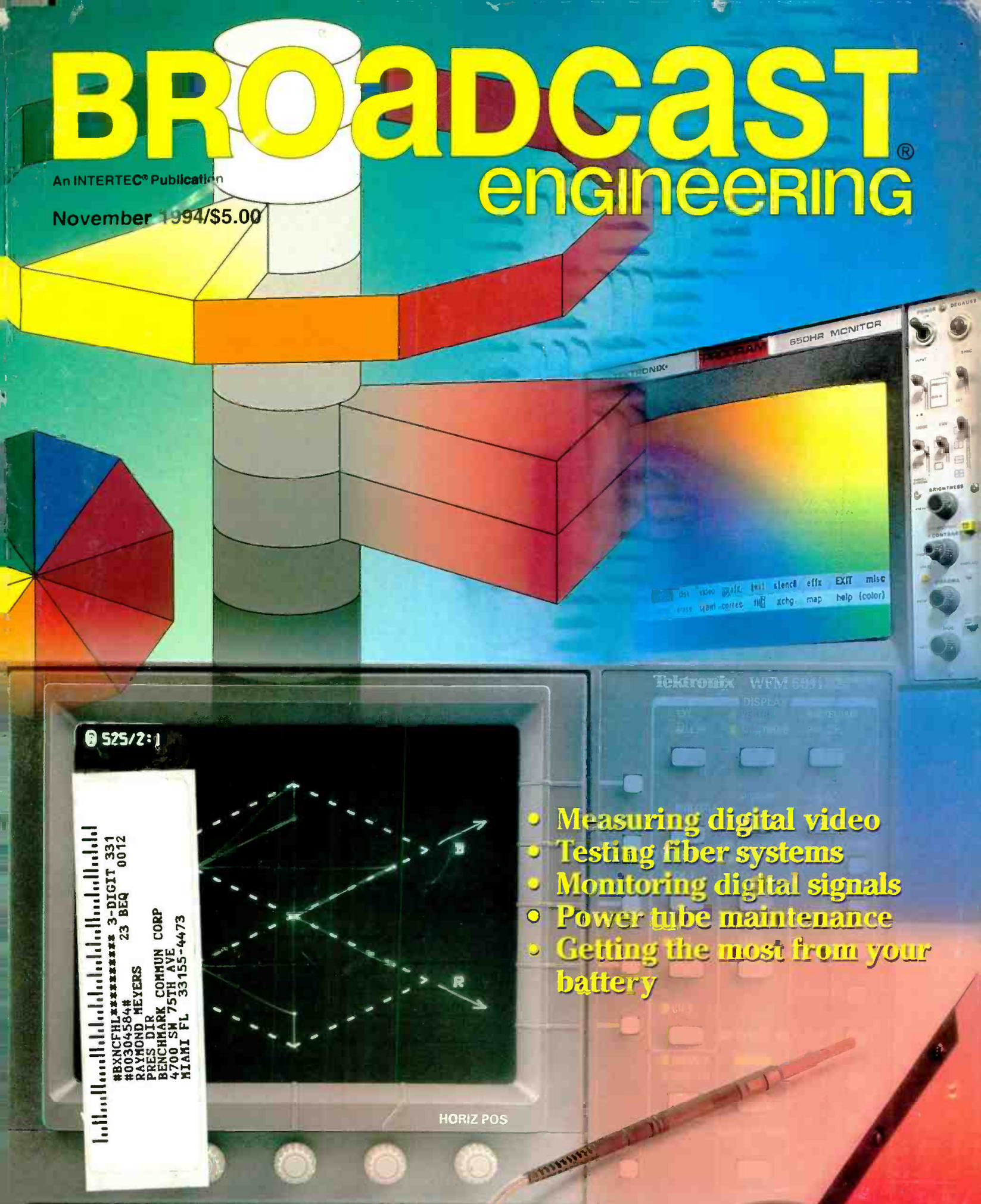
BROADCAST® engineering

An INTERTEC® Publication

November 1994/$5.00



- Measuring digital video
- Testing fiber systems
- Monitoring digital signals
- Power tube maintenance
- Getting the most from your battery

Also: Standards Converters & Buyers Guide Update

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Circle (1) on Reply Card

Exciting Exciter.

