Broadcast engineering®

An INTERTEC Publication

May 1993/$4.50

Program transmission systems:

- Building an STL
- Selecting a transmission line
- Replacing TV antennas

pecial reports:

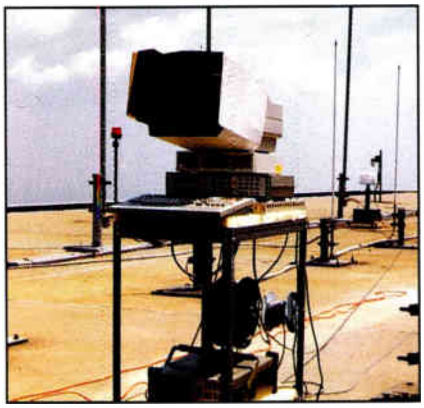
Terrorist bombs World Trade Center

Inside digital effects systems

Contents

May 1993 • Volume 35 • Number 5

BROADCAST ENGINEERING



Page 36

Photo courtesy © 1992 Bruce Mathews/MIDWESTOCK

Page 66

Page 80

PROGRAM TRANSMISSION SYSTEMS:

Wireless transmission is the singular element that separates broadcasters from other delivery mediums. Cable, DBS and MDS all have restricitons that limit where and when their signals can be received. Broadcasters bring to their audiences an advantage not shared by other delivery methods — the freedom to enjoy the service, no matter where they are. Whether it's in the car, on the beach or in the mountains, broadcasters always deliver.

THIS MONTH...

OTHER FEATURES:

DEPARTMENTS:

ON THE COVER:

As broadcasters look to an HDTV future, the questions surrounding RF systems are foremost in many minds. Today's station managers and engineers are looking for NTSC systems that can expand or grow forward into an HDTV age. Fortunately, broadcast equipment manufacturers are now marketing solutions to the NTSC-to-HDTV transition dilemma. (Cover credit: Harris/Allied.)

AirMaster 90

Starting at $5995

Very Affordable. Very Reliable.

The new AirMaster 90 specifications are compatible with digital technology. It uses superior thick-film hybrids. The AirMaster 90 has a user-programmable logic control system that utilizes a PIC microprocessor. Faders control precise stereo-balanced VCA's and push buttons are electronic with LED status indicators.

The AirMaster 90 has a TWO YEAR WARRANTY . . . after all, it has the highest possible reliability in the industry.

The Sound Of Perfection

AUDITRONICS®

3750 Old Getwell Road, Memphis, TN 38118
901-362-1350, FAX: 901-365-8629

Circle (5) on Reply Card

News

By Dawn Hightower, senior associate editor

NAB, EIA announce initiative on data broadcasting

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) and the National Association of Broadcasters (NAB) have announced a national initiative to develop a broadcasting service for dissemination of high-speed data-based information services.

The EIA and the NAB will form a National Data Broadcasting Committee (NDBC) to develop a voluntary technical standard for high-speed data broadcasting for NTSC TV stations. A national voluntary technical standard would help create new markets for dissemination of information to new data-based consumer receivers. A data receiver could be implemented as a new feature for NTSC TV receivers or a new class of consumer electronic products called "data receivers" with outputs to fax machines, computers or televisions.

The NDBC will be open to any interested parties, operate under EIA guidelines for voluntary standard-setting, and be jointly administered by NAB and EIA.

NRSC forms DAB subcommittee

The National Radio Systems Committee (NRSC) voted unanimously to begin voluntary standard-setting for in-band, on-channel (IBOC) digital audio broadcasting (DAB) systems.

The NRSC will evaluate IBOC DAB systems in coordination with the Electronic Industries Association's DAR subcommittee and, if appropriate, recommend a standard for IBOC DAB systems.

The DAB subcommittee will work closely with the EIA DAR subcommittee in developing comprehensive IBOC DAB test procedures. IBOC test results will be evaluated by the NRSC DAB subcommittee.

HP to develop encoders for Zenith/AT&T system

Hewlett-Packard (HP) Company has plans to develop and manufacture broadcast encoders for the Zenith/AT&T digital high-definition (HDTV) TV system.

Under an agreement with AT&T and Zenith, HP would support rapid deployment of digital HDTV encoder equipment to broadcasters, following the FCC's adoption of the new HDTV broadcast standard.

HP would license technology from AT&T and Zenith if the FCC were to adopt the Zenith/AT&T Digital Spectrum Compatible HDTV system. HDTV encoders are electronic systems used by broadcasters to process and compress HDTV signals. Early prototypes are expected to be available six to 12 months after the FCC selects an HDTV standard. Commercial-grade products are expected to follow about a year later.

IEEE call for papers

The Institute of Electrical & Electronic Engineers (IEEE) will hold its 43rd Annual Broadcast Engineering Symposium Sept. 22-23. The Broadcast Technology Society of the IEEE will sponsor the symposium at the Hotel Washington in Washington, DC.

Technical papers will feature AM, FM and TV digital transmission techniques, antenna design and testing, and transmitter development. Send abstracts by June 15 to Philip A. Rubin, Rubin Bednarek & Associates, 1350 Connecticut Ave. NW, No. 610, Washington, DC 20036 or fax to 202-296-9383.

For additional information on the symposium, call Ed Williams, symposium chairman, at 703-739-5172.

Satellite DAB could destroy radio industry

According to Edward O. Fritts, president and CEO of the National Association of Broadcasters (NAB), the Federal Communications Commission (FCC) risks destroying the system of local radio broadcasting if it authorizes 30 to 60 new channels in each market through national satellite digital audio broadcasting services.

Fritts said that allowing one service to control 30 to 60 channels in each market would represent a dramatic departure from the Communications Act's foundation principles of localism and diversity, especially when broadcasters are generally limited to a maximum of three or four signals in local markets. ■

BROADCAST ENGINEERING

Volume 35 • Number 5

EDITORIAL
Brad Dick, *Editor*
Skip Pizzi, *Technical Editor*
Steve Epstein, *Technical Editor*
Dawn Hightower, *Senior Associate Editor*
Stefanie Kure, *Associate Editor*
Tom Cook, *Senior Managing Editor*
Carl Bentz, *Directory Editor*

ART
Nenita Gumangan, *Graphic Designer*

BUSINESS
Harry A. McQuillen, *President*
Raymond E. Maloney, *Executive Vice President*
Cameron Bishop, *Group Vice President*
Duane Hefner, *Group Publisher*
Tom Brick, *Marketing Director*
Stephanie Hanaway, *Group Director, Special Projects*
Kathryn Buckley, *Promotions Manager*
Sandra Tomczak, *Promotions Coordinator*
Dee Unger, *Advertising Business Manager*
Mary Birnbaum, *Advertising Production Supervisor*
Shelly Larkey, *Advertising Coordinator*
Stephanie K. Carlson, *Classified Advertising Coordinator*
Lori Christie, *List Rental Sales*
Doug Coonrod, *Corporate Art Director*
Julie Neely, *Circulation Director*
Customer Service: 913-967-1711

TECHNICAL CONSULTANTS
Ned Soseman, *Contributing Editor*
Eric Neil Angevine, *Broadcast Acoustics*
John H. Battison, *Antennas/Radiation*
Dennis Ciapura, *Radio Technology*
Dane E. Ericksen, *P.E., Systems Design*
John Kean, *Subcarrier Technology*
Donald L. Markley, *Transmission Facilities*
Harry C. Martin, *Legal*
Curtis Chan, *Audio/Video Technology*

MEMBER ORGANIZATIONS
Sustaining Members of:
- Acoustical Society of America
- Society of Broadcast Engineers
- Society of Motion Picture and TV Engineers

Member, American Business Press — ABP
Member, BPA International — BPA

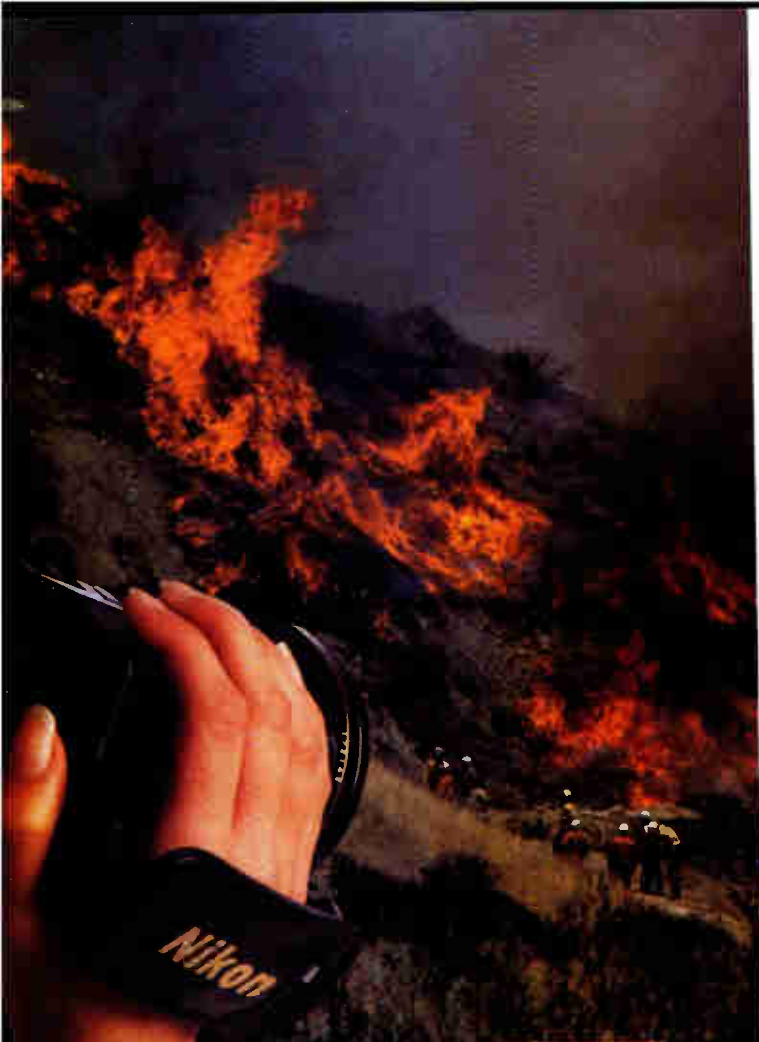
BROADCAST ENGINEERING is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities and government agencies. Qualified persons include consulting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

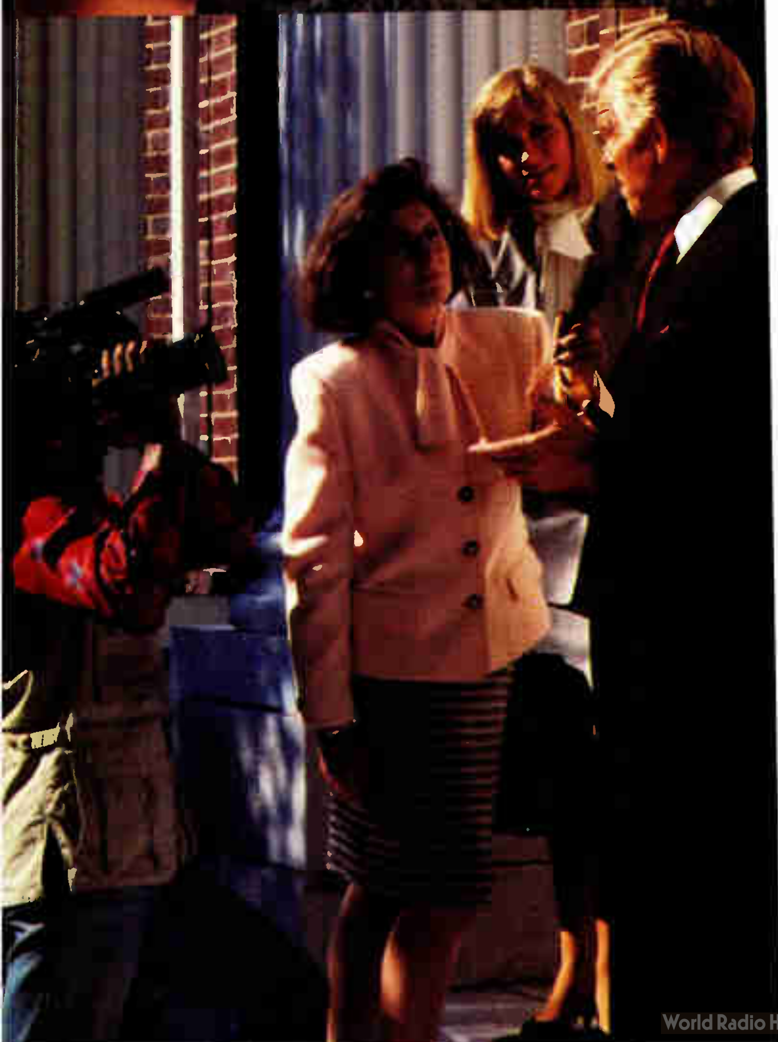
BROADCAST ENGINEERING (ISSN 0007-1994) is published monthly (plus three special issues) and mailed free to qualified persons within the United States and Canada in occupations described above. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to **Broadcast Engineering**, P.O. Box 12960, Overland Park, KS 66282-2960.

SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $50.00. Qualified and non-qualified persons in all other countries; one year, $60.00 (surface mail); $115.00 (air mail). Subscription information: P. O. Box 12937, Overland Park, KS 66282-2937.

CORRESPONDENCE
Editorial and Advertising: 9800 Metcalf, Overland Park, KS 66212-2215. Telephone: 913-341-1300; Editorial fax: 913-967-1905. Advertising fax: 913-967-1904.

INTERTEC PUBLISHING CORPORATION





Introducing The Nikon S19x8B

There'll be times it's the only lens for the job.

In the world of ENG/EFP, disasters aren't planned. So you've got to plan ahead. After all, the biggest disaster is being on the scene but too far back to get the shot. That's why Nikon went to great lengths to create the S19x8B Lens for CCD cameras.

For a lens of this range, it's wonderfully light and maneuverable. So you never have to get too close to get close enough. The smooth zoom whisks viewers right into the heart of the subject matter.

From making our own glass to the final QC tests, we make sure the S19x8B is worthy of the Nikon name. Extra-Low Dispersion (ED) glass, Nikon anti-reflection coating, high-flat MTF curve, it has it all, and more, all wrapped up in a rugged housing of magnesium alloy.

And never a time it isn't.

The S19x8B may well be the only lens you ever need. Forget about lugging around a variety of lenses and fumbling around mounting them. The S19x8B's minimum object distance (37") and 8mm minimum focal length, providing expansive wide angle coverage, make it ideal for everyday use as well. That's unsurpassed range for an ENG/EFP lens.

To guarantee you can use it every day, the S19x8B comes with something else that's unsurpassed — Nikon's unique Express Loaner Service. If disaster ever strikes your lens, we'll get you a loaner lens overnight. So now there will never be a time you're really 'out' in the field.

To find out more or for our complete brochure, call 800-NIKON-US or (516) 547-4355 or write: Nikon Electronic Imaging, Dept. D1, 101 Cleveland Avenue, Bayshore, NY 11706.

Nikon
ELECTRONIC IMAGING

Circle (6) on Reply Card

Editorial

Standing firm

Just 11 months ago, this column disclosed to the industry the unwarranted attack on the FOR.A Corporation of America (and other video equipment manufacturers) by Video Patents Limited, aka Video Processing Technology (Vid Pro). In that editorial, we outlined the attempt by Vid Pro to extort royalty payments by claiming patent infringement by FOR.A and other video equipment manufacturers. We stated then, and repeat now, that such litigious actions are counterproductive to the best interests of the video equipment industry, its manufacturers and the equipment users. Despite the efforts of Vid Pro to extort payments from an entire industry, we have good news to report.

A recent press release from the FOR.A Corporation announced that the company has successfully terminated the litigation against it by Vid Pro. The management at FOR.A and its Japanese parent, FOR.A Company, Ltd., are to be congratulated on their successful defense of themselves and the rights of all involved in producing video equipment. The settlement is more than a triumph for this particular equipment manufacturer, it's a victory for the whole video industry.

In an industry where new products and features are released monthly, it's hard to know the players without a score card. Yet, even the most novice buyer recognizes who is delivering innovative ideas to the marketplace and who is rehashing old ideas and concepts. Those who bring new and leading edge ideas to market reap the benefits of market share and profits. And that's as it should be.

Recall the story of the little red hen. She worked hard to produce a loaf of bread, and asked many in the barnyard to help her with the work. When they all refused, she proceeded alone. Yet, when it came time to enjoy the fruits of her labor — a loaf of freshly baked bread — suddenly a host of animals was ready to help her enjoy it. Fortunately, she had the wisdom to let them get what they deserved — nothing. So too should it be with intellectual property.

Those who develop intellectual property should be rewarded for their efforts. Likewise, companies that bring new ideas and products to the market should reap the benefits of their hard work. What we don't need is some Johnny-come-lately trying to extort payments from others for obsolete and antiquated patents that have little to do with today's technology.

In last June's editorial, we urged the entire video industry to stand firm and protect their rights and those of their customers. We suggested that aggressive protection of their and their customers' rights was the sensible choice. That's still good advice.

Legal warfare is expensive, time consuming and emotionally draining. Few companies, let alone individuals, can carry on such a confrontation for long. Although the process must have been arduous for those at FOR.A, the entire video industry is better off for the work just completed.

Brad Dick

By Brad Dick, editor

PURE PROGRESS.

FEATURE-PACKED
1.0 SOFTWARE
✔ Improved Sound
✔ Greater Control
CUSTOMIZE Your Sound

Stations Are Profiting From It.

FM stations around the world are finding more sophisticated ways to keep their listeners from cruising the dial. And OPTIMOD-FM 8200 has become a critical part of their strategy. Why? Because the 8200 is a technological breakthrough with bottom line impact. It lets you create a distinct, powerful sound that results in larger audiences, higher ratings and improved profitability.

Digital Makes the Best Even Better.

Digital technology not only improves the quality of the signal—it makes the OPTIMOD-FM 8200 more programmable, more flexible and more user-friendly. And it can actually help keep capital equipment costs down because it allows stations to expand and upgrade their system with software, rather than expensive hardware.

A case in point: all current 8200 owners will receive a new software upgrade free of charge. Version 1.0's sonic and operational improvements meet broadcasters' ongoing demands for superior audio performance and increased control—like customized bass response and automatic switching of presets for dayparting.

The New Standard.

The OPTIMOD-FM 8200 is now the new industry standard for digital audio processors. Call your dealer now for a hands-on evaluation of the 8200. In a market where stations live and die by the ratings, you can dominate the dial.

OPTIMOD▸FM
D I G I T A L

orban®

a division of AKG Acoustics, Inc.
1525 Alvarado Street, San Leandro, CA 94577 USA
Phone: (1) 510/351-3500 Fax: (1) 510/351-0500

FCC Update

Technical operations under an LMA

By Harry C. Martin

Many radio stations have entered into local marketing agreements (LMAs) under which they operate with a minimum of staff because sales, accounting and programming functions are performed by the brokering station. The following guidelines must be observed when implementing an LMA.

Chief operator requirement. All AM, FM and TV stations must have a chief operator, designated as such in writing, who is available at all times. This also is true with an LMA where most programming comes from the brokering station. The chief operator should be an employee (or contractee) of the licensee to ensure that the FCC responsibilities of technical operation and record keeping remain with the licensee. The FCC would consider delegating chief operator duties to the time broker as evidence of an authorized transfer of control, and would subject the licensee to fines in the event the broker's operator did not adhere to the rules.

Studio rule. Stations must maintain a main studio with at least one management-level individual in charge. That person must use the studio as the base office and be present during normal business hours on a regular basis.

This individual should be an employee of the licensee rather than the time broker. Otherwise, the FCC will consider the licensee to have abdicated control of its facility to the broker.

When the licensee's management person is not present, staff should be present at the main studio. This requirement can be met through dual employment of staff members by the licensee and the time broker. Management personnel cannot be shared because it violates the FCC's "cross-interest" policy.

The time broker can operate the brokered station from a remote-control point part of the time. Co-location of main studios is not a problem, as long as the licensee's manager maintains control over operations of the brokered station.

Cable re-reg rules adopted

In March, the FCC adopted rules implementing portions of the Cable Television Consumer Protection and Competition Act of 1992.

Must-carry. Cable operators must carry the signals of all local commercial TV stations. A local station is defined as any full-power station located in the same TV ADI as the cable system. Qualified local noncommercial educational stations are entitled to carriage upon request.

Stations operating under the LMAs must maintain a main studio with at least one management-level individual in charge.

A cable system with more than 12 activated channels must carry the signals of local TV stations, up to one-third of the aggregate number of its usable activated channels. The carriage of other broadcast signals is at the discretion of the cable operator. With respect to NCE TV stations, systems with 12 or fewer usable activated channels must carry the signal of one local NCE station. Systems with 13 to 36 channels must carry the signals of all local NCE stations up to a total of three. Larger-capacity systems are required to carry the signals of all qualified local NCE stations, except those whose programming duplicates that of another station by 50% more.

Retransmission consent. TV stations may elect on a system-by-system basis whether to proceed under the must-carry rules or under the companion retransmission consent requirements. Under the latter provision, no cable system is permitted to retransmit the signal of a TV station without authority unless the station has elected to assert its must-carry rights.

Time table. Commercial TV stations are required to make an initial election between must-carry and retransmission rights, and every three years thereafter. Cable systems must begin carriage of their must-carry complement of signals on June 2. On June 17, TV stations will be required to make their initial election of must-carry or retransmission consent status. Cable operators wishing to drop statutory must-carry signals, due to a failure to reach retransmission consent agreements with the carried stations, are required to notify subscribers by Sept. 6, 1993. The retransmission consent requirement becomes effective on Oct. 6.

Customer-service standards

Effective this July 1, the following FCC rules go into effect governing the provision of cable system customer services:

- Cable operators must maintain local, toll-free or collect call telephone access that is available 24-hours a day, seven days a week.
- Installations must be performed within seven business days after an order is placed.
- Cable operators must work on severe interruptions in service (loss of one or more channels) promptly and no later than 24 hours after the interruption becomes known. Other service problems should be addressed on the next business day after notification.
- Cable operators will be required to schedule service calls at a specific time during a 4-hour block during normal business hours. Operators may not cancel appointments with subscribers after the close of business on the business day prior to the scheduled appointment. The customer must be contacted and a new appointment made if the installer is running late.
- Operators must provide written information at the time of installation and annually thereafter to all subscribers about products and services, prices and options, installation and service maintenance policies, instructions for using the system, and billing and complaint procedures.

Renewal time

All commercial TV stations in Arizona, Idaho, New Mexico, Nevada and Utah need to file their renewal application by June 1. Also, renewals for LPTV stations in Oklahoma and Texas are due. ■

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

Both are reliable. Both are air-cooled.

TTC's HDR Series IOT Transmitter - An Engineer's Best Friend.

With over 26 years of transmitter design experience, it's no surprise that TTC is the leader in high power technology. The HDR Series transmitters are so energy efficient, your lease payment* can be covered by the savings in electric bills! Other HDR Series features include: the NEW High-Performance XLS-5 Exciter, Field-Proven CMOS controller, IEC 215 Safety Standard, Air *or* *Water*-cooling and of course, HDTV ready.

*Please contact factory for special lease rates.

A Global Force In Broadcast Transmission Technology

TTC

TELEVISION TECHNOLOGY CORPORATION

650 S. Taylor St., Louisville, CO 80027 (303) 665-8000 Fax: (303) 673-9900

To prepare for the future, call 1-800-TTC-HDTV.

Circle (8) on Reply Card

Part 5

Strictly TV

Strictly HDTV

What's new?

By Curtis Chan

This month, our column will focus on what is new in the HDTV arena as the next round of proponent testing closes in. We will also rehash the activities of the past few meetings.

No Narrow-Muse

On Feb. 8-11, the special panel of the FCC Advisory Committee on Advanced Television Service met. The Narrow-Muse system has been officially eliminated from further consideration, because of the quality of the images delivered, the delivery of images and the coverage areas. Although NHK's (Nippon Hoso Kyokai) system did not make the grade, it was recognized for its contribution toward the advancement of a future HDTV/ATV standard.

Digital is here...almost

The removal of the last analog proposal confirms that the future of television in the United States, if not the world, will eventually be digitally based. In reality, analog production and transmission will probably exist throughout the next decade and a half, but the future of digital is finally becoming a certainty.

All for one and one for all

Talks continue toward the possibility of a grand alliance between the remaining proponents. However, little progress has been made. Other issues concern whether the combined systems will use interlaced or progressive scanning and whether they will use MPEG.

To clarify the issue of interlaced vs. progressive, the ATTC, at the request of the proponents, presented a blind demonstration of computer-generated still images in both formats the morning after the special panel adjourned. The observers reportedly were hard-pressed to distinguish between the two. It was noted that extremely slight interlace errors were apparent only when viewed closer than four picture heights from the viewing screen.

Chan is the principal of Chan & Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

MPEG, too

Among the unresolved issues is the use of MPEG compression. The ATRC is maintaining that the MPEG standard renders its system more conducive to multimedia applications and global acceptability. However, GI and Zenith are basing their approach to HDTV compression on a proprietary scheme. The other proponents have differed, maintaining that MPEG II remains to be completed and was not originally intended for HDTV video. Presently, the MPEG II capacity is sufficient for one digital channel of HDTV per analog NTSC channel.

In another option, the potential combined system would use compression algorithms developed by GI or Zenith and incorporate an MPEG syntax, allowing the system to decode an MPEG bitstream.

In reality, analog production and transmission will probably exist throughout the next decade and a half, but the future of digital is finally becoming a certainty.

Data-intensive environment fuels interoperability issue

During recent months, the issue of interoperability has gained momentum. The Advisory Committee's Interoperability Task Force, which met for the first time in late March, began developing specific tests to challenge the flexibility of the proponent bitstreams in hopes that their tests will be added to the testing program. Among the 35-40 members attending were representatives from the four proponents and DARPA, CBC, Viacom, HP, Sun Microsystems, IBM, Apple, Bell Communications Research, DEC and the National Institute of Standards and Technology.

The "eyes" have it

As the next round of testing approaches, the ATTC is actively recruiting expert observers to judge the systems throughout the test period. As in the first round, three to five "experts" are needed for each week of testing. Although it is hoped that some of the veteran first rounders will return, still more are needed.

To qualify as an expert, the viewer must bring to the lab a personal history in such areas as engineering or video and film production. Examples of areas that will be focused upon include locating the threshold of visibility (TOV), the point at which an undesired signal begins to interfere with the desired signal, and the point of unusability (POU), the point at which a picture no longer is viewable. Interested parties should contact ATTC's Janet Martin at 703-739-3850.

Broadcasters need support

Elsewhere, the Association of Maximum Service Television (MSTV) recently told the FCC that it should ensure manufacturer support of the new TV standard. MSTV recommended that the FCC ensure the widespread availability of ATV receivers before it forces broadcasters to convert from NTSC to ATV.

Zenith acknowledges MSTV's comments by stating that such rules would wreak havoc on the entire consumer electronics industry. Zenith maintained that it estimated a $500 premium for non-HDTV receivers capable of receiving and decoding a digital ATV signal. It argued that more than 22 million color sets are bought in the United States each year, and more than 70% are purchased below $350 with 13-inch screen size or less accounting for 25% of total sales.

The Bureau of Economics seemed to agree with Zenith. It stated that requiring a dual-mode television can be undesirable and that such a requirement may harm consumers by limiting their choices and forcing them to purchase equipment they may not otherwise choose to purchase.

The bureau also maintained that such a requirement will harm consumers wishing to purchase only an NTSC or only an ATV receiver. ■

CERAMIC ARMOR METAL PARTICLE TAPES

In Your Hands Our Science Turns To Art

Let your imagination soar!
With Maxell Ceramic Armor Particle Tape Products, you'll have total creative control, combining great versatility, tremendous reliability and incredible output.
Available in D-2, D-3, DAT, HD Digital 1" & Betacam SP.
They are the tapes of tomorrow, produced for you, TODAY.

maxell®

Maxell Corporation of America
22-08 Route 208, Fair Lawn, New Jersey 07410
1-800-533-2836

Circle (9) on Reply Card

re: Radio

If you can't beat 'em, join 'em

By John H. Battison

This month's column strikes out in a different way to deal with radio's "archrival" — television.

It has been about 13 years since low-power television (LPTV) hit the industry. In that time, literally tens of thousands of applications for LPTV stations have been filed. Far too many of these were thrown out, or should have been, because they were poorly done by unscrupulous preparers for unsuspecting applicants. The number of licensed LPTV stations on the air or with a pending construction permit (CP) is close to 2,000.

Filing procedures

There is no secret to preparing FCC Form 346, *Application for a Construction Permit* for a low-power TV station or a TV translator. Some radio engineers who have shied away from television over the years could broaden their revenue bases by dabbling in LPTV. It is almost as straightforward as audio work.

Let's go through a simple LPTV application:

Buy a copy of CFR47, which covers Sections 70-79. Subpart G, Section 74.700 covers LPTV. Read and learn this section.

Your first client will probably come to you and say, "I have a channel to use and it's quite clean." Don't believe it. Clients rarely have any idea about what makes a clean channel. If you take the client's word for it and prepare an application that bounces, it will be your fault.

Spend several hundred dollars (charge the client in advance) with a broadcast-channel database service, and find a suitable channel using the rules in CFR 47.

FCC Form 346 is fairly simple to complete. The non-engineering portions are reasonably clear and should cause you no trouble. Section One requests general information. You are going for either an LPTV station or a translator. The only tricky parts are those that ask you to determine whether you are applying for major or minor changes in licensed facilities, major or minor modification of a CP, or amendment to a CP. To answer these, consider the following general rules:

- A *licensed facility* is one that has been licensed after filing Form 347. Until that time, you are operating with a CP and/or perhaps a Special Authorization.
- A *CP* is an authorization to build an LPTV station.
- A *modification* is a change in an approved authorization (that is, one for which a CP has been issued).
- An *amendment* is a change in a pending application before it has been approved and a CP issued. It may or may not have a file number, depending on how much time has elapsed since it was filed. All CPs and licenses have file numbers.

One day, the commission may have to require all LPTV stations to use offsets.

- A *major change* is one that increases your coverage area, moves the antenna site more than 600 feet or proposes to provide service to an area not covered in your present authorization.
- A *minor change* is one that does not increase your coverage area or move the site by more than 600 feet. It is typically used to change an antenna type, reduce power or make other similar small changes.

An important distinction exists between procedures for LPTV vs. other broadcast services. For the latter, it is usually possible to report small changes in final construction that differ from the CP on the *license application*. LPTV rules are extremely specific — Form 347-license application must *only* report what was previously authorized. If a small change was made during construction, such as a different antenna with the same characteristics, you must file a minor change on Form 346 before you can file Form 347 for a license.

Technical data

Section Two of Form 346 covers engineering issues. This is really the meat of the application. Again, most questions are fairly easy to answer. The question about *frequency offset* may be a little confusing, however. Frequency offset actually is a designed 10kHz difference in frequency between your station and another one on your channel. This little item often can make the difference between getting a CP and not getting one.

Essentially, if no frequency offset exists between co-channel applicants, neither applicant can let the 28dBu signal overlap the opponent's 74dBu contour. But if there is a 10kHz offset between the applicants, then the overlaps can occur at the *46dBu* and 74dBu contours.

This 10kHz frequency offset is only applicable to co-channel situations, but *both* stations must use offset to take advantage of it. Offset can be applied in any of three ways: +10kHz, −10kHz or ±0kHz. Each case implies the use of a precise carrier frequency control. More important, the last option, called *zero-offset*, is different from no-offset. No-offset does *not* employ precise carrier frequency control, so no other co-channel applicant can use offset of *any* kind to obtain the 46dBu contour spacing.

Many of the earliest filed applications used a no-offset method. This was probably because of the plenitude of channels available. Today, the story is quite different, and many times the only way of squeezing in a station is by use of offset. One of the legal devices used by engineers to help their clients keep competition away is to specify no-offset operation. This ploy means that competing co-channel applicants can get no closer to the no-offset station than its 28dBu contour. Unfortunately, this tactic also causes fewer channels to be available. One day, the commission may have to require all LPTV stations to use offsets.

Sometimes the only way to squeeze in a new application is to ask an existing no-offset station to go to offset operation and offer to pay their expenses. Even if the existing station accepts, this adds time to the new station's application process, because the FCC will not accept the 46dBu co-channel application until the proposed offset change has been officially completed. ■

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

Dual Domain Audio Testing

We have a *System* that works. *System One* from Audio Precision

In studios and labs, on benches and factory floors, in stations and networks, thousands of System One Audio test systems around the world attest to the fact that this *is* the System that works. Hardware and software refined to match the application produce both superior performance and superior reliability as demonstrated by our three year warranty on parts and labor.

THE RECOGNIZED STANDARD

System One is known the world over as the recognized standard in audio test and measurement. Component suppliers, manufacturers, equipment reviewers, and end-users all rely on Audio Precision for measurement quality they can trust.

COMPREHENSIVE & FAST

System One is a completely integrated digital and analog audio test system. By combining all the necessary instruments into one package System One provides higher performance at lower cost than conventional instruments. In addition, System One can grow with your needs. Your initial purchase of a basic System One allows you to add any option later.

Optional *FAST*TEST & *FAST*TRIG DSP capabilities test any audio channel, producing 160 measurements from a stimulus signal less than one second in duration. Options such as input and output switchers and the DSP-based FFT and digital domain modules make "one-stop" audio testing easy.

EASY TO USE

Straightforward features and stored sample audio tests make System One easy to use. Color graphic test results also may be copied to printers and plotters.

GO/NO-GO testing against limits and test sequencing with automated procedures save time and repetitive motions.

HIGH PERFORMANCE

New digital and analog technologies leave yesterdays "good enough" performance far behind. System One easily handles high performance challenges such as state of the art analog preamps or digital recording systems.

The integrated System One offers premium specifications and performance, but at no premium in price compared to lesser test sets or equivalent separate instruments.

Our worldwide force of Audio Precision representatives will be pleased to provide further information and an onsite demonstration.

Audio precision

P.O. Box 2209
Beaverton, OR 97075-3070
503/627-0832, 800/231-7350
FAX: 503/641-8906

Circle (10) on Reply Card

INTERNATIONAL DISTRIBUTORS **Australia:** IRT Electronics Pty., Tel: (61) 2 439 3744 **Austria:** ELSINCO GmbH, Tel: (43) 222 815 04 00 **Belgium:** Trans European Music NV, Tel: (32) 2-466 5010 **Bulgaria:** ELSINCO, h.e. Strelbishte, Tel: (359) 92 581 698 **Canada:** GERRAUDIO Distribution, Tel: (416) 696-2779 **China, Hong Kong:** A C E (Int'l) Co. Ltd., Tel: (852) 424-0387 **Czech Republic:** ELSINCO Praha spol. s r.o., Tel: (42) (2) 4702 I. 451, 452 **Denmark:** npn Elektronik aps, Tel: (45) 86 57 15 11 **Finland:** Genelec OY, Tel: (358) 77 13311 **France:** ETS Mesureur, Tel: (33) (1) 45 83 66 41 **Germany:** RTW GmbH, Tel:(49) 221 70 91 30 **Hungary:** ELSINCO KFT, Tel: (36) 112 4854 **India:** HINDITRON Services PVY, Tel: (91) 22 836-4560 **Israel:** Dan-El Technologies, Ltd., Tel: (972) 3-544-1466 **Italy:** Audio Link s.n.c., Tel: (39) 521-598723 **Japan:** TOYO Corporation, Tel: (81) 3 (5688) 6800 **Korea:** B&P International Co., Ltd. Tel: (82) 2 546-1457 **Malaysia:** Test Measurement & Engineering Sdn. Bhd., Tel: (60) 3 734 1017 **Netherlands:** TM Audio B.V. Tel: (31) 034 087 0717 **New Zealand:** Audio & Video Wholesalers, Tel: (64) 7 847-3414 **Norway:** Lydconsult, Tel: (47) 9 19 03 81 **Poland:** ELSINCO Polska sp. z o.o., Tel: (48) (22) 39 69 79 **Portugal:** Acutron Electroacustica LDA, Tel: (351) 1 9414087 / 9420862 **Singapore:** TME Systems Pte Ltd., Tel: (65) 298-2608 **Slovakia:** ELSINCO Bratislava spol. s r.o., Tel: (42) (7) 784 165 **South Africa:** SOUNDFUSION, Tel: (27) 11 477-1315 **Spain:** Telco Electronics, S. A., Tel: (34) 1 531-7101 **Sweden:** Tal & Ton Elektronik AB, Tel: (46) 31 80 36 20 **Switzerland:** Dr. W.A. Gunther AG, Tel: (41) 1 910 41 41 **Taiwan:** ACESONIC Intl Co., Ltd., Tel: (886) 2 719 2388 **United Kingdom:** SSE Marketing Ltd., Tel: (44) 71 387-1262

Part 3

Management for Engineers

Managing stress

Dealing with stress

By Judith E.A. Perkinson

A few months ago, a friend decided to learn more about stress management. He read books, listened to tapes and took a stress management workshop. As he progressed through his efforts, he became more frustrated. He didn't want to do most of the things that were suggested to him. He didn't like to jog. He couldn't imagine meditating, and thought that most of the suggestions he had received were a bunch of baloney.

