameters in the development of the CRT status display unit (center).

320.

The ProCam™ Video Camera with Plumbicon* tubes at Saticon** price.



JVC's experience – and success – in designing the highest quality and reliability into compact video production cameras is unmatched. Now, continuing this tradition of high performance at an affordable price, JVC has brought a "high-end" teleproduction camera within the financial reach of production people often victimized by modest budgets. This time, it's ProCam 320.

What a package!

SENSITIVITY. ProCam 320 features three, 2/3" Plumbicon pick-up tubes for incomparable picture quality. A refined f/1.4 prism optics system provides horizontal resolution of better than 600 lines at center. A 2H vertical contour correction circuit further assures image clarity. And minimum illumination measures only 38 lux (3.6 fc) at f/1.7, permitting shooting even in limited or artificial light.

A video S/N ratio of 57 dB. Color framing output signal (RS-170A). A split field color bar generator for consistent color reference. A genlock circuit for maintaining a stable picture while switching or mixing with other signals locked on the same source.

EASY OPERATION. Several 8-bit data memory chips offer operator conveniences for quick set-up and consistent performance. These include: Auto centering, auto-black balance and auto-white balance, auto black level stabilization and auto beam control circuits. Matrix masking for true color reproduction and automatic protection for the pick-up tubes are a few of the many features standard on this new camera.

VERSATILITY. Easy portability. Outstanding performance in low-level lighting. High degree of automation. An extensive selection of options and accessories combine to make the ProCam 320 suitable for both studio production, EFP, or ENG; or, indeed, to any application, anywhere, that calls for top quality video production while staying within a tight budget.

PROCAM TECHNICAL SUPPORT. Your ProCam sales representative will be happy to explain the availability and calibre of the ProCam technical support program.

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Professional Video Division
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PROCAM

JVC

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Professional Video Division

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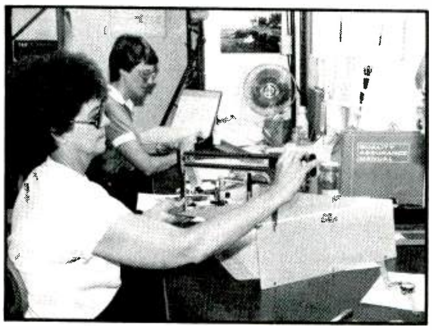
developed for the company's new C-QUAM AM stereo generator, allowing the carrier frequency of the station to be locked to WWV or another high-accuracy frequency standard. This feature is designed to address the "platform motion" problem, a possible concern for AM stations broadcasting in stereo with the C-QUAM format.

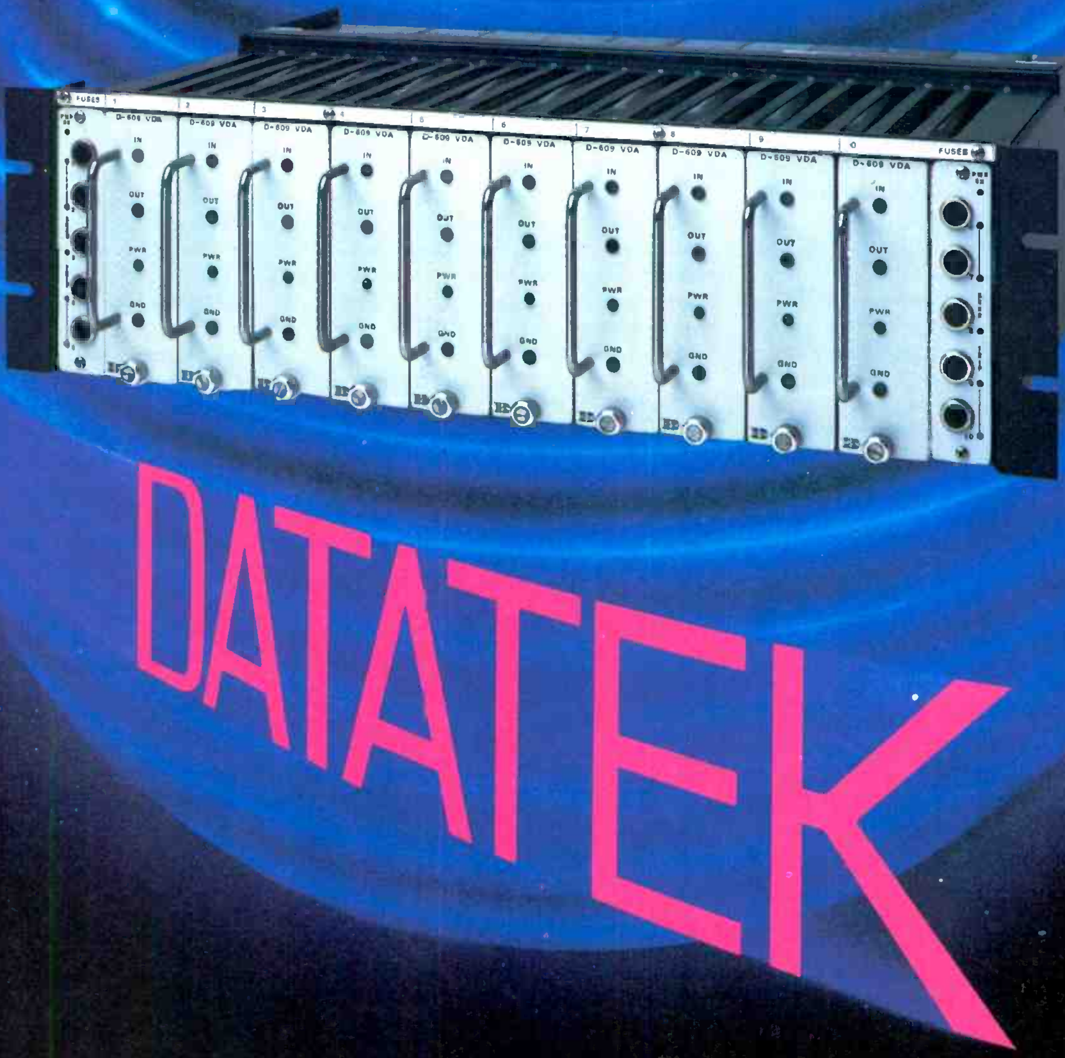
Company engineers report that if stations experiencing "platform motion" problems because of co-channel interference cooperate with each other and lock their carrier frequencies to a reference standard, the problem can be eliminated. This approach has been used successfully by televi-


At the machine shop, mechanical components are formed and milled, including turntable platters, cartridge components and transmission gear assemblies.


A portion of the incoming component and assembly quality control testing area. Workers here sample-test materi from vendors for specifications.


The company stockroom of small and medium-sized comonents, with similar parts stored in "family groups."

IN THE WORLD OF DA's... ONE NAME STANDS OUT–



HIGH QUALITY...products that equal or surpass the most demanding specifications.

FAMILY OF COMPATIBLE MODULES...fill your exact needs. Choose from a wide variety of video, pulse, time code, audio and switching modules.

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sion stations for years to reduce co-channel interference.

Developing a new product is a complicated procedure that involves analyzing the needs of the user, the market for the product and the technology available. Although development times for various products can differ greatly, the minimum period for pre-production work is usually about 9 months. The longest might be 2 to 2½ years.

The manufacturing process

The company bases its production work on predictions of future sales. It purchases components and builds units in anticipation of need, rather than in response to specific orders. The advantage is that the lead-time for customer orders can be reduced substantially.

The typical lead-time for a transmitter, for example, could be 6 months (from the time the individual parts are ordered from the vendors until the product is completed). Most customers, however, will not wait that long. Producing in anticipation of need—while posing some risks to a manufacturer—is required for quick response to marketplace demands.

Lead-times for complex pieces of equipment such as automation systems and transmitters can often be substantial because of the large number of specialized components required in the units.

When material from vendors arrives at the Quincy plant, it is sample-tested for adherence to specification at an incoming component quality control (QC) check point. This QC test includes not only individual components, but sub-assemblies for various pieces of equipment.

Components are stocked in a central storage area in so-called "family groups," with similar parts grouped together. As production schedules demand, stockroom personnel assemble the required components for various manufacturing runs. These packages are then delivered to the assembly lines as needed. The stock room also houses various PC boards built at the plant's assembly lines in anticipation of need.

The machine shop makes the individual mechanical components required for the products that Broadcast Electronics manufactures. Typical machined items include turntable platters, cartridge tape deck components and specialized assemblies for transmission gear. An outside vendor makes equipment cabinets and front panel cut-outs. The company paints and silk screens all front panels and cabinets.

One of the printed circuit board assembly lines, which produces all the boards used in the company's products.

A technician assembles a transmitter wiring harness at a wire harness construction station.

A technician, using wiring harness, combines electrical sub-assemblies and mechanical components to form a finished system.

Printed circuit boards are assembled in a central area of the plant. The PC assembly line produces the boards that are used in all of the company's products. After the cards are populated, they are run through a flow solder machine and then through a degreaser, which cleans the boards. The PC cards are next passed through a QC check and returned to the stockroom.