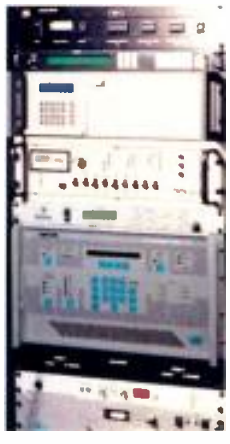
SNG is going digital, and Harris leads the way.

For SNG and other SCPC TV links, upgrading to digital compression and transmission is essential for efficient, cost-effective operation. The Harris DSE 1400 Digital Satellite Exciter and DSR 1400 Studio Grade Receiver will give you a competitive advantage now, and into the 21st century.

With this integrated Digital Satellite News Gathering (DSNG) system, you can access a wider range of transponder channels, achieve lower transponder costs, use less transponder bandwidth and less HPA power, get improved signal quality, and have simpler, more reliable operation. You can also save space and money by using a smaller antenna. The innovative design of the DSE 1400 Satellite Exciter provides the latest MPEG-2 video and audio compression standards with advanced motion compensation and digital coding algorithms in a compact video encoder, combined with QPSK modulation and frequency conversion in a single, rugged, 6RU high unit. The DSR 1400 Integrated Receiver Decoder (IRD) provides L-band downconversion, demodulation and decoding. These single units require less space than separate 3-unit configurations, and are easily installed or retrofitted in SNG vehicles or fly-away terminals.

Each part of this Harris Digital Satellite TV System is designed for simple, error-free operation. All commands are entered from a single, user-friendly keypad, and are confirmed by colored LEDs. Routine set up requires no subsystem adjustment. The MPEG-2 encoder with I, P and B frames, modulator and frequency converter automatically establishes, maintains, and displays the required operating status.

With this system, the cost of upgrading to digital technology is quickly offset by operational savings, which then continue, year after year.



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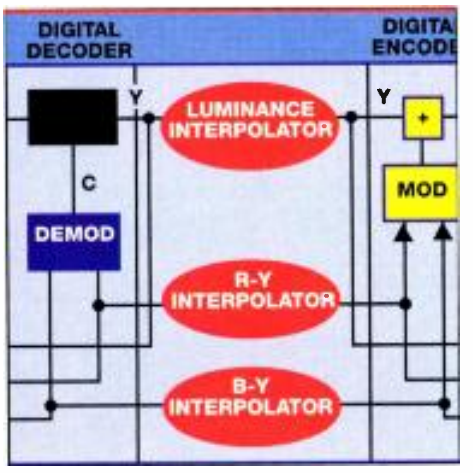

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TEST AND MEASUREMENT:

Digital technology forces the engineer to re-evaluate the approach to maintenance keeping two things in mind. First, digital systems are more reliable and stable than were their analog counterpart. Second, when they fail, they often do so completely and without warning. Nowadays, troubleshooting is more an issue of failure prevention, rather than quality adjustment.

DEPARTMENTS:

COLUMNS:

THIS MONTH...

ON THE COVER:
Photography courtesy of Tektronix.