This man misunderstood stress management. He was looking for a magic formula to eliminate stress. Stress management isn't something you pull out of a bag of tricks and do for a week when you feel stressed. Stress management is a combination of *awareness*, *attitude* and *action*.

Awareness

Parts 1 and 2 of this series have been devoted to stress awareness. Awareness is essential in developing a stress management program. Your ability to cope with stress is significantly increased when you understand the sources and effects of stress.

No two people are alike. Take time to examine your sources of stress and how you react to stress so that you can design a stress-coping strategy.

Attitude

Research studies have identified a personality type called the "hardy personality." This type of person doesn't get sick and is less likely to buckle when times get tough. These stress-resistant people share three common attitudes.

1. They have a strong sense of purpose.
2. They feel a sense of control over the events in their lives.
3. They are open to change.

Many of us need to develop mental muscle in order to survive the physical and emotional challenges of life. You can develop mental muscle through your attitude and outlook on life.

Your outlook is tied to how you view the events in your life. In order to build a positive outlook, you need to understand how you view the world, how you feel when things don't go your way, and how you react to people and events. The following are some helpful hints:

- *Personalizing.* When something bad is happening to you, take a moment to remind yourself that the world is not aimed at you. It didn't rain to ruin your day, the train didn't block the intersection to make you late for a meeting, and a piece of equipment didn't break down just to spite you.

Stress management isn't something you pull out of a bag of tricks and do for a week when you feel stressed.

Life can be easier if you don't take everything personally. You can enjoy life when you don't feel persecuted by other people, systems and events. The choice is yours.

- *Overreacting.* When events happen that bother, anger or frustrate you, the first thing to do is stop. The advice to count to 10 is a way to make you think before you react. Become proactive, not reactive, when faced with a problem. You will be more effective and avoid stress in the process.
- *Stop exaggerating.* Catastrophic thinking adds to stress. Avoid absolutes, such as never, always or the worst. If you're less dramatic and more analytical, you'll feel better and be able to handle the problem.
- *Facing the worst.* Avoiding problems makes them worse. We all imagine consequences that are much worse than reality. Face the problem, get it over with and move on.
- *Making lemonade.* When life hands you lemons, make lemonade. There is good in almost everything. Use the problems in your life to learn, grow and change. See change as a challenge, not a threat.
- *Adopting a positive attitude.* Be positive. When pressures are mounting, listen to what your inner self is saying. If you are hearing "I can't," then you're building stress. There are no guarantees for success, but believing you can do something will take you a lot further then believing you can't.

Action

It isn't where stress comes from that is important, but how you handle it. As important as attitude and awareness are, they cannot carry the entire burden of stress management. Stress-resistant lifestyles are born of good habits. You can use four areas of your life to dissipate stress:

- *Diet.* When stress is high, take stock of your diet. Salt, sugar, caffeine and fats should be reduced. Eat breakfast. It stabilizes your blood sugar levels and gives your body the fuel you need to handle a busy and stress-filled schedule.
- *Exercise.* Exercise may or may not be a part of your life. If you do exercise, keep it up. If you don't exercise, don't make excuses. Instead, make small changes that will add to the amount of exercise you get. Take the stairs instead of using the elevator. Park your car at the far side of the parking lot so you force yourself to do a little walking. Try walking at lunch or with a family member or a friend in the evening. Do an activity that makes you feel good.
- *Time control.* Getting and keeping control of the time in your workday can be one of the most effective stress management tools you have. Learn to say no, set priorities, organize your paper flow, protect the minutes of your day and stop procrastinating. In 1991, *Broadcast Engineering* ran a series in this column that dealt with time management. You might want to review those articles.
- *Be good to yourself.* When things get bad, don't make it worse by beating up on yourself. When you feel good about your world, you are better able to face whatever problem comes your way.

Remember, the goal in managing stress is to recognize the signs, define the sources of stress and deal with them. If you learn to do these things, you will be emotionally and physically healthier. ■

Perkinson is a member of the Calumet Group Inc., Hammond, IN.

Serial Digital Made Clear.

More than ever, seeing is believing! Go with the new Tektronix WFM 601 Digital Component Monitor and see what's happening at a glance in your serial digital signal. With its fast setup and familiar displays, you can focus directly on your signal and solve any problems before it's too late.

The WFM 601 means no more mental gymnastics, no second-guessing results. Instead you get the best of both worlds: single-wire digital technology plus crisp, clear displays in the analog format you're used to. Including:

- Component lightning display (above) for quick setup of the complete Y/B-Y/R-Y signal.
- RGB parade display of component color difference signals for easy source setup.
- Component vector display of B-Y/R-Y components.

The WFM 601 is just the latest in a long line of serial digital video products pioneered and perfected by Tektronix. Including the TSG 422 Digital Component Generator (inset) featuring the signals you need for systems installation or equipment service.

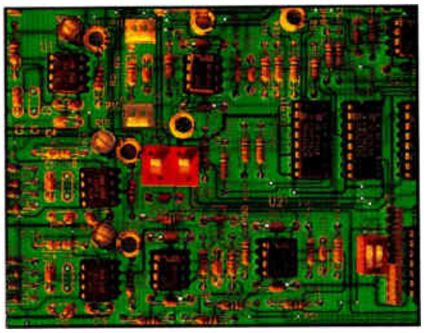
But take a closer look. Call 1-800-TEK-WIDE, Ext. TV, and see why Tek's advantage in serial digital has never been more clear!

Circle (11) on Reply Card

Tektronix

Part 3

Circuits



PLD basics

A practical system

By John T. McGaughey

In Part 3 of this series, a programmable logic device (PLD) will be used in a practical system. The PLD is of major interest, so only enough hardware detail will be shown to enable the logic description file to be produced. Although PLDs are extremely versatile, they are not a cure-all for poor problem specification. A good design begins with an understanding of the system requirements. Avoid the temptation to work on details before the system's needs have been clearly defined.

Stepping through the system

This example system was built and successfully used for nearly a year. Although it is small, it illustrates many of the features that make PLDs attractive to designers.

The first step was a problem statement. A requirement was stated to alert the operator of certain events that needed attention. These alarms originated in several different pieces of equipment physically separated from the operator's normal location. The distances resulted in delays reacting to events that could have been time critical. It was important to bring these conditions together at the stand-up operation point.

A further unrelated requirement was for an on-air tally system to indicate when any of several microphones were active. Some means of displaying these conditions and drawing the operator's attention to their existence was needed.

The first question: What kind of inputs are available? The first group of alarm conditions originated within the network's communications system. This essentially was a network information channel reporting, among other things, messages regarding schedule changes. The system had four different alarms available as latched contact closures. This eliminated the need to remember their occurrence in the proposed system.

The next alarm condition was an EBS alert. It had essentially the same characteristics as the group. The tally system had three inputs to indicate when any of three microphones were active. What type of outputs did the system need? Each of the inputs was to flash a front-panel LED that indicated which alarm was active. The EBS input did not need its own LED, because elsewhere in the system the time of its occurrence was displayed and flashed. However, the EBS input would be used in another way, as described later. If any of the three microphones was on, a relay would be activated. To draw attention to the presence of an alarm condition, a pulsing audible alert was sounded. It could not be activated if a microphone was on, because the sound would be broadcast.

Other requirements involved the priority of the alarms. Some of these did not require immediate attention, so a masking feature was included in the system. This allowed the alarm to activate the LED but not sound the audible alert. Control for this masking was provided by a set of four DIP switches in the system. To test the system, a lamp test push button was needed. Because the LEDs needed to flash, an oscillator input was required.

McGaughey is an instructor at the University of Georgia Center for Continuing Education, Athens, GA.

formation is not needed to begin the logic equation portion of the file. Remember, the pin declaration section isolates this detail so that as hardware information becomes available, the pin input section can be specified.

The next step is to find a PLD that can perform the work required. Because the logic needed is combinational, the major criterion falls on the number of pins for inputs and outputs. From the signal list there are 14 inputs and six outputs. The PEEL 273 by ICT Corporation was selected. This device has 12 dedicated input pins 1 through 23. Advantage is taken of the PLD to use two input/output pins as dedicated inputs. Also, two input/output pins are left over for expansion. This device is electrically erasable, so mistakes made in development can be corrected.

Because the logic compiler requires all signals to be named, they can be assigned to appropriate pins without regard to active pin levels. This allows an individual

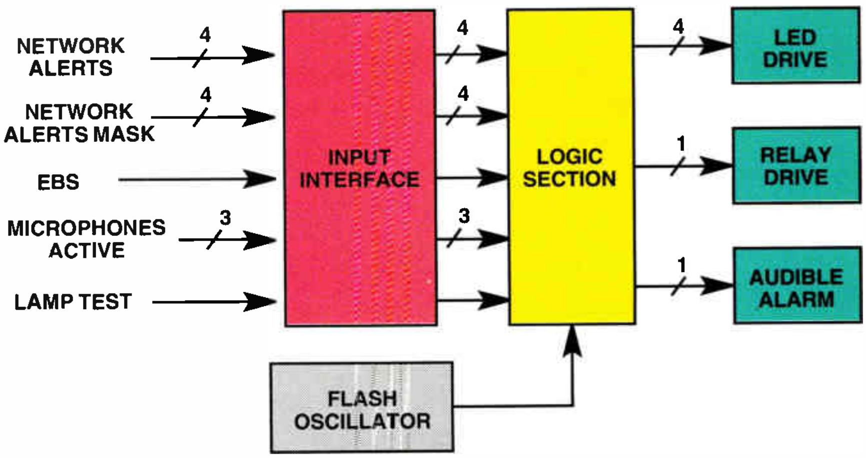


Figure 1. *Constructing a general block.*

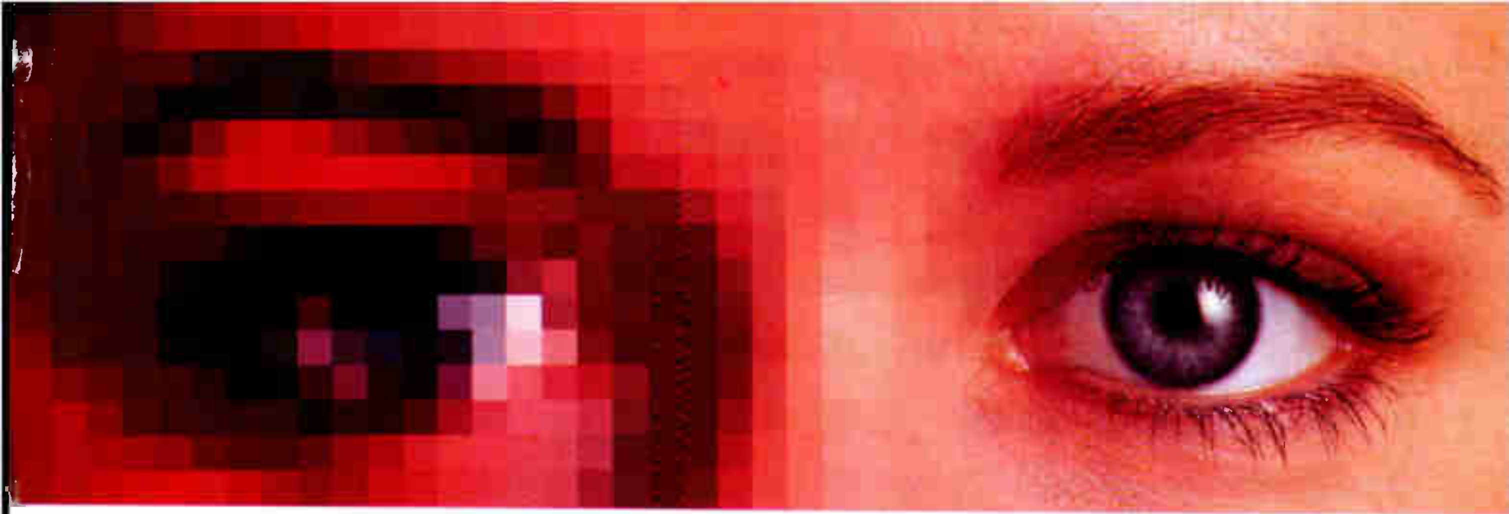
PLD advantages

With this information, a general block can be constructed, as shown in Figure 1. The system will be entirely digital, and the logic block will fit into one PLD. At this point, the advantages of PLDs begin to help in starting work on the logic block of Figure 1. Although it isn't known what the logic levels at the pins will be, this information is not needed to begin the logic equation portion of the file...

to move directly to the logic equations, because actual pin levels can be declared later as the hardware is specified.

hardware is specified.

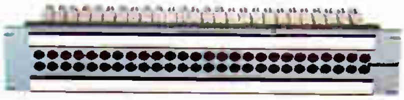
Next month, a logic description file will be generated. Until then, you may be able to come up with equations that will work equally as well. ■



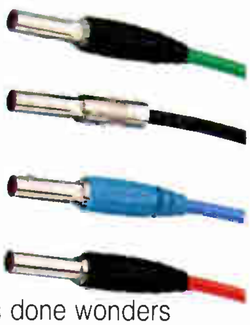
Look who's going to improve your image.

You've heard a lot about Switchcraft, a leading manufacturer of quality audio components for more than 40 years. Now, see what we can do. Because Switchcraft can supply you with video components, too.

Look to us for standard video broadcast equipment, all made with the reliability and high quality you expect from Switchcraft. When it comes to our video insulated patch panels, you'll find our eye for detail is second to none. Each one can accommodate up to 26 jacks for a variety of requirements. Dual jacks provide a normal-through signal path without the use of looping plugs or patch cords. And, each panel comes with large designation strips for your own labeling.



Our video patch cords are available in popular lengths and colors – all built for efficient video signal transmission. Our patch cords come with rugged metal handles and optional rubber "boots" for a better grip. The "boots" offer enhanced flex relief and are available in your choice of colors – red, black, green or blue. Switchcraft is dedicated to making your studio time as productive as it can be.



So whether you're thinking video or audio components, think Switchcraft. We've always done wonders with sound. Now we can improve your image, too.

For more detailed information, phone or FAX our Marketing Communications Department and ask for New Product Bulletins 426 and 427.

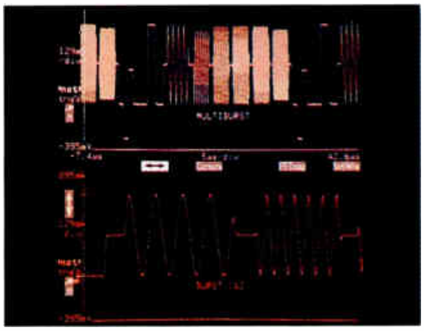
Switchcraft
A **Raytheon** Company

Switchcraft, Inc.
5555 N. Elston Avenue
Chicago, Il 60630
(312) 792-2700
(312) 792-2129 (FAX)

Circle (12) on Reply Card

Part 3

Troubleshooting



Care and feeding of coaxial transmission lines

Completing a coax section

By Dean W. Sargent

The final item needed to make a complete section of coax is the inner connector or bullet. This is where you can make or break the system. The most common bullet is the EIA type, ie; the fingers are large and few (EIA doesn't specify the number of fingers) relative to the size. This applies to all bullets. These are double-ended and are plugged into the inner with the Teflon insulator fitting into a groove provided for it in the flange.

The watchband spring

Approximately 35 years ago, RCA manufactured a bullet that was attached to the inner conductor via a watchband spring. This allowed the inner to expand and contract without "shaving" the bullet. At the time, shaving was a common problem and resulted in many line burn-ups. Figure 1 shows this spring inside the inner conductor. As the inner conductor expands and contracts, it slides over the spring while the bullet portion remains firm in the next section of line.

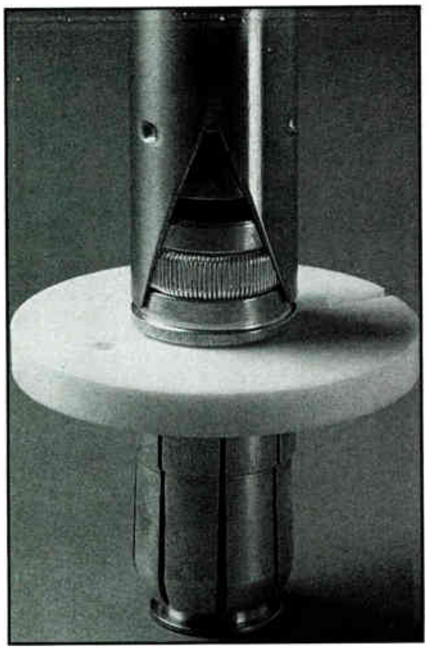


Figure 1. *A cutaway view showing the watchband spring inside the inner conductor.*

Sargent is president of D.W. Sargent Broadcast Service Inc., Cherry Hill, NJ.

It is important to have sufficient spring so that all of the wires of the spring are touching, otherwise heating and burning will result because of insufficient current-carrying capacity. Some transmission line was manufactured with the bullet soldered to the inner. This made it an integral part of the inner, and a watchband spring was in a groove. This spring was stretched so that when it was inserted in the next section the spring would not pop out.

The spring should be installed so that it cannot rotate, or it will be damaged. A good bullet design captivates the bullet in such a way that it can only slide.

Good bullet design

Another expansion system has shown up in recent years that makes use of an expansion bellows made into the inner conductor. This system does not slide, but moves like the bellows of an accordion.

A good bullet design will have a spring on the inside of the fingers to ensure that sufficient tension is exerted on the inner conductor when it is inserted. This spring should be located so it exerts pressure at the end of the inner conductor, not at the end of the bullet.

If you examine a bullet that has been in service for a while, you will notice where the silver has been scraped off in a narrow portion of each finger. This is the only place contact was being made. Figure 2 shows such a bullet. This is why bullets "shave," causing filings to settle on insulators, and eventually flash over from the inner to the outer. This results in a burn-up. The expansion system is designed to eliminate this.

The high-power connector

Another inner connector is known as a "high-power" connector. This bullet has many narrow fingers, all captivated at the end. This design uses a pair of springs radially under the fingers that supplies the necessary pressure to maintain good contact.

Like the watchband spring, this connector forms to the shape of the inner that it is inserted into. Because of the many fingers making contact with the inner, less pressure is required for good contact. As a result, this connector requires less pull to remove. It also has the ability to handle higher powers because of the excellent contact properties. This type of bullet will not shave.

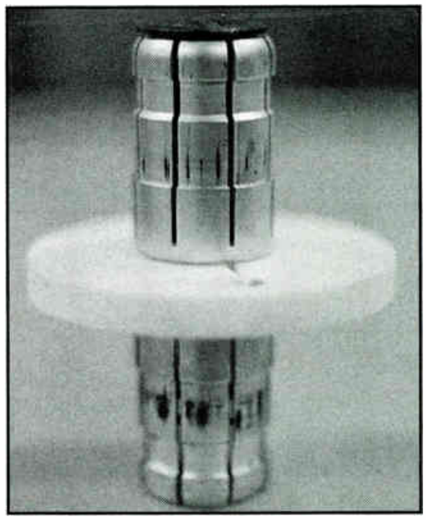


Figure 2. *A bullet where the silver has been scraped off in a narrow portion of each finger.*

Having more narrow fingers on a bullet does not make a better connector. One manufacturer makes a connector with many fingers, but relies on the spring of the metal for the contact pressure. This is not considered a good design.

Another bullet that was made (and may still be made) had double contacts, one for RF and one for thermal purposes. The RF contact was a watchband spring, and the thermal contact was supposed to transfer heat across the RF contact. Although this may be possible, it is incorrect. The idea of heat transfer is from the inner to the outer along its entire length, not from one section to the other.

Use a reinforced elbow at the bottom of the vertical run and in the complex at the top. These elbows should use captivated inner conductors and be optimized for the channel that is being operated on.

If the vertical run is longer than 600 feet, use two fixed hangers at the top just under any elbow complex. Support the line with spring hangers spread every 10 feet and properly tensioned. ■

The next generation of image compositing

By Curtis Chan

For those of you who remember, the basic principles of compositing algorithms have been in use in the film industry for more than three decades. Petro Vlahos, while working as the chief scientist at the Research Council for the Motion Picture Producers' Association in Hollywood, developed a blue-screen system that could deal with transparent objects and blurred edges. These basic principles were the foundation of his color-difference matting process. The process was first used in the production of Ben Hur in 1959. At the time, the technology was not advanced enough to realize Vlahos' vision electronically. Instead, an optical process was implemented using the color-difference matting process. As technology caught up with Vlahos' vision, the algorithms were implemented into hardware and formed the basis of a process for electronic image compositing. Let's look at a recent innovation in matting equipment.

The compositing process

The patented process combines images by summing them. The process performs a fully additive mix rather than a non-additive mix. The foreground and background are processed separately and then combined to produce the composite image. This is what enables this particular type of additive mix process to produce transparent or translucent objects in the foreground and to reproduce extremely fine detail in the foreground scenes.

For a new technology to be useful, it must be able to perform equal to or better than its predecessor.

Software-based compositing system

The advent of high-performance computing systems, DSP, large-capacity drives, and the ability to emulate hardware functionality through software has allowed the next generation of compositing technology to be integrated into a single software package. One such implementation is called CineFusion.

The basic principles of compositing algorithms have been in use in the film industry for more than three decades.

The software encompasses all of the algorithms included in the original analog hardware, plus an artificial intelligence mode that allows the software to assist the operator in selecting foreground, background and composite characteristics. Because the system is software-based, it can be integrated with conversion drivers to accept multiple file formats. The system is resolution independent and supports most major file formats, including SGI, TIFF, RLA, PIXAR and Kodak. The system also can composite using blue, green, red or black backings.

Two modes of operation

This new compositing technology operates in an interactive mode and an off-line mode. The interactive mode is used to set the compositing parameters and file list. The off-line mode is used by the SGI platform to process the images.

Flexible software-based controls

The software user interface offers 50 different control parameters. Eight matte controls allow the operator to adjust the density of the matte, and 10 foreground controls adjust the foreground blacks, whites and saturation. Ten background controls adjust the background blacks, whites, gammas and saturation. Four flare controls allow the user to adjust the color gates.

The system also provides nine "garbage matte" window controls for masking portions of the foreground image. Because software upgrades or enhancements are common in the computer industry, it would be easy to port over new solutions to current problems as they arise. The software offers various utility controls that provide solutions to special compositing problems. These utilities can be provided as menu controls or pull-down macros.

User intelligence

CineFusion incorporates an interactive menu, which helps the operator identify a certain scenario or problem and assists in locating where in the image the phenomenon is occurring. It then analyzes the pixels within the identified area, determines which controls are required to solve this problem, and automatically sets them. Once the operator identifies the areas that are printing through, the interactive menu does the rest.

Color conformance

Another feature of the user-intelligence mode is color conformance. It automatically adjusts all of the foreground and background color controls. This feature adjusts the color controls to provide a good color balance between the foreground and background scenes.

To create a proper color balance may require setting as many as 18 separate controls. Because the controls are interactive, it also can be time-consuming. With such capability, the inexperienced operator can get the same result as the experienced operator in one pass. To simplify the process, software should take away some of the analytical and redundant trial-and-error tasks associated with fine-tuning an image.

Although CineFusion is targeted at the pro market, it may be only a matter of time before this type of software will be available to the masses. With all of the upcoming technology, computers will soon have the horsepower needed to deliver acceptable performance levels when these types of programs can be ported over. With the advent of this technology, the world of desktop video production and post will never be the same.

Chan is the principal of Chan & Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

Acknowledgment: The author would like to thank Ultimatte, Chatsworth, CA, and RFX, Hollywood, for their contributions.

Program transmission systems

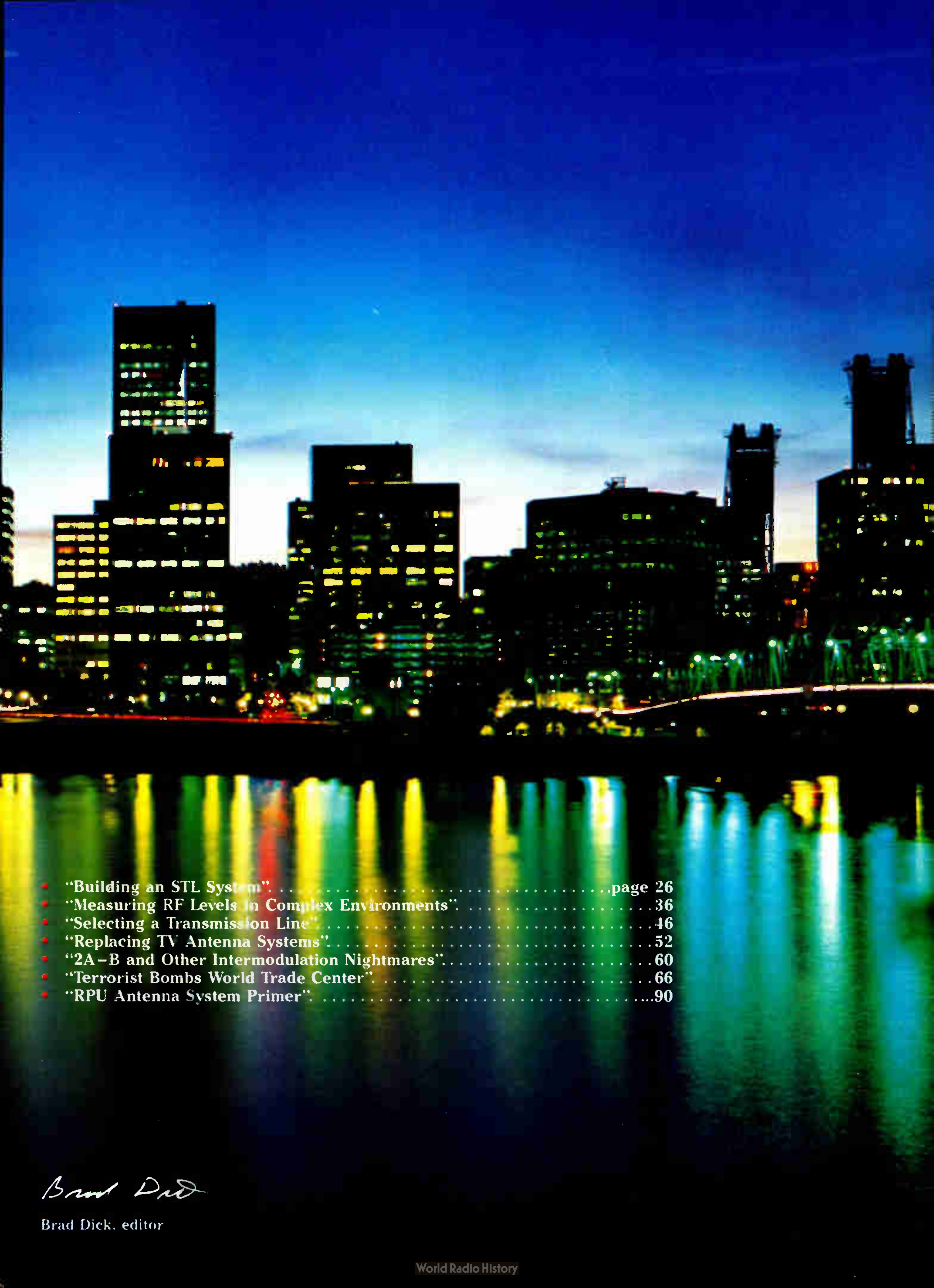
Although transmission systems don't represent the glamour side of broadcasting, they are the essential link in delivering the signal to the audience.

Although digital and video technology usually tends to grab the spotlight, there is an equally important area of technology for broadcasters. The transmission systems. We still need transmitters and antennas to deliver our signals to our audiences. This wireless link is what makes broadcasting so unique and valuable.

As RF technology has matured, the reliability and sophistication of transmitters and antennas also has improved. Modern transmitters operate easily via remote control. Solid-state operation provides for almost instant-on capability. Even RF combiners and diplexers provide features not possible a few years ago. Yet, as with all technology, with solutions come new problems.

This month's issue highlights some solutions to the problems facing today's RF engineers. Don't let the gremlins of complex RF systems damage your on-the-air record. Use the expertise of others to help you prevent those pesky RF problems from ever developing.

Finally, this month's *BE* contains an exclusive story on how the broadcasters located on the New York World Trade Center coped with the February terrorist bombing. The story, told by an engineer who works in the building, reviews what happened and how stations had to scramble to remain on the air. The tragic event revealed that few stations were prepared to cope with the type of disaster that occurred on that Friday afternoon. This special report highlights the importance of backup systems, no matter how secure you think your site might be.



Brad Dick

Brad Dick, editor

GIVE YOUR STATION A BREAK.

One revolutionary machine. A remarkable range of functions, from automated program playback and record to time delay and beyond. The Sony Flexicart™ multicassette system is truly unique – it's compact, format-independent and very affordable. Plus when combined with a Sony LMS providing commercial playback, the Flexicart will help your station break through to a new level of automation. For more information, call 1-800-635-SONY, ext. FLEX.

INNOVATION AT WORK.

SONY

Building an STL system

Today's technology presents some new options for aural STLs.

By Frederick M. Baumgartner

The Bottom Line

Getting a radio station's signal from the studio to the transmitter site has always been a critical part of the air chain. Today's environment has made this process even more challenging. Costs and spectrum crowding continue to escalate while the consumer's demand for high audio quality is growing. The trend toward consolidation complicates matters further. This all suggests that each station should re-examine its aural STL to verify that it is performing as well and as cost-effectively as possible. **$**

It seems like only yesterday that almost everything the professional broadcast engineer needed to know about studio-to-transmitter links (STLs) fit on a few pages and represented only three choices: telco circuits, discrete RF links or composite RF links — end of story.

Today, we realize that the story hasn't ended. In fact, the options are increasing rapidly, driven by improving digital and analog technology, tightening spectrum, and the consolidations brought about by LMAs, duopolies and additional services.

Although the need for an STL is usually dictated by geography (because the studio and transmitter are not co-located), the correct STL for the application should be determined by a needs/options and cost/benefit analysis. First, consider the options.

Telco services

In the early days of radio, the transmitter was often located at the studio. As the value of the land increased (forcing the transmitter out of town), and the broadcast business matured (forced the studio closer to the clients), telephone companies were happy to provide equalized (normally 5kHz, 8kHz or 15kHz) dedicated pairs. With the advent of FM and its line-of-sight transmission characteristics, terrain issues also drove the transmitter site to more remote locations in mountainous regions.

Yet, as the quality of broadcast equipment and consumer receivers improved, those telephone lines became the limiting factor to a station's audio fidelity in many cases. Meanwhile, divestiture and deregulation in the telco world caused telco STL rates to exceed the costs of purchasing and installing radio (RF) STLs, particularly on those long paths to remote mountain sites. Those who stuck with telco STLs soon found that the steadily shrinking number of equalized lines resulted in reduced dedicated staff and longer trouble-response times. Telcos clearly were focusing on the future (fiber optics, ISDN and other profit centers), not the past.

Until recently, the choice of an RF STL meant either a discrete or composite system.

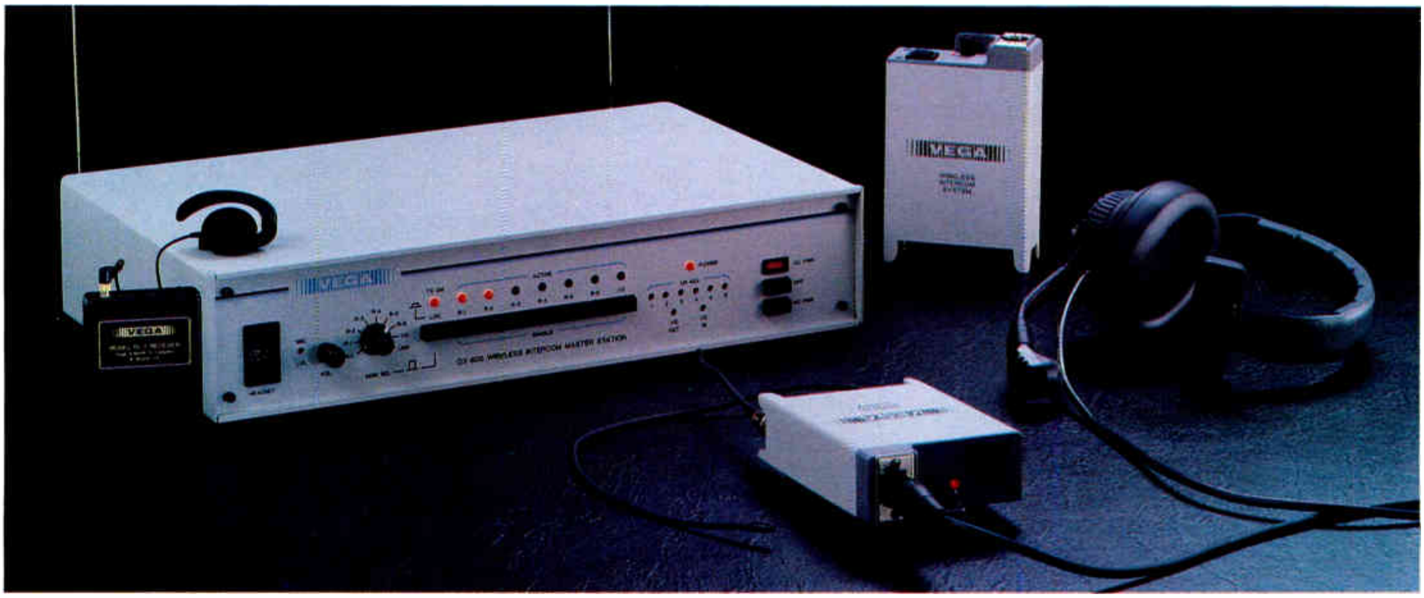
Today, telco T1 circuits (also called DS1 circuits) are available to many locations, including transmitter sites and studios. T1 circuits are digital, full-duplex (bidirectional) paths, and their capacity of 1.5Mbit/s can carry a number of digital audio and data channels to and from the transmitter. The number of audio channels can be increased by sacrificing some quality in the form of reduced audio bandwidth, data rate reduction (data compression) or, in the case of auxiliary data, by reducing speed. Because T1 circuits are in common use for other industries, the service tends to be well-maintained and cost-competitive.

RF STLs

By the mid 1970s, many aural STLs were RF types, which in the United States

Baumgartner is a product manager for TFT, Santa Clara, CA.

Advanced wireless intercom system



Vega Q600

- **Rugged, reliable, metal beltpack remotes**
- **Hybrid UHF/VHF operation to conserve scarce VHF frequencies**
- **Inexpensive VHF monitor receivers to lower system costs**
- **High-quality, low-noise, low-distortion audio**
- **Up to six beltpacks per master station**
- **Designed specifically for broadcast and production**
- **Directly compatible with all standard wired intercoms**
- **Many advanced circuit and system design features**

In the studio or on the set, Vega's wireless intercom systems are the choice of professionals who demand ruggedness, reliability, broadcast-quality audio, and a full set of professional features. Designed from the ground up for broadcast and production work, the Q600 UHF/VHF system provides all the functions and technical capabilities required for these demanding applications.

The Q600 system provides continuous, full-duplex, hands-off communications between up to six people plus an unlimited number of "listen-only" users.

The QTR-600 beltpack remotes are extremely easy to use and provide operation similar to that of hard-wired intercom beltpacks. They are compatible with popular dynamic or electret headsets, such as Beyer, Clear-Com, and Telex. The cases are welded aircraft aluminum alloy with a high-impact, molded Cycolac (ABS) control panel that will withstand the roughest use.

One QX-600 master station supports up to six QTR-600 remotes with "hands-free" two-way communications, and an unlimited number of PL-2 receivers for listen-only users. Circuitry is provided to interface external line audio with the system or to link two QX-600s into a 12-user system. The master station is directly compatible with all standard wired intercom systems such as Clear-Com, RTS, ROH, Telex, and many others via internal programming switches. A local headset position and extensive control, adjustment, and monitoring provisions are also included.

The PL-2 VHF mini-receiver provides a high-performance, low-cost solution to providing one-way "listen-only" communications. Very often, individuals need to receive instructions but are not required to speak. Using PL-2 receivers for this application avoids the expense of additional full two-way remotes and can significantly lower the cost of a typical system. The PL-2 is fully compatible with the Q600 system and is designed to provide reliable communications in the most demanding RF environments.