The cable work for any major piece of equipment—such as an automation system, audio console or transmitter—is vitally important to the performance and serviceability of the unit. All cable harnesses are constructed on wiring forms and the individual wires in each harness are numbered for identification.

Units are assembled in separate areas of the plant for the various product lines. The system assembly stage brings together the mechanical hardware, PC boards and wiring harness to produce a finished product.

Following the unit assembly stage, the product is aligned and checked for proper performance at one of several quality control stations. Products also go through a burn-in process to weed out any problem components, usually integrated circuits. In the case of cart machines and turntables, the units are cycled to simulate normal use.

After final inspection, the finished products are put on the shelf for shipment to customers. All small items are packed in a special foam material to prevent damage during shipment.

Transmission equipment

System assembly areas for transmission equipment are divided into low power (5kW and below) and high power. Sub-assemblies built in other parts of the plant are brought together with the wiring harness and mechanical hardware to form a completed transmitter. One person works on a transmitter at the "cabinet level." When completed, the transmitter is tuned and proper operation of all control circuits is verified. A full proof-of-performance—including an RF proof—is then run.

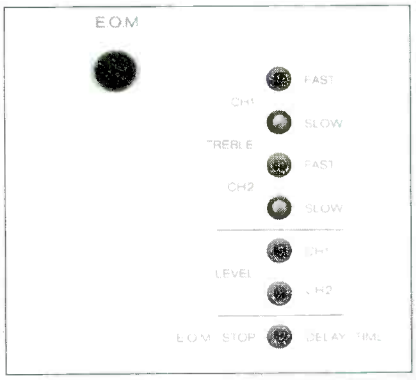
Automation equipment is assembled in still another portion of the Quincy plant. As before, circuit boards and sub-assemblies made in other areas of the facility are brought together with the wiring harness and mechanical hardware to form a completed unit. Test programs are then run on the system to confirm proper operation.

All mechanical and electrical drafting work is done by a central drafting department. The drafting staff prepares documentation drawings for internal company use and equipment instruction manuals. The drafting

The Revox Automation Advantage

The new Revox PR99 Playback Only presents a ten point program for more cost-effective broadcast automation.

1. Compatible with Existing Systems–The PR99 Playback Only is fully compatible with practically every existing broadcast automation system. In many cases it can be swapped for existing decks in a matter of minutes.



2. Front Panel Controls–Immediate access to repro levels, EOM stop delay time, and treble EQ for both speeds. Mode switch selects track 1, track 2, mono, or stereo; a calibrate/uncalibrate button switches from front panel adjustable output to standard reference level.

3. EOM Stop Delay–Adjustable from 0 to 24 seconds. Front panel indicator illuminates when 25 Hz signal present.

4. Switchable Sensor Circuit–The 25 Hz sensor circuit may be switched out of the signal path to allow extended bass response.

5. Easy Maintenance–Modular plug-in circuit boards make servicing a breeze. Most parts subject to wear are easily accessible and quickly replaceable.

6. Lightweight and Compact–Weight is a mere 40 pounds. Front panel dimensions are 19" x 15¾"; depth is 8". Rack mount flange is standard.

7. All Formats–Choose mono or 2-track stereo; 3.75/7.5 or 7.5/15 ips speed combinations.

8. One Plug Does All–A single Cannon multipin connector carries all the audio, status, and remote signals. These signals may also be accessed through parallel XLR and DIN connectors.

9. Studer Revox Quality–A fully professional machine in every respect, the PR99 Replay Only features die-cast aluminum alloy chassis and head-block, servo-controlled capstan motor, contactless full logic switching, and a Studer-made play head. Careful German craftsmanship shows in meticulous attention to every detail.

10. Attractive Pricing–Best of all, the new PR99 Playback Only actually costs less than last year's best-selling reproducer. So before you order an automation system or replace your present decks, call or write for more details. You'll find that the Revox Automation Advantage was well worth the wait.

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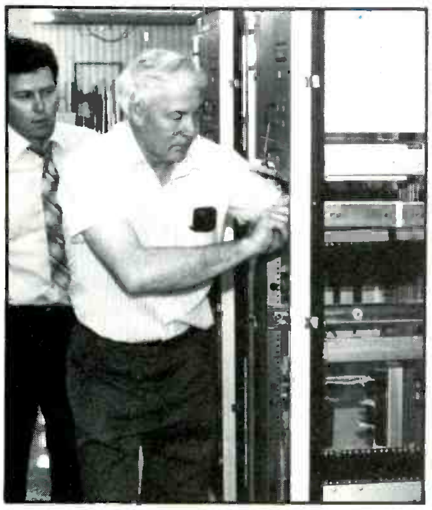

At the medium- and low-power transmitter system assembly area, subassemblies and mechanical hardware are combined with wiring harness to form the finished unit.

A cartridge tape machine is aligned and tested for proper performance (left). Cart machines are cycled to simulate normal use.

Technicians adjust a 300W dual transmitter before performance testing.

department also prepares all circuit board artwork.

Customer service

The customer service department works closely with the engineering and production departments on any problems that customers may experience in the field. Customer service is an important part of any broadcast equipment manufacturing operation. When a problem occurs at a station, it is rarely a minor event.

Radio and TV engineers require, and demand, a high level of support from the factory because of the need for continuous, uninterrupted performance from all equipment. The ability to react quickly to a customer's need for information or replacement parts is a key part of this support. Field service engineers can often assist station personnel in preparing a problem over the phone, or at least direct the engineer to the probable cause.

Future plans

The company has a number of items on the "front burner," including expansion of current product lines and the introduction of new ones. Expected soon are a new modular audio console, 10kW FM transmitter, AM stereo exciter and multichannel TV sound generator.

Stereo TV is the one to watch.

Flash. *Stereo TV is the hot topic at the 1984 Consumer Electronics Show in Chicago.*

Flash. *Every major TV set manufacturer plans to put multichannel units on the street by 1985.*

Flash. *NBC announces The Tonight Show and Friday Night Videos will soon be recorded in stereo.*

Flash. *ABC tests bilingual broadcasts of The Fall Guy in Spanish markets; ratings soar.*

Flash. *NEC introduces VHF and UHF transmitters with full stereo sound.*

In 1977.

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Stereo TV may be hot, but it's nothing new at NEC.

You see, we prototyped it way back in 1969. And signed on with our first multichannel transmitter in 1977.

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Tested. Tenured. And fine-tuned.

Stereo TV Transmitters. Right now. From NEC.

Stereo TV is just a matter of when. So what can you do now?

Well, you could buy unproven technology. And pray that you don't pay for trial and error. Sooner and later.

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RF power amplifiers

By Clarence Daugherty, senior broadcast technology instructor, Harris Broadcast Group, and Jerry Whitaker, radio editor

Our examination of PA plate overload problems continues this month, with a look at the theory of operation of tetrode tubes commonly used in radio and TV transmitters. Efficient and accurate troubleshooting requires an understanding of the principles upon which proper operation of the equipment is based. Usually the most critical part of a station's transmission system is the RF chain in the transmitter, specifically the power amplifier stage. The heart of any PA circuit is the power tube itself.

The most common FM and TV transmitting tube is the tetrode. An understanding of how the tube works begins with an understanding of its component parts.

Anode (plate) structure

The plate of a tetrode power tube resembles a copper cup with the upper half of the plate contact ring welded to the mouth and the cooling fins silver soldered or welded to the outside of the assembly (Figure 1).

The lower half of the anode contact ring is bonded to the base ceramic spacer. At the time of assembly, the two halves of the ring are welded together.

Screen grid structure

The screen grid consists of a number of vertical supports fastened to a metal base cone. The lower end of the cone is bonded to the screen contact ring, as shown in Figure 2. The inductance of the individual vertical supports is reduced by building the screen grid using a large number of the conductors in parallel.

The vertical supports are held rigid by horizontal rings welded to the supports and a metal cap on the top of the assembly. The detailed construction of the screen contact ring, metal base cone and cylindrical metal base give the assembly low lead inductance and RF resistance.

A cutaway view of the plate and sceen circuit (Figure 3) shows the concentric construction that resembles a coaxial transmission line.

The current path

The plate-to-screen circulating current of the tetrode is shown in Figure 3. As an example, consider that the output RF current is generated by an imaginary current generator located between the plate and screen grid.

The RF current travels along the inside surface of the plate structure, because of the skin effect; through the ceramic at the lower half of the anode contact ring; around the anode contact ring; across the bottom of the fins; and to the band around the outside of the fins. The RF current then flows through the plate bypass capacitor to the RF tuned circuit and load, and returns to the screen grid.

The return current travels through the screen bypass capacitor and screen contact ring, up the screen base cone to the screen grid and the imaginary generator.