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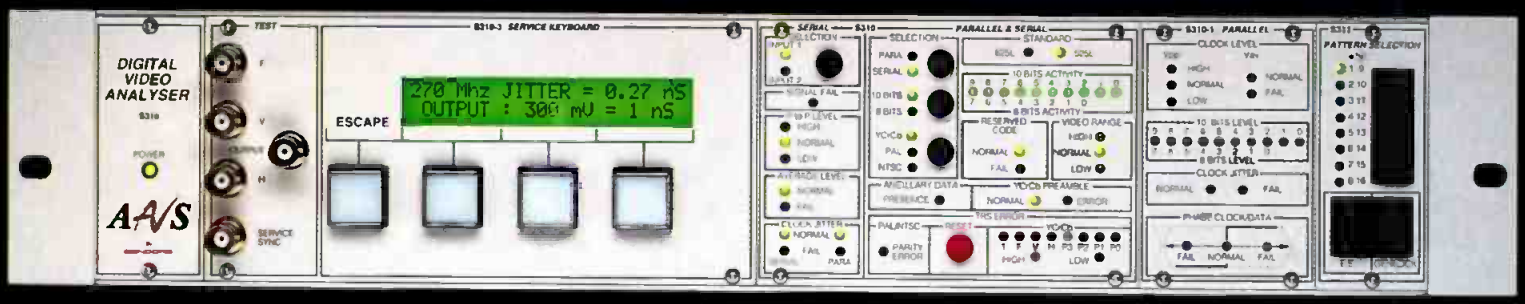

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- Parallel clock jitter
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In addition, the S310 is equipped with:

- User-selectable alarm thresholds that provide out-of-limit parameter warnings.
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A-S By Sencore

The Name To Know In Digital Video Testing

News

By Dawn Hightower, senior associate editor

Advanced TV summit draws industry execs

On Sept. 26-27, broadcasters, TV network executives, transmission specialists and others gathered on Hilton Head Island, SC, for the first "Advanced Television Summit." It was sponsored by *Broadcast Engineering* and *World Broadcast News* magazines, together with Advanced Television Publishing and its *HDTV Newsletter*.

The summit brought together these executives to sort through the pressing challenges brought upon the broadcast industry by high-definition television, interactive television and other advanced TV services.

Represented at the ATV Summit were Dr. Joe Flaherty, senior vice president of technology at CBS; Preston Padden, president of network distribution at Fox Broadcasting Company; and Dr. John Abel, vice president of the National Association of Broadcasters. Participants also included executives from TV stations around the United States, PBS, The Defense Intelligence Agency, NASA, and Asia Television Limited (Hong Kong), among others.

More information on key discussions occurring at the ATV Summit will be provided in future issues of *Broadcast Engineering* magazine.

NATAS awards Technical Emmys

Once again, the National Academy of Television Arts and Sciences (NATAS) has awarded its 1993-1994 Technological Achievement and Scientific Development Emmy Awards. The awards were presented at a ceremony in New York on Oct. 4.

The academy bestowed the Lifetime Achievement Emmy Awards in Technology to: Julius Barnathan, former senior vice president, technology and strategic planning, Capital Cities/ABC, Inc.; Joseph A. Flaherty, senior vice president, technology, CBS, Inc.; and Michael J. Sherlock, executive vice president, technology, NBC, Inc.

This year the Emmy Awards were presented to the following 10 companies:

• *Ikegami Electronics* (USA, Inc.) and *BTS* (Broadcast Television Systems) for the implementation of controlled edge enhancement using hue keying.

• *AVS-Tekniche, Laser Pacific Corporation* and *Snell and Wilcox, Ltd.* for the development and implementation of technology for the removal of temporal artifacts from film-originated 525 material to 625.

• *Time-Warner Cable* for the development and implementation of technology for the development of AM fiber-optic technology for distribution.

• *Eastman Kodak Company* for the development and implementation of machine-readable key type numbers on motion picture film.

• *Sony Corporation* and *Matsushita Electronic Company, Ltd.* for the design and implementation of Microlens technology used in broadcast CCD cameras.

• *Pinnacle Systems* for pioneering the development of address compression technology.

SBE elects officers and directors

The Society of Broadcast Engineers (SBE) elected its officers and directors at its national election at its annual meeting in Los Angeles in October at the World Media Expo.