When the job demands hands-free, full-duplex operations in the most demanding environment, go with the Vega Q600, the system recommended by professionals worldwide.

VEGA

a **MARK IV** company

9900 East Baldwin Place
El Monte, California 91731-2294
Telephone: (818) 442-0782
Toll-Free Telephone: 800-877-1771
Fax: (818) 444-1342
FaxBack: (818) 444-2017
Toll-Free FaxBack: 800-274-2017

Circle (16) on Reply Card

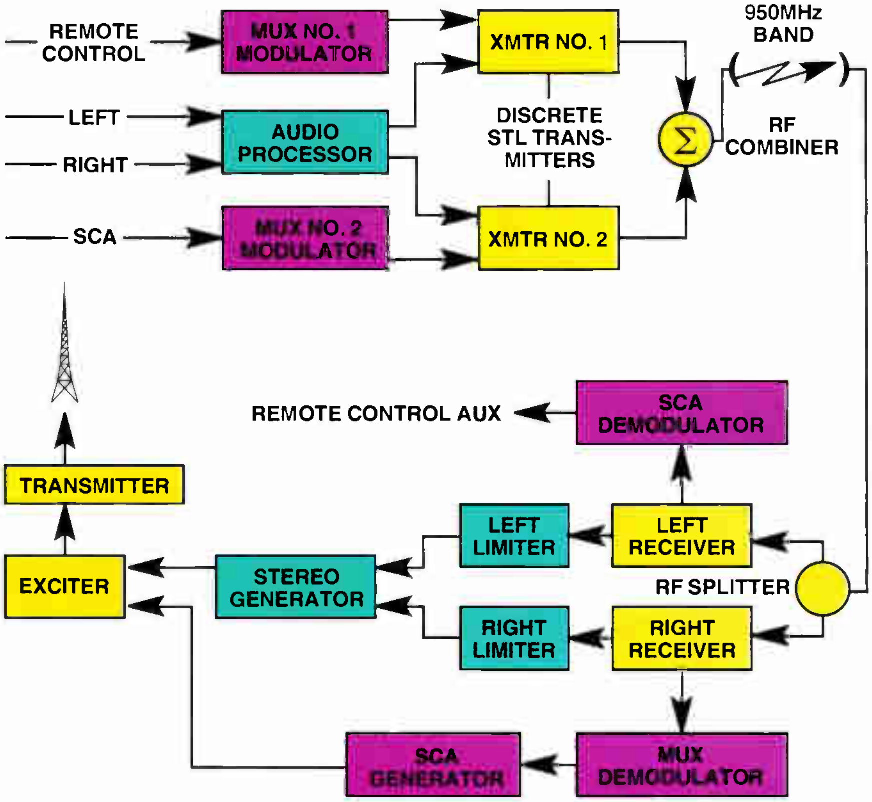


Figure 1. *A typical discrete RF STL with multiplexed SCA and transmitter remote-control signals.*

meant that they existed in 10,500kHz-wide channels between 947-952MHz (Part 74, Subpart E of the FCC Rules and Regulations). In 1990, STL spectrum from 942-944MHz was reassigned, reducing the number of available channels and putting an increased premium on aural STL spectrum in congested areas.

The method of modulation used on these links is FM, with bandwidths from 120kHz for mono links without subcarriers, to 250kHz for a more typical mono link, to 500kHz for composite stereo STLs with subcarriers and remote-control multiplex channels. Channels can be split to accommodate several less-spectrum-hungry STLs. Mono STLs can even be placed between composite signals. (The remainder of this discussion will consider only stereo STLs, because most of the considerations for stereo apply equally to mono systems, and because less demand exists for mono STLs.)

Traditional approaches

Until recently, the choice of an RF STL meant either a discrete or composite system. The discrete system (see Figure 1) offers the advantage of some built-in redundancy. Loss of a single receiver or transmitter, or interference on one channel, can be temporarily compensated for by switching to a mono broadcast using the good STL channel. On the other hand, the final audio processing and stereo generator must be at the transmitter. It also is sometimes difficult to maintain identical audio characteristics between the right and left channels (any difference affects stereo imaging). The costs in spectrum and hardware are relatively high for this approach.

A practical discrete installation requires RF filters, combiners (with sufficient transmitter-to-transmitter isolation to prevent intermodulation products), and two channels with frequencies far enough apart to not interfere with each other or anyone else.

An interfering signal can be devastating to a composite STL.

A cost/benefit improvement over discrete STLs can be realized by transmitting the composite stereo signal. Here, the audio processing and stereo generator are at the studio. (See Figure 2.) Thus, only a limited amount of equipment is needed at the transmitter to receive and demodulate the STL signal, remove any unwanted subcarriers (traditionally, the subcarriers or multiplex channels above 100kHz are used for remote-control-type applications

HDTV BROADCASTERS

ARE YOU LOOKING FOR OUT OF THIS WORLD QUALITY?

Then your transmission tube choice has to be EEV

EEV has set up a special HDTV Engineering Group to provide broadcasters and transmitter manufacturers with assistance for maximizing the HDTV performance of their transmitters, whether they be new or modified conventional tube equipped units. Transmitters equipped with EEV's IOT tubes have already carried HDTV signals both in laboratory and "over the air" environments. With a track record like this where else should you go?

EEV Broadcast Products

USA: EEV Inc, 4 Westchester Plaza, Elmsford, NY 10523 Telephone: (914) 592 6050 or 'Toll Free' 1-800-DIAL-EEV Telex: 6818096 Fax: (914) 682 8922

CANADA: EEV Canada Ltd., 67 Westmore Drive, Rexdale, Ontario M9V 3Y6 Telephone: (416) 745 9494 Telex: 06 989363 Fax: (416) 745 0618

UK: EEV Ltd, Waterhouse Lane, Chelmsford, Essex CM1 2QU, England Telephone: (0245) 493493 Telex: 99103 Fax: (0245) 492492

Subsidiary of the General Electric Company plc of England GEC

Circle (18) on Reply Card

and are not to be transmitted by the FM transmitter), and remodulate the exciter and FM transmitter.

An alternative approach that can improve fidelity allows for the removal of the STL modulators and demodulators from the system by using a combined STL receiver/exciter. In this case, the composite 950MHz signal is not demodulated but simply downconverted to the appropriate FM broadcast frequency and deviation.

> *Digital STLs can ignore the presence of most interference.*

Composite also is popular for AM stereo. However, the additional step of demodulating the composite signal into left and right is required before feeding the AM stereo generator. Should redundancy be desired on a composite system, the cost can more than double with the addition of switching and increased RF equipment. The elegant simplicity of the composite STL has one major weakness: the RF signal path itself. An interfering signal can be devastating to a composite STL.

Digital RF STLs

This is where the benefits of a digital STL become evident. Any analog STL will faithfully add interference or noise from the path to the final broadcast signal. Even extremely high-gain antennas, full STL power, tight receiver filters and a clear path cannot guarantee problem-free operation in congested areas. Digital STLs can operate with signal levels under 100V (the minimum for which an analog STL receiver will provide reasonable quality) at the receiver, and ignore the presence of most interference.

The wide bandwidth of digital audio signals forced early digital RF STLs to use pseudovideo PCM converters and video links in the 23GHz band, where multimegahertz channels were available. This band was subject to severe path-length limitations and rain fading. Data-reduction systems now allow digital STLs to use the existing 950MHz band and its 500kHz or narrower channels. Because of the data reduction required, many analog STLs can still approach or exceed a digital STL's audio quality given an interference-free and sufficiently strong RF signal at the receiver (typically 300V [–58dBm] or more).

Economics also play a part in this decision. With the appropriate coding and modulation schemes, digital STLs can offer more audio channels for a given slice of baseband and RF spectrum. In some cases, the digital signal's spectrum requirement can be so low that it allows analog

S-VHS

With Panasonic's S-VHS newsgathering systems you can lower the cost of being there without lowering the quality of your look on-air.

Panasonic Digital Signal Processing cameras dock directly to our S-VHS VTRs. DSP gives camera operators the benefit of Panasonic Emmy award winning technology: near-instant set-up on the scene or in the newsroom; on a pedestal or on your shoulder; outdoors, indoors, day or night.

Panasonic's AG-7000 and AG-5000 Series S-VHS VTRs provide news departments with rugged, fully featured edit bay systems with multiple audio tracks, S-component video, and available SMPTE Time Code.

TO GET THE NEWS, YOU HAVE TO BE THERE.

Need tape stock in the field? S-VHS and VHS are so widely available, it's virtually impossible to be caught without stock. You can even roll "amateur" VHS video into your program.

S-VHS from Panasonic. It's everywhere and anywhere. Think of it as the next best thing to a bigger budget.

For more information call: 1-800-528-8601 ***(Upon request, enter product code 14)***
One Panasonic Way, Secaucus, NJ 07094

Panasonic
Broadcast & Television Systems Company

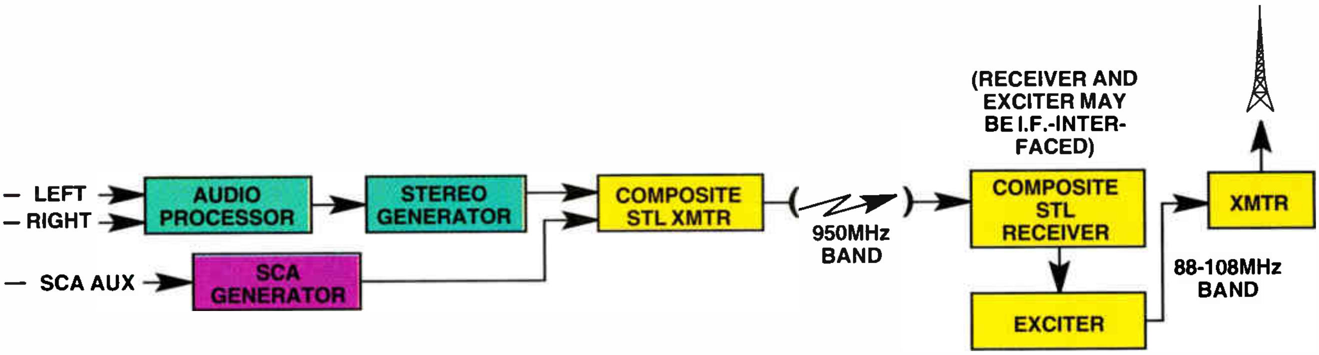


Figure 2. *A typical composite RF STL system.*

subcarriers for remote control and other uses to coexist within the channel. For multicast applications, converting to a digital STL may even permit *two* digital program signals to fit where one analog signal went before. A digital STL's ability to function with lower RF levels also can allow smaller or lower-mounted antennas to be used, thereby reducing cost and windloading.

A digital STL system is either built as a modem/multiplexer that attaches to an existing composite STL (see Figure 4) or as an integrated system with the RF and modem circuitry sharing the same chassis. Depending on the manufacturer's design, it is sometimes necessary to modify existing RF equipment to accommodate the baseband bandwidth requirements for the digital encoder and decoder, or to replace the STL transmitter and receiver.

Planning the STL system

The first step in planning an STL involves a study of your options. Is telco T1 available and, if so, at what price? How many audio channels are needed, now and later? Is there an RF path? This last issue requires the most analysis.

If the RF path is short, and the transmitter STL receive site can be seen from the STL studio transmitter site, the task is often relatively simple. In most cases, paths are too long to be determined by eye and topographic maps — often several $7^1/_2$-minute maps are required. In some cases, a relay point is required to get around an obstruction or to extend the path over large distances. It is standard practice to plot the path's vertical characteristics (height of the transmit and receive antenna, ground level and building heights) on special *curved earth* paper that compensates for the radio curvature of the earth. Having an optical path alone is not adequate, because radio waves require an additional *Fresnel zone* of clearance that can be calculated from the distances and frequencies involved.

Once the path is found, a frequency must be located. The Society of Broadcast Engineers (SBE) provides frequency coordination for most of the country. The society maintains a database of all known users and other particulars, such as power, polarization, bandwidth and locations.

The SBE can provide information and make recommendations, but it cannot pick a frequency for you. Ultimately, the licensee is responsible for any interference that is caused to an existing operation. Even after all of the frequency coordination is complete, it is wise to check the desired frequencies at several locations using a spectrum analyzer or high-quality communications receiver.

A check of the physical facilities also is required. Is there a place to mount the antennas and feedline? Are the buildings secure and dry, and the temperature controlled within the operating range of the equipment? Are the power, lightning protection and access adequate?

Finally, an RF budget is calculated to determine how much signal can be delivered to the receiver and at what cost. Most of the elements that make up the RF budget are variable. For example, antenna gain, STL transmitter power and transmission line loss can all be adjusted to improve the signal level at the receiver, but at additional cost for hardware and installation.

The cost/benefit analysis can help you decide which option best fits the station's needs. Begin by ruling out unworkable options. In most cases, the choice comes down to analog or digital RF STLs. If the path is marginal and/or the channel capacity requirements are high, the digital STL may be the most cost-effective. If the path is solid, an analog STL will likely be the choice.

The success of the STL installation is almost always determined by the quality and completeness of the engineering planning before installation. Be sure you are aware of the many new options available for STLs today. They can overcome many of the limitations that not so long ago were impossible or economically prohibitive to solve.

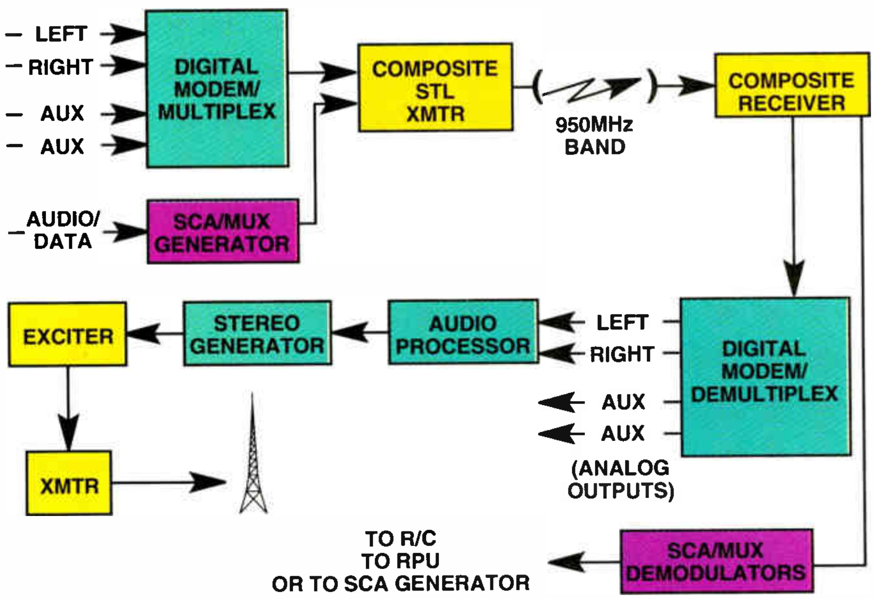


Figure 3. *A typical digital RF STL system.*

➡ *For more information on STLs, circle Reader Service Number 300.* ■

In 20x10 and 20x20 Switching, Datatek has it all.

Digital Video • Digital Audio
Analog Video • Analog Audio

Digital or analog, audio or video, Datatek has a 20x10 or 20x20 switcher to fill your complete needs. Datatek's extensive line of switchers may be used independently of each other or in combination to form flexible and coordinated digital and analog routing systems.

- The **D-2530** Serial Digital Video Switcher for D1, D2 and D3 signals (10x10, 20x10, or 20x20 in 2 Rack Units only).
- The companion **D-2540** Digital Audio Switcher routes AES/EBU or consumer format signals with sample frequencies to 48 kHz.

For more information, call or Fax:

- The **D-2511** Analog Video Switcher features a 40 MHz bandwidth and 20x10 switching in 1 RU or 20x20 switching in 2 RU.
- The **D-2535** Wideband Video Switcher is a 100 MHz system for 20x10 in 1 RU.
- The **D-2520** Stereo Switcher features matched left and right channel performance with .05% THD at +26 dBu (20x10 in 1 RU or 20x20 in 2 RU).

Each of these cost-effective switchers includes RS-232C or RS-422 control as standard for computer or modem control. A wide selection of control panels is also available for reprogrammable, X-Y, alphanumeric, keypad, pushbutton per source, etc.

Please call or Fax Datatek for more information.

DATATEK CORP

1121 BRISTOL ROAD, MOUNTAINSIDE, NEW JERSEY 07092
PHONE: 908-654-8100 ● TOLL FREE: 800-882-9100 ● FAX: 908-232-6381

Circle (21) on Reply Card

EVER WONDER WHAT KIND OF TAPE IT TAKES TO DELIVER 30 PERFECT GENERATIONS?

For a lot of people, tape is tape.

They'll spend months analyzing the purchase of a new system or format, then just assume the tape will work when they need it.

Most people don't even think about having tape problems. At least not until they're in the last place they can afford them: the edit suite.

That's when they realize, perhaps too late, that poor tape performance can compromise even the best equipment—and can ruin even the most carefully crafted production.

The fact is, your tape is just as important to the performance of your system (and to the quality of your product) as your drive or your editor or your switcher. Tape should really be thought of as an integral part of your system. And to deliver 30 perfect generations, it should really be designed as part of your system as well—and should be designed to meet the demands of your application.

Tape is tape...unless it's this tape.

We recognize that for perfect multi-generational performance under the rigorous demands of post production, the tape and drive must work together as one.

So we developed a tape in parallel with a drive to provide unprecedented performance, consistency, and interchange.

The result is the Ampex DCT 700t Tape Cartridge.

It was conceived, designed, and developed specifically to match perfectly the operational characteristics of the DCT 700d Tape Drive. And together they provide a level of compatibility unmatched by any other post-production system on the market today—a consequence of Ampex's more than 30 years of experience in perfecting the tape-to-head interface, setting the industry standards for precision performance and gentle tape handling.

The DCT 700t Tape Cartridge sets its own standard with a high coercivity metal particle formulation that delivers improved output at high frequencies.

The tape incorporates new dispersant technology to ensure a uniform distribution of particles throughout the mix, and it employs advanced coating techniques to achieve a smoother surface.

This produces a tape with digital error performance well below the DCT system's data management threshold, assuring you of outstanding picture quality.

And to ensure that that quality is maintained under the rigors of post production, the tape also utilizes a tough, highly crosslinked binder system that provides clean-running performance and greater durability over multiple generations.

Even the cartridge itself has been designed for greater dependability, incorporating numerous advancements in materials and plastics engineering. The patented hub design, for example, provides for stable spool rotation which, with the precision flanges, helps prevent tape damage and ensures smooth tape packs.

And every DCT 700t Tape Cartridge is manufactured and assembled to meet strict, no-compromise quality assurance levels. By employing advanced test systems, computerized inspection devices, and state-of-the-art Class 100 clean room facilities (similar to those used in advanced semiconductor manufacturing), you're assured of superior performance end to end.

In fact, when coupled with the gentle tape handling of the DCT 700d Tape Drive, you'll never have to worry about your tape during heavy editing again.

So what's the result of all this innovative technology, precision engineering, and painstaking attention to detail?

Perfect picture quality. Even after 20, 25, 30 generations.

You won't believe it until you see it. And you can see it in the new DCT Multi-Gen demonstration videotape available *for viewing by appointment with your local Ampex Systems sales representative.*

Not just a new product, a new perspective.

The DCT 700t Tape Cartridge, however, is only part of the story.

DCT from Ampex is actually a *system.*

In fact, it is the first system conceived and optimized for post production in the digital component environment.

And while each device in the system offers unparalleled performance on its own, when taken together, they offer a post-production solution with a level of precision integration and efficiency never before achieved in this industry.

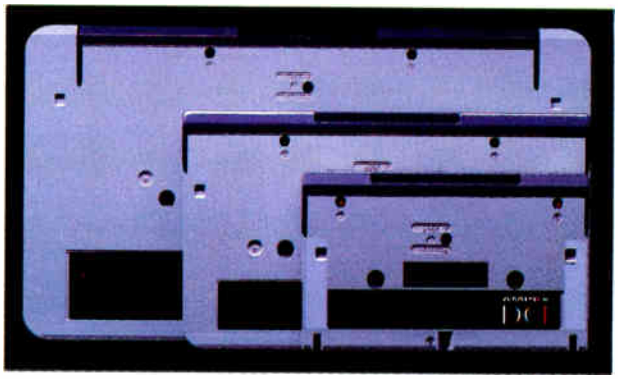
The Ampex DCT System is also the first complete digital component system available from one manufacturer. In addition to the DCT 700t tape, it includes the new DCT 700d Tape Drive, a new production switcher, new computerized edit controllers, ADO® digital special effects, and interconnect equipment.

It is a compact, sophisticated, practical digital component system that unlocks a whole new world of creative—and competitive—possibilities.

Starting where the disk stops.

The Ampex DCT 700d Tape Drive gives you all the creative freedom of a transparent multilayering environment, like a disk-based system, combined with the speed, flexibility, and efficiency of a powerful editing tape drive. So, unlike any other component system currently available, you can use it to create a complex commercial, for example, then turn right around and use it to edit a long documentary.

In fact, the DCT 700d has been optimized in every detail to work the way you want to work in a digital component environment. It is built for demanding professionals, and employs the most advanced tape transport mechanism ever designed. It is precision engineered to maintain ultratight tolerances through the rigors of post production, edit after edit, day after day, year after year.



Finally, the switcher you want in a size you can use.

The Ampex DCT 700s Production Switcher may well be the first sensible digital post-production switcher you've ever seen—because you can do as much with it as you can with even the biggest panels.

It offers you unprecedented transparency with a full 4:2:2 digital component signal system, and two key layer processors for unmatched performance, flexibility, and versatility.

It gives you big-switcher performance in a small package. So it gives you the freedom to be more creative... and the power to be more competitive.

It's not where you are, it's where you're going.

DCT is the digital component system from Ampex, the company that has been creating video solutions longer than anyone in the world. The company that has been the leader in applying technical innovation to solve practical problems.

That's why DCT *today* is already more than a generation ahead of any other digital component system on the market—or on the drawing board.

So while other people keep waiting for the "next" millennium, you can seize all the creative and competitive advantages of this one now.

With DCT from Ampex.

AMPEX
DCT™

Ampex Systems Corporation
401 Broadway, M.S. 3-23, Redwood City, CA 94063-3199

Measuring RF levels in complex environments

Discover how one of the most complex transmitter sites in the world meets ANSI guidelines.

By Dean W. Sargent

The Bottom Line

When it comes to multiple transmitter/antenna sites, none is more complex than the World Trade Center (WTC). As the WTC considered how it could ensure compliance with ANSI guidelines, it quickly became obvious that standard measurement methods were inadequate. The author describes an automated and sophisticated measurement system designed to make the thousands of measurements and calculations required to determine if the stations on the World Trade Center met the rules adopted by the FCC. $

Sargent is a consultant to Port Authority of NY & NJ World Trade Center and a consulting engineer based in Cherry Hill, NJ.

With the introduction of ANSI C95.1-1982, the need to measure (or calculate) the RF radiation near broadcast antenna sites became a requirement for many stations. The FCC made the process fairly easy in the case of a single station. The required data can be taken off of graphs provided by the FCC.

However, other facilities also are required to take RF measurements. Although the process often can be completed by using a broadband measuring device, there are some cases where the measurement process is extremely complex. Such was the case at the World Trade Center (WTC) in New York City. This article describes the process used at the WTC to complete the RF analysis. The techniques outlined here may be adapted to other installations where similar challenges exist.

A complex RF environment

A complex installation, such as the WTC in New York City, cannot be adequately surveyed by using only a broadband measuring system.

First, because of the multiple stations involved (27 carriers are on the WTC) and the inaccuracies of broadband instruments, it is impossible to know how much each carrier contributes to the total RF level.

Second, the proximity of the 2-way radio antenna farm adds to the inaccuracy. These conditions required that narrowband measurement techniques be used.

In the case of RF levels, a high value often is due to a single carrier. The narrowband device makes it relatively easy to identify the cause. It's usually a simple matter to detune or otherwise fix the problem once the offending frequency is known.

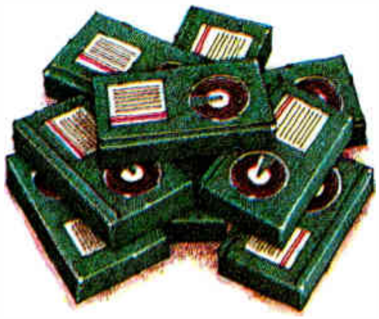
In some cases, stations have been required by the building owners to operate at reduced power because of the fear of radiation. Narrowband measurements frequently show that these stations are contributing so little to the total radiation because of antenna elevation pattern shape that they can increase their power with little effect on the total radiation level. Broadband devices are useful because they can help uncover high-level locations, which may need further investigation with narrowband techniques.

Designing a measurement plan

Identifying the required measurement locations is an important first step. Begin by constructing and labeling a grid in the area to be measured. In the case of the WTC, a 5-foot grid system was used. Two measurements then were made at each point where the grid lines cross, one at three feet and one at six feet above the roof. In addition to the grid points, a broadband meter was used to probe the entire area. Any high RF level points were added to the grid for precise measurements.

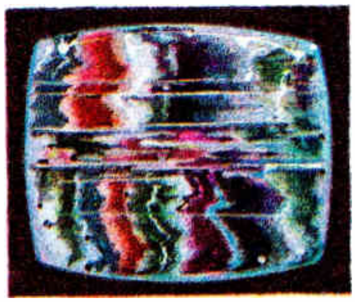
Once the measurement plan was complete, it was necessary to determine what data was needed. It was obvious that the individual radiation values for each station were needed. In the case of TV stations, this meant two carriers: aural and visual.

The FM stations had only one carrier to measure. The process also required that

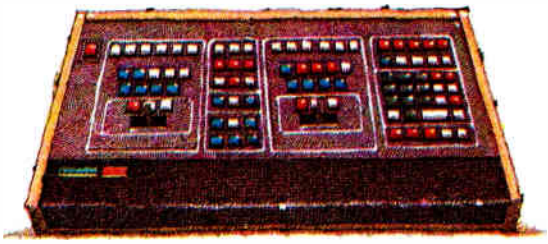


B-rolls

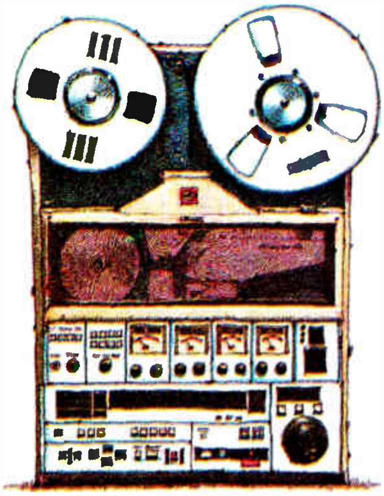
Production Switchers



Fuzzy Freeze Frames



Separate Edit Controllers



Multiple Source VTRs

Costs

Things you can cut down on in a room with a VUES.™

If you want to be on the cutting edge of digital post-production while cutting down on costs, perhaps it's time to invest in a room with a VUES.

This high-powered digital editing system from NEC consists of a single rack of equipment: a computer-control workstation, the NEC DTW-102 wipe generator, a background color generator/shadow processor, a 20×10 routing switcher, NEC VUES interface, and the real heart of the system, the NEC VUES VSR-11 solid state recorder.

With VUES, all editing functions—from wipes and complex mix/effects to multi-layered composites—are performed in the VSR-11. Best of all, you only need to use one source machine, one channel of character generator and one channel of digital effects to accomplish all of these tasks. And with the use of the VSR-11's DRAM memory, each source can be used indefinitely without ever performing a B-roll.

The compact design of VUES requires less space, less cooling and less maintenance (because there are no moving parts). Plus, because VUES utilizes a computer-control workstation, there are no expensive production switchers or edit controllers to buy.

If you would like more information about the finer points of VUES, please call us toll-free at 1-800-323-6656.

NEC

Circle (23) on Reply Card

The robot was required to make measurements at two elevations. Shown here is the 3-foot level.

everything be measured regardless of polarization or the direction from which it was coming. This process helped ensure that the readings included direct and reflected power.

The measurement antenna selected was the same one used by the EPA for some of its tests. The antenna was an active device known as an *electric field sensor.* The device covers frequencies from 10kHz through the UHF TV band. The device consists of two units, an active antenna and a control unit. The battery-powered antenna is 4.7 inches in diameter and has a dipole radiation pattern.

The antenna unit converts the electrical fields to optical signals and transmits them via a fiber-optic cable to the control unit. The control unit converts the optical signal back into a precision RF signal, which is then fed into the measuring instrument. The control unit switches relays mounted inside the antenna based on the received signal level. Control is accomplished on the same fiber-optic cable carrying the signals. The control unit uses an IEEE 488 computer interface bus.

A Hewlett Packard model 8562A spectrum analyzer completes the signal measurement package. The analyzer is frequency synthesized so it can operate on any frequency between 1kHz and 22GHz. It also is equipped with an IEEE 488 bus. The analyzer has another important feature. It is designed specifically for measuring electronic magnetic radiation so that measurements are not flawed from radiation into the instrument. Only radiation picked up by the antenna is measured.

Because the antenna is actually a dipole, it is necessary to make measurements in three mutually orthogonal orientations of the antenna at each location. This is accomplished by mounting the dipole at an angle of approximately 55° from the vertical (we call it the magic angle) and making measurements at three positions 120° apart. The measured levels from each of the three positions are added together to get the total RF level for that location.

Because it was necessary to make these measurements at two heights and in three positions, a robot was designed to hold the antenna, rotate it, and raise and lower it upon command. To make positioning easy and stable, the robot had lockable casters and a leveling system because some parts of the roof are sloping. The robot was constructed with PVC material so that it would not reflect signals. The photo to the left shows the robot in operation on the roof of WTC 1 at the three foot height. The photo below shows it elevated to the 6-foot measuring height.

Shown in the 6-foot elevated position, the robot assembly had to make three RF measurements. Signals were interconnected via fiber-optic cable to the spectrum analyzer.

Thousands of measurements

The measurement and calculation process generated a large amount of data. The spectrum analyzer had to be adjusted for frequency, span, resolution bandwidth and level before the actual RF level could be recorded. This step had to be completed for each frequency. Once these steps were completed, the antenna was rotated 120°, and the measurement process was repeated. The antenna was then rotated another 120°, and a third set of measurements was made. The result was a data record with each frequency's three measurement values and the total RF value.

Because of the large number of readings needed, a computer with an IEEE 488 bus was incorporated into the measurement package. Custom software was written to perform all of the measurements and store the data. Once the station information is entered, the program initializes all of the instruments up, stores the measured data, computes the totals and labels it.

Once the readings are taken, the computer begins performing the calculations and storage functions. This takes some time, so while this is taking place, the antenna must be returned to the home position. This function is performed automatically by the computer program. If this isn't done, the fiber-optic cable would wind around the antenna support post.

Limit switches

The original pedestal used mechanical limit switches on the robot to sense when it was in a correct measurement position and stop it when it got to the next position. The design didn't work because more limit switches were broken than there were spares.

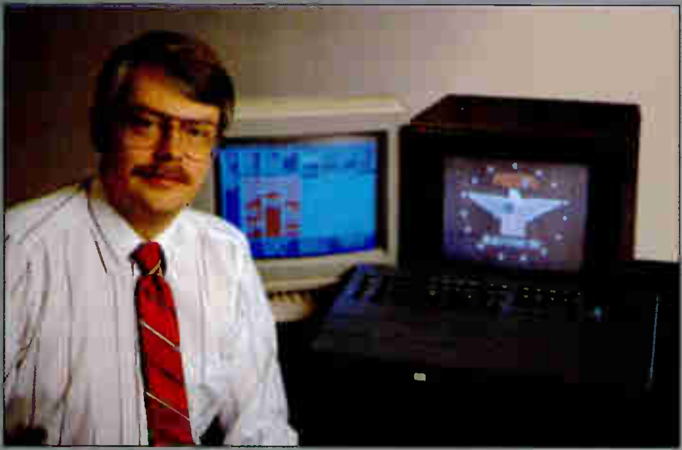
The solution was to drill small holes in a disc and use an infrared detector to sense an infrared light source. When the light passes through the hole, the detector picks it up and stops the rotation.

The sensors are connected to an H-P 3488A switch/control unit, which has an IEEE 488 bus port. The switch/control tells the computer where the antenna is, when it is moving and when the analyzer can take data. The device has an LCD display feature that tells where the antenna is positioned, what it is doing — all while taking data. This feature helps the operator know what's going on even though the robot may be up to a 100 feet away.

The computer assembly is shown in the foreground of the photo below, the antenna robot is shown in the far background. Because the units were interconnected with 100 feet of fiber-optic cable, only minimal relocation of the entire system was required.

The measuring system is contained on a portable cart containing the computer, interface device and spectrum analyzer.

"I'm an engineer, not an artist. But when I created our station's graphics on the Prizm DVE system. . .



—*Tim Winn, Director of Engineering KFDA-TV, Amarillo, Texas*

. . .Something exciting happened!"

"I'm an engineer by trade, not an artist. But the Pinnacle Prizm 3-D digital effects system we recently bought from BTS made it almost a snap to design our station's news show opens and IDs.

"We're a small-market station. Our only staff artist is me, so I had to have a system that featured advanced effects, was intuitive, and didn't cost either an arm or a leg. The Prizm worked on all counts.

"I'm especially pleased by the DVEator feature, which lets me map live video onto animated 3-D shapes. It's brought more punch to our news open than I would have thought possible.

"I'm sure people here were wondering if I'd lost my mind by acquiring a high-quality professional DVE system. After all, I'm just an engineer. But I'm really pleased with the results.

"I wonder what a real artist would do with it?"

NEW BTS MINI CONTROL PANEL

(Rear illuminated)

BTS

A PHILIPS AND BOSCH COMPANY

For more information, call (800) 962-4BTS

Outside the U.S., call (801) 977-1551

Circle (24) on Reply Card

Creative Television Technology from BTS


Trim Track
PRODISK 404
OTARI

This photograph was taken during the original development and test phase. The equipment has since been assembled in its own housing. The hood shown on the CRT made it easier to see in bright sunlight.

Signal analysis and reports

The computer program is configured to add all RF signals as if they were in-phase. A 0.6 conversion factor is used to transform peak-of-sync measurements so that the program assumes maximum possible visual power is transmitted in the TV signal. This conservative approach ensures that if the final results are below the ANSI guidelines when all signals are totaled, the client can be assured that the individual station carrier RF levels will actually be lower than the calculated sums. The program uses the EPA guideline for ground reflection coefficient of 2.56.

One problem posed by such a sophisticated system is what to do with all of the collected data and what form the output should take. After consulting with the clients, two basic types of report formats were developed.

When you only want to know whether ANSI guidelines are being met, a bar graph display is used. Figure 1 illustrates this type of report. The bar graph displays the percentage of maximum permitted ANSI level broken down to VHF TV, FM and UHF TV, plus the total of the three RF levels. The figure shows a total of 10 measurement locations, with measured RF levels at the three feet and six feet heights.

Broadband devices often are useful because they help to uncover high-level locations, which may need further investigation with narrowband techniques.

Table 1 lists each station and its individual radiation level, plus the total RF radiation level for that particular location. When combined with the bar graph in Figure 1, a station engineer or manager can know the exact contribution of that station's carrier for that location.