The screen grid has RF current returning to it, but because of the assembly's low impedance, the screen grid is effectively at RF ground potential. The RF current generator, therefore, appears to be feeding an open-ended transmission line consisting of the anode (plate) assembly and the screen assembly. The RF voltage developed by the anode is determined by the plate impedance

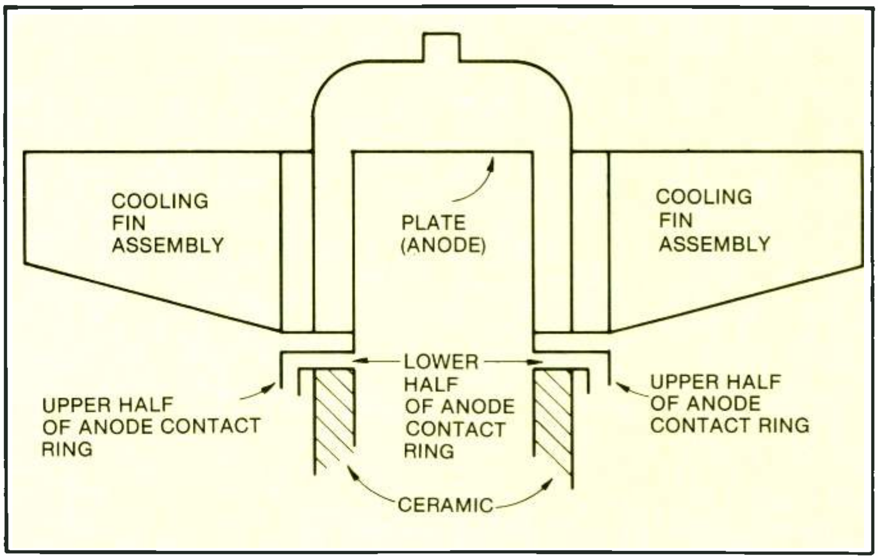

Figure 1. A cutaway view of the anode structure of a tetrode RF power amplifier tube of the type used in FM and TV transmitters.

OPTIMOD®-AM STEREO.

MOTOROLA APPROVED

In the past, if you were considering C-QUAM®AM stereo, the exciter manufacturer may have suggested a certain audio processor. But now you have a choice—after extensive testing in Motorola's lab, OPTIMOD-AM Model 9100A/2 with the new #1-S Stereo Compatibility Card has been fully approved by Motorola for use in C-QUAM installations. There are *already* scores of 9100A/2's driving C-QUAM exciters. Now that Motorola is telling its customers and using the 9100A/2 to demonstrate their system at trade shows and technical exhibitions, we expect OPTIMOD-AM to become an even more popular choice for C-QUAM stereo. (In addition to C-QUAM, the versatile 9100A/2 can be configured to operate ideally with *any* of the other AM stereo systems.)

OPTIMOD-AM: The Original AM Stereo Matrix Processor

Our 9100A/2 was designed *from the ground up* for the matrix (sum-and-difference) processing that is necessary to achieve full loudness on mono radios. So we only need to use *two* carefully-harmonized AGC stages from input to output: a slow "hand on the pot" AGC, and a six-band limiter with patented distortion-cancelled multiband clipper. The result? Competitive loudness is complemented by uncanny smoothness and naturalness. Pumping and other processing artifacts are below perceptibility. And efficient single-chassis card-cage construction assures easy circuit board access without removing the unit from the rack.

In contrast, the competition added a matrix processor onto an existing non-matrix system. There are four boxes, four power supplies, and up to *six* stages of AGC in cascade. One large board is used per box, making updates and repairs inconvenient. Is it any wonder that this system not only introduces more processing artifacts, but is also substantially *costlier* than OPTIMOD-AM?

Single-Channel Modulation Control

To prevent distortion in C-QUAM receivers, Motorola recommends limiting single-channel modulation to 75% negative. In published advertising, our competitor has falsely claimed that our system works by switching to mono under single-channel conditions. In fact, we perform as much control as possible by L and R clipping. Distortion is prevented by a variable-blend circuit which reduces L-R gain as necessary to prevent overdriving the clippers. On most program material, the effect is inaudible. On material with extreme stereo separation, image width is slightly reduced. However, the signal never becomes mono, or even close to it. And sound on mono radios *is never audibly affected.* Because most of your diary-holders will be listening in mono for some time to come, we think this point is crucial.

In contrast, our competitor performs this control by means of limiters in the L and R channels. If the limiters are not coupled, this can cause a stereo image shift similar to "platform motion." And this circuit can punch "holes" in both stereo *and* mono when the limiters act.

As usual, there's no free lunch. But Orban's system fully protects your mono listeners, while our competitor's doesn't.

Preemphasis

OPTIMOD-AM offers a continuously-variable front-panel HF EQ control. This boosts high frequencies to extend the effective bandwidth of the receiver, providing a sound more competitive with FM. Its curves were computer-optimized on the basis of a two-year engineering study of typical auto, table, and portable radios. With the introduction of new wider-band AM stereo radios, we made available three plug-in modules which can change the *family of curves* produced by the HF EQ control to suit the needs of your target audience. In addition, we provide a fully-parametric BASS EQ control.

The competition offers an EQ control on their matrix processor which provides only a single curve family of unspecified origin. If you use their four-band compressor, you also get a four-band graphic-type equalizer.

We believe that most stations do not want or need excessive numbers of equalization controls which, if misadjusted, can easily produce colored, honky, unnatural, and fatiguing sound. OPTIMOD provides controls to get the sound right—not controls to lead you astray.

But if your situation demands a broader equalization range, you can combine our 622B stereo Parametric Equalizer with OPTIMOD-AM to create an integrated *system* with far more powerful equalization capabilities than the competition—at about the same cost as our competitor's processor alone!*

Consistency

Many consultants now believe that one of the keys to a polished, professional, audience-building sound is *consistency* in texture and tonal balance from source to source. OPTIMOD-AM's six-band limiter with steep-slope crossovers provides this consistency automatically—laborious re-equalization and processing in the production studio are almost never required.

Even with their four-band compressor, the competition can't match this level of consistency because of their compressor and crossover design. The longer you listen, the more you'll appreciate OPTIMOD-AM's superiority.

Protecting Your Investment

We like to think that Orban earned its #1 place in audio processing with a solidly-engineered and superb-sounding product line which is backed with ten years of quality, reliability, and customer service—plus the best manuals and documentation in the industry. Plug-in construction allows low-cost updates as AM stereo technology advances. All these factors combine to protect your substantial investment in AM stereo processing—for C-QUAM, or any other system.

Fighting The FM Challenge

Your FM competition is after your audience share. OPTIMOD-AM offers a remarkably favorable tradeoff between loudness and processing artifacts, plus smoothness, consistency, and a bright, open sound that holds its own against FM stereo—on *real-world* AM radios.

When you add it all up, it becomes clear that there's really only *one* choice for AM Stereo processing: OPTIMOD-AM 9100A/2.

—Robert Orban

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Ask your Dealer if he can provide a No-Obligation evaluation demonstration in your station.

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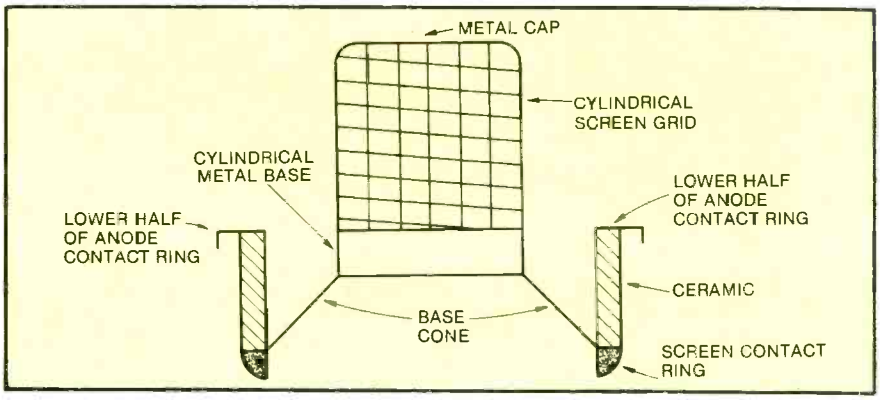


Figure 2. The screen grid assembly of a typical tetrode PA tube.

(Z_p) presented to the anode by the resonant circuit and its load.

Control grid and cathode

The control grid and cathode assembly are also cylindrical and concentric. The control grid is built in a manner similar to the screen grid, but slightly smaller in height and diameter. Figure 4 shows the anode, screen grid, control grid and cathode assemblies as they are located in the tetrode tube.

Figure 4 also illustrates the current path of an RF generator (the RF driver stage output) feeding a signal into the grid/cathode circuit. The grid/cathode assembly resembles a transmission line whose termination is the RF resistance of the electron stream within the tube.

The outer contact ring for the cathode heater assembly makes up the inner conductor of a transmission line formed by the cathode and control grid assemblies. The filament wires are returned down the center of the cathode assembly.