Charles W. Kelly, Jr., of Quincy, IL, has been elected president for a second term. Terrence Baun has been elected to a second term as vice president. He also will chair the Industry Relations Committee. Keith Kintner was elected to a second term as secretary. Robert Goza was elected to a fifth term as treasurer. Elected to first terms as board members include: Leonard Charles, Michael G. McCarthy, Thomas Weber and John F. Schneider. Elected to second terms were Michael Fast and Troy Pennington. James Bernier was appointed to fill the unexpired board term of Philip Aaland. Continuing their terms are Dane Ericksen, David Carr, Edward J. Miller, Robert Reymont and Martin Sandberg.

Also, this year at the SBE's annual awards banquet, Albin Hillstrom, retired TV engineer with KSAZ-TV, Phoenix, was awarded SBE's Engineer of the Year Award. Wallace Johnson and Charles Sakoski also were named Fellows of the society. ■

BROADCAST engineering

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BROADCAST ENGINEERING (ISSN 0007-1994) is published monthly (except semi-monthly in November) 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 12902, Overland Park, KS 66282-2902.

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. Advt. fax: 913-967-1904.

INTERTEC PUBLISHING

NIKON'S NEW ENG LENSES ARE MAKING SMALL NEWS

Smaller Size Smaller MOD Smaller Price

S15X8.5B1-III

S9X5.5B1-II

Nikon's two new ENG lenses, the S15x8.5B1-III and the S9x5.5B1-II are lighter, smaller and incorporate an internal focus system for greater flexibility and ease of operation. Both boast aspheric lens technology for high performance with minimal chromatic aberration.

The S15x8.5B1-III Standard ENG lens is the smallest, lightest and most compact in its class, and has a built-in 2.2x extender which gives you 280.5mm, the longest focal length in its class and a Nikon exclusive. Add to that a convenient zoom speed adjustment knob, Nikon's exclusive user adjustable zoom torque and the shortest MOD in its class, just 0.55m (22"), and you have one of the most versatile lenses available anywhere, at any price.

The S9x5.5B1-II also features internal focus, adjustable zoom speed and zoom torque. And the body and servo have been ergonomically redesigned for maximum comfort. With the highest zoom ratio (9x) and wide angle of 5.5mm (77.3°) this super wide angle lens meets today's new digital demands.

To learn more about the value of owning TV Nikkor lenses and our overnight loaner lens service, call 1-800-52-NIKON or (908) 758-0308 for our brochure. Or write to Nikon Electronic Imaging, 5775 Lindero Canyon Road, Westlake Village, CA 91362.