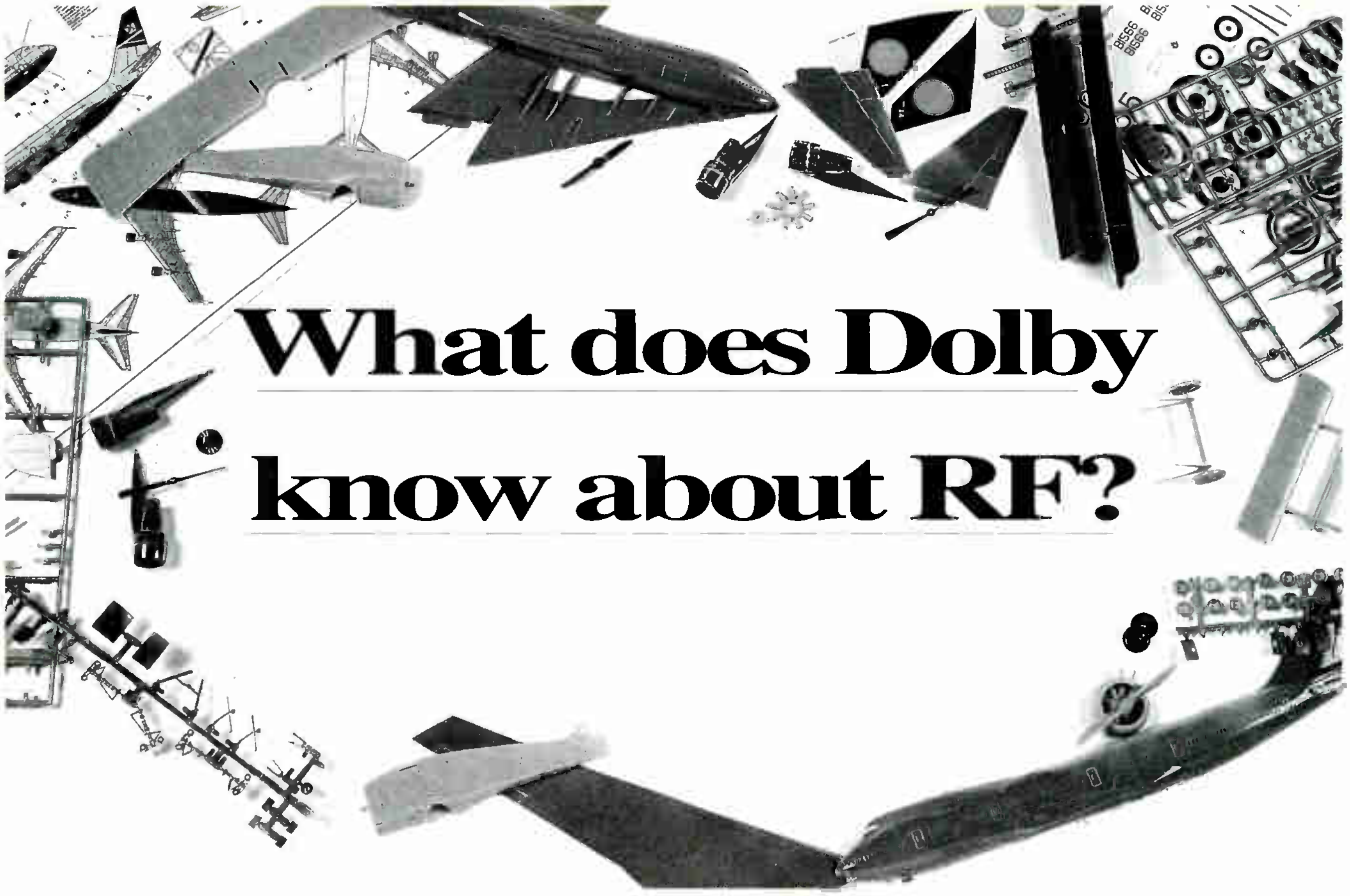
Carefully documented

All of the readings were taken twice on the roofs of each of the two WTC buildings. One set of readings was taken with all stations operating their main antenna systems. A complete second set of readings was taken with those stations having standby antennas using them, while those without standby systems operated their main systems. In addition to these measurements, the observation floor (below the roof) on WTC 2 also was surveyed to detect the RF levels coming through the windows.

Now that a new ANSI guideline is being adopted, will this data still be useful? Yes. Because the transmitted levels aren't any different, it's only necessary to change the computer program parameters and print new reports.

Program capabilities

Although this project involved a total of 27 RF carriers, the current computer program can accommodate up to 100 RF carriers. However, the more carriers that are measured, the longer it takes to complete the measurements. With 27 carriers, it takes approximately 10 minutes per loca-

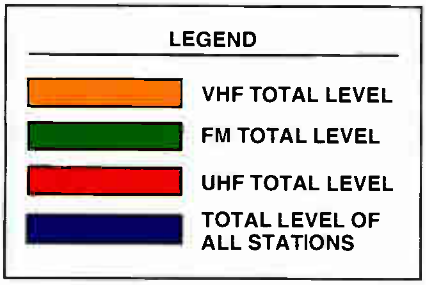


What does Dolby know about RF?

tion to take the measurements at two heights.

The program also allows the operator to recall on the CRT any measurements, at any location, at any time. This comes in handy if it is necessary to investigate a particular location without waiting for the report to be generated. The data can even be printed on location if desired.

Although we haven't used it, the system can accommodate a standard measurement antenna if needed. The antenna would permit measurements above the UHF band, which are too high for the active antenna. Because of the standard antenna's physical size, measurements are



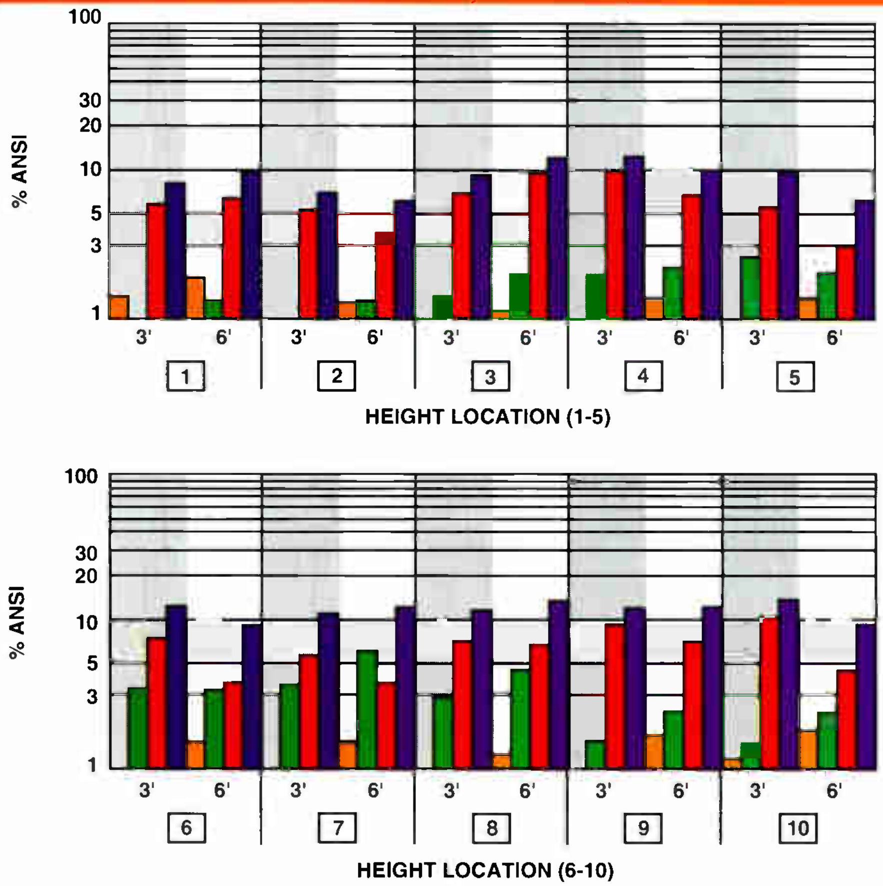


Figure 1. The bar graph displays relative percent of maximum permitted ANSI RF level by frequency band. See the legend for a color key.

MEASURED RFR LEVELS WTC (REPORT NO. 1)	
Location: A01	Height: 3 Feet
Date: Aug. 9, 1989	Time: 10:44:51
Total Level: 146.2μw/cm^2	
STATION	**μw/cm^2**
Station 1 - visual	0.481
Station 1 - aural	0.575
Station 2 - visual	0.708
Station 2 - aural	0.208
Station 3 - visual	0.435
Station 3 - aural	0.140
Station 4 - (FM)	0.193
Station 5 - (FM)	1.692
Station 6 - (FM)	2.541
Station 7 - (FM)	5.301
Station 8 - (FM)	0.265
Station 9 - visual	7.594
Station 9 - aural	1.803
Station 10 - visual	0.082
Station 10 - aural	0.052
Station 11 - visual	0.281
Station 11 - aural	0.213
Station 12 - visual	0.398
Station 12 - aural	0.577

Table 1. The table shows, by station, each station's contribution to the total RF level as well as the total RF level for that location.

limited to approximately 800MHz. Changing antennas simply requires telling the program which antenna is being used. Calibration information also can be entered as needed into the program.

A final note

This project took approximately two years to complete. In case you think everything went smoothly, I would like to note that it didn't. First, one of the UHF TV antennas burned up twice during the measurement period. Second, Hurricane Hugo blew through and we had to stop while the roof was swept so debris wouldn't blow off. In addition, my assistant, Susan Drummond, had two babies before we were finished.

Given the original challenge, the results are impressive. The project shows that with careful design it is possible to accurately document not only total RF levels, but also individual contributions by station carriers. Although the process was complex and lengthy, those stations involved can rest assured that they are meeting the requirements of the ANSI standards, the FCC and ensuring a safe operating environment for their staffs. ■

Selecting a transmission line

Semiflexible line offers many advantages over rigid coax.

By H. R. Nudd

The Bottom Line

As broadcast transmission moves to a digital future, lower transmitter powers may be employed. This could allow the use of semiflexible transmission line at facilities where rigid coax was traditionally required. The benefits and trade-offs of such a change are covered here, along with differences between the two types of coax. Installation, maintenance and repair procedures also are discussed. $

Nudd is manager of design engineering for HELIAX products at Andrew Corporation, Orland Park, IL.

Semiflexible RF transmission lines have been available as antenna feeds for high-frequency communications for many years. In addition to their broadcast applications, they also are used extensively in land mobile, cellular, HF, terrestrial microwave and satellite communications systems. Both coaxial cables and waveguides are available. Coaxial cable is the usual choice at frequencies up to 2GHz or 3GHz because of practical size limitations. At higher frequencies, waveguide is generally preferred because of its lower attenuation.

In today's U.S. broadcast industry, semiflexible coaxial cables are widely used in AM and FM radio, and to some extent in VHF television. At present, semiflexible lines are not in common use for UHF television, because of their increased attenuation at these frequencies and the generally higher transmitter powers involved. Larger rigid coaxial lines or UHF waveguide is chosen for those applications.

On the other hand, future HDTV broadcasting, which also is expected to employ these UHF frequencies, will likely use lower power levels due to its digital format. This could allow wider use of semiflexible cables at UHF, providing lower cost, easier installation, high reliability (resulting from long continuous lengths) and the elimination of joints (bullets) between sections of inner conductor.

Semiflexible coaxial cables are available in sizes from one-quarter of an inch to several inches in diameter. Constructions are of either the *foam-dielectric* or *air-dielectric* type. Foam is commonly used for smaller sizes, eliminating the need for pressurization systems. In sizes where both types are available, however, air-dielectric cables do offer advantages, even with their need for pressurization.

Air-dielectric features

Air-dielectric cables may be chosen for a number of reasons. When a large-diameter cable is required, it may only be available with an air dielectric. Today's manufacturing technology cannot reliably produce a foam-dielectric cable larger than the $1^5/_8$-inch diameter, and the high powers encountered in the broadcast industry often require larger cables. An air-dielectric cable also may be preferred because the antenna or some other equipment requires pressurization, and the cable provides a convenient pressure feed.

Even in smaller sizes, an air cable may offer some benefits. An air-dielectric cable has lower attenuation than a foam-dielectric cable of identical outer conductor size. Air cable contains less dielectric, which reduces the dielectric loss contribution and lowers the loss contribution from the conductors themselves (because of the increased inner conductor size of air cable that is required to maintain correct characteristic impedance).

Also, size-for-size, the average power-handling capability of air-dielectric cable is higher than that of foam cable. This is partly because of the reduced attenuation. However, the mechanics of heat transfer between inner and outer conductors for the air cable construction also are a factor. Heat transfer in air cable occurs by convection and radiation, with some conduction also taking place through the solid dielectric spiral insulation. In a foam ca-

One of the rare times when reality exceeds expectations...

Proven High Power UHF Tetrode Transmitters!

Acrodyne, the pioneer in tetrode technology, has **delivered** the **only** 30kW single tetrode UHF TV transmitters in the world. Consider the following:

- Plant efficiency—cuts cost 50-60%—**Proven**
- Tube life 24,000 hours—**Proven**
- Price advantage—**Proven**
- Less precorrection needed—**Proven**
- Tube operating voltage less than 10kV—**Fact**
- Smaller footprint—**Fact**
- Low cost tetrode replacement—**Fact**
- No diplexer—**Fact**

The proof is in; the facts are undeniable. Models are available from 5kW to 60kW. Talk to Acrodyne...the leader in UHF tetrode technology for 25 years.

Tomorrow's digital TV transmitter company.

ACRODYNE

Acrodyne Industries, Inc.
516 Township Line Road
Blue Bell, PA 19422
800-523-2596 or
(215) 542-7000
FAX: (215) 540-5837

Circle (29) on Reply Card

ble, the heat transfer occurs only by conduction through the foam dielectric, which has a low thermal conductivity (similar foamed plastic materials are used extensively for thermal *insulation*). The trend toward lower foam densities for reduced RF attenuation further degrades heat transfer and average power rating of foam-dielectric cable.

Finally, an air-dielectric cable and its associated pressurization system can give early warning of a leak development. Loss of pressure or excessive running of the dehydrator signals a problem. Conversely, a leak in a foam-dielectric cable system may allow water to collect undetected until total failure occurs.

Air-dielectric components

An air-dielectric cable system consists of the feeder cable, terminations to standard connector interfaces (which may include a gas barrier), a suitable pressurization system and various accessories.

Semiflexible air-dielectric cables are available in sizes from half an inch to five inches in diameter. The inner conductor is a welded copper tube, corrugated for strength and flexibility. (See the photo on this page.) For the smaller sizes, sufficient flexibility is obtained from a smooth tube or solid wire.

The dielectric section supports the inner conductor and is made from an extruded polyolefin material (usually polyethylene), helically wound on the inner conductor using a relatively short pitch for adequate support during cable bending. Sections for the larger cable sizes are notched for flexibility. The quantity of dielectric material is optimized to provide an optimum trade-off between attenuation, mechanical and heat-transfer properties.

An air-dielectric cable has lower attenuation than a foam-dielectric cable of identical outer conductor size.

The outer conductor is a helically corrugated copper tube. In order to protect the cable from the weather during handling, the outer jacket is extruded black polyethylene. Connectors are designed to terminate the cable with a standard interface appropriate to the cable size. Figure 1 shows a typical construction.

For non-pressure-sealing connectors, the connector's insulator has a through hole. Gas-barrier-type connectors are solid and fitted with sealing O-rings on inner and outer circumferences. The outer body assembly contains a pipe plug for connection to the pressurization system. Sealing gaskets between the outer body and clamping nut, and between clamping nut and cable outer conductor, contain pressure and exclude moisture. Connectors are designed to be fitted in the field with commonly available hand tools.

A typical semiflexible transmission line using air-dielectric coax, with outer conductor partially cut away to show insulator and inner conductor.

Choosing a pressurization system depends mostly on the volume of air to be supplied, and the availability of maintenance and electrical power. Small volume systems may use a dry-air hand pump or a nitrogen bottle, if the pressure can be inspected every few days. For most systems, a fully automatic dehydrator system is recommended. Dehydrators of the latest technology incorporate a membrane separation drying method rather than a dessicant.

Accessories needed to complete an installation include the cable hangers (special insulated hangers are typically used for mounting cables on AM towers), grounding straps, wall/roof feedthroughs for equipment building entry, hoisting grips and burial kits.

Installation

Correct installation procedures are important to the satisfactory performance of the transmission line. Remember that semiflexible coaxial cable is a precision electrical product. Although it is sturdy enough to withstand the stresses of normal installation, mistreatment can lead to permanent damage. If appropriate care is taken during installation, the line will provide long and trouble-free service.

New cable is packed on strong reels that must be transported vertically, resting on the flange edges, not on the flange faces. Reels should be off-loaded carefully and as close as possible to the pay-off position. The reel should be positioned at the foot of the tower, on a horizontal axle, so that the cable pays off the *bottom* of the reel. This results in less cable bending and better reel control.

At the top of the tower, the pulley system used to lift the cable must be rigged high enough and be capable of supporting the full weight of the hoisted length. The cable itself should be tied to the lifting line at 200-foot intervals to avoid stretching when hoisting.

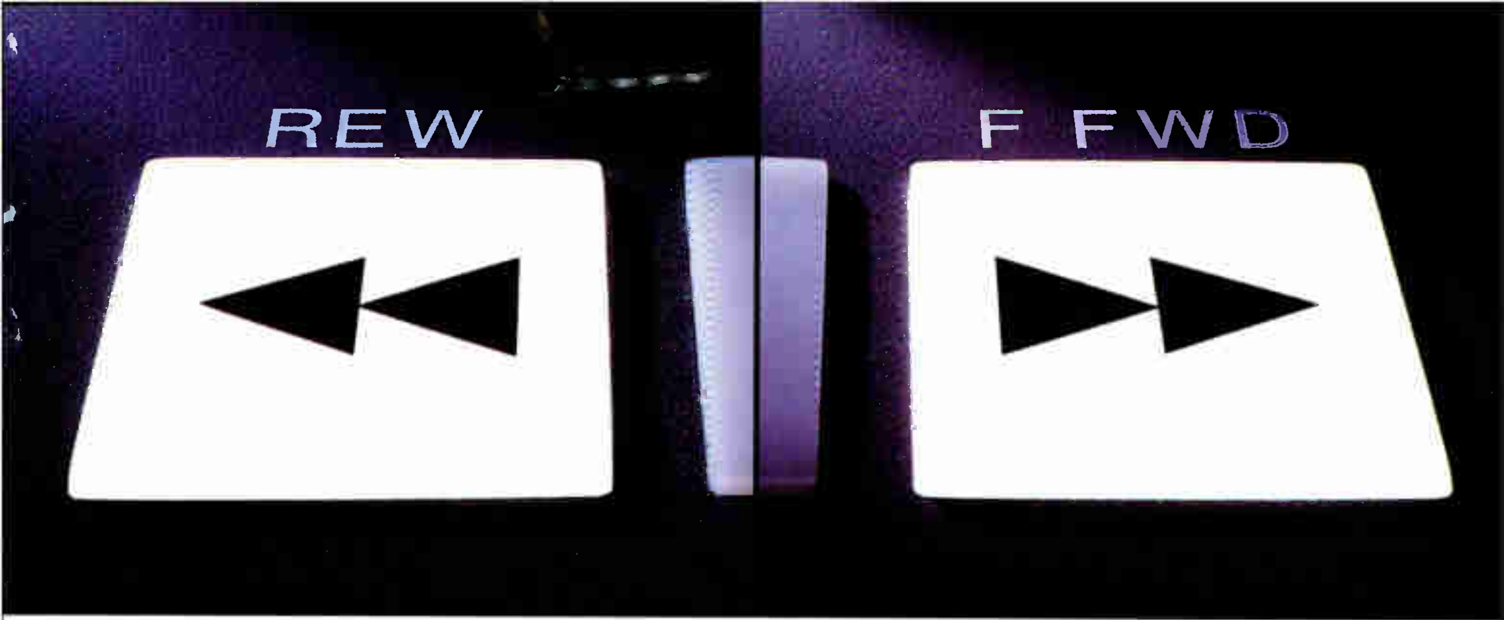
After lifting, the vertical run should be securely fastened to the tower, the maximum hanger spacing depending on the cable size. At heights greater than 200 feet, hanger spacing should be reduced because of increased wind speeds. Incorrect hanger spacings and improperly tightened hangers are the most common sources of trouble with an installed transmission line. The horizontal run to the equipment building must also be firmly supported by an ice bridge or other structure, again using cable hangers separated by proper distances. Ground straps are usually fitted at the antenna, the bottom of the tower (at the cable bend) and at the building entry.

Maintenance

If the cable has been correctly installed, little maintenance is required. The most important piece of diagnostic equipment on an air-dielectric coaxial cable is the pressure gauge. Pressure loss is an early warning of possible water ingress and an indicator of potential future problems. The system should have a pressure gauge, and it should be checked regularly.

For older automatic dehydrator systems using a dessicant, too much pressure tightness in the line also can cause difficulties. The dehydrator needs to cycle regularly. Long periods of inactivity can cause the desiccant to saturate. When temperature variations restart the dehydrator, it may pump wet air. This is most likely to occur in the fall, and is sometimes avoided by introducing a deliberate leak into the system. The dehydrator can be cycled occasionally by opening a valve in the system. Newer membrane dryers eliminate this potential difficulty.

The only other point of maintenance involves occasional checking for hanger tightness as part of normal tower work. A loose hanger performs no support func-



IT MAKES THESE TWO BUTTONS OBSOLETE.

How much time have you spent over the last few years waiting to get there?

The Pioneer VDR-V1000 Rewritable Videodisc Recorder just saved you that much time and more. It offers instant access (0.3 seconds average) and the fastest, most precise frame-by-frame editing in a recording device.

Gone are the typical problems associated with shuttling and jogging. The VDR-V1000's unique, dual-head configuration lets you search while play, record while play, or erase and record simultaneously. With 32 minutes recording time, and non-linear playback capability, you can assemble-preview your edits in realtime before recording. No pre-roll or post-roll is necessary.

THE PIONEER REWRITABLE VIDEODISC RECORDER WITH INSTANT ACCESS.

For a quick return on investment, the VDR-V1000 offers endless possibilities to these and other operations:

- On-line Non-linear Editing
- Commercial Insertion on the Fly
- Flexible Time Delay
- Efficient Still Store
- Instant Replay
- News Presentation
- Animation
- Satellite News Gathering

With so much going for it, the VDR-V1000 leaves only one question unanswered: What are you waiting for?

For more information, press the buttons on your phone, and contact your regional Pioneer representative: East - Tom Mykietyn at (201) 327-6400; West - Craig Abrams (310) 522-8600.

PIONEER®
The Art of Entertainment

Pioneer New Media Technologies, Inc.
2265 East 220th Street, P.O. Box 93131, Long Beach, CA 90810

Pioneer is a registered trademark and LaserDisc is a trademark of Pioneer Electronic Corporation.

Circle (30) on Reply Card

tion and allows the possibility of vibration in the wind, leading to fatigue and failure.

Repair and replacement

Occasionally, a cable can sustain damage by accident, wind or inclement weather, and may then require repair or replacement. Cables can be damaged by lightning strikes to antennas, especially if the part of the antenna that is hit is directly connected to the inner conductor. (The normal ground straps will handle strikes to the outer conductor or earthed antenna housing.) Cables also can be accidentally damaged by people working on or around a tower. Sometimes towers may fall prey to vandalism.

Major cable damage will be evident by a gross pressure leak and/or large electrical degradation. The damaged portion of the cable run probably will be apparent by visual inspection, but if not, electrical fault location can be used. A time-domain reflectometer (TDR) is preferred because of its direct indication of the problem's position. However, this also can be inferred by examining ripples produced by the fault in a VSWR vs. frequency analysis.

Small bullet holes may sometimes be repaired without replacing cable. This is recommended only if the bullet has passed cleanly through the cable without leaving a metal slug loose inside. If the cable is substantially undistorted, the small holes can be patched and sealed without significant performance degradation. For more serious damage, a length of cable may need to be replaced with one or more splices.

A splice is a short machined length of line that attaches to the semiflexible cable using the same tab-clamping mechanism that is applied to connectors. To fit properly, the damaged section of line must first be cut out. For a horizontal run, this is a straightforward procedure. For a vertical run, however, it is important that copper chips, which might be produced when cutting the cable, are not allowed to drop inside the section below the splice. With appropriate care, this can be accommodated (for example, using snips rather than a saw to make the initial cut). It may be preferable to replace a damaged vertical run all the way down to its lower bend.

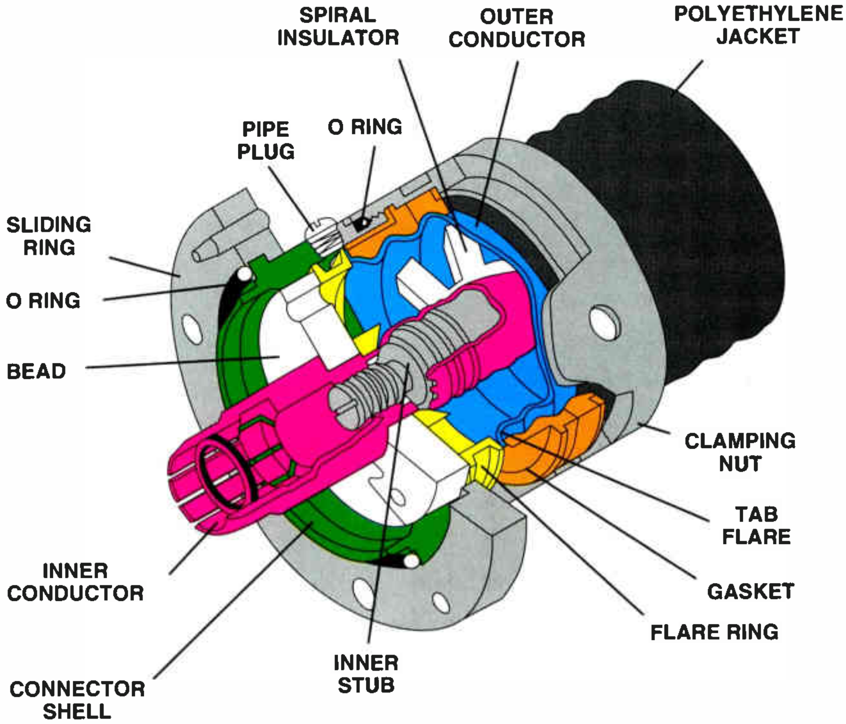


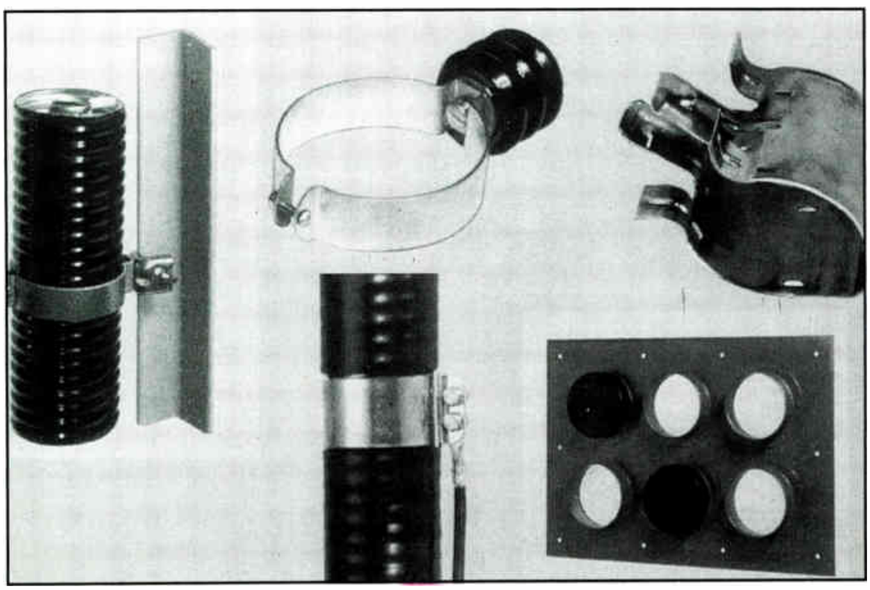
Figure 1. *Cross section of a typical air-dielectric transmission line connector.*

Summary

Where transmitter power levels permit their use, semiflexible coaxial cables can offer significant benefits over sectioned rigid transmission lines. These advantages include reduced cost, simpler and cheaper installation and improved overall reliability. In the event of damage to a semiflexible line, the affected portion can be cut out and a replacement length fitted using appropriate splices.

Among semiflexible designs, air-dielectric cable has better attenuation and power-handling characteristics than foam-dielectric cable, given equal outer-conductor dimensions. In the larger sizes, only air cables are available because of the limitations of foam core manufacture. Though they require pressurization, the early warning of imminent problems provided by pressure leaks is another benefit of air cable.

With appropriate installation and maintenance procedures, a semiflexible transmission line will give long and trouble-free service.



Some accessories used in semiflexible transmission line installations. Clockwise from left: non-insulated vertical hanger, insulated vertical hanger, horizontal hanger, building pass-through panel and grounding connector.

➡ *For more information on transmission line, circle Reader Service Number 302.* ■

Trust the Power

You Can Rely on Varian Tubes.

When the name on your transmitter tube is Varian, you're getting something no other tube can offer — Varian reliability. Varian's klystrons and Eimac® tubes keep your signal strong and on–the–air for years of worry-free dependability.

Varian reliability is beyond the ordinary because we understand the demands you place on broadcast tubes. Before a Varian tube is shipped to a customer, it undergoes stringent tests to insure maximum performance when you powerup.

Since we invented the klystron and designed the first Eimac tube over 50 years ago, we have been delivering reliable power for broadcasters worldwide. And with our commitment to continuous improvement, we have increased tube life, power levels, and efficiency to meet your evolving requirements.

Call us today and see for yourself why Varian tubes are the ones broadcasters trust. In the U.S. call 1-800-544-4636. From other countries, call 415-424-4819.

varian

Circle (31) on Reply Card

Replacing TV antenna systems

Updating your antenna can improve coverage and signal quality.

By Donald L. Markley, P.E.

The Bottom Line

Although HDTV transmission may appear to be just around the corner, NTSC transmission will remain the mainstay of broadcast television for at least the next decade. The qualitative and quantitative improvement that a new antenna can bring to a station's signal may make one more replacement cycle for the NTSC transmission system well worthwhile. An experienced consultant spells out the process and pitfalls.

Depending upon which guru you are currently listening to, NTSC television will meet its doom somewhere between 10 and 20 years from now. Although that means that we will all eventually be working with ATV systems, NTSC is the system that must be kept going for some time to come. Good antenna systems for that transmission method will continue to be needed for awhile. Unless a station's antenna is of fairly current vintage, replacement may well be needed before the demise of the existing system.

TV antenna system replacement is usually called for by one of three occurrences. The most common is the simple failure of one or more components of the system. Antennas wear out from aging interior elements or after repeated damage from lightning. Transmission line systems suffer from wear to the inner conductor connectors and are subject to damage from lightning, interior moisture, mechanical problems or flashover resulting from antenna failure.

The second reason involves inadequate coverage in a given area. As cities expand and shift, suburban areas become increasingly important to a station's service area. A corollary of Murphy's Law states that the spot in your market with the worst signal will coincide with the location of the station owner's home, unless the station is absentee-owned. In the latter case, the weakest signal area shifts automatically to the general manager's home, with side nulls falling near all major advertisers. In any case, a station's service often can be improved by using the beam-shaping and null-filling now provided by all manufacturers. Careful attention to the shape of the antenna beam can make up to 10dB difference in the received signal close to the antenna (within a few miles). This often can be extremely helpful in heavily populated urban areas.

The third reason for antenna replacement usually comes from the desire to add a vertically polarized component to the transmitted signal. For VHF stations, that component may well be equal to the horizontally polarized signal, thereby creating circular polarization. UHF stations usually do not go to full circular polarization, because the transmitter power required, but do find a definite benefit from adding up to 25% power in the vertically polarized field. The virtues of circular polarization are not the intent of this discussion. Suffice it to say that some vertically polarized signals will help a station's coverage, especially where viewers attempt to receive the signal on indoor devices of questionable polarization and undetermined orientation.

The late Andrew Alford, one of the great antenna engineers, once said that circular polarization for UHF TV was less helpful than moving the antenna six inches. Unfortunately, viewers are not equipped to move the antenna via remote control. Therefore, a small amount of circularly polarized signal can be a definite help.

Beam steering

One of the current buzzwords in the TV antenna field is *beam steering*, which can be better identified as *differential gain*. For an antenna, this simply describes the change in beam tilt in the main lobe as

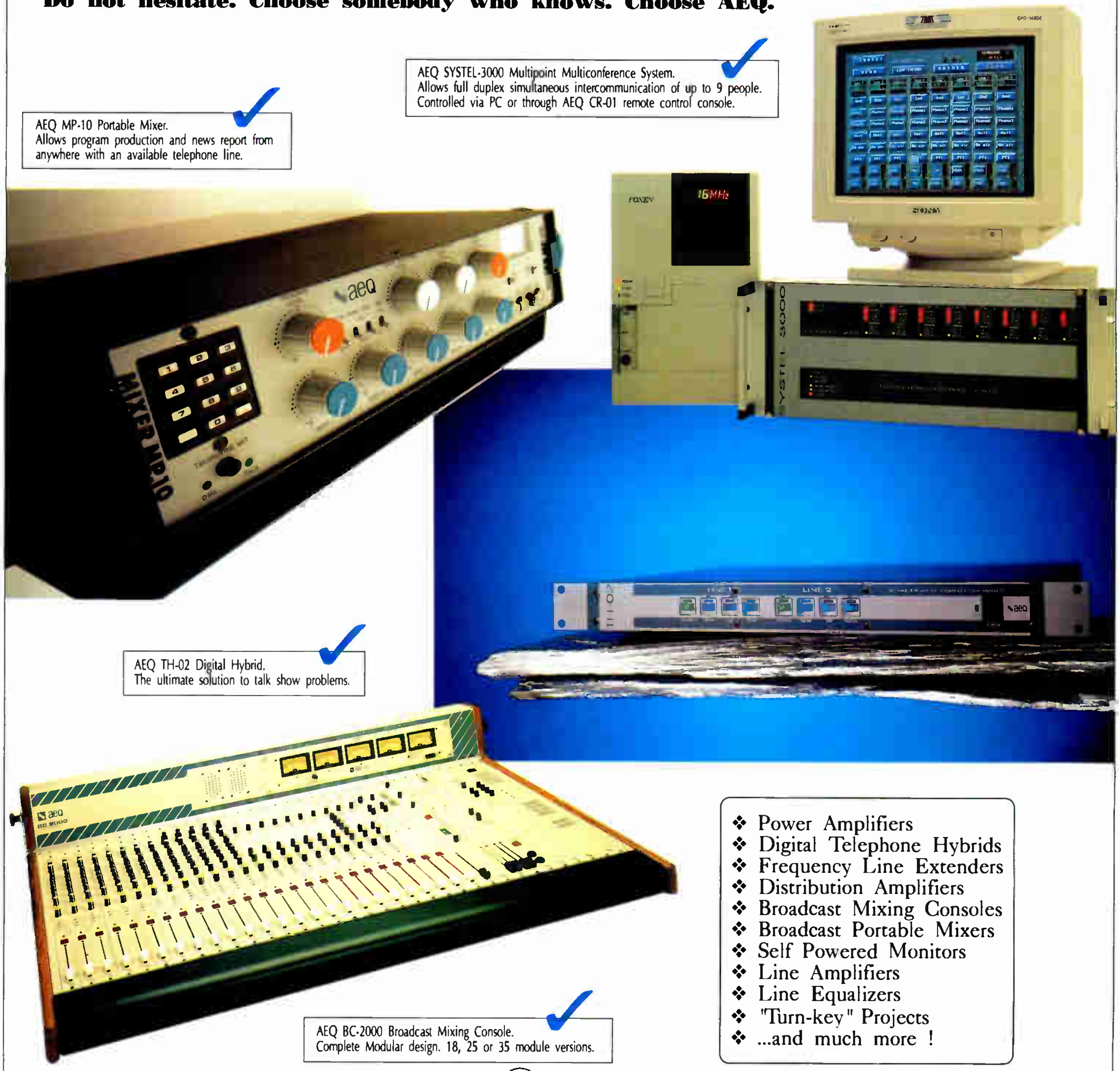
Markley is president of D.L. Markley & Associates, Peoria, IL, and *BE's* consultant on transmission facilities.

There are just a couple of things we can't supply to broadcasters... buildings and voice talents.

Call AEQ and you will find almost everything you need for your local radio station or for your international broadcast network.

Our talented engineers can provide you with Systems Engineering Design, state of the art equipment, technical advice and, most of all, the expertise obtained through the set up of over a hundred radio stations using our own designed equipment over the last ten years.

Do not hesitate. Choose somebody who knows. Choose AEQ.



AEQ SYSTEL-3000 Multipoint Multiconference System.
Allows full duplex simultaneous intercommunication of up to 9 people.
Controlled via PC or through AEQ CR-01 remote control console.

AEQ MP-10 Portable Mixer.
Allows program production and news report from anywhere with an available telephone line.

AEQ TH-02 Digital Hybrid.
The ultimate solution to talk show problems.

AEQ BC-2000 Broadcast Mixing Console.
Complete Modular design. 18, 25 or 35 module versions.

- Power Amplifiers
- Digital Telephone Hybrids
- Frequency Line Extenders
- Distribution Amplifiers
- Broadcast Mixing Consoles
- Broadcast Portable Mixers
- Self Powered Monitors
- Line Amplifiers
- Line Equalizers
- "Turn-key" Projects
- ...and much more !

AEQ

APLICACIONES ELECTRONICAS QUASAR, S.A.