Cathode bypassing

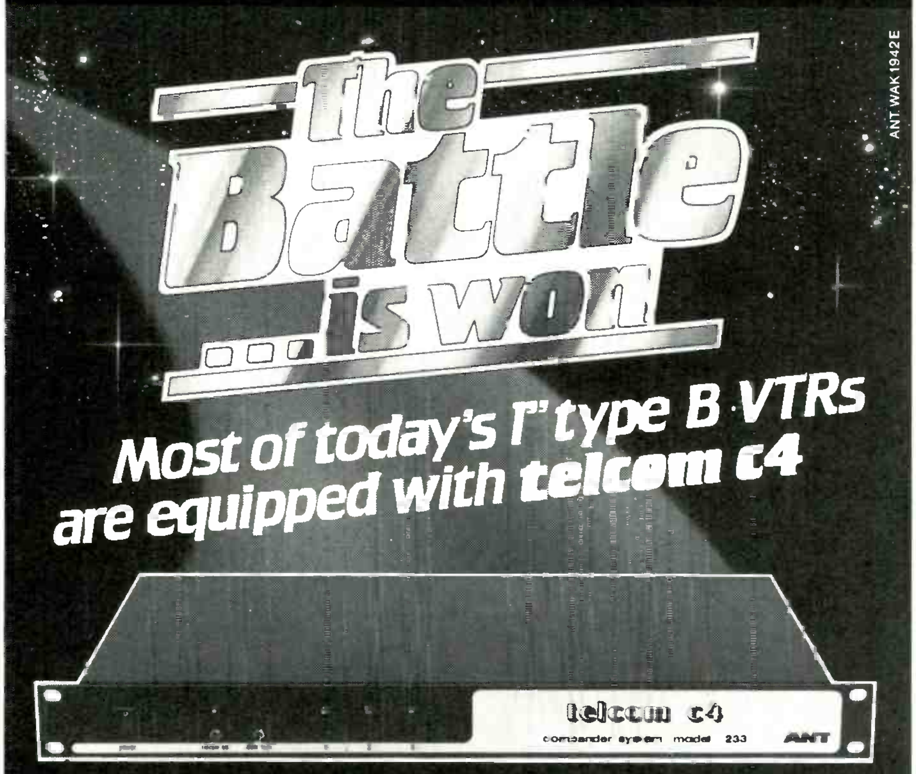
For the tube input circuit to work correctly, the cathode must have a low RF impedance to ground. This cathode *bypassing* can be accomplished in several ways.

Below 30MHz, the cathode can be grounded to RF voltages by simply bypassing the filament connections with capacitors, as shown in Figure 5 (a).

Above 30MHz, this technique does not work well because of the stray inductance of the filament leads. Notice that in Figure 5 (b), the filament leads appear as RF chokes, preventing the cathode from being placed at RF ground potential. This causes negative feedback and affects the efficiency of the input and output circuits.

In Figure 5 (c), the cathode circuit is configured to simulate a ½-wave transmission line. The line is bypassed to ground with large value capacitors ½-wavelength from the center of the filament (at the filament voltage feed point). This transmission line RF short is repeated ½-wavelength away at the cathode (heater assembly) and effectively places it at ground potential.

Because ½-wavelength bypassing is usually bulky and expensive, transmitters are often designed using certain values of inductance and capacitance in the filament/cathode circuit to create an artificial transmission line that will simulate a



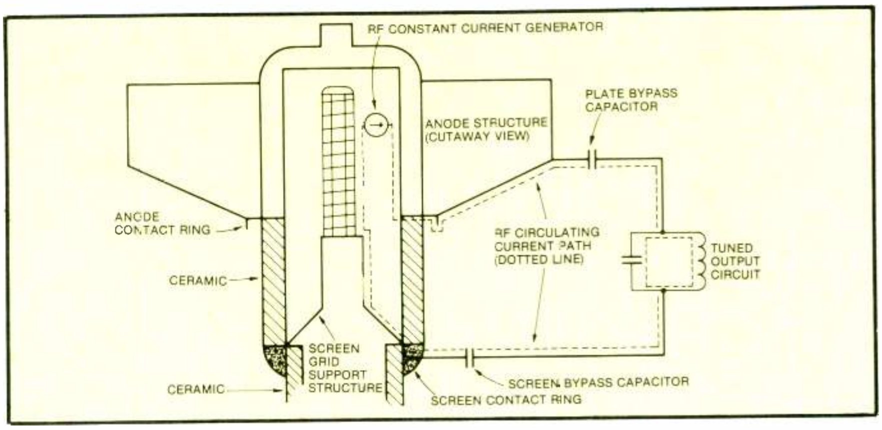


Figure 3. The path for RF circulating current between the plate and screen in a tetrode PA tube.

½-wavelength shorted transmission line.

Figure 5 (b) reveals that the inductance and capacitance of the filament circuit can resemble an artificial transmission line of ½-wavelength, if the values of L and C are properly selected.

If you have a VHF tube-type amplifier whose grid/cathode circuit is not the concentric transmission line type, you may have had to select various lengths, widths and numbers of conductors (inductors in this case) connecting the cathode to the bypass capacitors. You have bent, shaped and changed those conductors until the amplifier achieved the proper operating parameters, including efficiency, grid current and RF input drive. You were, in effect, resonating the cathode circuit to place it at RF ground.

Most of these adjustments on your transmitter were performed by factory test or field service personnel. They need not be readjusted unless the tube manufacturer changes the internal design of the tube, or you change the transmitter's operating frequency. If the operating frequency is changed, notify the manufacturer's field service department for assistance.

Troubleshooting suggestions

Of all the problems that can occur in a transmitter, probably the best known—and most feared—is the plate supply overload. Occasional plate trip-offs (one or two a month) are not generally cause for concern. Most of these occurences can be attributed to power line transients.

More frequent trip-offs require a closer inspection of the transmission system. For the purposes of our discussion, we will assume that the plate supply overload occurs frequently enough to make continued operation of the transmitter difficult.

The first step in any transmitter troubleshooting procedure is to switch the system to *local control* so that you, not the studio operator, have control over the unit. This is important for safety reasons.

The second step is to switch the transmitter's automatic recycle circuit off. While troubleshooting, you do not want the transmitter to cycle through an overload any more times than are necessary. Such action only increases the possibility of additional component damage.

Other preliminary steps in troubleshooting include:

- Determining the exact fault condition and failure history.

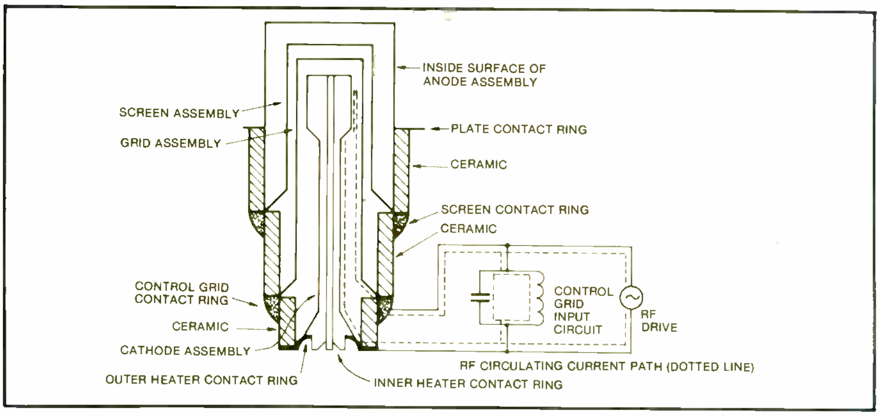


Figure 4. The internal arrangement of the anode, screen, control grid and cathode assemblies of a tetrode power tube. Also shown is a simplified RF input circuit. (The control grid bias supply is not shown.)

- Checking all low voltage systems for proper operation.
- Inspecting the internal transmitter circuitry.

These steps were discussed in detail in the December "Troubleshooting" (page 92). If plate overload problems persist, consider these suggestions:

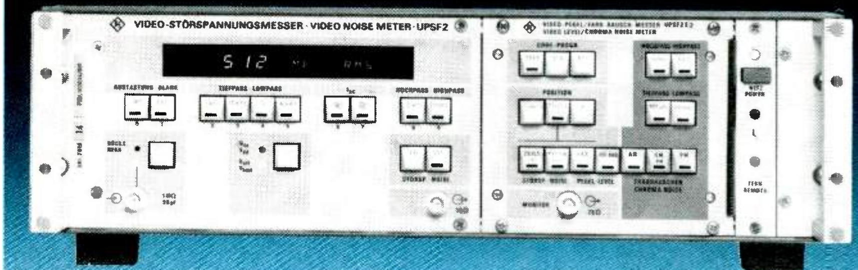
- Confirm that the problem is not caused by an antenna or transmission line failure. (See the November "Troubleshooting," page 124, for more information.)
- Determine whether the plate supply overload is RF- or dc-based. With the plate off, switch the exciter off. Bring up the high voltage (plate supply). If the overload problem persists, the failure is based in the dc high voltage power supply. If the problem disappears, the failure is centered in the transmitter's RF chain.
- It is important that proper bias is present on all vacuum tube stages of the transmitter RF chain when this test is performed. The PA tube bias supply is usually switched on with the filaments, and can generally be read from the front panel of the transmitter. Proper bias should be confirmed before applying high voltage with no excitation.