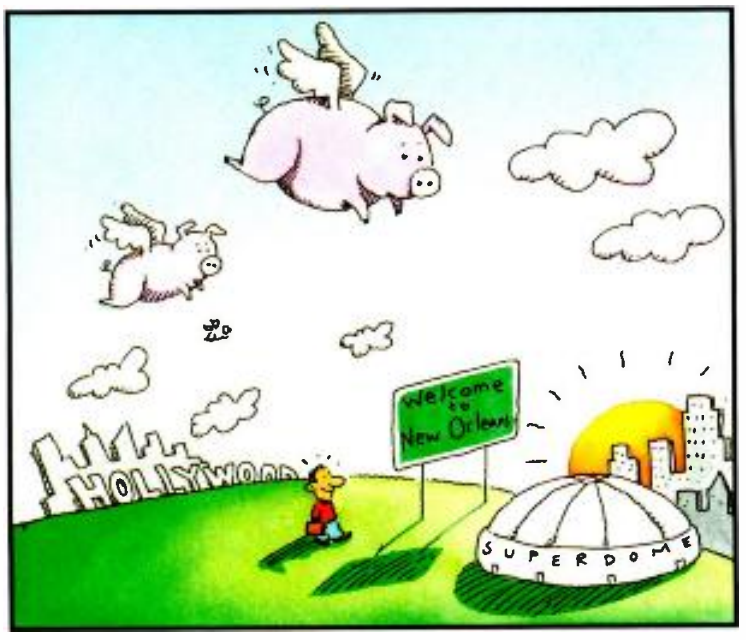
Nikon
ELECTRONIC IMAGING

Circle (11) on Reply Card

Editorial

An "E" for effort

After attending the first World Media Expo last month in Los Angeles, I'm reminded that this magazine was the first to publicly call for an alliance between the associations that founded the event. In September 1993, I wrote an editorial called "When Pigs Can Fly," which acclaimed the associations' cooperative arrangement. The October L.A. event marked the first of the group's attempts. Well — did it work?



There was little agreement among the exhibitors as to the show's overall success. Depending upon who you asked, the responses ranged from:

- "The show's a success."
- "Too many radio attendees."
- "Too many TV attendees."
- "Attendance sucks — but the quality is high."

There was little middle ground when it came to evaluating the show's performance and location.

Some of the traditional big name companies were conspicuous by their absence. These companies announced that after last year's poor showing at SMPTE in L.A., they would adopt a "wait-and-see" position on this year's exhibition.

There was not a major influx of new players either. Although the exhibition's title includes "World," there was little evidence of any international presence. Likewise, the "Media" in World Media Expo turned out to mean only radio and television. If the intent was to draw the multimedia crowd to the show, it didn't work.

The lack of East Coast attendees was another concern to the video exhibitors. While it was easy for those west of the Rocky Mountains to get there, L.A. is a long way from Manhattan and other East Coast pockets of video production. Despite the positive spin put on by show organizers, convention attendance was not spectacular. Marginal might be a better description.

In addition to the serious concern about the relatively low turnout, there was one other common complaint. Exhibitors complained loudly about the convention's location. "I hate coming to L.A," was a recurring statement. Although attendees didn't seem to mind so much, those that pay the tab (the exhibitors) don't want to repeat the L.A. venue every other year as is the current plan.

Was the show a success? The answer is yes and no. It wasn't a flop, but it certainly wasn't the raging success we all hoped it would be. Even so, NAB did a good job for a first try and should be given credit for helping to bring together the groups for a combined effort. Overall, I'd give the show an "E" for effort.