HEADQUARTERS: C/ Rey Pastor, 36 - Pol. Ind. Leganés - 28914 Madrid - ESPAÑA - Phone: + 34 1 686 13 00 - Fax: + 34 1 686 44 92
AEQ AMERICA: 2211 South 48th Street, Suite H - Tempe, AZ USA 85282 - Phone: + 1 602 431 0334 - Fax: + 1 602 431 0497

Circle (33) on Reply Card

a function of frequency. This occurs in all antennas that do not have all individual radiating elements driven by transmission lines of equal length. To arrive at a meaningful value for the differential gain, the ratio of the amplitude of chroma vs. the amplitude of the visual carrier is determined at various elevation angles and is normally expressed in decibels. The receiver AGC circuit primarily looks at the visual carrier and adjusts the receiver gain accordingly. Anything that changes the chroma significantly with respect to the visual carrier level will have an adverse effect in the received signal.

The actual concern of the broadcaster is to determine that the antenna is properly designed to keep the variation within acceptable limits. That, in turn, assures that an acceptable ratio and adequate level of visual and chroma signal will be provided to the receiver. This will be assured if differential gain is measured on the transmitting antenna and maintained within the limits shown in Table 1. (Also see Reference 1.)

Beam tilt tolerance:	±0.2°
Azimuth interval for vertical pattern measurements:	45°
Vertical measurement interval:	1.0°
Vertical measurement span:	+5° to −10°
Measurement frequencies:	Visual Carrier Aural Carrier Color Subcarrier 1MHz intervals over the full channel
Maximum differential gain:	3dB at any measured frequency referenced to the visual carrier

Table 1. *Vertical pattern specifications recommended for beam-steering evaluations.*

The replacement process

Once a station decides to replace its antenna system, a number of important new decisions are required. This change represents a major cost for the station. The system should be planned carefully to ensure that a good return on investment and the maximum possible coverage improvement are achieved. Unless the station is in an area with perfectly flat terrain, a complete terrain study is a good first step.

Good antenna systems for NTSC will continue to be needed for awhile.

The study can be done by a consulting engineer, and it will help determine just where a station's critically weak signal areas are located. The market area can be analyzed with the terrain study to determine the desired shape of the lower side of the main lobe (usually called *null-fill* or *smoothing*) and the desired beam tilt.

Using some beam tilt is a good idea if the station's antenna is above the average terrain value by any significant amount. Failure to use beam tilt simply results in half or more of the signal being sent off into space. The signal should be placed where it may actually be watched. (For more on beam tilt, see Reference 2.)

The station also must determine what applications must be filed with regulatory bodies before making any antenna changes. If horizontally polarized effective radiated power (ERP) is not changed, vertical or circular polarization can be covered with a new application for license (FCC Form 302) following construction. If there will be a change in the height of the center of radiation greater than one meter, a change in the site location, an increase in the overall height of the structure or a change in ERP, an application must be filed with the FCC for a construction permit.

If the overall height or the location of the structure will be changed, Form 7460-1 also must be filed with the FAA. All of those applications can be handled by the station's consulting engineer. If the overall height is to be decreased, a notification should be filed with the FAA. That notification can be made by letter, advising them of the correct height when the work has been completed.

It also is usually necessary to clear any height increases with local zoning authorities. Typically, that change is not a problem if it is minor and involves an existing tower. If the site is being moved, major problems can occur, usually based on the "not in my backyard" syndrome.

Check with local authorities to determine if building permits are necessary and what documentation will be required. In some cases, the antenna installers will have to obtain a local license or associate themselves with a local firm that has such a license. Most riggers are familiar with such bureaucracies and associated fees. These fees can sometimes add several thousand dollars to a project.

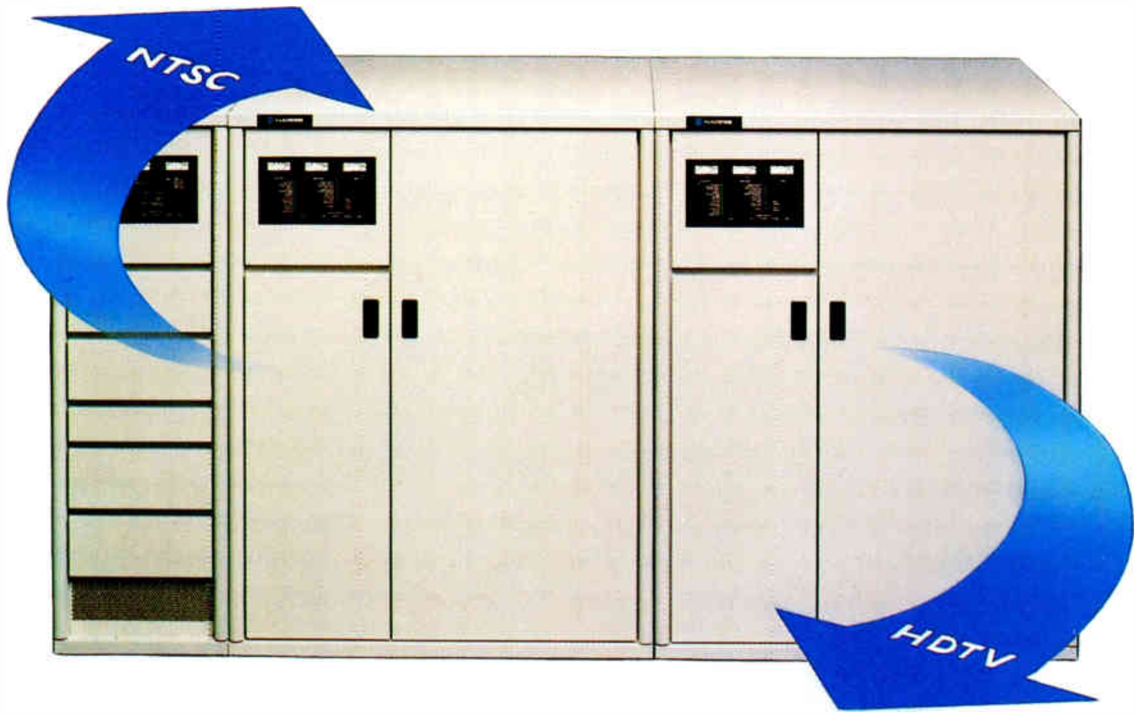
A station's service often can be improved by using beam-shaping and null-filling.

Last, but certainly not least, towers must be evaluated to determine if they can support any increased loads. For example, a change from 6¹/₈-inch coaxial line to waveguide may cause a tower's design values to be exceeded. The tower fabricator should be consulted to determine what changes are practical and/or legal.

Also check with the station's insurance carrier and explain fully the nature of the proposed changes. A report from the tower supplier is helpful for this process. Clearing the changes with the insurance company comes under the heading of "covering your appendages" (CYA) and is highly advised for the station's chief engineer. A change to the tower that is not

	VISUAL CARRIER	AURAL CARRIER	COLOR SUBCARRIER	WITHIN 6MHz
Antenna Only	1.04	1.06	1.06	1.08
Complete System	1.05	1.08	1.08	1.10

Table 2. *Recommended TV antenna system VSWR limits at specified locations/bandwidths.*



Trust Harris Allied to make it a smooth transition

IOT efficiency with HDTV capability. That's what you'll get with the all-new Harris Sigma™ Series, a family of 15–240 kW UHF TV transmitters.

Designed from the ground up specifically for the HDTV transition, Sigma sums Harris' experience in broadcast transmission innovation, digital technology, solid state design and total systems integration.

Sigma provides you with exceptional redundancy, headroom and protection with such features as main/standby exciters, EEV-approved thyratron crowbar protection for the IOT and reserve IPA power.

You'll appreciate the low-maintenance design with user-friendly controls, easy sub-assembly access and the lowest ambient noise level available. Our field-proven IPA and newly developed exciter should give you years of trouble-free operation. What's more, a wide range of configurations and options will ensure you get the best transmitter for your application now or when you move to HDTV.

We invite you to find out why Sigma is *the* no-compromise choice for now and the future. Trust Harris Allied to make it a smooth transition. The world's leader in broadcast technology.

Phone: 217-222-8200
Fax: 217-224-1439

HARRIS ALLIED

σ sigma
THE TRANSITION TRANSMITTER

Circle (32) on Reply Card


for Digital
Component Digital Video Cassette
SONY
Digital BETACAM
for Digital
Component Digital Video Cassette
SONY
SONY
PDP-120
SONY
DAT
HCT-63 UNIHI
SONY
BCT-D124L
METAL TAPE • Back Coated Envers Enduit
Digital BETACAM
124
Digital
BETACAM
ANTI-STATIC
BETACAM SP
D2M-64M
Composite Digital
SONY
Hi8
120
P6-120HMPX
SONY
Hi8
120
E6-120HMEX
ONLY
ON
SONY
PROFESSIONAL TAPE

approved by the insurance company can lead to a determination of little or no coverage in case of a claim. That will, in turn, lead to a great deal of heat from management, which will be directed at the station's engineering department.

In addition to retaining a consulting engineer, a station considering antenna replacement also should contact antenna and transmission line manufacturers for their help in recommending an appropriate system.

Instead of complete replacement, refurbishing an existing transmission line system can be a cost-saving answer to problems caused by worn inner connectors. This can be as simple as replacing bullets or springs, or as complex as removing dents and replacing the entire inner conductor assembly. (See "Inner Conductor Replacement for Rigid Transmission Lines," December 1991.)

Once a station decides to replace its antenna system, a number of important decisions are required.

Replacement of coaxial line with waveguide first requires a determination that adequate space exists for the waveguide to enter the tower and that it will be able to move with thermal expansion. The process then involves arranging for new hangers and interfaces between the hangers and tower. Also be sure that waveguide sections can get into the tower. It can be embarrassing to find out during installation that the top plate has to be removed from the tower to insert the waveguide. This can result in smirks from the tower crew and lots of off-air time for the station.

Installation

Verify the credentials and license(s) of the tower crew, and make certain that they carry adequate insurance. The amount of the insurance is up to the individual station, but it should include the cost of all your new equipment and, if not covered by the station's insurance during construction, everything on the site. Again, coordinate this with the station's insurance carrier to be sure that a major catastrophe will not wipe out the station. It is a good idea to insist that the station and consulting engineer are named as co-insured under the construction project policy. This keeps any subsequent conflicts between the involved insurance companies, with the station covered under multiple policies.

The antenna should be tested on the ground before erection. The testing should be done with the antenna held vertically and clear of the tower, using non-metallic rigging lines. The initial VSWR of the antenna should be in accordance with Table 2 before it is installed. The transmission line or waveguide should be measured during installation. If construction starts at the bottom, the line can be checked after every 100 feet or so, by attaching a proper termination at the temporary top.

There are a few installers who can properly measure antennas, coaxial cable and waveguide. Those companies are highly qualified and will do a good job for the station. Even then, the measurements should be verified by the station's consulting engineer. For any other installation crew, the measurements should be made by the consulting engineer or a subcontracted firm. Don't expect the manufacturer to pursue absolutely optimum system status unless its feet are held to the fire by someone with sole allegiance to the station. If the system is not installed exactly right, it will not improve with age. Correcting problems after initial installation is difficult and expensive.

The final system measurements are performed after the installation is complete. As a minimum, the values shown in Table 2 should be met. The measurements should be made with a vector network analyzer using properly tuned adapters and operated by an experienced engineer. For coaxial systems, a time-domain reflectometer (TDR) will isolate any minor problems with connectors or discontinuities in the line. If desired by the consulting engineer, RF pulse measurements can be helpful in identifying and locating system problems.

Replacing an antenna system is a major project and should be treated accordingly. It is a golden opportunity to make a significant difference in a station's coverage. It also is the only time that changes can be made. Modifications to the system to correct problems after the installation is completed are expensive and may not even be possible. Plan well and analyze carefully before buying, and install properly with full documentation. Following those steps should result in optimum performance of the transmitting system.

Unless the station is in an area with perfectly flat terrain, a complete terrain study is a good first step.

Antenna replacement checklist

By Donald L. Markley, P.E.

Here's a handy list to consult when you set out on an antenna replacement project. The following 16 steps are listed in a generally appropriate chronological order:

- ☐ Discuss the project with the station's consulting engineer.
- ☐ Conduct and complete terrain study.
- ☐ Determine desired beam tilt and null-filling/shaping.
- ☐ Check on building permits and zoning requirements.
- ☐ File FCC Form 301 for any changes in ERP or HAAT.
- ☐ File FAA Form 7460-1 for any increase in overall height.
- ☐ Check local license requirements for tower crew.
- ☐ Check local union requirements for tower crew.
- ☐ Have structural analysis performed on tower.
- ☐ Select new antenna and transmission line.
- ☐ Observe antenna testing as applicable.
- ☐ Check tower crew insurance on arrival.
- ☐ Test antenna before installation.
- ☐ Test installed or modified transmission line.
- ☐ Test complete system as installed.
- ☐ File FCC Form 302 to cover any changes.

References

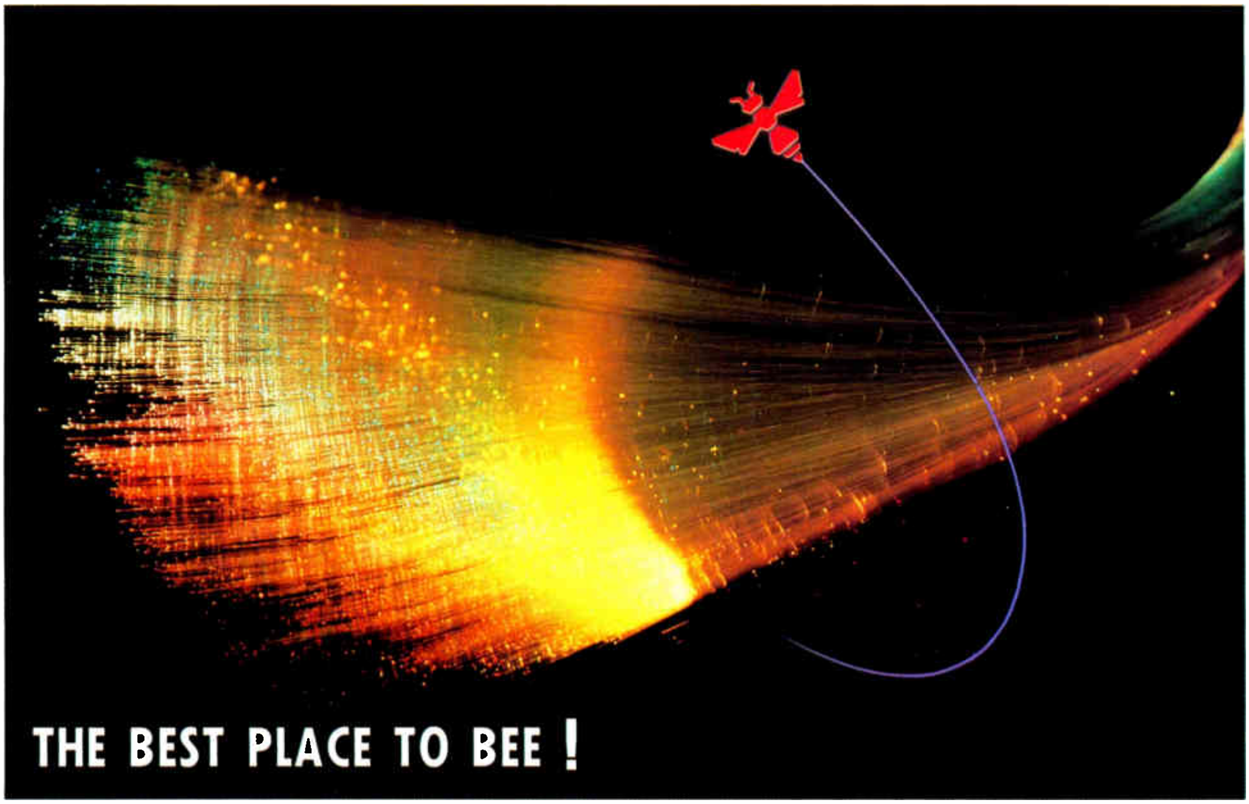
1. "A Technical Discussion of Beam Steering and Differential Gain Issues Relating to High-Power Television Broadcast Antennas." G. Dienes and K. Cozad, Andrew Corporation, 1989. Technical Paper SP042-02.
2. "Optimizing Vertical Coverage of UHF-TV Antennas." *Broadcast Engineering*, October 1974. Intertec Publishing Corp. (Available from Andrew Corp. as Bulletin 8605.)

➡ *For more information on TV transmitting antennas, circle Reader Service Number 303.*

Inter BEE '93

29th International Broadcast Equipment Exhibition

November 16-18, 1993
Nippon Convention Center (Makuhari Messe)



The world's leading broadcast equipment experts will gather at Inter BEE '93 to catch up on all that's new and exciting in this field.

The 29th International Broadcast Equipment Exhibition promises to reveal the latest high-tech developments in broadcast, video and professional audio technology. It's the place to exchange information, meet old and new friends, and to take part in Asia's largest exhibition of its kind.

And attendance figures show just how popular Inter BEE is among those who count. Inter BEE '92 attracted over 26,000 visitors from almost 40 nations worldwide.

Forums, seminars and symposiums will be held over the three days of the exhibition, in addition to the trend-setting exhibits.

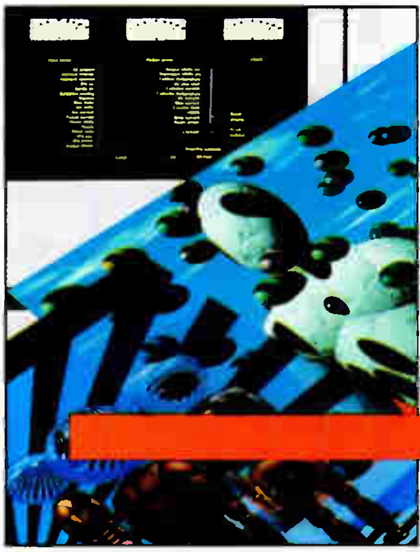
Be sure to attend Inter BEE '93. It helps bring people and products closer together in today's widespread world and wide-open markets.

Japan Electronics Show Association
Tokyo Chamber of Commerce and Industry Building
3-2-2, Marunouchi, Chiyoda-ku, Tokyo 100, Japan
FAX : 81-3-3284-0165

Inter BEE '93

Circle (34) on Reply Card

2A–B and other intermodulation nightmares



Interference can come from innumerable RF signal combinations.

By Donald E. Kolbert

The Bottom Line

RF interference is a bad dream for broadcasters. Tracking down the culprit can be an even bigger horror. The most complicated interference problems are those that occur when legal and proper transmissions from multiple stations interact inside receivers or other transmitters. Certain frequencies' combinations can occasionally wreak havoc, and these problems may not be limited to the broadcast bands. Here's a look at how this happens, with some real world examples and solutions.

Kolbert is chief engineer at KLSE/KZSE, Rochester, MN; KXLC, La Crescent, MN; and KLCD, Decorah, IA.

Interference is one of the biggest headaches in the broadcast industry today. Each year, millions of dollars are spent trying to prevent interference, yet it still occurs. Some reasons for interference include poor installation techniques, inadequate troubleshooting skills and the ever-growing number of RF energy sources in any given area.

Most broadcasters are familiar with interference caused by the overloading of receivers within the *blanket area* of transmitters. They also are familiar with interference caused by spurious harmonic outputs of transmitters. Among all the types of interference, however, perhaps the most vexing one is caused by the interaction of two or more frequencies — *intermodulation interference*. It can occur at any frequency, resulting from either in-band or out-of-band transmissions, or combinations of the two. "Intermod" is exhibited in several different areas within broadcast systems.

The first of these is called *receiver-induced third-order intermodulation effect* (RITOIE). It occurs when one or more signals overloads the input stage(s) of a receiver so that non-linear amplification occurs. The non-linearity causes harmonics to be produced even though the original signals were clean. These harmonics can produce sum and difference frequencies between themselves and with other signals that enter the receiver.

The following is a real life example in which carrier signals from two FM broadcast stations created a condition that potentially could have interfered with aircraft receivers in the VHF band of 108-120MHz.

During 1990, a regional FAA office denied approval of an FCC-approved application for an increase of power and antenna height at an FM station on 101.7MHz. According to the FAA, a new FM station on 105.7MHz, and approximately 60 miles away, would interact with the applicant station's signal to produce electromagnetic interference (EMI) or a RITOIE product. This could interfere with the instrument landing system (ILS) frequency of 109.7MHz assigned to a nearby airport. The potential interference was derived from the familiar 2A–B formula: $2 \times 105.7 - 101.7 = 109.7$.

As it turned out, the applicant was later approved on appeal to the FAA because the protected service volume (coverage area) of the airport was 54 miles from the applicant station. Stations located more than 30 miles away from a protected service volume were no longer being contested. However, some stations have had to lower power and/or antenna height to reduce their field intensity in protected areas because of this type of potential interference.

FM-to-TV problems

Another common situation involves two FM stations creating receiver-induced interference to TV reception. Here, a TV booster amplifier employed between a TV antenna and the TV set is a common source of trouble. Strong RF energy, even if it is not in the TV bands, can cause the automatic gain control (AGC) on that am-

VIDEO SWEEP

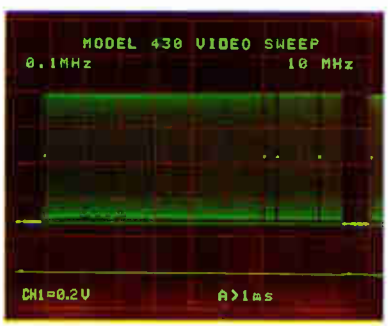
Meet Your Frequency-Response Requirements*

Model 408
Video Sweep and Multi-Purpose Test Signal Generator

An extremely versatile test signal generator, Model 408, only $3395, provides both multiburst, with last burst variable to 15 MHz, and field-rate video sweeps at 0.3 to 15 MHz and 0.1 to 5 MHz. Fixed frequency markers are provided for both sweep bands. The 408 includes a VHF/UHF modulator (DSB) operating from 30 to 900 MHz with memory storage of standard cable channels, plus presetable carrier frequencies within the operating range in 10 kHz steps. Other features include RGB, Y/R-Y/B-Y and SYNC and audio outputs, genlock and user programming of 100 test setups where selected test pattern, channel or carrier selection, operating conditions and video parameters are assigned. Test patterns include SMPTE bars and modulated stairstep for DG and DP measurements.

Model 430
Dedicated Video Sweep and Multi-Burst Generator

Model 430, only $1795, offers field-rate start-stop sweep operation with maximum sweep range up to 10 MHz. Five sets of fixed-precision markers are provided, which may be used singly or together. Separate continuous control of sweep amplitude is provided, as well as control of the full composite amplitude. Sync, blanking and burst may be turned off for those sweep operations where they are inappropriate (sweeping preamps, for example). In addition, the 430 provides multiburst at 0.5, 1.25, 2, 3, 3.58, 4 and 7 MHz.



Video Sweep Waveform

*New FCC Cable Rule 76.605(6)

Call toll-free
1 800 645-5104
In NY State
516 231-6900

LEADER
FOR PROFESSIONALS WHO KNOW THE DIFFERENCE

Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, New York 11788
Regional Offices: Chicago, Dallas, Los Angeles, Atlanta. In Canada call Omnitronix Ltd., 416 828-6221

Circle (35) on reply card for product information only.
Circle (36) on reply card for product information & demonstration.

Maximum Order of Products Checked: 3
Reporting Products Falling Between 54-88MHz

Frequency No. 1: 88.5
Frequency No. 2: 90.7
Frequency No. 3: 91.7

No.	Order	×	Freq.	Sum/Dif.	Order	×	Freq.	=	Product
1.	2	×	88.5	–	1	×	90.7	=	86.3MHz
2.	2	×	88.5	–	1	×	91.7	=	85.3
3.	3	×	88.5	–	2	×	90.7	=	84.1
4.	3	×	88.5	–	2	×	91.7	=	82.1

No.	Order × Freq.	Plus	Order × Freq.	Minus	Order × Freq.	=	Product
5.	1 × 88.5	+	1 × 90.7	–	1 × 91.7	=	87.5MHz
6.	1 × 88.5	+	2 × 90.7	–	2 × 91.7	=	86.5
7.	1 × 90.7	+	2 × 88.5	–	2 × 91.7	=	84.3
8.	1 × 91.7	+	2 × 88.5	–	2 × 90.7	=	87.3
9.	1 × 88.5	+	3 × 90.7	–	3 × 91.7	=	85.5
10.	1 × 90.7	+	3 × 88.5	–	3 × 91.7	=	81.1
11.	1 × 91.7	+	3 × 88.5	–	3 × 90.7	=	85.1
12.	2 × 88.5	+	2 × 90.7	–	3 × 91.7	=	83.3

No More Frequency Products Within Desired Range

Table 1. *Example of a computer-generated report on intermodulation products in the low VHF TV band (channels 2 to 6) produced by three FM stations.*

plifier to push its gain block into non-linear operation.

One example of this situation involved a TV viewer who called an FM station operating at 91.7MHz to report poor reception on TV channel 6, accompanied by audio from the FM station. He had an outdoor antenna with a booster amplifier, and lived about two miles from another FM station operating at 88.5MHz, but heard none of *that* station's audio. Momentarily cutting the 91.7MHz carrier eliminated the interfering audio, but it did not restore channel 6 reception.

After performing some 2A–B calculations, the source of the problem was discovered: The TV owner was within the blanket area of the 88.5MHz station. When it was off the air, the 91.7MHz station's audio disappeared, and channel 6 video came in clearly. The station at 88.5MHz was overloading the booster amplifier. Its resultant second harmonic at 177.5MHz minus the other station's fundamental frequency of 91.7MHz produced an intermodulation product of 85.3MHz. This frequency falls within the channel 6 bandwidth of 82-88MHz.

Solving this type of interference problem may require two traps, one for each FM frequency, if both are overloading the amplifier. The traps should be placed between the TV antenna and the booster amplifier.

Intermodulation products also can be created in power lines and house wiring where corrosion causes rectifier action between the conductors. This provides the non-linearity required for the phenomenon to occur.

These problems are compounded when sections of conductors happen to be cut to lengths that are resonant to the RF energy being received. In this case, fundamental, harmonic and intermodulation product frequencies can be re-radiated by antennas or cables. Metal downspouts, gutters and plumbing also can act as re-radiators, with metal siding on buildings and semitrailers, causing occasional problems.

Transmitter final problems

Intermodulation interference can occur between two or more stations when the transmitted energy from one carrier appears in the final amplifier of another transmitter. This type of problem often is produced when two or more transmitting antennas are located on the same tower.

Consider the case of two AM stations that produced an intermodulation product, knocking out reception from a third station in the same community. A 5kW station operating on 1,140kHz had a tower located within a few blocks of a 250W station operating on 1,230kHz. So much RF energy was being picked up by the 250W station's tower that when it was off the air, its RF ammeter still showed current. The second harmonic of 1,230kHz minus the 1,140kHz fundamental produced a spurious signal at 1,320kHz, which interfered with listeners' reception of a third station in the market operating on that frequency (1,320kHz).

The problem was solved by inserting a special LC trap into the 250W station's antenna-tuning circuitry and adjusting it for an RF null of the 5kW station's signal. The trap was re-nulled weekly as part of the off-the-air maintenance schedule or whenever interference occurred. (Ground conductivity changes, such as those caused by heavy rain or frost, had a profound effect on the tuning.)

Note that these intermodulation products can be produced even though each transmitter has filters that properly remove its harmonic content. The problem still occurs because station B's energy is picked up by station A's antenna and fed back into station A's final amplifier, where the station B energy sees a *non-linear* device. The non-linearity of station A's final amplifier causes harmonics of station B's signal to be produced, and these heterodyne (beat) with station A's signal to produce third-order intermodulation products. Meanwhile, station A's signal is doing the same thing in station B's final amplifier.

Transmitter manufacturers are now able to provide system designers with data on a transmitter's susceptibility to intermodulation interference. This factor, called *mixing loss* or *turnaround loss*, describes how much intermodulation interference (in decibels) will be produced by an interfering signal.

Solutions

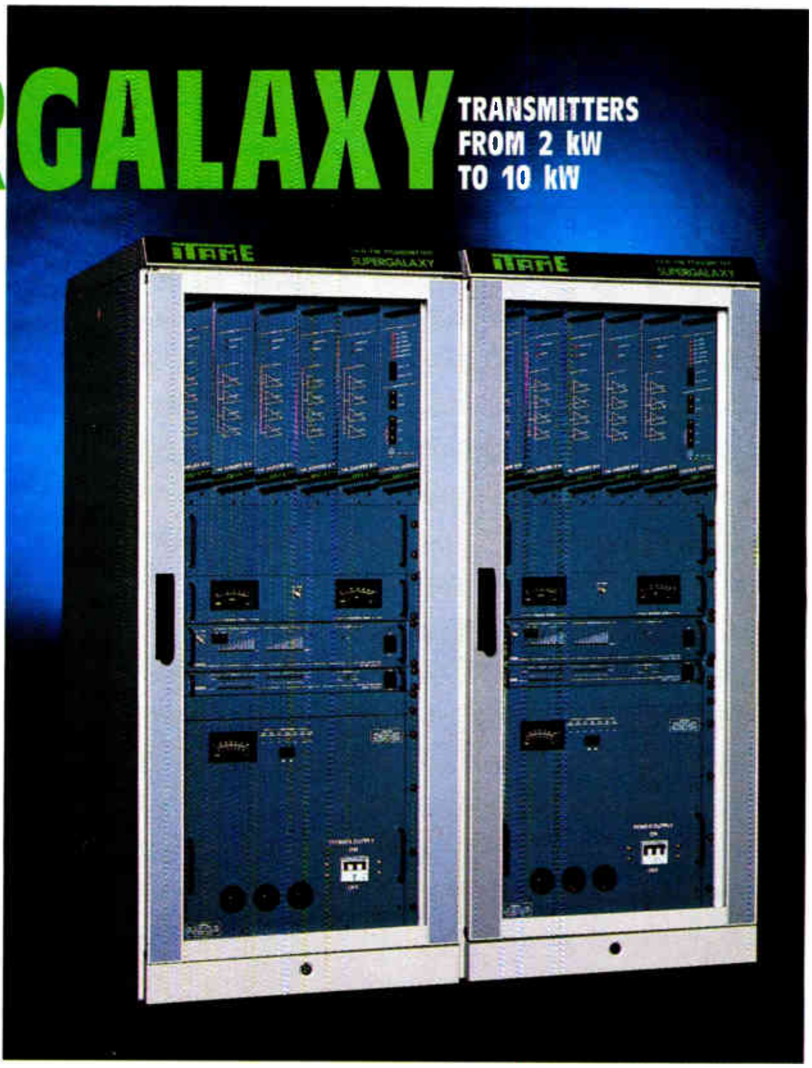
The best way to minimize these final amplifier interactions in the VHF and UHF frequency ranges is to use cavity-type filters in the transmission lines to trap out the other station's energy. Depending upon the frequencies and the power levels, the system designer may use bandpass, band-reject or combinations of the two to reduce the radiation of these spurious signals.

For example, assume that station B's energy feeds back into station A's final amplifier stage at 45dB below station A's power output level. Also assume that station A's transmitter has a turnaround loss of −15dB. Station B's energy level then would only be 60dB down from that of station A. Station A would be radiating a spurious signal at station B's frequency. To reduce that spur to the FCC-required level of −80dB, a cavity filter with an overall attenuation of −20dB would be required (including the normal insertion loss that the filter would present to station A's output level).

Again, remember that station A's signal is probably feeding back into station B's final amplifier, so the same type of filtering likely will be needed in station B's transmission line.

FM SUPERGALAXY

TRANSMITTERS FROM 2 kW TO 10 kW



A MODULAR SOLID-STATE WORK OF ART

- APC (Automatic Power Control)
- Full microprocessor control
- MOS FET technology

FM SUPERGALAXY 10-kW TRANSMITTER ►
Two 5-kW transmittters combined via a 3-dB coupler. 5 + 5 hot-standby configuration.

▲BASIC 1-kW POWER AMPLIFIER MODULE.

◄FM SUPERGALAXY 2-kW TRANSMITTER:
Two 1-kW amplifier modules, a combiner and the microprocessor control unit.

Because broadcast stations keep changing

- PRIMARY PRODUCTS MANUFACTURED BY ITAME:
  - **FM transmitters or repeaters:**
    Solid state: GALAXY SERIES: 100 W, 300 W, 600 W, 1 kW and 2kW.
    SUPERGALAXY SERIES: from 2 kW to 10kW.
    Tube-type: 1 kW, 3 kW, 5 kW, 10 kW, 20 kW, 30 kW.
  - **AM transmitters:** 5 kW, 10 kW, 20 kW.
  - **Analog and digital radio links** in all bands from 140 MHz to 1700 MHz.
- TURN-KEY SERVICES ANYWHERE IN THE WORLD.

ITAME

c./Campezo 6 Pol. Ind. Las Mercedes
28022 MADRID SPAIN
Tel: (34-1) 747 74 44 - Fax: (34-1) 747 75 07
Telex: 28257 ITAME

Circle (37) on Reply Card

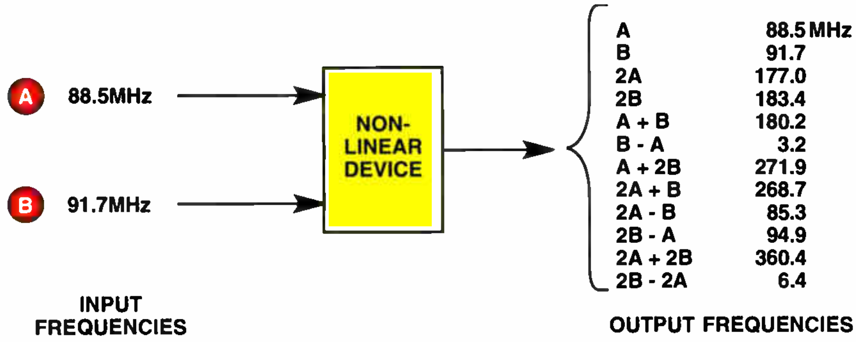


Figure 1. *The result of feeding two signals into a non-linear device. The output consists of the two signals, their second harmonics and eight intermodulation products.*

Summary

If two signals, A and B, are fed into a purely resistive load, the output will include just the two original signals. Resistors are linear devices, so their output waveforms will be exactly the same as their input waveforms. Amplifiers can be linear devices also, as long as they faithfully reproduce the input waveform.

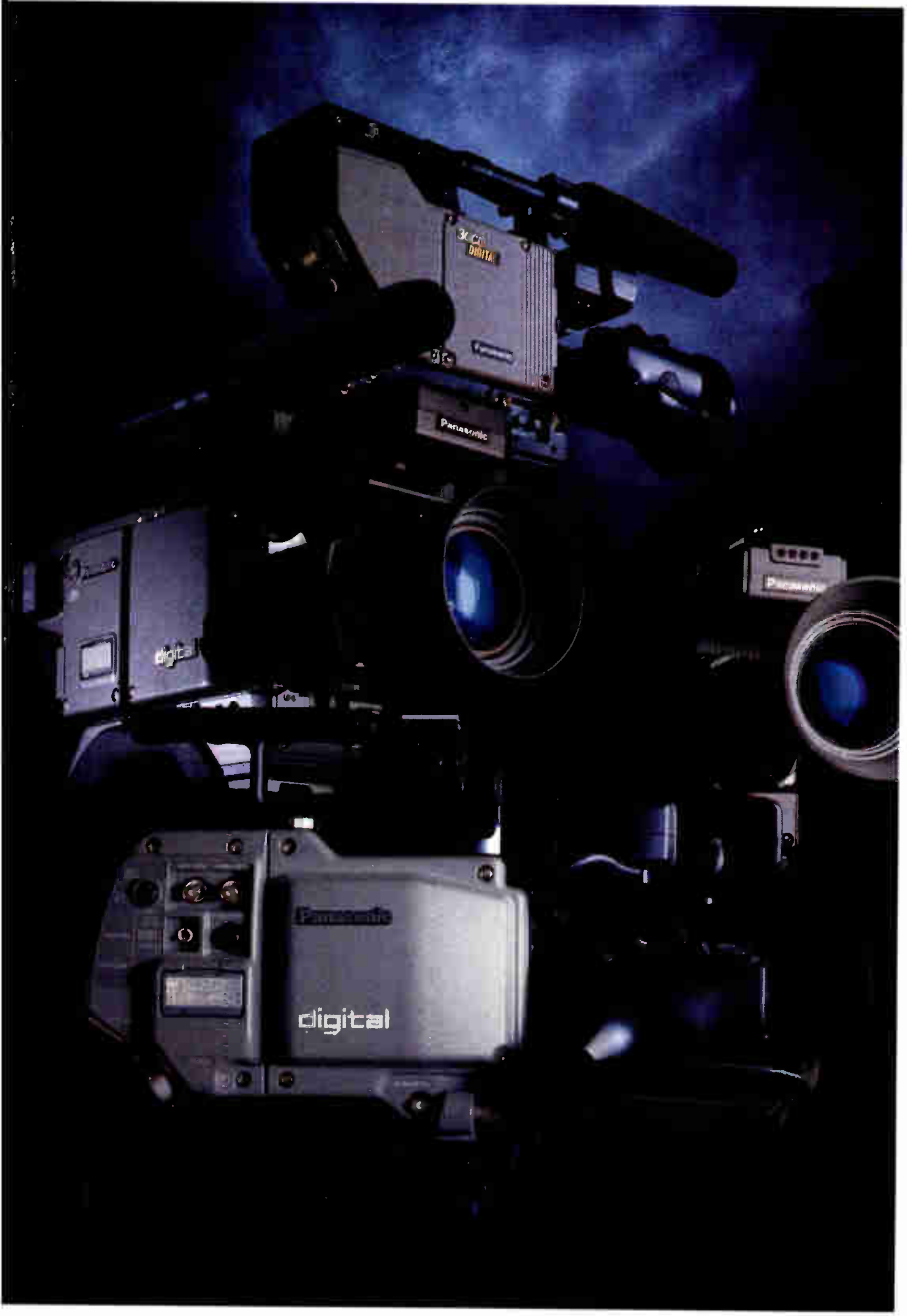
Non-linear devices cause the signals to be distorted in such a way that harmonics are produced and heterodyning takes place between the original signals and their harmonics. If the slope of the waveforms becomes distorted, *even-order* harmonics are produced. If the peaks of the waveforms are flattened or clipped, *odd-order* harmonics are produced. A typical non-linear device will cause both conditions to occur, producing a plethora of intermodulation products. Figure 1 shows the result of passing two signals through a non-linear device. If a third frequency is involved, the plot thickens. Now the possible intermodulation products include the sums and differences of three frequencies, in both fundamental and harmonic forms ($nA \pm nB \pm nC$, $n = 1, 2, 3 \ldots$). Figure 1 shows only second-order harmonics ($n = 1, 2$). For third- and higher-order harmonics ($n \geq 3$), the combinations become too complex to figure with paper and pencil. One of the computer programs available for this purpose is recommended.