It is also important that the exciter is switched off while the high voltage is off. Removing excitation from a transmitter while it is on the air can result in the generation of large transient overvoltages that can cause arcing or component damage.

- If the overload is based in the high voltage dc power supply, shut down the transmitter and check the schematic diagram for the location in the circuit of the plate overload sensor relay (or comparator circuit). This will show you within what limits component checking will need to be done.

The plate overload sensor is usually found in one of two locations: the PA cathode dc return or high voltage power supply negative connection to ground. Transmitters using a cathode overload sensor generally have a separate *high voltage dc overload* sensor in the plate power supply.

A sensor in the cathode circuit will substantially reduce the area of component checking required. A plate overload with no excitation in such an arrangement would almost certainly indicate a PA tube failure, because of



either an inter-electrode short inside the tube or a loss of vacuum in the tube.

Do not operate the transmitter when the PA tube is out of its socket. This is not an acceptable method of determining whether a problem exists with the PA tube. Substitute a spare PA tube instead.

Operating a transmitter with the PA tube removed can result in damage in other tubes in the transmitter when the filaments are on, and damage to the driver tubes and driver output/PA input circuit components when the high voltage is on.

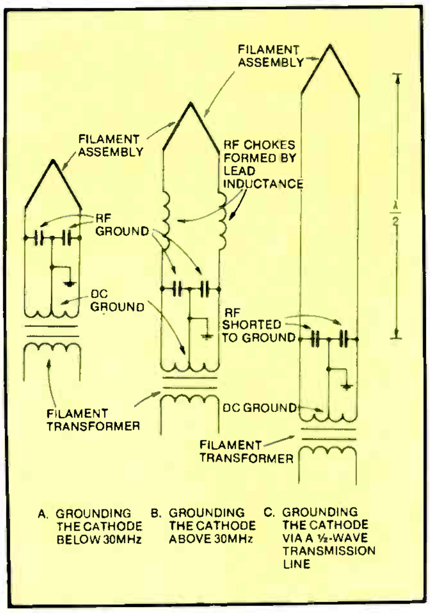


Figure 5. Three common methods of providing RF bypassing of the cathode of a tetrode PA tube.

- Use an ohmmeter to check for short circuits in the power supply. Remove all power from the transmitter and discharge all filter capacitors before beginning any troubleshooting work inside the unit. When checking for short circuits with an ohmmeter, take into account the effects that bleeder resistors and high voltage meter multiplier assemblies can have on resistance readings.

Most access panels on broadcast transmitters use an interlock system that will remove the high voltage and ground the high voltage supplies when a panel is removed. For the purposes of ohmmeter tests, these interlocks may have to be temporarily defeated. Never defeat any interlocks unless all ac power has been removed from the transmitter and all filter capacitors have been discharged using the grounding stick supplied with the transmitter.

- Following the preliminary ohmmeter tests, check the following components in the dc plate supply: all oil-filled capacitors for signs of overheating or leakage; all feedthrough capacitors for signs of arcing or other damage; the dc plate blocking capacitor for indications of insulation breakdown or arcing; all transformers and chokes for signs of overheating or winding failure; transient suppression devices for indications of overheating or failure; all bleeder resistors for signs of overheating; any surge-limiting resistors placed in series with filter capacitors in the power supply for indications of overheating or failure. A series resistor that shows signs of overheating can be an indication that the associated filter capacitor has failed.

- If the plate overload trip-off occurs only at elevated voltage levels, ohmmeter checks will not reveal the cause of the problem. It may be necessary, therefore, to troubleshoot the problem using the process of elimination. This aspect of transmitter troubleshooting will be discussed in the February column.

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Strictly TV

Continued from page 8

vertical interval. The method allows a receiver to lock onto a signal with carrier-to-noise ratios to 0dB, although typical CNR values would generally be between 10dB to 14dB.

Intended for use in the 12GHz Ku-Band spectrum, B-MAC allows smaller receiving dish antennas, a compatibility with some standard NTSC or PAL receiving equipment at consequently reduced system costs, addressing up to 4 billion individual receivers and multiple channels of Dolby digitally processed sound.

The scrambled signal uses encryption to completely disrupt unauthorized reception of audio and data. Dynamic line translation of video creates a totally unrecognizable image on the screen.

The 31.4kHz sampled digital audio uses delta modulation for a dynamic range of more than 84dB from each channel. Any audio channel may be converted into a 320kb/s data channel. The picture may also be replaced with digital information for an additional 10.8Mb/s data capability.

Why components?

Using components for large area transmissions has various advantages over NTSC, PAL and SECAM. One is the lack of a color subcarrier in the transmission path. Whether 3.58MHz, 4.43MHz or some other number, the subcarrier impairs the picture.

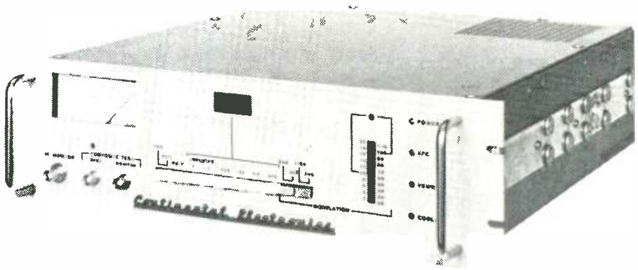
But color difference signals, such as Y, R-Y and B-Y, allow relatively easy conversion to any of the primary color standards. Subcarriers are needed by current receivers, but can be inserted in receiving equipment. At the same time, VCRs and home computers will lead to more RGB or other component receiver monitors by consumers.

Transmissions via satellite will undoubtedly create some ideological problems, because the signals are not geopolitically bounded. Multichannel audio, however, suggests a multiplicity of language could be carried with the video program to ease the international problems.

Enhanced visual imaging is also a possibility with all but A-MAC. By making more efficient use of the spectrum already allotted to a TV channel, more picture information may be transmitted at least to appropriately equipped receivers. Enhanced performance, however, should be a common occurrence as MAC transmissions become a reality.

Editor's note:
Figures provided courtesy of Digital Video Systems Division, Scientific Atlanta.

Introducing the ultimate FM Exciter!



Continental's Type 802A solid-state FM Exciter offers broadcasters unmatched performance.

Modulation performance of this new exciter exceeds all currently known or marketed FM exciters.

No tuning adjustments are required other than selecting the operating frequency.

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Special circuits protect amplifier from mismatched loads. Automatic power control maintains output at preset levels from 5 watts up to the maximum level.

The Type 802A FM Exciter accepts composite baseband signal from a stereo generator, STL system or monaural and SCA programming.

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Case design is very clean: front panel analog or digital meters and LED readouts give clear, accurate indications of system status and performance. A digital LED display shows true peak level of modulating signal in 5% increments with an accuracy of better than ±2%.

Modular subassemblies may be removed from the exciter without removing the exciter from the transmitter. The exciter moves on slides for easy access from front of transmitter.

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AM Stereo Update
Continued from page 12

an oscilloscope are required. High quality industry standard test tapes for reel-to-reel and cartridge machines are a must. The proper alignment fixtures and gauges are also required for maintenance of source gear.

Figure 1 shows a typical test setup for a reel-to-reel or cartridge recording machine. Proper polarity must be observed on all input and output connections. Figure 2 shows the basic oscilloscope displays that will be seen when checking the alignment of a stereo source.

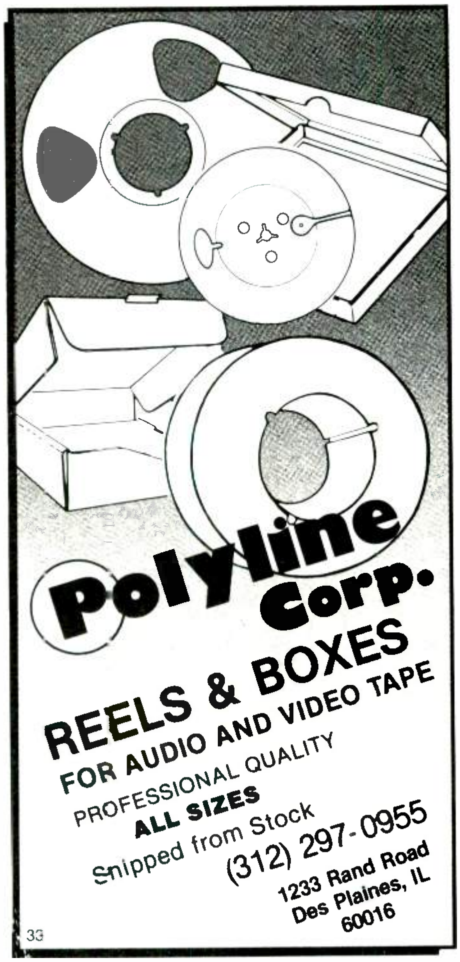
The scope photos and test equipment hookup shown in Figures 1 and 2 apply to basically any 2-channel audio system. For example, the *unit under test* shown in the diagram could be a stereo telephone company loop, 2-channel STL or even the entire transmission chain.