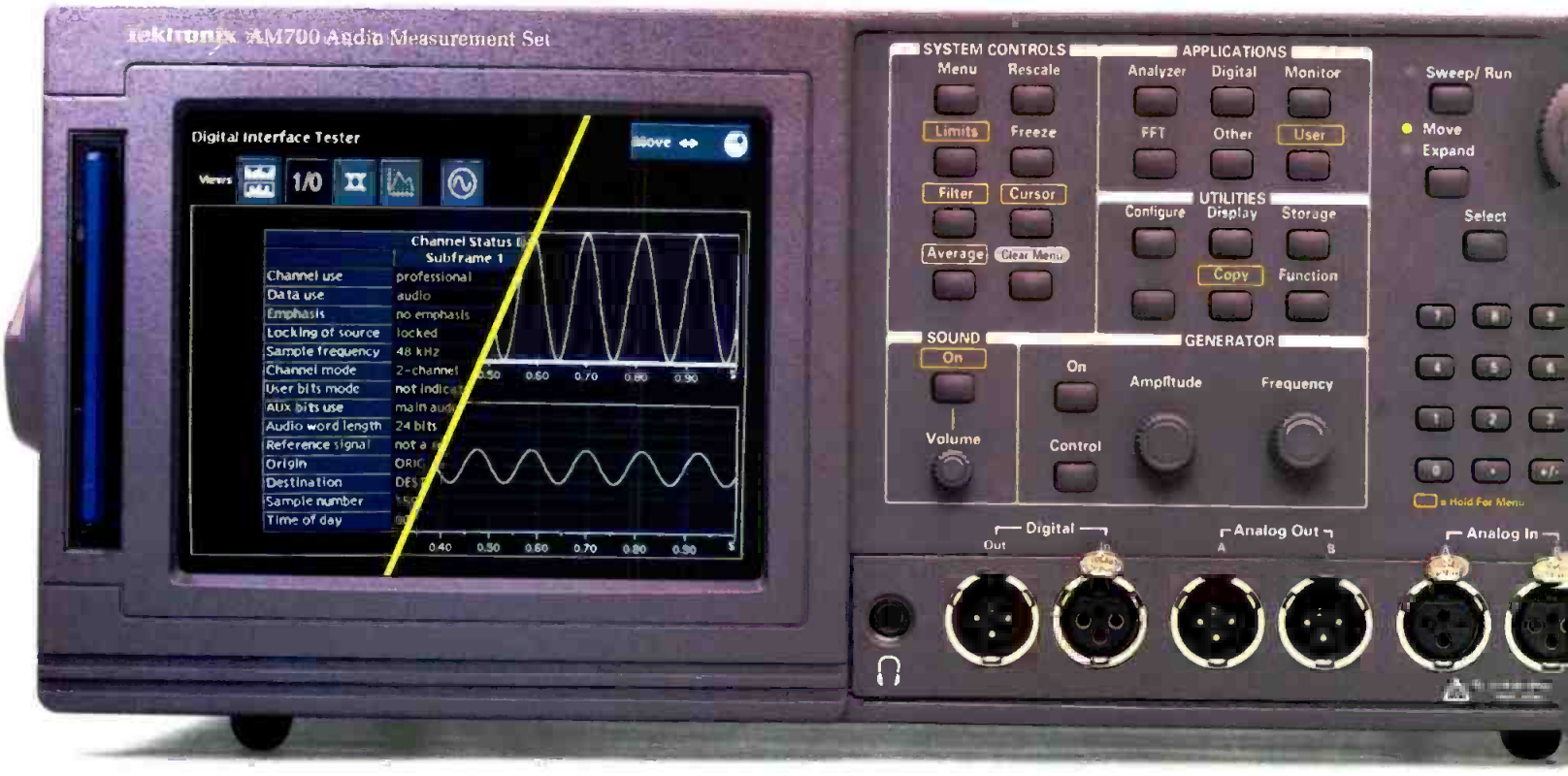
Most exhibitors are looking forward to next year's New Orleans location. One reason is the hoped-for higher attendance. Another often-mentioned reason is the good food New Orleans is known for.

Next year's second-round effort should be better. Hopefully, everyone will come away from next year's show saying it was the next best thing to the spring NAB convention. See you in New Orleans.

Brad Dick

Brad Dick, editor

The one audio tester you can use in mixed company.



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FCC Update

New agreements with Mexico

By Harry C. Martin and Andrew S. Kersting

The United States and Mexico have begun implementation of three broadcasting agreements: an expanded AM band agreement, a new FM agreement, and a multipoint distribution services (MDS) agreement. The agreements are effective immediately.

The expanded AM band agreement establishes a procedure for the assignment of AM broadcasting stations on the 10 channels in the 1,605-1,705kHz frequency band within a distance of 450km from the common border. These frequencies had not been previously designated for broadcasting. Stations that are derived from the allotments will be permitted maximum powers of 10kW during the day and 1kW at night. Other operations will be limited to a maximum power of 1kW day and night.

BROADCAST STATION TOTALS

AM Radio	4,923
FM Radio	5,070
FM Educational	1,708
Total	11,701
UHF Commercial TV	598
VHF Commercial TV	559
UHF Educational TV	240
VHF Educational TV	123
Total	1,520
UHF Low-Power TV	1,023
VHF Low-Power TV	527
Total	1,550

Broadcast stations licensed as of Aug. 31, 1994.