An example of such a computer-generated report is shown in Table 1. It lists possible intermodulation products created in the low VHF TV band (54-88MHz) by three FM stations at 88.5MHz, 90.7MHz and 91.7MHz. Harmonics to the third order are considered.

From this investigation it is clear that many possibilities exist for broadcasters to create interference, given the proliferation of frequencies used in a given community or region. If you are designing a new facility, you can prevent many headaches and FCC/FAA violations by calculating all of the potential intermodulation products ahead of time, installing the proper filters, and choosing the power and antenna heights that will minimize potential interference problems.

Accurate prediction and effective correction measures also must take into account all other radio and TV services. Expensive test equipment (spectrum analyzers and field-strength meters) and technical expertise (often involving a professional consulting engineer) will be required and, in many cases, some expensive filters may need to be installed. Nevertheless, the most important factor in solving these problems is patience. ■

MAKE YOUR BETACAM A DIGITAL BETTER-CAM.



With a Panasonic Emmy Award winning DSP camera.

There's no need to wait to add Digital Signal Processing to your Betacam SP VTR. Right now, Panasonic, *and only Panasonic*, offers a full line of Digital Signal Processing cameras, from the full-featured AQ-20D to the value-packed WV-F700 and WV-F500, for all professional VTRs, including Betacam SP.

Panasonic's DSP Cameras dock directly to most Betacam SP decks, or use a simple adaptor.

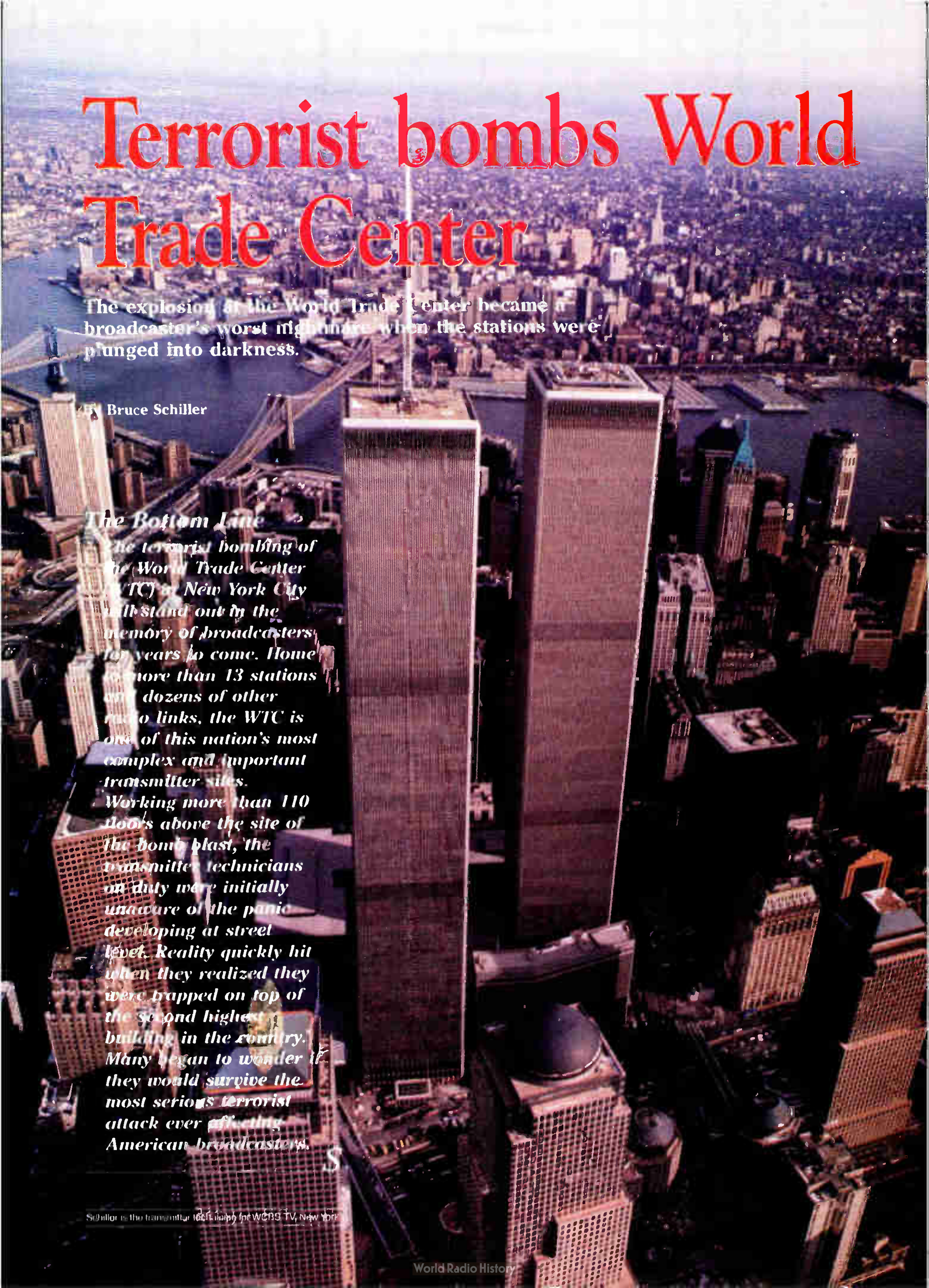
With Panasonic Digital Signal Processing camera set-up is easier, certain and repeatable. DSP cameras maintain strict uniformity in RGB signals and ensure that phase and frequency characteristics remain stable. They provide for 2-dimensional cross-color filtering, variable enhancements, high-chroma aperture correction, accurate one-touch gamma adjustment and auto knee circuitry.

Others ask you to wait for digital, and then you'll be up-to-date. But, for Panasonic, *then* is now.

Panasonic Broadcast & Television Systems Company was awarded two 1992 EMMYs for Outstanding Achievement in Technical Engineering Development for its Digital Signal Processing technology as implemented in its line of DSP cameras. Betacam is a trademark of Sony Corporation.

For more information call: 1-800-528-8601
(upon request enter code 07)
One Panasonic Way, Secaucus, NJ 07094.

Panasonic
Broadcast & Television Systems Company



Terrorist bombs World Trade Center

The explosion at the World Trade Center became a broadcaster's worst nightmare when the stations were plunged into darkness.

By Bruce Schiller

The Bottom Line

The terrorist bombing of the World Trade Center (WTC) in New York City will stand out in the memory of broadcasters for years to come. Home to more than 13 stations and dozens of other radio links, the WTC is one of this nation's most complex and important transmitter sites.

Working more than 110 floors above the site of the bomb blast, the transmitter technicians on duty were initially unaware of the panic developing at street level. Reality quickly hit when they realized they were trapped on top of the second highest building in the country. Many began to wonder if they would survive the most serious terrorist attack ever affecting American broadcasters.

S

Schiller is the transmitter technician for WCBS-TV, New York.

On Friday, Feb. 26, at 12:18 p.m., a terrorist bomb exploded without warning, killing six people and injuring more than 1,000. In minutes, the normally tranquil city-sized World Trade Center (WTC) became a war zone.

As the 50,000 occupants struggled to exit burning, smoke-filled staircases, broadcasters watched helplessly as their stations, one by one, went dark. The battle for survival had begun. Not all would be successful.

The bomb exploded on the B2 subbasement level beneath World Trade Center tower No. 1 and the Vista Hotel in the underground parking garage. (See Figure 1.) Tower No. 1 houses most of the TV transmitters in New York, the nation's largest market. These stations were soon to experience a broadcaster's worst nightmare — being off the air without recourse. The technicians who staff these sites were about to endure the most traumatic experience of their lives. Before it ended, many would wonder if they would live through the ordeal.

The explosion

The explosion disintegrated the rented truck used to transport the bomb. Although many occupants of the WTC were injured, the majority of injuries were related to smoke inhalation, and the patients were soon released. This bombing has been called the most destructive terrorist attack ever in the United States.

The blast ripped out sections of three structural slabs and their columns in the basement levels under the WTC complex. Basement levels B1 through B6 were demolished, along with critical equipment needed later by those stranded some 110 floors above.

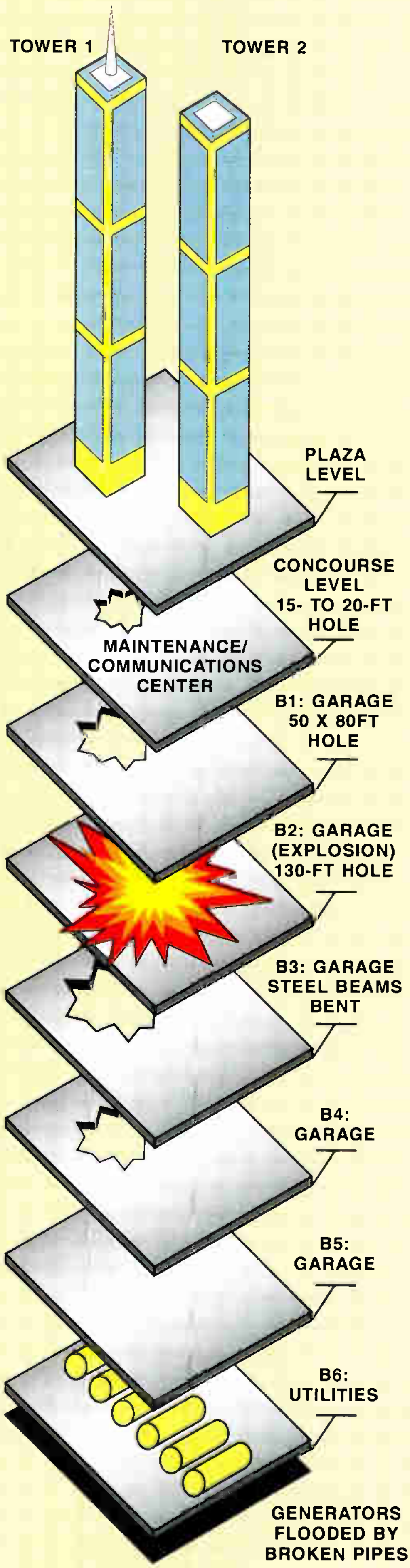


Figure 1. *The World Trade Center is home to 13 broadcast stations. Transmitters are located on the 110th floor, and stations share a common mast mounted on the roof. The bomb exploded on the B2 basement level. The auxiliary power generators located on level B6 failed because of a lack of coolant and rising water levels.*

"Rocky peaks, icy winds, knee-deep mud, earth tremors, a rumbling volcano, the dreaded Inca Curse ...but our Ikegamis keep on rolling."

"We were in Ecuador's remote Llanganati Mountains with the 60-person Discovery II Expedition. The group was composed of archeologists, botanists, historians and high-tech equipment operators. Our goal was to find the legendary treasure of Atahualpa, estimated to contain 780 tons of gold. My mates and I formed a four man, one woman videographic crew from American Video Productions of Dania, Florida. Our job was to record the expedition for the television documentary, "Legends of Inca Gold". The story had already gained a worldwide reputation as being a real life Indiana Jones adventure, and as we were learning quickly, that was not just hype.

The horrible weather was no surprise. It was a total shock.

We gathered in Quito, Ecuador where the weather is eternally spring-like. We carried two Ikegami HL-V55 Beta SP cameras and thought that if the weather in the mountains was the same as we were experiencing in Quito, this assignment would be a piece of cake.

We quickly learned that the South American winter was two-faced. Reaching Chury Ucto, a town at the edge of the Llanganati Mountains, we were told that the cold, drenching rain had persisted -for the past six weeks and showed no sign of letting up. Worse than that, the cloud cover was so heavy and constant, the Ecuadoran Army helicopters scheduled to fly us into the mountains were grounded. In effect, we were on our own and if we wanted to go ahead, we'd have to walk. That's exactly what the expedition leader decided to do.

Our cameras and gear were packed in watertight, rubberized cases, but we were concerned that the thick, persistent fog would limit our ability to get good pictures.

The "cave of gold" was 100 feet deep, with a water trap and a nest of secret tunnels.

We stopped outside Chury Ucto to explore what natives believed to be a secret Inca gold repository. At a depth of 100 feet, expedition members found hand-chiseled tunnels, a water trap so

This narrative was supplied to Ikegami by American Video Products. Photo credits: Michael Mancusi and Wende Klipper.

ingenious it would have ended the career of Indiana Jones, and a wall of stones not indigenous to the area. This led Discovery II archeologists to believe this site had been a hiding place for gold. In the dim, artificial light carried with us, our Ikegamis passed their first major test. The

hyper-gain feature was especially useful in helping us record this spectacular scene.

From the cave, we snaked our way into the mountains. At 15,000 feet, icy wind gusts threatened to fling us off treacherous trails, sections of which were knee-deep in mud. At night we were awakened by the rumbling of nearby Tungurhua, an active volcano. The tremors shook the precarious ledge on which we had pitched our tents. We were getting all the adventure we had bargained for, and then some.

The buried Inca temples were right beneath our feet. But so was the mud.

Standing above a canyon on our march into the mountains, the expedition director spotted the outlines of a buried roadway leading to several symmetrically arranged grassy mounds. Infra-red scanners and magnetometer readings indicated the presence of ruins beneath the grassy mounds. Had we reached our destination? This was the Maqui Valley and it was decided to settle in and wait for a change in the weather so preliminary excavations could begin.

It was a long wait, four weeks to be exact. Four weeks of constant driving rain, accompanied by freezing temperatures and thick fog. Digging out around the mounds was useless as each hole would quickly fill with muddy water within minutes. Morale fell as supplies dwindled. We were reduced to breakfasting on two saltine crackers and a mug of lukewarm tea.

Weather or not, our own video crew was buoyed by the fact that our Ikegamis allowed us to do our job of recording the grandeur, albeit dark and cloudy, of the surrounding mountains and the frustrations of the expedition.

If we were not to discover hidden gold, at least we'd bring back an exciting story.

When snow came, leaving was a choice of now or never.

Snow came and some of us began to believe that Inca spirits were sending us a message to get out and leave their secrets alone.

With food and medicines almost gone, we walked out of the Llanganati Mountains as we had walked in, only this time battling sickness, hunger, exhaustion and snow drifts. The search for Inca Gold would be continued another time.

Had we failed? Obviously, the archeological team would have liked to achieve what they had set out to do, but they would be back. As for our crew, we were thankful that our Ikegami HL-V55 cameras were able to withstand adverse conditions and adjust to dampness, darkness and below freezing temperatures. Lightweight and compact, they gave us

the capability to carry them anywhere to get some of the most spectacular shots any television audience will ever see. For us, gold or no gold, it was 'mission accomplished' ".

When you're going for the gold, no camera travels as well.

HL-V55 Camera Recorder

2/3" 3 Chip FIT CCD, Betacam SP® VTR
Res: 700 TVL
Sens: f8.0, 2000 Lux; SNR 62dB
Continuously Variable Speed Extended Shutter

400,000 Pixels
Hyper Gain: +30dB
Triax Available
List Price: $50,000

Price and specifications subject to change without notice.

Ikegami®
The Professional's Choice

Ikegami Electronics (U.S.A.), Inc. 37 Brook Avenue, Maywood, NJ 07607
East Coast: (201) 368-9171 • West Coast: (310) 534-0050 • Southeast: (305) 735-2203
Southwest: (214) 869-2363 • Midwest: (708) 834-9774

Circle (40) on Reply Card

Shortly after the blast, smoke was sucked up the elevator shafts and throughout the building by the difference in wind pressure between the top and bottom of the building. As more than 130 fire engines converged on the scene, the normally busy streets in front of the WTC looked more like a war zone than a financial and business center.

Zero hour

A WPIX-TV technician was returning from a lunch run for Chinese food when the blast occurred. As he strolled past the bank of 10 escalators leading down to the subway trains, the bomb exploded. Feeling the blast shock wave, he recoiled as a wave of dusty gray smoke began drifting upward from the escalator passage. To his amazement, the escalators stopped, then began running backward down into the smoke. As panic spread, people in the lower subway level attempted to return to the ground floor by running up the downward moving stairs. Their urgency to escape increased as the 2-story ceiling began filling with acrid smoke.

The technician found a phone and quickly called the 110th floor transmitter to report that something had happened, but he wasn't exactly sure what it was. It didn't look like he was going to be able to return to the transmitter any time soon. The hungry tech waiting for his lunch asked, "Does this mean I don't get my egg roll?" His sense of humor would help him endure the next 16 hours.

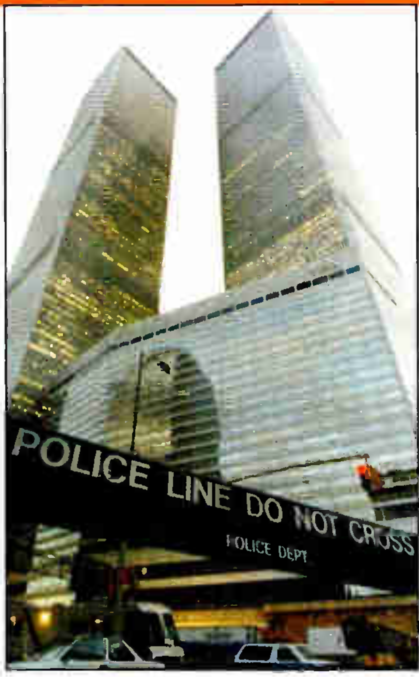
The nation's No. 1 TV market goes dark

Soon after the initial blast, stations began going dark. At the time of the explosion, circuit breakers on five of the eight

Basement levels B1 through B6 were demolished, along with critical equipment needed later by those stranded some 110 floors above.

high-voltage feeder lines tripped off when the cement slabs from the subbasement levels B1, B2 and B3 crashed down on the power distribution equipment located in the central refrigeration plant on level B5.

The generators started automatically when the AC power failed. This allowed



The World Trade Center twin towers were surrounded by local, state and federal authorities as they attempted to control panicked workers and crowds of onlookers. (Courtesy of AP.)

WNBC-TV to immediately return to the air. However, after approximately 20 minutes, the generators overheated and shut down. The engine coolant pipes connected to the

The urgency to escape increased as the 2-story ceiling began filling with acrid smoke.

external heat exchanger were ruptured in the explosion and could no longer carry the engine coolant. Also, water from above the basement floors and refrigerant system drained downward, flooding the B6 level where the generators were located. The remaining stations at WTC soon slipped back into darkness.

By 1:30 p.m. all of the transmitter sites on the WTC were without power. The fire department requested that Consolidated Edison, the commercial power supplier, discontinue service to the entire building. It was feared that rescue workers and trapped victims might be electrocuted.

At this point, New York had only one VHF and one UHF station on the air. The VHF station was now operating from its Empire State Building backup facility, and the UHF station that normally broadcasts from the same site was on the air. These stations were alone in their ability to remain on the air to serve the millions in the city and surrounding areas desperately seeking information about events and loved ones.

Downtown Manhattan was in bedlam, with hundreds of emergency vehicles and ENG trucks vying to get close to ground zero. Unfortunately, the loss of power at the WTC transmitter and ENG sites meant that most stations had no way to report this major story to their viewers, even if they could be on the air.

FM stations remain on the air

The FM stations in New York fared somewhat better than the TV broadcasters. Most FM stations that were initially located on the Empire State Building chose to keep their main sites even when the WTC became available. These stations remained unaffected.

Of those that had moved to the WTC, one FM station, WPAT, switched to its old transmitter and antenna at the AM site to return to the air. The other stations scrambled to get a signal on the air as best they could. WQCD used a 100W exciter, with a makeshift antenna hung out of a window on the parapet of the Empire State Building, and a PCM STL link on 7GHz to return to air a few hours after the explosion.

Terror reigns on the 110th floor

Although it was a terrifying experience for most, at first some technicians on duty at the WTC remained unconcerned. After all, just a year ago there had been a fire 20 floors below. At that time, three floors were evacuated, and only one fireman was treated for smoke inhalation. That serious event had caused them few problems. Surely this incident couldn't be any worse — or could it?

Water from above the basement floors and refrigerant system drained downward, flooding the B6 level where the generators were located. The remaining stations at WTC soon slipped back into darkness.

What the transmitter technicians didn't realize was that they were trapped on the 110th floor. There was no easy way down, because the elevators were stopped. The only other choice was to walk down 110 stories of enclosed, dark and smoke-filled fire escapes.

As the full extent of their situation began to sink in, many of the technicians felt panic rising in their throats. For those not there, it is impossible to understand the sheer terror of being trapped in the dark on the top floor of a burning, smoke-filled skyscraper. Thankfully, most of the telephone service remained uninterrupted. This allowed those on duty to call their families. Some feared that they might never get out alive.

Staff from those stations operating by remote control tried unsuccessfully to gain access to their sites on the 110th floor. Safety workers were trained and under orders to get people out, not in. The trapped technicians had to decide whether to sit tight or walk down 110 floors to the ground.

Some on the 110th floor joined together to force the fire escape stair doors open. These doors are normally electrically latched and controlled by the Operation's Desk on level B1. What the technicians didn't know was that the operations center was in shambles after taking a major blow from the terrorist bomb. Even worse, no one was alive on B1 to help them open the doors or tell them of their situation.

Officials examined the wreckage of a car in the underground parking garage after the explosion that killed five and injured approximately 300 others. (Courtesy of AP.)

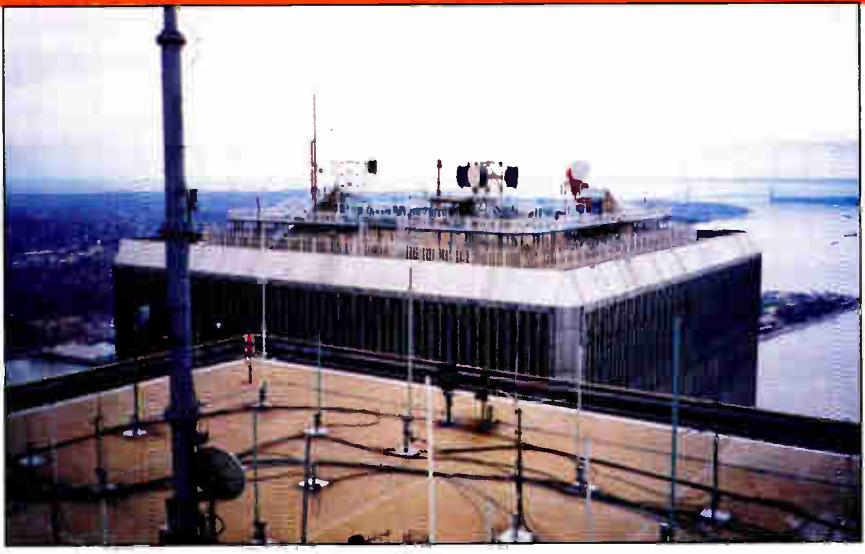
Even seemingly minor aids, such as emergency evacuation announcements, couldn't be made by the WTC officials. The tower's public address system relies on power amplifiers that are capable of 9,800W of audio. Unfortunately, the system also depended on the same generators that the broadcasters did — power that was unavailable. There was no one able to give them the information they needed.

It is difficult to understand the dilemma posed for those in the tower's transmitter rooms. The 110th floor has no windows. Thus, it wasn't possible to see the outside and to know exactly what was happening below. As smoke filled the hallways between transmitter sites, it became impossible to see even the walls of the hallway through the transmitter room door's security peephole. Looking through the peephole showed an empty hallway rapidly filling with smoke.

Walking into darkness

As pandemonium reigned below, the tower's work force of 50,000, seeking escape from the smoke, poured into the dark stairwells. With every descending floor, the crowding became worse and the smoke thicker.

The crater from the terrorist bomb caused extensive damage to several floors in the underground parking garage. (Courtesy of AP.)



The observation deck of the World Trade Center tower No. 2, shown in the background, allows visitors to view the New York skyline. A group of school children were trapped on that roof at the time of the bombing. They were later escorted down without injury.

Although the smoke was from a fire more than 100 floors below, some chose to leave as soon as the doors to the fire stairs were forced open.

One of the technicians chose to walk down carrying an oxygen unit. After almost two hours, he reached the ground floor. He reported it took another three days for the soreness in his legs to wear off. Although the technician never used the oxygen unit, he loaned it to an aged diner coming from the Windows of the World restaurant on the 107th floor. The grateful man called the following week from his hospital bed to thank the technician for helping save his life.

The dimming lights of hope

Each transmitter room has battery-powered emergency lighting. However, the emergency hallway and stairwell lighting needed auxiliary power from the generators located on level B6. As previously noted, the generators were unavailable because their cooling systems shut down and water was filling the basement level.

By 1:30 p.m., all of the transmitter sites on the WTC were without power.

After the AC power failed, the seconds ticked by slowly. Then, one by one, the batteries for the UPS supplies for computers and other low-power equipment ran out. As darkness closed in, the fear of what might happen next began to creep into the souls of those remaining on duty.

Some transmitter rooms had Scott Air-Paks filled with compressed air for emergency use during a discharge of Halon by fire-prevention systems. These proved invaluable during the disaster. Technicians had access to breathable air — enough for approximately an hour of protection from the acrid smoke from below.

Using water-soaked rags and napkins, technicians sealed cracks around the doors against the encroaching smoke. Because access to the roof is controlled by the Operation's Desk, there was no way to get fresh air from the roof into the transmitter rooms.

At this point, New York had only one VHF and one UHF station on the air.

Finally, after several hours, firemen broke down the roof access door, allowing an inrush of fresh air and access to the roof by the trapped personnel. Hope for a tomorrow was carried on the winds of the clean air from the WTC roof.

Trying to get the word out

Once access to the roof was obtained from inside, emergency rescue personnel lowered themselves from a helicopter and felled a 2-way antenna and a high-power floodlight. The helicopter landed, and officials began making provisions to evacuate some of the transmitter personnel. A pregnant technician was removed from the roof soon after the first rescue helicopter landed. Others followed later.

Most of the technicians remained on the 110th floor to help return their stations to the air as soon as possible. They also were able to help police and emergency personnel by using transmitter sites as temporary command posts.

As night fell, the building remained black and was no longer visible on the Manhattan skyline. Broadcast technicians, always mindful of the need for public safety, notified the FAA that the tower lights were out. As night wore on, the power was slowly restored from the ground up, reaching higher and higher up the darkened monolith.

Later, groups of replacement transmitter operators slowly began working their way up to the transmitter sites under the direction of fire crews and safety personnel. As relief transmitter operators made their way up to the top floor, the battle-scarred technicians began returning home to their families and a weekend of well-earned rest. Many of these devoted technicians returned the next day.

Most stations located in the WTC were able to return to the air by around 11:30 Friday night — a little more than 11 hours after the blast.

Transmitters are fired up

The process of getting a transmitter back on the air after any type of smoke or fire condition can be a nightmare. In tribute to system design and transmitter maintenance, the process proved to be relatively easy.

One station had recently installed a new solid-state transmitter. It was on when

Continued on page 94

The roof of the World Trade Center provides the base of the multistation mast. The mast is located just above the 110th floor, which houses the transmitters for TV and FM stations.

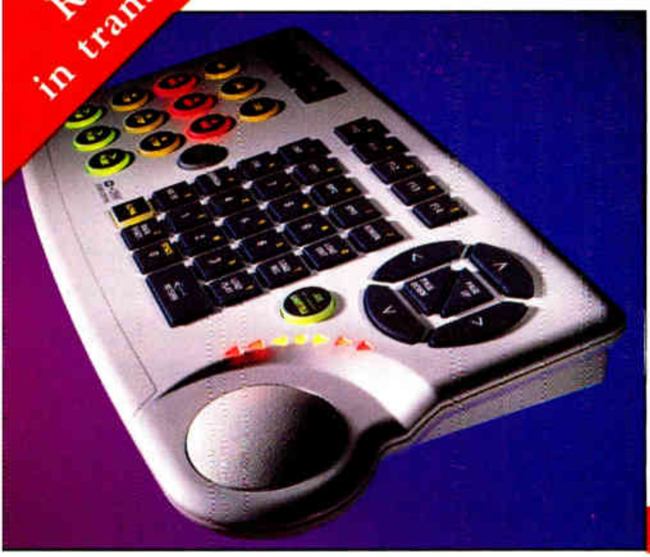
It Has Outperformed, Outclassed, Outsold, Outdistanced And Outlived Every Mixer That Ever Hit The Road.

Nothing compares to the Shure M267 Mixer. Nothing even comes close.
The M267 is the most rugged, reliable, remote mixer ever made.
And it has a road record to prove it. In fact, there's only one word to describe it:
Outstanding.
Call 1-800-25-SHURE. The Sound Of The Professionals®...Worldwide.

SHURE®

Circle (39) on Reply Card

Radio in transition



Newsroom production systems

Specialized digital workstations are making their way into news/talk.

By Mike Starling

The Bottom Line

New digital technologies allow great flexibility in management and storage of a wide variety of information. Nowhere is this more important than in broadcast news and talk radio operations. Yet, little specific development has come to pass in this area. The author of this month's radio revitalization feature considers the obstacles and the current technology from a position of experience. Merging of audio, text and other data in a single, simple and fast system seems to be the key to succesful implementation. $

Despite the availability of more than 100 tapeless recording and editing systems on the world market, the digital audio workstation revolution is still in its infancy. To date, the developers of these new tools have focused primarily on the glamour segments of the audio industry, such as multitrack production and archival restoration. Topics, such as PQ subcode generation, relative scaling, and ripple edits are mainstays for the serious workstation recordists.

Meanwhile, workstations limited to maximizing the efficiency of routine cut-and-paste operations have been lost in the scramble for increasingly sophisticated functions in the multitrack waveform editing environment. In today's high-tech context, where would a mere cut-and-paste desktop digital workstation be useful? The news/talk environment is the answer.

Workstations' basic appeal

Currently, DAWs are the mastering medium of choice for intensively produced broadcast audio. Yet, DAWs' advantages of non-destructive editing, random access, and lower costs are now becoming generically applicable to much broader uses than this rarefied environment.

Regarding lower costs, monetary savings may seem like an oxymoron with purchase prices reaching five and even six figures. Nevertheless, particularly for larger installations, significant operating savings are inherent in the decreased reliance on consumables and lower heat, power, maintenance and space costs compared with conventional equipment. There is a correspondingly increased cost-effectiveness of operators' labor, but it is less easily quantified.

In terms of random access, a host of devices have recently appeared within the radio industry whose primary attributes are ease of random access and time-domain manipulation. Digital storage and retrieval devices with custom software interfaces have been used for several years and are becoming more popular. Many broadcast facilities have streamlined operations with computer-based audio controllers. Data-reduction (compression) techniques of 4:1 or greater are often used in these systems. The raging controversy over these algorithms is beyond the scope of this article (and often beyond most listeners' awareness, because of the fidelity limits of typical analog radio air chains).

In today's high-tech context, where would a mere cut-and-paste desktop digital workstation be useful? The news/talk environment is the answer.

These systems are attractive for a number of reasons, whether used on the air or for production support. Anyone who has done a tour of duty in traffic and operations support will testify that people are poorly suited to perform repetitive, sporadically timed events with precision. Every day, in every state of the nation, there are missed feeds because of misloaded or unloaded tape, improperly set timers and misdialed sources.

On the other hand, these digital storage and retrieval devices can be as faithful as their software is friendly. Need channel 5 recorded at 4:50 p.m. and played back promptly at 7:30 a.m. tomorrow? Need the local cutaway to be filled by a 30-second PSA rather than the scheduled commer-

Starling is director of technical operations for National Public Radio, Washington, DC.

Photos courtesy of Basys.

cial that expired yesterday? These devices are welcomed for their reliability and their decreased consumption of staff time on ministerial chores.

Currently, DAWs are the mastering medium of choice for intensively produced broadcast audio.

Finally, non-destructive editing provides the ability to re-define the aural mix as subtly or as drastically as desired without cumulative time penalties. This is the most obvious benefit to anyone who owns or has thought about the purchase of a digital audio workstation. Reassembling the original mix elements from scratch has been replaced with opening a file and manipulating track variables as desired. Anyone who has ever used tie-lines to master down the hall to capture a good take out of a dozen attempts on a 5-machine mix will appreciate this momentous advance.

Applying DAWs to news/talk

News/talk formats are simultaneously among the most successful of radio formats and the most labor-intensive. In this industry, personnel costs always represent the lion's share of facility budgets, making news/talk also the most costly format to produce.

Another trait of news/talk is the competitiveness of the enterprise. With a myriad of local TV news, cable outlets and satellite-based news/talk programs competing for audience, successful services need to be nearly instantaneous in their response to news events, yet comprehensive and concise. This blur in source loyalty and appetite for quality places much pressure on such a resource-intensive format within a consolidating industry.

The primary needs for news/talk formats are plentiful storage, easy manipulation, and flexible management of an extensive and constantly changing number of audio segments. Time is often the greatest obstacle.

Given this context, three approaches have emerged among the specialized digital products aimed at burgeoning news and talk-radio markets.

Virtually stand-alone, minimally networked digital editors are especially cost-effective and quite useful. These can range from editing on digital cart machines with a variety of removable media to low-end desktop DAW systems.

A second approach gaining interest at

the network level involves multi-user access to centrally stored audio, including basic integration with text services (such as newswires and newsroom management software). This approach also can offer "windowing" to on-line research services for the serious news/talk users. Systems of this type are currently on-line at several leading news operations around the globe.

Finally, a new generation of integrated Information Resource Managers is under development. This approach promises a new paradigm in news/talk program production: full integration of sound, text and even video clips with instant access to information databases in-house or on-line.

The future of digital news/talk radio

Some broadcast organizations are beginning to view the digital storage and retrieval environment as an information management enterprise. Under this approach, a one is a one, a zero is a zero, and whether the file is sound, still photo, graphics, video or text is merely a matter of software pointers.

The staff of a network news or talk show operation will produce and use hundreds of information files each day in each of these media. All of this information is essential for the comprehensiveness of research to support a listenable and journalistically proper program.

A digital news radio production system in use at the Australian Broadcast Corporation.

With topics often lying dormant in the press until a breaking event returns the subject to center stage, a news operation's offices may be incapable of storing all of the research required by each story. This results in an extraordinary amount of re-research. Thus, the need for a central storage unit that can house text, facsimile, audio and even video clips is apparent.

Database management will link data files on stringers, guests, time zone availabilities, closest uplinks, experts and even "will not appear with guest X" files as sidebars to each of the hundreds of topics covered every year by a news organization.

Storage for this purely supportive data will require aggressive compression techniques. Even then, this approach will still require lots of hard drive capacity and possibly the use of a multiple optical drive system for access to both pre-recorded and locally produced archives. An intensive software development effort also will be imperative. Efforts are under way to demonstrate the viability of this concept.

As with the computer revolution, each new development brings new users into the market, which stimulates further hardware and software improvements. Even today's relative flint-ax variety of digital workstations are making rapid inroads into newsrooms and talk-show studios throughout the world, quickly demonstrating their value.

➡ *For more information on digital newsroom production systems, circle Reader Service Number 307.* ■

Courtesy of Pinnacle Systems Inc

Inside digital video effects systems

Today's DVEs are more powerful than ever.