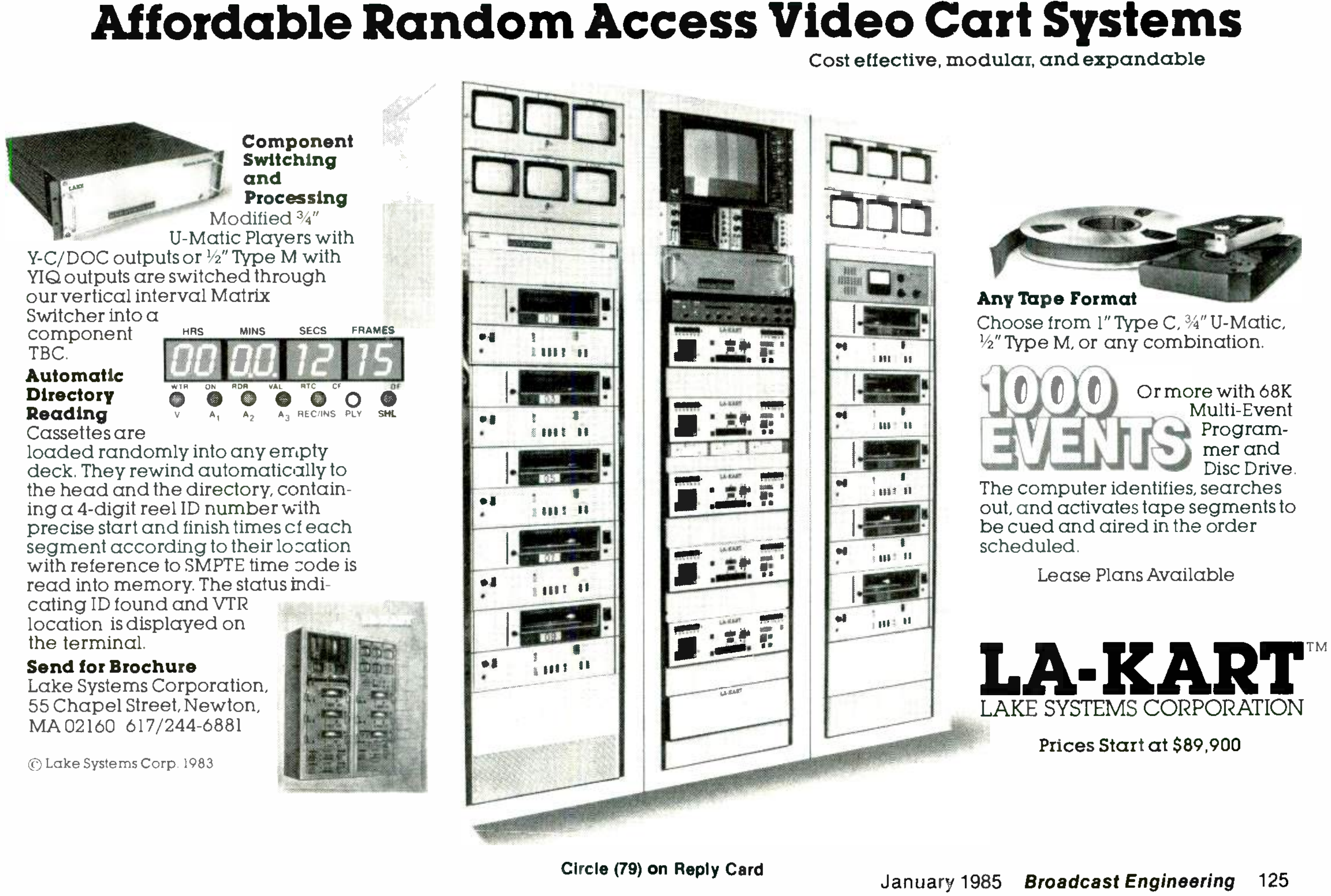
Although the most common monitoring arrangement for a stereo station (AM or FM) is a pair of loudspeakers—one for the left channel and one for the right channel—provisions should be made to monitor the sum (L+R) signal at the operating position. A reversed-phase monophonic source will result in low (ideally zero) modulation of the L+R audio channel. This will go unnoticed by listeners using stereo receivers, but will result in dead air over a monophonic receiver. Because the vast majority of the AM audience will be listening in mono for some time to come, make the maintenance of proper phasing a top priority.

Audio processing

Another area of studio operation that deserves close attention is audio processing. It is common for stations to use an automatic gain control unit with a long-time constant at the studio to maintain a reasonably high overall modulation level to the STL system. To preserve the stereo effect, however, the dynamic properties of the left and right channel must be closely matched. This can be accomplished by linking the two automatic gain control systems. Nearly all modern AGC units can be *strapped* for this type of operation.

If the two channels are not strapped, more attenuation at a given instant may occur on one channel, than on the other. Therefore, under *center channel* program conditions, a left-right imbalance will be created. This will cause the sound field to move back and forth in a sideways fashion in a stereophonic receiver, and may cause listening variations in a monaural receiver.





FCC Update

Continued from page 14

- Operation not authorized in license. The commission has found that some stations operate at times and with modes or powers not specified in their station licenses. Problems occur when stations operate non-directionally when directional operation is specified or neglect to change power at sunset or sunrise as called for in the station license.
- Directional antenna system tolerance. Some stations inadvertently violate Section 73.62 of the rules, which requires that antenna base currents and antenna monitor currents be kept within the allowable 5% tolerance.
- Antenna tower painting and lighting. Rule violations also occur as a result of licensee failure to adequately maintain tower facilities. The condition of lighting fixtures required to be illuminated must be inspected once each 24 hours. Alternatively, the lights must be guarded by an automatic indicator of light failure or an automatic device to sound an alarm upon light failure. All towers must be cleaned or repaired as often as necessary to maintain good visibility. Mechanical control devices, indicators and alarm systems used to maintain tower lighting must be inspected for proper functioning at intervals not to exceed three months. Failure or improper functioning of tower lights must be recorded in the station log.

The commission said that licensees should regularly review all technical aspects of their operations and correct any violations they find. Should violations not decrease, the commission said it will increase its enforcement efforts and issue more fines.

Editorial *Continued from page 20*

from one end of town to the other, is uncomfortable with those who mathematically examine attributes and consequences of a 1050-line TV image.

Of the trade organizations, SBE is probably the most available to broadcasters. Each of the 85 local SBE chapters holds regular meetings, offering informative programs on technology, operating methods and specific product applications. Were you there when they explained AM stereo, stereo TV, how to use a spectrum analyzer or basics of camera lens design?

SMPTE and AES have local chapters that are unfortunately limited to cities where film, video production, recording and the performing arts are centered. Their meetings enjoy better attendance from a

Continued on page 128

Our cart machines work the way Arthur does. At various speeds.

Ordinarily Arthur runs at 3.75, 7.5 or 15 i.p.s. (ideas-per-second). He also has a few unique variations. And so do Fidelipac's new Dynamax™ CTR100™ Series Cartridge Machines.

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Music cartridges can be played uptempo. Special effects can be created and pitch controlled. And Vary Speed enables you to interlock with other machines using a SMPTE controller or a 9600 Hz-based synchronizer.

Vary Speed is just one of many standard features our new cart machines have. No cart machine comes close to offering what the Dynamax CTR100 Series offers. And the price is right. Substantially lower than the ITC 99B, for example.

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Continued from page 126

membership mostly from film, manufacturing, production companies, recording and the networks.

Major SMPTE and AES conferences, like NAB, provide a chance for a worldwide membership to meet. They showcase hundreds of products and are a forum for technical lectures. Some of the topics are practical and tutorial, and many are product-oriented.

Because time is limited, both seeing the exhibition and hearing the papers becomes difficult. The grassroots attendees will opt for the new products, because they find the papers beyond their understanding and not applicable to their needs. As a result, worthwhile tutorial presentations end up playing to the manufacturer members who already understand the subjects and who least need exposure to new technologies, proposed machine control protocols and operating parameters.

A bond between the two aspects of the industry is possible and necessary, but it means an effort from both parts. Solutions are not solely in the laps of the trade organizations. They must make their ideas more available to the grassroots. But, the grassroots must make themselves available. Serve on a committee and let your needs be known.

Join. Attend the meetings. Ask questions, if you don't understand. Others in the audience are in the same situation. If you disagree, say so. You are going to have to live with the standard digital studio interface. Take the opportunity to understand it. If it doesn't fit your needs, say so.

Are you aware that, as a staff engineer of an NAB member station, your opinions may be voiced to NAB? Topics may be operating methods, technical parameters or other broadcast business. Have you ever voiced your opinion, beyond an occasional local criticism of NAB?