By Curtis Chan

The Bottom Line

Digital video effects (DVE) systems are no longer limited to megabucks facilities. Even the smallest station or production facility can afford one of today's systems. Recent advances in digital technology have resulted in more powerful, smaller and less-expensive DVE systems than ever before. Learn how to select the right DVE for your facility. It may be the margin you need to be number one. $

Chan is the principal of Chan & Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

Author's note: Thanks to Ajay Chopra, chairman of Pinnacle Systems Inc., Stuart English, Ian Nicoll and Sheila Stefani of Abekas for their contributions to this article.

Are your station production personnel having a difficult time trying to create an image with your logo? Are your pre-show bumpers lacking in pizzazz? Does your news look drab compared to the competition's? Perhaps you are an independent producer looking for a competitive edge. One solution may be a digital video effects (DVE) generator. This article looks inside DVEs and establishes some criteria as to what to look for when it's time to make a purchase.

What is a DVE?

A DVE is a device that generates and combines many different visual elements into a single complex image. Early units were hardware oriented with simple filtering and address generation circuitry. Today's systems combine powerful processing power with complex algorithms and intelligent user-interfaces to give unprecedented control and flexibility.

Once, dazzling high-quality video effects could only be achieved by using high-end DVEs. Today, these have given way to lower-priced, high-performance, multifunction integrated systems. Some high-end 4:2:2:4 DVE systems still cost more than $200,000, rewarding the user with higher-performance throughput, sophisticated user interfaces, multiple channels and many effects options. On the other hand, many DVEs cost less than $100,000 and have much to offer.

DVE applications

For stations, a DVE allows dazzling logos and effects to be produced in-house, eliminating the need to farm-out the work. For high-end production houses, DVEs continue to complement the high caliber of in-house creative talent and their ability to create effects. For the independent producer, a DVE can help develop a competitive look that could win the first of many contracts. A budget DVE will probably pay for itself after the first commissioned production. Whatever the application, you will probably find a DVE within your price range.

A myriad of applications exist for DVEs. For each application, there is a DVE that fits the situation. In off-line applications, a DVE is considered a tool to be used as part of a project, such as building a morphing effect. In on-line, the DVE's main objectives are immediacy, operator feedback and real time operation. Whatever you are looking for, manufacturers are converging upon one basic objective: introducing sophisticated digital effects systems and promoting creativity by reducing operating costs and complexity.

The basics

DVEs come in many flavors. Although any DVE will perform a variety of effects, each system has different attributes that make it unique to justify its cost. These areas center on the ability to perform real time effects, output video signal quality, flexible features, user-interface, I/O, 2-D/3-D capability, and options. Also consider reliability, serviceability and mean time to obsolescence when making a selection.

A DVE in its most basic form writes data into the store (memory) using clocks and addresses derived on the input side. (See Figure 1.) The pictures are then read out of the store with similar clocks and addresses produced on the output side. In a 4:2:2-based system where the luminance sampling clock is 13.5MHz, a sample is written into the store every 74ns. Digital picture processing is like solving a crossword puzzle: The more information you have, the easier it is to guess what is missing. To this end, some high-end systems employ a technique called *upsampling*.

Upsampling employs an interpolation technique to predict what the information should be between the existing 13.5MHz data samples. This results in writing data into the store every 37ns, effectively doubling the sampling rate. Similarly, if the key and chrominance signals in a 4:2:2:4-based system are upsampled, this results in an effective 8:4:4:8 system as used by some high-end DVEs. The ability to upsample is one of the areas that distinguishes high-end DVEs from their low-end cousins.

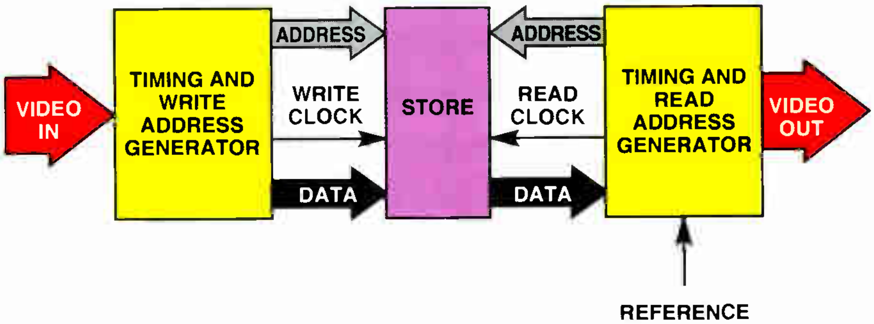


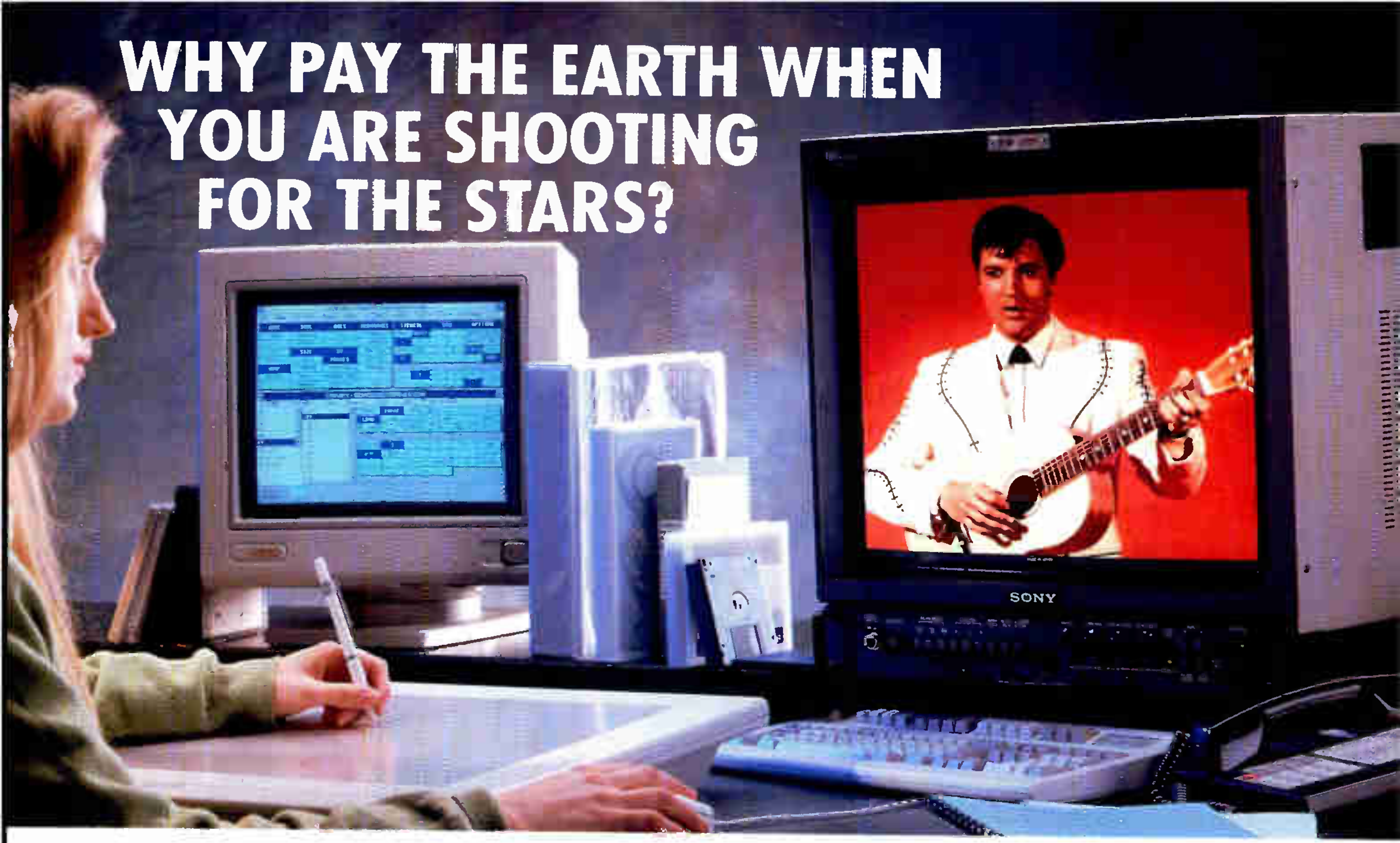
***Figure 1.** A basic DVE consists of a timing and write address generator for the input side. This generator writes data into the store (memory). A similar timing and read address generator, locked to reference, reads data from the store and sends it to the output.*

Frame and field motion interpolation

Once information is stored, we need to look at what happens when the image is moved. Consider two fields of stored data where a picture is moved slightly, with no change in picture size. To accurately predict what has happened, you must create data between the stored samples by interpolation. Averaging the previous and current field data might bring acceptable results, until the difference between this data and the previous field is considered. To be more accurate, the motion component of the data sample in question must be examined.

For example, consider a situation where a set of propeller blades rotate 45° every field. Using the averaging method, depending upon which field is used will result in a different position for the propeller blades. The effect would be a flickering of the blades between the two fields. Therefore, interpolation across field lines is necessary where there is motion. Interpolation across frame lines is valid only when little or no motion occurs. Because of this, most high-end systems allow the operator to select between field and frame

WHY PAY THE EARTH WHEN YOU ARE SHOOTING FOR THE STARS?



The new version of Videopaint by EVS is an *integrated graphics design system.* The *modular construction* of Videopaint allows you to add power and function according to your post-production and budgetary requirements.

The foundation module for Videopaint includes a full-function painting system and a RAM recorder. You can add to this foundation according to your own post-production needs.

Choose the SHOW module for high quality presentation graphics. Choose the ZAP module data for communication with other computer graphics workstations.

Choose the VIDEO SILICON RECORDER (VSR) module to use the RAM recorder under the control of your video editing system. Add RAM incremently to the system to increase the frame storage capacity to a full 32 seconds.

Non-linear Editing of still pictures

Presentation graphics can be quickly and easily produced; e.g. to make a weather forecast program. Conventional digital video effects can be combined with still picture sequences with *no rendering required*. So animation sequences can be made in a matter of seconds.

Communication with other workstations

ZAP allows you to easily transfer digital video sequences between Videopaint and other computer based workstations.

Using Ethernet technology workstations can be networked via appropriate gateways. In a typical application you may produce pictures on a dedicated 3D workstation and then transfer them to Videopaint for retouching and animation.

RAM recorder in your edit suite

By choosing a VSR module you are able to benefit from your Videopaint RAM recorder in your edit suite. Your editor can take command of the RAM recorder using an RS 422 interface - Sony protocol, giving you an additional digital recorder.

32 seconds of real time storage

The foundation module of Videopaint has 6.4 seconds of real time storage. Each RAM extension module adds 6.4 seconds. Four extension modules can be added giving a total of 32 seconds. This capacity adds functionality. For example you can have direct access to a complete 30 second commercial rather than limited access to segments.

Other features include:

- Full digital 4:2:2 system
- Multi layer DVE animation
- Switchable formats, 16:9 or 4:3
- Push and mix between two live sequences
- User programmable macro functions
- Four frame buffers

Call EVS now or post the coupon.

EVS BROADCAST EQUIPMENT Rue Courtois 22, B4000 Liège Belgium.

Please send me details on the new version of Videopaint.

Name ____________ Company ____________

Address ______________________________

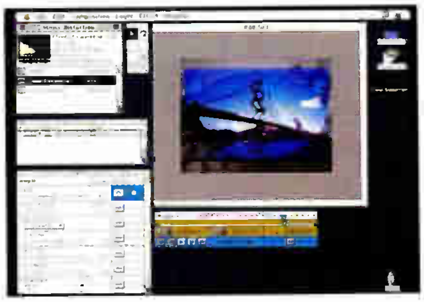
EVS BROADCAST EQUIPMENT Rue Courtois 22, B4000 Liège Belgium.
Telephone: 32/41/22 00 70 Fax: 32/41/22 22 98

EVS BROADCAST EQUIPMENT

VIDEO PAINT

Circle (74) on Reply Card

Scene from Boy George Crying Game video. Effects were created using high-end digital video effects. (Photo courtesy of Quantel and Editel LA.)



Screen shot of computer-based DVE, including menus and the effect. (Photo courtesy of CoSA.)

interpolation. In contrast, low-end systems often employ field stores, motion detection on blocks of pixels (rather than individual pixels) and output every other field. Depending on image motion, this may result in motion judder of the image. Although the output video quality may meet RS-170A specs, the lack of smoothness and jaggies are a dead giveaway.

Adaptive frame-based selection

Another characteristic found in higher-end systems is the ability to perform *adaptive motion detection* on each pixel respective of luminance, chrominance and key data. The intelligence decides to what degree either field, frame interpolation or a mix of the two is appropriate for each point in the picture. Looking at the motion path of each pixel requires an enormous amount of horsepower. Lower-priced systems may forego this by looking at blocks of pixels at any given time, thereby sacrificing video quality.

This adaptive technique is useful in a noisy image where some interpolators may be triggered to change to either field or frame operation. On some high-end systems, this field/frame adaptive selection is available separately on the video and key channels so that a static key signal could be held in frame mode while the video is set to adaptive.

Digital filters in DVEs

Another attribute that distinguishes DVEs is the sophistication of the filtering methods used. Digital filters are used to transfer or map digital input signals into digital outputs. These digital signals represent discrete time processes, which usually arise as a result of sampling analog signals. Today's filters are programmable and vary the weighting factor according to the amount of size reduction being done at the time. There are two ways to maximize filter response. One is at the read or output side of the DVE. For a desired data point, data is read out from several different memory locations on either side of the required data point. The weighted average of all the points involved requires access to as many separate points as there are filter stages. For a post-store filter, the memory must be subdivided into a corresponding number of correctly addressed sections.

The second way is to write a pre-filtered image into the store, depending on the conditions required at the output. Increasing the number of selectable filter characteristics means less compromise in the filtering of the video. This results in smoother image transitions. Noise in lower-priced systems may be sufficient to mask any switching between different filter characteristics. However, in digital systems where noise may not be a factor, filter characteristics should be as large as possible to minimize any visible filter switching.

Pre-store filter parameters are determined by the particular transform being applied as the video is input into the main store. This technique yields a greater number of discrete cut-off points and a sharper rolloff slope. In effect, a near-correct filtered image can be written into the main framestore, which would result in smoother transitions when performing effects. The processing speed needed to perform operations on predicting pixel motion paths and filtering comes close to mini-supercomputers operating in the gigaflop range. Again, lower-priced systems may compromise on some of these areas. The result should be good but not pristine-quality video.

DVEs from A to Z

High-end systems boast a plethora of features. Users who can afford the price of admission are rewarded with a system that can perform a dazzling array of sophisticated effects in real time with broadcast-quality output. For non-real time systems, 3-D modeling and animation, quality and sophistication are essentially independent of the speed and cost of the processor. However, the goal for many companies today is to find new solutions to the problem of inexpensively producing sophisticated real time effects. Although there are some compromises in the lower range systems, the performance features offered are alluring to all but the most devout high-end DVE users.

Low-cost, high-performance alternatives

Many companies offer low-cost, high-performance alternatives to the high-end systems. Probably the most common performance factors compromised are in the areas of 1) output video quality while performing complex effects, such as page turns, swoops, pushes and warps; 2) rendering time when performing 2-D/3-D work; or 3) the sophistication of the user interface when setting up effects.

Indeed, many low-cost systems are based on an add-on kit of plug-in cards and software for a Mac, IBM-PC or Amiga. Depending upon whether the vendor's card performs most of the number crunching or relies on the host computer determines, to some extent, the processing time. The output signal quality from these systems is typically quite good for industrial video or low-end broadcast use. Processing artifacts on low-end systems often can be seen during complex DVE moves or composites because of limitations in motion prediction, storage and filtering. In addition, some of these low-end systems cannot be gen-locked.

In the effects department, low-cost units might have limitations in the number of input sources and graphics layers they can handle simultaneously. Look for the ability for each effect parameter to be programmed independently as a function of time adjusting parameters, such as transitions, scaling, effect, shadow, border and input/output window sizing. If the low-cost system employs a character generator, look for limitations in the number of fonts offered, the ability to size fonts or choose colors. Additional limits may apply while performing animation, compositing over live video or on backgrounds and multiple moving objects.

Mid-range integrated, computer-based DVEs

The next level up from simple plug-ins are integrated computer-based DVEs. These systems usually are built from plug-ins for the host computer, an external processor and upgradeable software. Typically, 4:2:2/4:2:2:4 internal processing and analog component I/O are standard. Such systems also offer the ability to upgrade with such options as a montage/still-store or a full bandwidth key channel, dedicated control panel with 3-axis joystick, or a composite/component I/O capability.

Bridging the gap between DVE and 3-D

3-D modeling and animation systems of today are capable of creating effects that

3-D point effects created using a high-end graphics system. (Photo courtesy of Quantel and the Weather Channel.)

resemble photographs rather than computer-generated images. On the DVE side, effects, such as morphing, creation of geometric and esoteric shapes, mapped video and warping, are becoming the norm on even low-end systems. These features encourage creativity, but the playback is generally not real time.

However, a new breed of systems allows the integration of sophisticated 3-D modeling and animation software with real time digital effects. They accomplish this by first off-lining the modeling and animation process, then combining the data with the effects generator for real time playback.

High-end systems

Moving upscale toward dedicated DVE systems demands a higher cash outlay. Typical systems start at $25,000 and move upward exponentially. For the money, users can expect a system to have multiple features not found or offered as options in their lower-priced cousins. High-end systems differ from others in image quality, the degree of control and the specialization of effects. Users expect a high degree of image quality, smooth image transitions and a lack of jaggies. The degree of control corresponds to the ability and ease to create motion paths. Likewise, the specialization of effects centers on attributes, such as color correction, defocus, blurs and compositing tools.

These systems often provide real time 3-D capability, state-of-the-art effects; control interfaces that support serial, GPI and V-LAN; component (RGB, Y/C, CCIR-656/601) and composite formats, up to frame-based 8:4:4:8 processing with internal key channel; multiple channels (one to eight); direct interfacing to switchers; and free-form modeling and mapping of video.

High-end systems also may use proprietary high-speed processing with novel approaches to digital filtering. In some cases, control interfaces are routed through ethernet communications, ensuring easy installation and flexible configuration options. Multiple signal systems and consoles then can be shared on the network.

Aside from the multitude of effects offered, high-end systems also offer special or unique features. Single-channel drop shadow eliminates the need for a second channel by providing a separate motion path for the target framestore's drop shadow feature. Key-only freeze frees a VTR or external framestore required to supply a key signal. A matte key channel eliminates matte reels. Other features include intelligent global command sets and a cohesive migration path.

Remember that a DVE also must accept a variety of signals from different sources as well as output its own signals. Many high-end systems offer a flexible timing system allowing gen-lock to color black, along with the ability to store input and output timing values independently on an input-by-input basis. This feature allows transformed images to be sent to a switcher for upstream manipulation or allows the transformed images to be real timed to the output of a switcher in a downstream

DVEs: A buyer's guide

By Steve Epstein, technical editor

The following are some points to consider when contemplating a DVE purchase. Before buying a DVE, sit down with those involved and discuss what features are needed. It's important that the technical and creative staffs be involved in the planning and decision-making process.

Technical considerations:

- *Compatible with present and future needs.*

  ☐ Analog ☐ Digital
  ☐ Component ☐ Composite

- *Expansion capabilities.*

  ☐ Memory ☐ Storage
  ☐ Video channels ☐ Key channels

- *Upgradeability.*

  ☐ Hardware ☐ Software

- *Keyer requirements.*

  ☐ Internal ☐ External
  ☐ Linear ☐ Luminance

- *Timing requirements.*

  ☐ Gen-lockable ☐ Software-based
  ☐ Multiple setups for use in more than one suite ☐ Hardware-based

- *Output signal quality.*

  ☐ S-VHS ☐ 1-inch Type C ☐ D-1

- *Remote control.*

  ☐ GPI ☐ Serial RS-422 ☐ LAN

- *Maintenance aids.*

  ☐ Self-diagnostics ☐ Internal pattern generators
  ☐ Manufacturer support-board exchange, on-line help

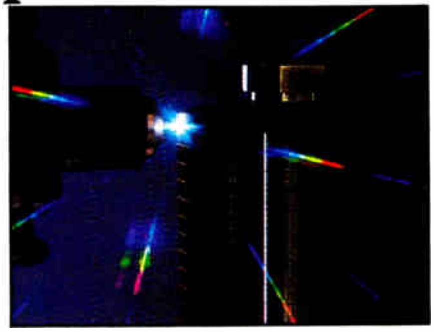
Operational considerations:

- Dedicated keyframe programming and editing controls.
- Numerical entry for quickly entering data values.
- Dedicated menus or controls for commonly used functions.
- Manual and automatic input selection for each channel.
- Multiple matte generators.
- Registers for effects storage.
- Transform control area (3-axis joystick) for control over all picture manipulation areas.
- VTR-like remote-control capabilities (play, pause, jog).

mode.

Last word

Because of the diversity available in digital video effects systems, you should be able to find a DVE that meets the needs and budget of your facility. DVEs have given broadcasters the ability to create complex effects, which only a decade ago was the domain of high-end post houses. ■



Abekas pre-transform keying

By Stuart English

The Abekas A57 digital special effects system is a high-quality device capable of sizing, positioning and rotating live video images in 3-D space. The system uses sophisticated techniques, including 10-bit, frame-based image processing. In addition to these technical advances, the special effects system includes a pre-transform keyer that adds to its power.

Any keying system requires video signals and a key signal. The key signal cuts a hole in the background video into which the foreground, or fill video, is inserted. The special effects system includes two such keyers, one on the output side and one on the input side of the 3-D transformation circuits. In the output, or post-transform keyer, the transformed video is automatically selected as the fill video, with a key signal to match its size and shape. The only controls needed are final key opacity and the selection of the background video. The background can be an internally generated color matte or a live video input.

Pre-transform keying

The pre-transform keyer provides a wider range of controls. This keyer feeds the system's 3-D transformation section, and may replace an external switcher M/E feed.

English is product manager with Abekas Video Systems, Redwood City, CA.

Figure 1 shows the location of the pre-transform keyer in the video processing path. The two video inputs are labelled A and B; either may be selected as the background or foreground signal. The key signal can be one of the external key inputs, a self-key signal generated from the luminance content of video input A or B, or a full raster white field signal. Using the full raster signal forces the pre-transform keyer into mix/wipe mode instead of key mode.

Any keying system requires video signals and a key signal.

There are three modes for the keyer. Leaving it off maps the A video to the front side of the 3-D image and the B video to the back side. The key signal feeding the 3-D transformer is the full field of white, and the key source used by the post-transform keyer is the resulting compressed white field.

The special effects system's internal wipe generator may act as a mask for the white field signal, and this becomes the key signal that feeds the post-transform keyer. For example, a circle wipe can cut a disc from the input video, or the square corners of an image can be rounded so the source can be mapped onto an old TV screen.

The pre-transform keyer provides a wider range of controls.

The first pre-transform keyer mode is background. This mode uses an external key signal, such as from a character generator. A wipe can mask part of the key signal, and this modified key signal feeds the 3-D transformer. For example, using text video and key with a box wipe lets the user lift a group of characters and "fly" them independently of the rest of the text.

In the effect mode, the pre-transform keyer uses an external key, a self-key or wipe to key between the A video and a copy of the A signal, which has passed through the input effects circuits. These circuits offer color correction, defocus, mosaic and posterization. This mode lets the user define the area of the image in which these effects occur. Examples of common applications for this include crime suspect I.D. protection, and defocusing only the

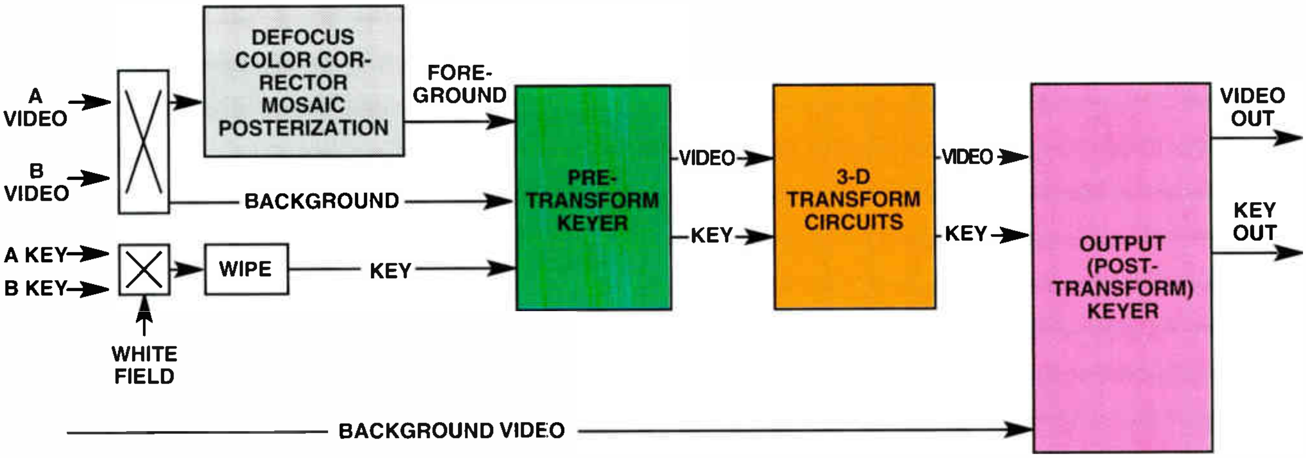


Figure 1. Block diagram of the A57 special effects system.

whites in a scene to simulate the effect of a film lens.

Finally, there is the input mode. Both the A and B images are visible, and the keyer uses an external key signal to key between them. The keying priority (A over B or B over A) and key opacity are adjustable. Using the white field key signal converts the pre-transform keyer to mix/wipe mode, where key opacity defines the A to B mix transition. The wipe generator can be used to create dynamic wipe transitions between the A and B video sources.

Some common applications

Over-the-shoulder box effects, such as those in sports and newscasts, are examples of applications of the pre-transform keyer. A scene that requires compressing a title keyed over a VTR feed into a box calls for two switcher M/E banks: one to key the title over the VTR feed and a second to key the digital effects output over the news set background. Using the system's pre- and post-transform keyers allows for the complete setup, A to B key (or A to B mix or A to B wipe), compression, and final key over the live background, to occur within the effects system itself.

Over-the-shoulder box effects, such as those in sports and newscasts, are examples of applications of the pre-transform keyer.

The system's pre-transform keyer, wipe generator and SuperWarp option, when combined, offer a single pass, dual-sided page turn in a single channel. Because this would normally require a second effects channel, the inclusion of the pre- and post-transform keyers in the A57 can mean reduced hardware requirements for live news and sportscasts.

Editor's note: SuperWarp is a trademark of Abekas Video Systems. ■

Preview

JUNE...

NAB CONVENTION REPLAY

- **From the Convention Floor: A Perspective**

A look at the latest developments from the convention floor and session rooms.

- **Pick Hits of '93**

BE's panel of experts toured the exhibit floor looking for those special devices and equipment for this year's winning roundup.

- **Engineering Conference Report**

A review of the major technical themes at the 1993 Engineering Conference.

- **Show of Shows: A Comprehensive Exhibitor Listing**

- **Developments in Magnetic Tape**

A review of the latest technology in magnetic tape recording.

- **Radio in Transition**

Radio stations must address the issue of on-air audio processing if they are to succeed. The article examines the types of audio processing available and how to best take advantage of them.

JULY...

Video Technology Update

- **CCD Camera Technology**

Using CCDs in cameras is taken for granted. However, manufacturers have been hard at work improving an already great technology. The article looks at the technology of CCD imaging.

- **DBS: Tomorrow's Opportunity**

Broadcasters and cable systems are looking to the sky for the arrival of their newest competitor — DBS. How does this technology work? What opportunities lie ahead for savvy engineers and managers?

- **Desktop Video for Broadcasters**

The PC-on-a-chip technology means more power for less money. The article examines how the desktop computer workstation can perform tasks that used to take racks of expensive and sophisticated equipment.

- **Radio in Transition**

More radio stations rely on some form of program automation. The article looks at some of the types of radio automation systems available.

RPU antenna system primer

A review of the fundamentals for remote pickup system antennas.

By John Collinson

The Bottom Line

Remote pickup unit (RPU) manufacturers and the 2-way industry have developed many types of antennas that are applicable to remote broadcasts. Having the right antenna can make or break a remote, no matter what other equipment is involved. Because most RPU applications are live to air, everyone notices if there's a problem. Here are some practical hints for selecting the right antenna for your application.

$

Collinson is chief engineer at WDAF-AM/KYYS-FM, Kansas City, MO.

Today's new technologies present more options than ever for remote broadcasting: Switched-56, fiber, satellite, digital microwave, T-1 — and the list continues to grow.

Yet, economics require that most stations rely on traditional remote pickup equipment for the majority of their remote broadcasts. Massive increases in telco program-circuit charges are forcing many to find creative ways to make RPU shots work where they were formerly considered impossible. Increased band congestion and interference make any RPU shot more critical than ever. For these reasons, proper antenna selection and implementation has become increasingly vital.

Primary receive site

The most critical antenna in the RPU system is at the receive site, whether it is at the studio or a remote tower location. Unlike the transmit antenna, the receive point cannot simply be moved half a block down the street if the shot doesn't work. Locations must be chosen carefully, especially in congested RF environments.

Most stations use some form of vertical whip or dipole array, mounted as high as possible. This enables a moderate amount of antenna gain while providing omnidirectional coverage. In general, the higher the gain, the larger the physical size and windloading, and the higher the cost of the antenna.

When putting up a new receive site, check carefully (especially on a shared tower) to see if other nearby towers or antennas could cause intermodulation or front-end overload. If any same-band transmit antennas are on the same tower, separate the receive antenna from them by a few wavelengths, even if it means mounting lower on the tower. Filters or cavities may be required to eliminate interference. Each case must be handled separately, considering power levels, physical separations and frequencies involved.

Single whip-type antennas often suffer from shadowing effects when mounted on larger towers. Spacing the antenna out from the tower a few feet reduces the effect. In some cases, another antenna may be mounted and the two combined. Be aware that signals coming from certain directions may suffer from this approach, if the path places the antennas at an odd multiple of a half-wavelength apart.

In some situations, a directional receive antenna on a rotator system may be worthwhile. Gain and interference resistance are drastically improved, although the mounting scheme may be cumbersome. A tower shadowing problem may still exist, depending on the rotation method. Stations using receiver multicouplers for 2-ways or multiple RPU receivers would not find this a viable alternative because it could only be aimed one direction at a time. Aircraft pickups also would be impractical.

Ultimate solution

The most effective (and expensive) approach to covering all directions is the panel-type antenna. Panels have been used for years in FM and TV transmit applications to eliminate the pattern distortion caused by large towers. They are available for receive applications in the UHF bands, usually in 4- or 8-panel configurations. The panels' outputs are fed via matched-length coax cables to a combiner to minimize phase cancellations. Panel antennas typically offer 7dB to 10dB of gain in all directions.

Each panel provides coverage of approximately 90°. This characteristic could be used to create a null in the direction of a persistent interference problem. For example, cellular telephone towers are notorious for spewing unwanted emissions in the 450MHz bands. A null could be created in the direction of a cellular tower, if needed.

In addition to cost, the drawbacks of panel antennas are the increase in windloading on the tower, and the losses incurred in the combiner. In some cases, a pre-amp may be needed to overcome this loss, but beware of potential intermodulation. (See "Solving RPU Intermod Problems," May 1992). Panel antennas also can increase interference problems because many are both vertically and horizontally polarized. On the other hand, this dual polarization may be of benefit to stations receiving transmissions from aircraft. At a 60° or 70° bank (not uncommon for some pilots), the transmit antenna becomes nearly horizontal. Polarization of the transmit antenna can change continually as the aircraft turns. Marked improvement in reception has been noted where panels were installed. Portable radio users can encounter this horizontal antenna problem when a hand-held unit is laid down or held sideways. Thus, panel receive antennas may help in these applications as well.

Economics require that stations rely on traditional remote pickup equipment for most of their remote broadcasts.

Feedlines

The advantages of high antenna location are tempered by the signal losses encountered in the long coax cable runs that these installations require. Semi-rigid lines are nearly always called for in these long runs to keep losses down to acceptable levels. Loss figures are available from line manufacturers. Most commonly used diameters are 1/2-inch and 7/8-inch. Foam-dielectric line usually exhibits slightly higher loss than the same size of air-dielectric line. However, the differences are minor compared to the ongoing cost and inconvenience of maintaining the pressurization equipment that air dielectric requires. Furthermore, foam line is cheaper than air dielectric for comparable lines.

Mobile and portable setups usually employ RG-8 type coax. For extremely short runs, even RG-58 can be used. Avoid the sharp bends that often can occur behind a transmitter or receiver. A 90° elbow can be used to keep stress off the line and connector.

On location

At most remote sites (for example, car dealerships and restaurants) the transmit setup normally follows one easy guideline: the higher and more directional, the better. Higher gain antennas give better received signal-to-noise and lessen chances for interference, both to you and caused by you. They may also allow lower transmitter power if it is adjustable. CFR 74.461 mandates the use of minimum power necessary for satisfactory service.

Many stations use low-power transmitters to relay a signal from inside a building to a station vehicle parked outside, where the main RPU transmitter and antenna mast are contained. These short relay hops may be subject to serious fade and multipath from steel in the building's construction, nearby vehicular traffic or by people walking. Simple whips plugged directly into the transmitter are common, but are usable only for extremely short, unobstructed hops. A short magnetic-mount whip on a steel plate will perform much better because of the available ground plane. Directional antennas on the transmit and receive ends will drastically improve fade margins and multipath problems. If the vehicle permits, a small yagi can be mounted permanently on the roof for relay hop reception. Once swiveled into position, it will perform far better than a simple whip, especially when a whip is used on the relay transmitter.

Small yagi antennas of four to six elements are frequently used for remotes. A stacked pair yields approximately a 3dB increase in gain over a single unit, but side and rear lobes also increase because of the effects of the mounting boom. More elements result in more gain. The choice usually is based on practical and mechanical limitations.

Magnetic-base whips are common for short, unobstructed RPU service. They offer the advantage of quick mounting and removal. Some do have moderate gain figures (3dB to 4dB). As with many simple solutions, magnetic mounts suffer from a number of inherent disadvantages. Automotive vehicles (especially recreational vehicles) are increasingly made of aluminum or fiber glass. Even if there are steel reinforcements, the available ground plane is small, distorting the coverage pattern and limiting range. Another more mundane problem involves the magnets. Usually, they are glued into the base and tend to break loose at inopportune times.

Overhead power lines are the nemesis of remote broadcasts.

If drilling a hole in the remote vehicle's roof is feasible, a conventional roof-mount whip is preferable to a magnetic mount. The hard mount allows a better ground plane to be established, and the antenna rarely comes off unaided.

Aircraft

Another specialized case concerns installations in aircraft, most often used for traffic reporting. Never install fixed antennas and equipment in any aircraft without hiring a certified aircraft mechanic to inspect the work and properly sign it off in the airframe log. The added expense of this step is far outweighed by the potential liability from litigation in the case of an accident. The aircraft owner or operator also should be concerned about this.

Use antennas certified for aircraft service, which are usually small rigid whips or enclosed fin styles. A fin antenna is a form of whip with an aerodynamic radome around it to reduce drag. Lash all power and coax runs down with large quantities of tie wraps. Vibration is a constant enemy of equipment in small aircraft. If multiple transmit antennas are installed, keep them as far as possible from each other to prevent transmitter-induced intermodulation. Some aircraft are prone to collect water in the lower belly during heavy rains. Beware of the corrosion that can result.

Safety notes

Overhead power lines are the nemesis

of remote broadcasts. Deaths have resulted from masts coming in contact with power lines. The use of any type of warning device or placard to help prevent such an accident is worthwhile. The life you save may be your own.

Remote pickup units have not yet been placed under the ANSI standards for RF radiation exposure. Nevertheless, common sense dictates that an active transmit antenna should not be touched. Small RF burns can result from point contact, even at the low power levels involved. Keep antennas as far away from the public as possible.

Maintenance

Assuming no one drives the remote vehicle under a low-hanging tree branch, few things normally happen to antennas. Some yagis use elements made of aluminum rods threaded into the main boom. Keep these tight, and apply a thread-locking compound to keep them from vibrating loose. Some hollow elements are prone to collect water. Carefully placed weep-holes should solve this problem.

Repair of antenna elements can be a challenge. Although aluminum is easy to drill, cut and tap, don't try to solder elements. Instead, replace small aluminum rods and tubing yourself, and farm out the welding to a shop that has a tungsten inert gas (TIG) setup, if possible. TIG (also called heliarc) can make strong, pinhole-free welds.

Stainless-steel whips also can be repaired, but it is a delicate process best left to a welding or machine shop. In some cases, it may be cheaper to replace an antenna than repair it.

Stay connected

RPU equipment and antenna manufacturers nearly always use either N- or UHF-(PL-259) type connectors. The N-connectors are weather-resistant and electrically better, but are prone to several problems. Inner conductor pins can easily retract if the connectors are improperly mounted. Male cable connectors with captive center pins are sometimes hard to find, but they do an excellent job of staying aligned.

UHF connectors are not weather-resistant and are less impedance-constant, but may be preferable in cases where non-technical personnel are setting up equipment. They are cheaper, easier to attach and panel jacks are more rugged. Either type is prone to poor connection to the coax braid if not mounted correctly. If the connector spins on the cable at all, don't attempt to use it.

Wrap any connector exposed to weather with good electrical tape or connector-sealing compound made for that purpose. Then, wrap it again. Once moisture has penetrated a connector, it can be difficult to dry it out. Some coax is prone to wick water up into the braid, which is then trapped under the outer jacket. This leads to corrosion.

Because the RPU spectrum is close to various 2-way radio bands, a wide variety of antennas intended for 2-way service are available from a number of manufacturers. Therefore, antenna suppliers, RPU manufacturers and 2-way shops are all good sources of specific information to aid in the selection of the right antenna for a given application.

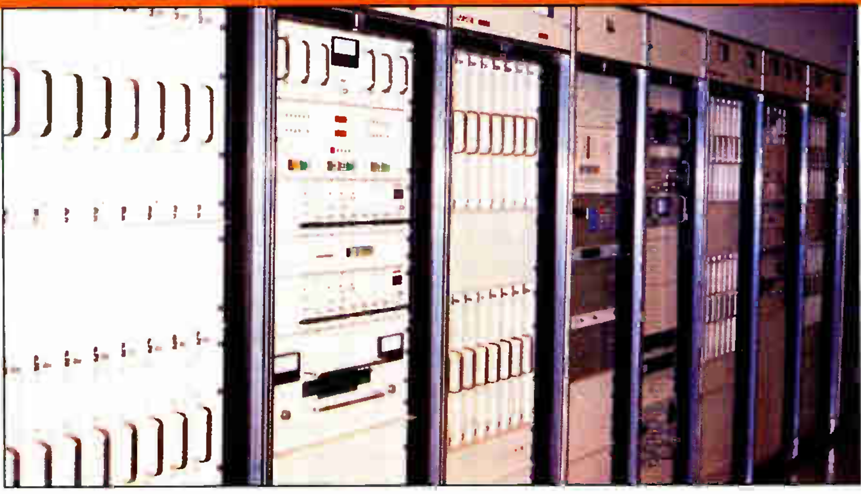
References

"Antenna Test Ranges Develop Accurate Specifications." *Mobile Radio Technology*, September 1992.

The ARRL Antenna Book. Published by the American Radio Relay League. Newington, CT.

➡ *For more information on RPU systems, circle Reader Service Number 310.*

■



Transmitter site of WWOR-TV located on the 110th floor of the World Trade Center.

power was cut to the 110th floor. When AC returned, it automatically came up in the proper mode, with no human intervention. Some stations had a few minor problems, such as stuck interlock relays on control panels. The power outage had forced these relays into new operating modes, ones they hadn't seen in years.

Other problems included one transmitter's high-voltage safety shorting relay. The contacts were welded shut by the sudden arc developed when the power was cut. Oscillators in cold crystal ovens for transmitters and microwave receivers refused to initially lock onto the correct frequency.

The telephone distribution room wasn't powered up immediately, and most stations had to rely on their backup STL systems. The video phone lines started working an hour later.

As some technicians blew the soot out of the transmitters and replaced air filters in the days after the emergency, each transmitter was given a careful inspection. Because each station relies on its own air drawn in from outside, the damage was slight.

The explosion proved to be a difficult ordeal for station technicians. However, it was their vigilant maintenance that returned the WTC stations to air so quickly.

Back to normal

Several weeks after the explosion, water was still not available throughout the building. Nevertheless, the routine slowly returned to normal. Both towers of the World Trade Center are now open, but every office worker and visitor must display a valid ID at all times.

For the broadcasters who felt the building shake and inhaled the acrid smoke from the terrorist bomb 1,350 feet below, it was an experience of a lifetime and one not to be repeated. Some technicians didn't come back to work for a week, and a few have requested transfers to the studio.

For those who call the WTC their home away from home, life will never be the same. Only time will cure the nagging doubt that it could happen again. ■

New Products

Disk editor

By Studio Audio

• **SADiE:** professional digital audio disk editor for Windows; designed to run on a PC; fully functional Windows 3.1 user interface with all features mouse selectable; 2-in/2-out or 2-in/4-out versions; AES/EBU and SPDIF digital inputs and outputs; optional analog I/O and time-code interface.

Circle (351) on Reply Card

Touchscreen remote control

By NSI

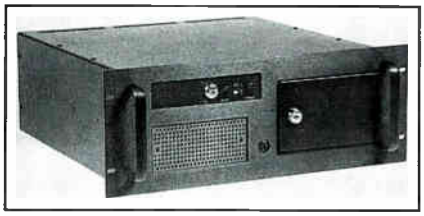
• **MC5:** digital remote-control system designed to provide complete control, positioning and monitoring of steerable antennas and their radios; can be used as a master or slave; interfaces with a 14-inch rack-mounted color VGA touchscreen monitor or an LCD readout screen with push-button selectors.

Circle (352) on Reply Card

Intelligent device controller

By Full Circle

• **REX-2000:** enables remote control and switching of multiple devices (using serial interface or GPI) from a single unit; features intelligent, menu-driven voice prompts for switching of sources and destinations for a multilevel router; includes unlimited user-defined macros, unattended time base operation, multiple security codes and advanced machine control capabilities; contained in a 4-rack unit rack-mounted electronics frame that includes floppy and hard drives.

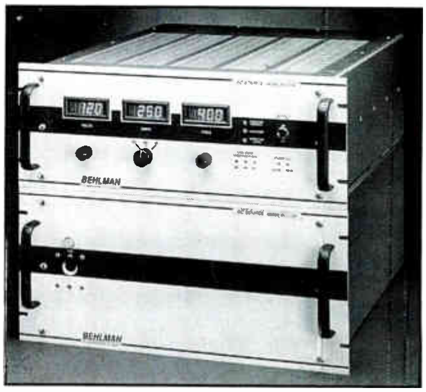


Circle (354) on Reply Card

Ultracompact power source

By Behlman

• **Models BL10000 and BL20000:** 10kVA and 20kVA precision AC power sources are one-third the size of conventional units; require as little as 15.75 inches of panel height; multipulse input transformer offers low harmonic distortion and high input power factor, as required by MIL-STD-1399 and European standards; features built-in IEEE 488/RS-232 interfaces for computer-controlled frequency ranging from 45-500Hz (45-1,000Hz optional), voltage from 1-135/234V in single or three phases.

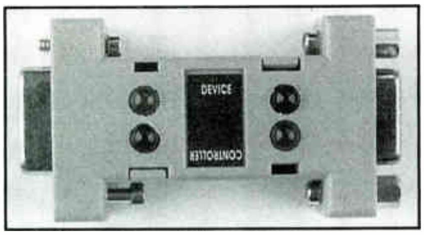


Circle (353) on Reply Card

Passive tester

By Greenway

• **COMTEST:** pocket-sized passive tester for RS-422 circuits; uses LEDs to indicate correct and faulty cables, port configurations and the presence of data; can function as an in-line tester or on an open port or cable end; 63x33x25mm.



Circle (355) on Reply Card

Digital audio routing switches

By NVision

- **NV3064-A:** asynchronous digital audio routing switch designed for routing asynchronous digital audio signals that conform to the AES/EBU data format; AES/EBU word rate from 28-54kHz; accommodates all of today's digital audio sampling frequencies, including the full ±12.5% varispeed.
- **NV3064-TC:** designed for routing time-code signals to videotape recorders, R-DATS and other analog or digital devices that conform to the ANSI/SMPTE 12M-1986 time-code standard; features processed outputs and controlled rise time with 2.5V peak-to-peak amplitude independent of time-code rate.

Circle (366) on Reply Card

Database

By EarthWatch Communications

- **NewsVision:** customized database provides 2-D or 3-D computer graphics of virtually every street and road in the United States; StormWatch software package has automated displays of severe weather warning that include text, crawls and 2-D maps of threatened counties; allows weathercaster's voice to be stored in memory, permitting personalized audio narration 24 hours a day.

Circle (376) on Reply Card

Software product

By SunRize Industries

- **SMPTE output:** stand-alone software product used to stripe LTC time code onto audio- and videotape; generates and sends SMPTE time code out of the Commodore Amiga's audio jack; locks to the video sync pulse of each frame of video when used in conjunction with a gen-lock or Video Toaster; NTSC and PAL compatible; features include 24, 25, 29.97 and 30 frames per second time-code generation, drop frame and non-drop frame time code, multiple reset points, fast forward, rewind, play and pause buttons.

Circle (367) on Reply Card

Workstations

By Digital Audio Research

- **Sabre:** 8-channel optical disk-based workstation; allows for recording and editing on removable, reusable optical disks; features 8-channel playback from one disk; compatible with DAR SoundStation Delta and Sigma systems; provides analog and digital audio I/Os; supports 32kHz, 44.1kHz and 48kHz sampling frequencies; Exabyte backup drive can be added for additional storage security.

Circle (61) on Reply Card

Circle (62) on Reply Card

• **Delta:** features SoundStation touchscreen interface; can be configured for 4-, 8- or 16-channel operation; supports such options as optical disk storage, VTR emulation and autoconforming.

Circle (369) on Reply Card

Programmable controllers

By Artisan Controls Corporation

• **Model 475OH:** 7-day controller programs two separate 15A SPDT relays to turn on or off up to 56 times in a 7-day period, a maximum of eight events per day; keypad data entry sets the desired schedule by using either the handbook or program guide on the front cover; needs no batteries or power to sustain programming, even during a power failure.

• **Model 495OH:** wired to a 9-pin terminal strip; rear cover plate is housed in a metal enclosure to provide circuit isolation; 12VAC, 24VAC or 240VAC, and 12VDC and 24VDC operating voltages.

Circle (368) on Reply Card

Lightning/nuclear EMP protection publication

By PolyPhaser

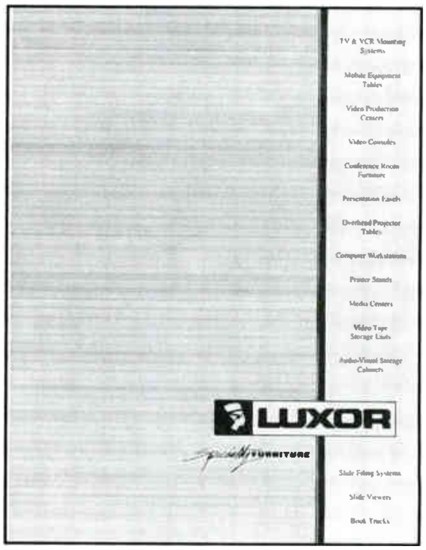
• ***The "Grounds" for Lightning & EMP Protection:*** expanded and updated second edition; contains 100 pages of information detailing the proper techniques for grounding and the protection of electronic equipment from lightning and nuclear EMP; focuses on protecting radio communications equipment; also includes information on protecting telephone central office equipment, computers, LANs, cable television, TVRO and security cameras.

Circle (372) on Reply Card

Furniture catalog

By Luxor

• **1993 Specialty Furniture catalog:** full color; includes several new model additions to the current line of Hi-Tech computer workstations and furniture, along with five new accessories for the Luxor mounts; contains a newly designed 1993 16-page insert.



Circle (371) on Reply Card

Circle (63) on Reply Card

Circle (64) on Reply Card

Circle (65) on Reply Card

Circle (66) on Reply Card

Digital STL

By Dolby

• **DSTL:** 4-channel 950MHz digital studio-to-transmitter link; consists of the model DP5503 transmitter and the model DP5504 receiver; conveys four program channels and two RS-232 data channels in little more then 400kHz of bandwidth.

Circle (370) on Reply Card

Editing software

By Akai Digital

• **QMacII:** Macintosh editing software for the DD1000i and DD1000s; able to control up to six DD1000s, allowing play commands to be sent to all units simultaneously; software can take advantage of color and large-screen monitors; can be controlled by the J.L. Cooper CS1.

Circle (357) on Reply Card

Video signal multiplexer

By Sumitomo Electric

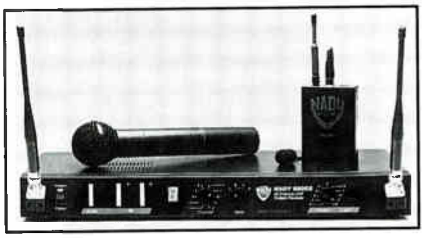
• **VIEWPLEX-2000:** displays up to 16 different channels simultaneously on one screen; virtually any type of video source can be used; allows user to generate color characters and color borders.

Circle (374) on Reply Card

UHF wireless system

By Nady Systems

• **Nady 950GS:** a rack-mount, true diversity unit with 40 frequency synthesized channels, arranged in four user-selectable groups of 10 channels each; up to 20dB quieter than other VHF or UHF wireless systems on the market; features include switchable balanced level out (line/mic), control and front- or rear-mounted high-efficiency antennas; operates in the 800MHz range.



Circle (361) on Reply Card

Automatic disconnect systems

By The Power Doctors

• **BX4M and BX4A:** constantly monitor power line voltage and automatically remove all power when a dangerous voltage level is detected; feature four outlights with a 3-foot power cord; operate on 120VAC with a capacity of 15A or 1,850W.

• **SLC:** designed to be placed inside an existing breaker box and hard wired to any 120V, 30A or smaller breaker; resets when the voltage has remained safe and stable for 30 seconds.

• **SLC2:** similar to SLC; designed to operate on 240VAC at 30A.

• **TC:** ideal for vehicles left outside in cold climates; monitors outside air temperature; at temperatures above −10°F, no power is supplied to the vehicle's engine heaters; between −10°F and −40°F, power is supplied at a rate of six minutes on and six minutes off, below −40°F, full power is applied to the heaters; operates on 120VAC with a maximum load of 15A or 1,850W.

Circle (373) on Reply Card

CD recorder

By Carver

• **PDR-10:** compact, stand-alone CD-R unit; offers a full complement of digital input and output options: AES/EBU format on XLR connectors, and SPDIF format on either RCA electrical or Toslink optical connectors; generates a temporary TOC during recording, allowing the user to stop and restart record at any point, and mark any false starts or unwanted track for deletion; offers automatic laser power calibration for optimum recording; incorporates 1-bit bitstream D-to-A converters for improved linearity at the output stages.

Circle (360) on Reply Card

Equalizers

By Matthey

• **"GE" range of equalizers:** designed to satisfy CCIR Report 624-3; units are installed in the baseband video feed to the transmitter, where they pre-correct the signal group delay response to anticipate the shaping introduced by the receiver.

Circle (356) on Reply Card

Wideband transformer brochure

By North Hills

• **10-page brochure:** fully illustrated, color brochure describes company's line of off-the-shelf wideband transformers; includes an applications section; products covered include isolation transformers, baluns, coaxial impedance adapters and power dividers.

Circle (377) on Reply Card

Digital recorder

By Akai Digital

• **DR4d:** 4-track hard disk recorder designed to work with any external SCSI hard drive with 18ms access time; system can be expanded by connecting up to four units for 16-track hard disk recording; comes with four analog-balanced inputs and outputs.

Circle (358) on Reply Card

Time-code generator

By Horita

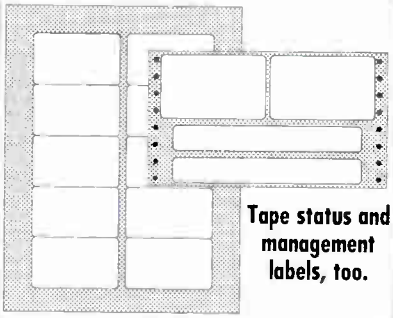
• **GPS-MTG:** SMPTE time-code generator uses atomic clocks in the Global Position Satellite system to generate SMPTE longitudinal time code matched to UTC (local) time and date; also acts as a global real time clock/calendar; can be used as a stand-alone SMPTE studio clock to time and control events or studio automation systems; continuously monitors UTC satellite time every second; corrects generator time if the accumulated video frame error ever exceeds five frames in 24 hours.

Circle (362) on Reply Card

Surge arrestors

By Lumex Opto/Components

• **Light-duty gas tube surge arrestors:** UL-listed for protection of board-level components from on-off switching, load



changes, inductive lightning, power failures and similar circuit surge sources; models in the line cover breakdown voltages from 70-750VDC; available as 2- or 3-lead units for AC or DC applications.

Circle (375) on Reply Card

Voltage regulator

By Hipotronics

• **G380-547YZB/S:** 360kVA provides a 380V, 3-phase output at 1%, compensating for individual line variations of ±30%; housed in a dust tight, waterproof-sealed NEMA 4-type enclosure; controls and metering contained behind sealed doors with heavy gauge plexiglass windows.

Circle (378) on Reply Card

Illuminators/test slides

By DSC Laboratories

• **Ambi/Combi system:** offers users complete control over image quality; can be used in the studio or in the field; Combi test patterns include gray scale, colorbar, resolution and geometry information; Ambi test pattern holder provides even illumination and uses ambient light to illuminate the pattern.

Circle (365) on Reply Card

Digital audio recorder

By Arrakis Systems

• **Trak*Star:** digital audio recorder, mixer and editor; available in 2- and 8-track models; ready-to-use; multiple workstations may be networked for transfer of audio files or schedules between and among workstations.

Circle (363) on Reply Card

Character generators

By Brek Connor Group

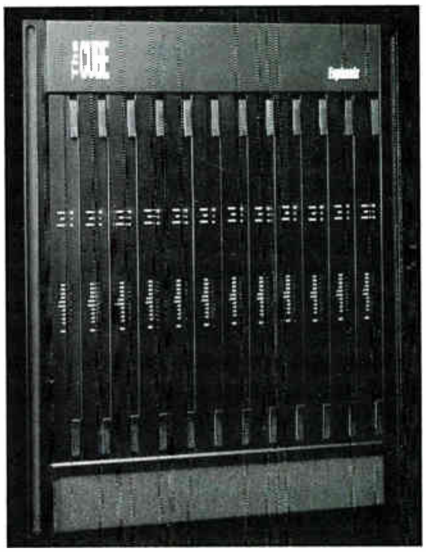
• **Manuscript and Manuscript Plus:** feature fully anti-aliased AGT fonts, on-line sizing, international language capability and 256 transparency levels; offered in configurations for composite, Y/C, RGB, YCrCb and digital video formats.

Circle (364) on Reply Card

Routing system

By Euphonix

• **The CUBE:** digitally controlled modular routing system; can be added to any existing installed CSII or can be ordered with new consoles; design allows different configurations to be specified to add up to 96 aux sends, mix-minus feeds, film mix buses and multitrack buses to the console; can be configured to operate as a matrix switcher.



Circle (359) on Reply Card

■

Professional Services

NETCOM
STATE-OF-THE-ART ENGINEERING FOR AUDIO & VIDEO
TURN-KEY SYSTEMS
DESIGN & DOCUMENTATION
EQUIPMENT SALES
CAD SERVICES
1465 PALISADE AVE., TEANECK, NJ 07666 / (201) 837-8424

JOHN H. BATTISON PE.
CONSULTING BROADCAST ENGINEER,
FCC APPLICATIONS AM, FM, TV, LPTV
Antenna Design, Proofs, Fieldwork
2684 State Route 60 RD #1
Londonville, OH 44842
419-994-3849

East Coast Video Systems
ON-LINE . IN-TIME

A full service Company providing...
- Consultation
- Engineering & Design
- Installations
- Training

Serving...
- Cable Systems
- Corporate Facilities
- Broadcast Facilities
- Teleproduction Facilities

52 Ralph Street, Belleville, NJ 07109 (201) 751-5655

For Classified Advertising
or Professional Services information
Call Renée Hambleton at 913-967-1732
or fax your material and insertion order to 913-967-1901.

R E C
Radio/Tv Engineering Company
"Serving Broadcasters over 35 Years"
Consultants Norwood J. Patterson, Pres.
1416 Hollister Lane Los Osos, Ca 93402
Ph. (805) 528-1996 & Fax: (805) 528-1982

Classified

EQUIPMENT WANTED

WANTED: USED VIDEO EQUIPMENT. Systems or components. **PRO VIDEO & FILM EQUIPMENT GROUP:** the largest USED equipment dealer in the U.S.A. (214)869-0011.

WANTED: * ELECTRON (VACUUM) TUBES ***.** Magnetrons, Klystrons, Planar Triodes, etc...The Vacuum Tube Exchange (800) 995-TUBE or fax lists to (800) 995-6851.

HELP WANTED

ELECTRONICS FIELD/SHOP ENGINEER. Swiderski Electronics, Inc. located in the Chicagoland area, is looking for an Electronics Field/Shop Service Engineer with a min. of 2 years exp. Individual to work with Broadcast/Industrial 1/2", 3/4" & 1" VTR's and related equipment. Full time position. Full company benefits. Send resume & salary history to: Human Resources Dept., 1200 Greenleaf Ave., Elk Grove Village, IL 60007. Fax resume to: (708) 364-5019.

CHIEF ENGINEER WANTED for top thirty market AM/FM combo. E.O.E. Send resume and salary requirements to: General Manager, P.O. Box 767 Indianapolis, Indiana 46202.

STUDIO MAINTENANCE ENGINEER needed in SUNNY FLORIDA. FCC License, prefer SBE Member, Certified Broadcast Engineer. Experience with GV Switching, Kscope, Post Production equip., Betacam, Microwave, Uplink, MS-DOS, Lans, 800 Trunking. Call 813-939-2020 Wayne Phillips CE.

EQUIPMENT FOR SALE

AVAILABLE: Complete corporate audio-video Betacam SP edit suite. Component. Low usage. Could be sold in pieces. Includes Ampex CVR-507 camera package w/ zoom, CVR-75 recorders, CVR-60 player, Vista 10 input video switcher, ADO-2000, ACE-200, Trident console, Dubner digitizer, switchers, controllers, editors, monitors, speakers and much more. Call 203-838-2021.

FOR SALE

SATELLITE UPLINK TRUCKS. A.) 2.3M Andrews dish w/2 port feed, SA7555 video exciters, 300W Ku band TWT amplifiers, 27KW genset. B.) 2.3M Andrews dish w/2 port feed, LNR LVE-14 video exciters, 600W Ku band TWT amplifiers, 20KW genset. Both trucks are fully redundant and are equipped with DX receivers, Lenco video and Logitek audio distribution amplifiers. AVCOM spectrum analyzers and Andrews dry air systems. Truck A.) $200,000.00. Truck B.) $250,000.00 Serious inquiries only @ 216-747-4111. Offered for sale by Mobile Uplink, Inc.

MISCELLANEOUS RADIO STATION EQUIPMENT AS A PACKAGE. Includes: 5 Tascam 42B, 1 Otari MX-5050 reel-to-reel machines. 6 Dynamax CTR-10 cart decks, 3 eraser and splice finders. 8 8x2 DAs. Cassette duplicator. Call for complete inventory. Ron Russ, CE, KBLA (213) 665-1580.

COMPLETE INTRAPLEX TDM-153 T-1 SYSTEM with 2-15kHz, 3-7.5kHz and 3 four-wire voice modules per side. Includes expansion shelves, backup power supplies and spare master modules. System used for nine months only. Perfect condition! Will include two ADC Kentrox CSUo. Blowout priced at $8,000. Contact Ron Russ, KBLA, 213-665-1580.

ADVANCED SCA DEMOD CARDS —Set to frequency. Widely used by the broadcast industry — $19.95. Professional SCA radios now available. SCS Radio Technology — 1-800-944-0630 or 417-881-8401.

FREQUENCY MEASURING AND BILLING PROGRAM. The Frequency Measuring Program will allow its users to input and store monthly frequency measurements for TV and Radio stations. The program will also store all of the radio and TV stations name, call-letters, address, state, etc., and FCC assigned frequencies for each station. Also the program will track any payments made by each station. Finally, the program will print monthly statements/billings for each station you have been keeping frequency measurements for. Possible FCC frequencies are (AM, FM, Pilot:, TV_A, TV_V, TV_A/V, COLOR:, SCA1, SCA2, SCA3, STEREO TV, STEREO AM.). The three databases used are: the Frequency Measurements Database, the Payments Database and the Stations/Accounts Database. All of the databases include easy to use drop-down menus and pop-up pick-lists, in addition to an on-line help system for in-depth information about the program. Beta-tested for four years. Requires, IBM PC XT, or better. CGA, or better. Price, $365.00. Please specify disk size and format. Terry Trees, 2159 S. Corona Ave., Colorado Springs, CO 80906 (719) 635-4396.

USED EQUIPMENT
Place free classified ads to sell video equipment. Call 708 673 9200 or Fax 708 673 9205 to receive list or to sell equipment. List updated daily!
Broadcast Equipment Classifieds

SONEX *Source*
58 Nonotuck St., Northampton, MA 01060
"Your Source for Sonex Acoustical Foam"
Best Prices--Nationwide Delivery
800-484-1003 Ext. 0032 to order
Credit Cards Accepted
413-584-7944 fax or info

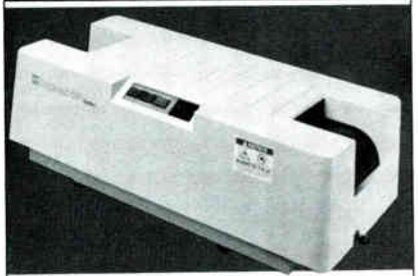
SONY . AMPEX . BTS . DUBNER
GRASSVALLEY . PANASONIC
If You're Looking For the Best in Used Equipment
and You Want the BEST: . DEAL . VALUE . SERVICE
CALL MIDWEST: (708) 251-0001 . CANADA (604) 850-7969
midwest
AUDIO/VIDEO EXCHANGE, INC.
1131 Central Ave. Wilmette, Illinois 60091
International Brokers and Appraisers Serving the Audio / Video Industry

Circle (80) on Reply Card

Classified

FOR SALE

TAPE ERASERS



garner

WHEN COST IS IMPORTANT AND QUALITY IS CRITICAL

1-800-228-0275

Erases all formats in quantities of 1 to 1,000,000

garner industries

4200 North 48th Street • Lincoln, NE 68504

Identify and prevent RF communications site interference in minutes rather than hours.

Powerful PC software that picks up where all other intermodulation programs leave off.

- Transmitter Noise/Receiver Desense Analysis
- Intermodulation Signal Level Analysis
- Eliminates Manual look-up of filter curves

COMSITE™ PLUS

For a brochure, call 1-800-845-0408

NEW FROM COMTRONIX SYSTEMS, INC.

HIGH PERFORMANCE VHF/UHF

SOLID STATE AMPLIFIERS

UP TO 200 WATTS PLUS

SEND FOR INFORMATION

TEL 413/785-1313 FAX 413/739-1352

CALL US For New and Rebuilt Radio Broadcast Equipment

HALL Electronics

(804) 974-6466

1305-F Seminole Trail • Charlottesville, Va. 22901

---

dPatch Machine Control Patching System

RS-422 NORMALLED PATCHING

JFc Jem-Fab Corp.

516/867-8510

Circle (81) on Reply Card

Get Ready for NAB

SONY BVC-10 Betacart w/ 4 BVW-95 Beta-SP Players **$125,000**

SONY BVH-3100 1" VTR **$26,000**

SONY BVH-2500 1" VTR **$17,500**

IKEGAMI 312 3 cam. heads, 3 CCUs, 3 Canon 18x lenses w/ acc., 1 cam. set-up comp. 3 TVP peds, and multicore cable. **ANY OFFER!**

HITACHI SK-96 3 cam heads with 1 parts cam, 4 Fujinon A22x12.5 lenses, and 4 CCUs. **ANY OFFER!**

MICOR VIDEO EQUIPMENT Sales

CHICAGO 312 334 4300

REQUEST YOUR FREE CATALOG OF OVER 300 AUDIO ACCESSORIES FOR THE PRO AND SEMI-PRO USER

(800) 634-3457 FAX (702) 565-4828

SESCOM, INC. "the audio source"

2100 WARD DR., HENDERSON, NV 89015 USA

RS422 VTR REMOTE CONTROL

SONY, AMPEX, JVC

PANASONIC, HITACHI

Low Cost - Lots of Features

DNF INDUSTRIES (213) 650-5256

1032 N. Sweetzer Avenue, #212

LA, CA 90069

BE Classified Advertisements generate results.

Sony Interface for your VPR-2 or NEC-7000

- Convert Sony serial to parallel control.
- Complete editing capability.
- RS-422 Interface for editors and automation.
- Controls ATR's and VCR's.

Phantom II VTR Emulator

For Information:

Call 1-800-331-9066

cipher digital 5350 PARTNERS COURT • PO BOX 170 FREDERICK, MARYLAND 21701

Their Way	The Broadcast Store
1. Only new equipment or used equipment	1. New equipment and used equipment.
2. Salespersons	2. Sales Engineers
3. Limited inventories.	3. 15,000 pieces of gear
4. Sales pitches	4. Technical Newsletters
5. Sell equipment only	5. Buy, consign, sell, trade

BCS is changing the way you buy video equipment

NY-212-268-8800

LA-818-551-5858

BCS BROADCAST STORE INC.

Circle (82) on Reply Card

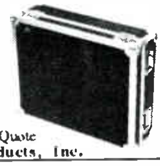
BE CLASSIFIEDS

Call now & be part of the best classified section in the industry.

913-967-1732 Ask for Renée.

Factory Direct Cases

Our prices can't be beat.



Custom or Stock Sizes

Call for Catalogue or Quote

Roadie Products, Inc.

800-645-1707

In NY 516-563-1181

Fax: 516-563-1390

BE Classifieds generate *fast* results.

For Classified Advertising or Professional Services information

Call Renée Hambleton at (913)967-1732.

Classified

FOR SALE

Obstruction Lighting That's Not Sky High

ElectroFlash™ Aviation Lighting Systems

- Medium and High Intensity Obstruction Strobe Lighting
- ETL Certified. FAA, Transport Canada and ICAO Approved
- Compatible with Dual Installations - Auto Restart
- Available with AC, DC, or AC/DC Combination Input Voltage
- Installation and Service Maintenance Available
- Equipment Warranted for 24 Months - Includes Flash Tube

P.O. Box 329, Nashua, NH 03061
Phone: (603) 883-6500
Fax: (603) 883-0205

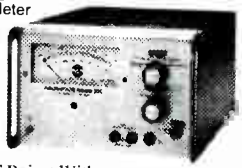
FLASH™ TECHNOLOGY

The Best Audio Test Meter Made!

Advantage Model 310
Precision Audio Signal
And Noise Level Meter

Professional Price!

$399



- Low THD/Hi RF Reject With Valley Audio's Trans-Amp™
- Lo-Noise Wideband Circuitry
- Large Dual Scale Meter
- Super-Accurate Filters
- Average, RMS Or Peak Det
- -100 dB to +30 dB Range
- Scope and Preamp Monitoring Outputs

Valley People
Merriam, Kansas

Call For The Nearest Dealer:

1-800-800-4345

SERVICES

Freeland Products, Inc.
Serving the world with quality rebuilt tubes since 1940.

CALL TODAY FOR A FREE INFORMATION PACKET
1-800-624-7626

75412 Highway 25 • Covington, LA 70433
800-624-7626 • 504-893-1243
Fax 504-892-7323

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons with seminars in Washington, Newark, Philadelphia. Bob Johnson Telecommunications, Phone (213)379-4461.

USE BROADCAST ENGINEERING CLASSIFIEDS

Classified Advertising Rates

Classified advertising now available as Classified Display or By-the-word.

Classified Display: $119 per column inch, per insertion, with frequency discounts available. 1 inch minimum, 10 inches maximum per ad. Blind ads $40 additional. Reader Service number $50 additional. Spot color available for $95 (color deter mined by publisher).

By-The-Word: $1.75 per word, per insertion. Initials and abbreviations count as full words. Blind ads $40 additional. Minimum charge $40 per insertion. No agency discounts allowed for classified ads.

Contact Renée Hambleton, at (913)967-1732, for information on frequency and pre-payment discounts. To place your classified ad send your order and materials to Broadcast Engineering, Classified Ad Mgr., P.O. Box 12901, Overland Park, KS 66212-2215.

Benefit from the *value* of BE's classified *readership*. Reach nearly 74,000 Management level decision-makers.

Sell your product, offer your services or fill your recruitment needs! Only $1.75/word or $102/column inch (12x rate). What are you waiting for? (Ad closing date is the 5th of the month, preceding each issue). Call ♦♦♦♦♦

Renée Hambleton, Broadcast Engineering
Fax: 913-967-1901 or Call: 913-967-1732.

Your name ______ Date ______
Company (if applicable) ______ Phone ______
Address ______
City ______ State ______ Zip ______
AD COPY Headline: (i.e., For Sale, Misc., Help Wanted, Service) ______
Ad Copy ______

❏ Please run my ad in (designate month or months preferred) ______
❏ Call me about questions regarding my ad. Signature ______

Ad Index

*Denotes demographic coverage

Advertising sales offices

NEW YORK, NEW YORK
Gordon & Associates
210 President Street, Brooklyn, NY 11231
Telephone: (718) 802-0488
FAX: (718) 522-4751
Joanne Melton
Telephone: (212) 332-0628
FAX: (212) 332-0663
888 7th Avenue, 38th Floor
New York, NY 10106

CHICAGO, ILLINOIS
Vytas Urbonas
Telephone: (312) 435-2361
FAX: (312) 922-1408
55 East Jackson, Suite 1100
Chicago, IL 60604

SANTA MONICA, CALIFORNIA
Jason Perlman
501 Santa Monica Blvd. Ste. 401.
Santa Monica, CA 90401
Telephone: (310) 458-9987
FAX: (310) 393-2381

ENCINO, CALIFORNIA
Duane Hefner
16820 Ventura Blvd., 2nd Floor
Encino, CA 91436
Telephone: (818) 386-0630, FAX: (818) 986-5454

OXFORD, ENGLAND
Richard Woolley
Intertec Publishing Corp.
Unit 3, Farm Business Centre,
Clifton Road, Deddington, Oxford OX15 4TP England
Telephone: (0869) 38794
FAX: (0869) 38040, Telex: 837469 BES G

TOKYO, JAPAN
Mashy Yoshikawa
Orient Echo, Inc., 1101 Grand Maison
Shimomiyabi-Cho 2-18
Shinjuku-ku, Tokyo 162, Japan
Telephone: (03) 235-5961,
FAX: (03) 235-5852,
Telex: J-33376 MYORIENT

FREWVILLE, SOUTH AUSTRALIA
John Williamson
Hastwell, Williamson, Rep. Pty. Ltd.
109 Conyngham Street
Frewville 5063, South Australia
Phone: 799-522, FAX: 08 79 9522
Telex: AA87113 HANDM

CLASSIFIED ADVERTISING
OVERLAND PARK, KANSAS
Renée Hambleton, P.O. Box 12901
Overland Park, KS 66282
913-967-1732

Introducing the Comark IOX.™ The only IOT transmitter with 3 million hours of operating experience built in.

When considering a UHF IOT transmitter, you want reliability and experience. You want the latest generation from the company that introduced Inductive Output Tube technology seven years ago—Comark.

Over 3 million hours of on-the-air Inductive Output Tube experience went into the design of the IOX. Its leading-edge crowbar design, optically-isolated solid state control logic, Class A drivers, constant impedance output bandpass filters, and IEC-215 implementation make it the most advanced UHF-TV transmitter in the world today.

Like all Comark transmitters, the IOX includes our patented aural carrier corrector technology and an advanced linearity corrector essential to meeting today's requirements for high efficiency distortion-free transmission.

Most importantly, the IOX includes our exclusive **DUAL USE**™ system, making it an investment that pays off today and guarantees HDTV tomorrow. The IOX operates with NTSC now and, in the future, can either be converted to D-HDTV or split apart into two systems—one for NTSC and the other for D-HDTV. It's also available in any world transmission standard.

Three million hours of transmission experience helped us build features into the IOX our competition doesn't even know they need. For more information on Comark's IOX transmitter line, or to request a set of our latest **HDTV TECH BRIEFS**,™ call us today at 1-800-688-3669.

COMARK
A THOMSON-CSF COMPANY

1990 Emmy Award for Engineering Excellence

Route 309 & Advance Lane • Colmar, PA 18915
TEL: (800) 688-3669 • FAX: (215) 822-9129

Circle (2) on Reply Card