No doubt your station provided a good bit of expensive air time leading up to the 1984 elections to suggest that people get out and vote. Have you cast your professional vote lately?

Good engineering is truly a craft, an art form, if you will. Yet, as most of us are not true artists, we may need to discuss the color, line and form of our business with others to better understand the image we work with. By joining and attending a broadcast professional organization, we, too, can help to shape and to strengthen the art form called broadcasting.

Without our participation, our skills may become obsolete in the face of new technologies. Our opinions will go unheeded by those who need most to hear them.

associations

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SMPTE concentrates on components

"Components of the Future" is the title of this year's TV-only SMPTE conference, with emphasis placed on digital components, analog components, future technology and stereo audio for television.

Along with more than 30 technical presentations, program plans include a component video signal handling demonstration. The demo revolves around the SMPTE standards activities in components and serial/parallel technologies.

The conference will be Feb. 15-16 at the Westin St. Francis Hotel, San Francisco.

Digital component papers will discuss production switchers, wideband frame stores and an all-digital studio. Progress reports on digital VTRs, studio standards and the SMPTE/EBU control network are planned. A tutorial titled "Digital Component TV Made Easy for Everyone" will lead the session.

National Association of Broadcasters

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NAB engineering sessions

Planning has been completed for the 39th annual NAB Engineering Conference. The engineering sessions, to be held in conjunction with the annual NAB convention in Las Vegas, April 13-17, cover a wide range of radio and TV topics, including: AM radio improvement; electronic graphics production; AM/FM allocations; TV multichannel sound transmitter conversion; spectrum management; advanced TV systems developments; AM stereo; non-ionizing radiation; and broadcast auxiliary systems.

The Saturday technical sessions will be repeated this year because of their favorable response at NAB '84. In response to requests from radio and TV engineers, special maintenance workshops have been scheduled for Sunday, April 14, the opening day of the exhibits.

new products

Effects software

Picture cropping allows separate size, location and rectangular shape manipulation of key signals derived from *NEC America's* E-Flex, without altering the video. Cube maker upgrades the Optiflex option, allowing 6-sided rotating cube effects.

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Audio control

The AFD-200 series from *Scantex* provides audio-follow capabilities with eight inputs. Follow, separate and editing modes allow the system to replace an expensive audio desk when simple functions are required.

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Camera light

For attachment directly to a camera with the LS2 Lightstud, the *Frezzolini* 100W Mini-Fill operates approximately 25 minutes from one VBSO 12V-4A battery.

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Studio camera

Ikegami introduces the SC-500 camera for economical studio operation. The ⅔-inch prism-optic design features extensive automatics, including centering, weighed iris, capping, white/black balance and auto black.

Circle (453) on Reply Card

Battery care system

CASP stands for charger, analyzer, sequencer and power supply from *Christie Electric*. The six ports can accommodate six entirely different types of batteries, while a microprocessor system handles sequenced charging and compiles data to analyze the condition of all the batteries.

Circle (454) on Reply Card

Digital effects

Microtime presents Genesis 1, a cost-effective effects system using digital techniques for zoom, flip, tumble, crop, H/V compression, border, posterize, mosaic, smooth and freeze effects. Composite or component inputs may be used.

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Editing workstation

A cinemagraphic editing workstation interfaces to the *EECO EMME* editing computer, allowing the editor to worry about creative editing, not calculations with time code numbers. A mouse control unit is used to select functions from a CRT display.

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Master control

Ease of operation is one design criteria for the *Robert Bosch* MCS-2000 master control switcher system. Dual stereo or four monaural channel capability, auto or manual transitions, 6-wipe pre-programmability and serial communications for machine control are some features.

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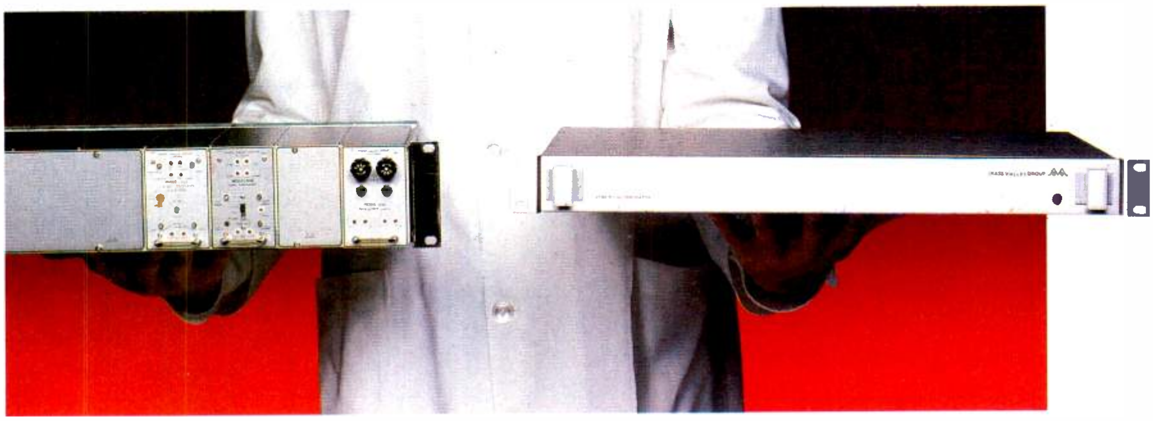
Would You Turn Trader For $500?



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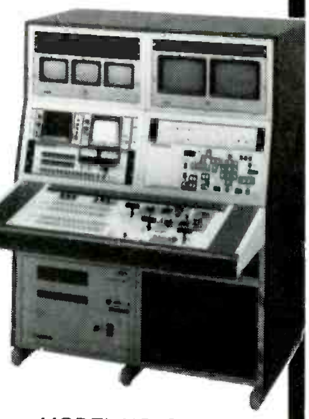

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VCR timebase correction

Nova Systems' 510 TBC allows direct color (subcarrier feedback) or heterodyne process modes at the flick of a switch for non-segmented ¾-inch and ½-inch VCRs. A companion model, the 490, offers only the heterodyne mode for U-matic, VHS and Beta formats.

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Digital disc system

Real time record and playback are features of the A62 digital disc unit from *Abekas Video Systems*. An 8-inch Winchester drive holds 50 seconds and allows looping sequences to be created. Digital decoded RGB outputs are available from the system, which also allows random access to any image stored.

Circle (459) on Reply Card

Machine control interface

RS-422 serial protocol increases *Panasonic* M-format systems through the AU-IA422 interface adapter, allowing M-format recorders to be mixed with 1-inch and ¾-inch formats in the production system.

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Lighting controller

The 2400-D2 desk model controller is available for use with the Unitrol SU-1 wireless lighting dimmer from *Union Connector*. As with the original Digi-1 hand-held controller, the Digi-2 desk unit may service up to 256 individual dimmer units without special control wiring.

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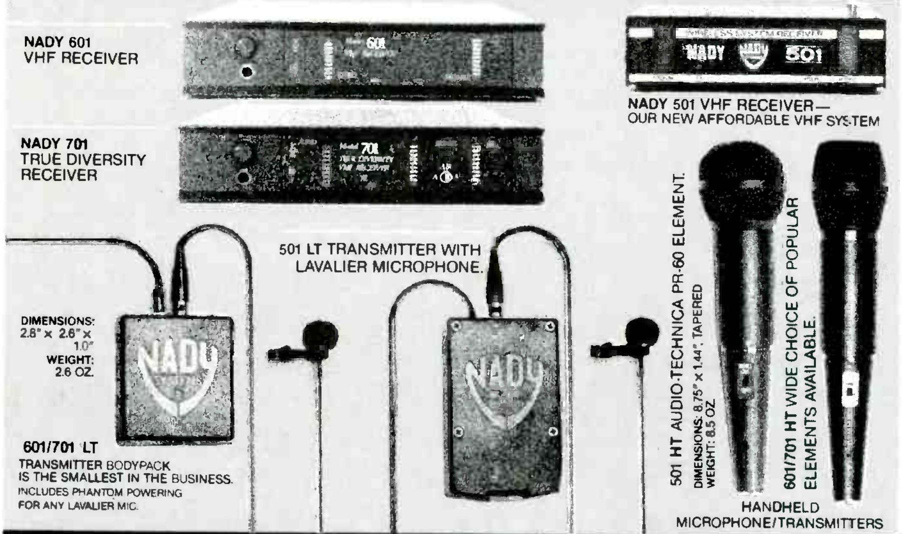
Production switcher

Three encoded composite and four component video inputs to the 6116 *Crosspoint Latch* video mixer includes

Nady VHF. The best sounding wireless is now also the most user friendly.



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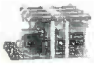

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32 patterns, pattern duration control, border effects, DSK with edging and option RGB chroma-keyer. With sync and subcarrier drives required, the 7209 editor controller may be interfaced.

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Layback recorder

For video post-production use, the *Studer Revox America* A80VU-3 LB video layback recorder can be converted to recorder and reproduce three audio tracks on either B- or C-type video tapes, with a frequency response of ±2dB from 30Hz to 18kHz. The unit is compatible with most popular editing controllers.

Circle (463) on Reply Card

Distribution amplifier

One video and stereo audio amplifiers are housed in a single 1-in, 8-out 1.75-inch rack unit. The DA-108 DA from *Mycomp Technologies* touts a 115dB audio S/N ratio and harmonic distortion <0.005%. Output noise in video is more than 70dB below 1Vp-p with a -0.5dB response to 10MHz.

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Lighting instruments

The *Litetronic* fixtures include an electronic ballast built into the lighting instrument for simplicity. The noiseless, dimmable product may operate with dc as well as 50Hz or 60Hz ac power. Remote focus and off-on control are optional.

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Video keyer

ISO chroma-key for CDL series 80 switchers, from Central Dynamics, includes newly designed RGB and en-

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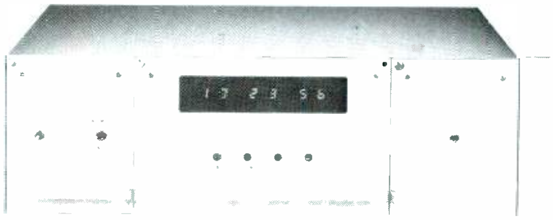

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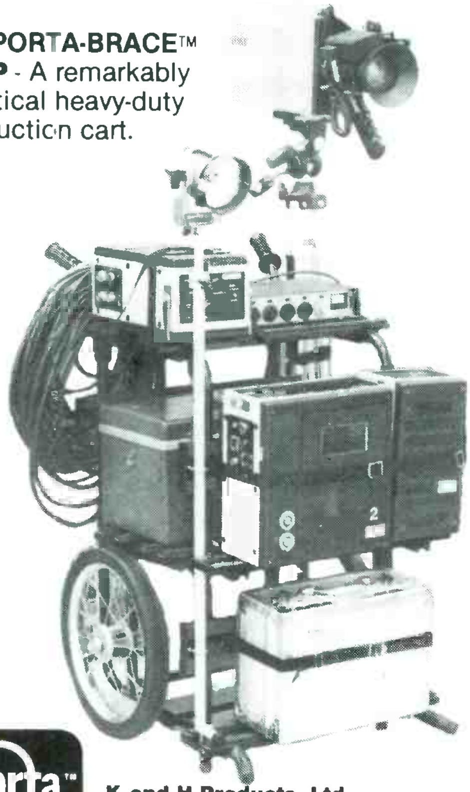

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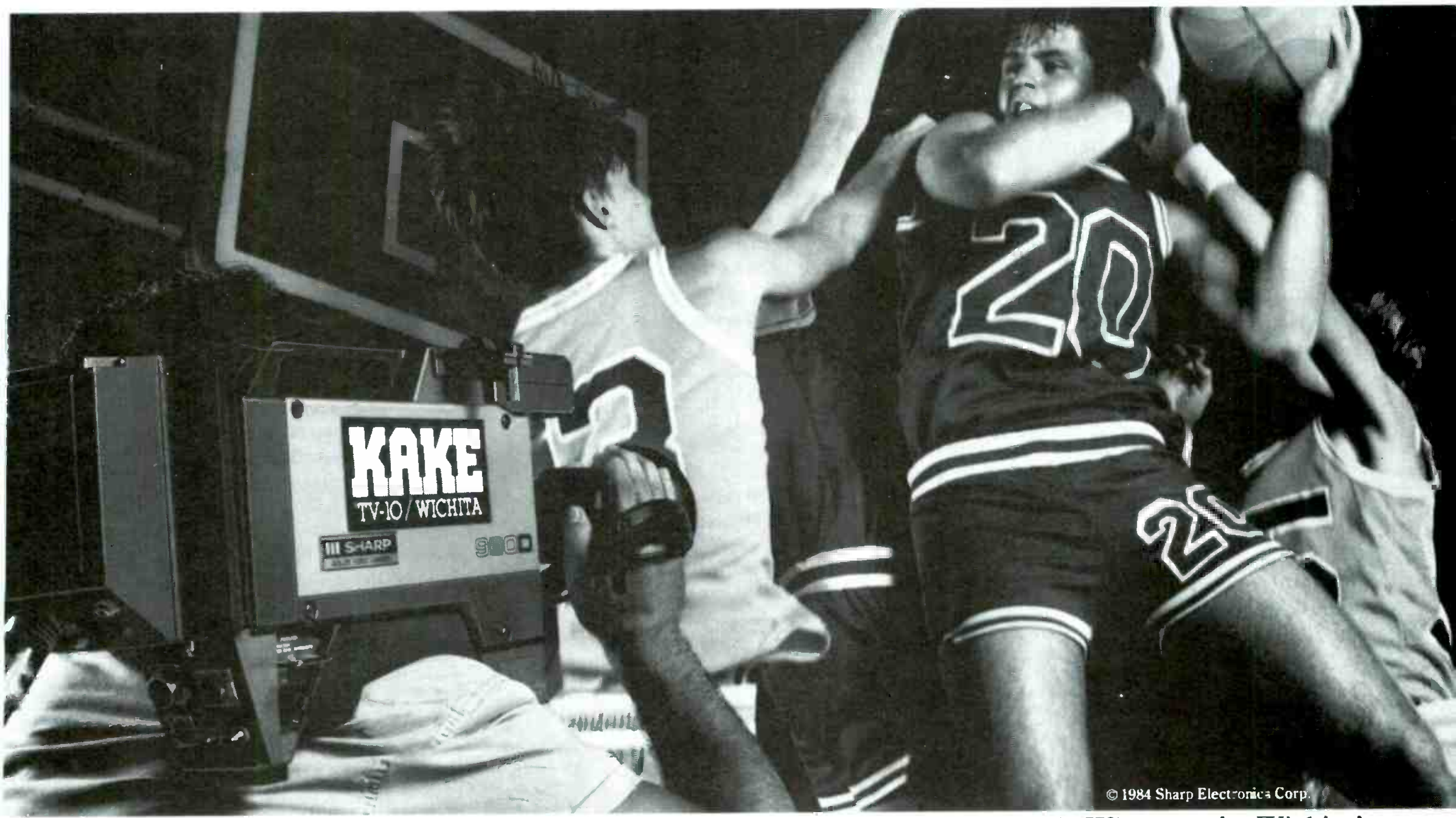

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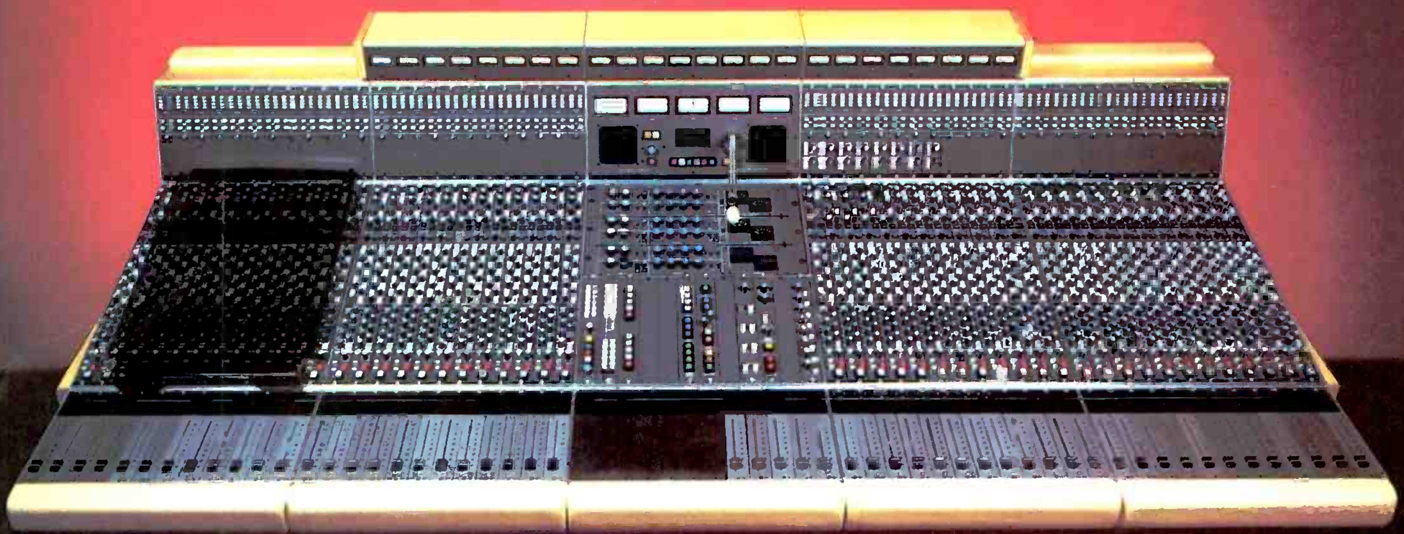

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