The FM agreement replaces the U.S.-Mexico FM agreement of 1972. It affects all FM stations and proposals within 320km of the U.S.-Mexican border. The technical criteria adopted under this agreement offer flexibility over those specified in the existing 1972 agreement. Because of the added intermediate station classifications, the FM agreement will afford many U.S. FM stations in the border area, including those short-spaced to Mexican FM stations, the opportunity to upgrade.

Martin and Kersting are attorneys with Reddy, Begley, Martin & McCormick, Washington, DC.

The MDS agreement establishes a procedure for the assignment of frequencies and use of the 2,500-2,686MHz frequency band for point-to-multipoint distribution services within 80km on each side of the common border. A station will not require coordination with the other administration if: 1) the power flux density of its signal does not exceed -70dBW/square miles at the border, and 2) the proper polarization and frequency offset is observed. Notification of the operating parameters of such a station is still required.

Local duopoly rule

Section 73.3555(a) states that no license for an AM or FM broadcasting station shall be granted if it will result in an overlap of the principal community contour of that station and the principal community contour of any broadcasting station directly or indirectly owned, operated or controlled by the same party, except in these circumstances:

- In radio markets with 14 or fewer commercial radio stations, a party may own up to three commercial radio stations, provided that the commonly owned stations, if other than a single AM/FM combination, represent less than 50% of the stations in the market. No more than two can be in the same service (AM or FM).
- In radio markets with 15 or more commercial radio stations, a party may own up to two AM and two FM commercial stations so long as the proposed acquisition will not result in a combined audience share exceeding 25%.

Principal community contour: The principal community contour for AM stations is either the predicted or measured 5mV/m groundwave contour computed in accordance with §73.183 or §73.186. For FM stations, the principal community contour is the predicted 3.16mV/m contour computed in accordance with §73.313.

Radio market: The number of stations in a radio market is the number of commercial stations whose principal community contours overlap with the principal community contours of the stations in question. Also, if the area of overlap between the stations in question is overlapped by the principal community contour of a commonly owned station or stations in a different service (AM or FM), the number of stations in the market includes stations whose principal community contour overlap the principal community contours of commonly owned station or stations in a different service.

Audience share: A station's audience share is the average number of persons age 12 and up on an average quarter-hour basis, Monday-Sunday, 6 a.m.-midnight, who listen to the station. It is expressed as a percentage of the average number of persons listening to AM and FM stations in that radio metro market or a recognized equivalent, in which a majority of the overlap between the stations in question takes place. The combined audience share is the total audience share of all AM or FM stations that would be under common ownership or control following a proposed acquisition. Where no metro market or recognized equivalent exists, the relevant audience share data is the data for counties that are within the principal community contours of the stations in question, in whole or in part. ■

FCC celebrates 60th anniversary

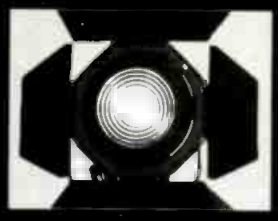
President Franklin D. Roosevelt approved legislation establishing the FCC in 1934. Accordingly, on Oct.4-7, 1994, the FCC observed its 60th anniversary.

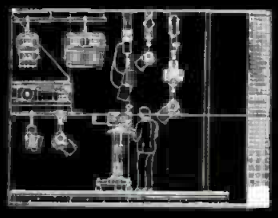
In 1934, the FCC employed 233 persons, including seven commissioners, and had a budget of $1.14 million. At that time, the FCC regulated a broadcast business consisting of 623 radio stations, and a telephone industry with 14 million phones and total revenues of $940 million.

Now, 60 years later, the FCC has five commissioners, 1,964 employees, and a budget of $160.3 million. The broadcast industry has grown to 21,640 stations (radio, TV and LPTV), and this year the total revenues of the telephone industry will approach $200 billion.

Dateline

Dec. 1, 1994, is the due date for annual ownership reports for commercial stations in Alabama, Georgia, Connecticut, Massachusetts, Maine, Minnesota, New Hampshire, Rhode Island, Vermont, North Dakota, Montana and Colorado.





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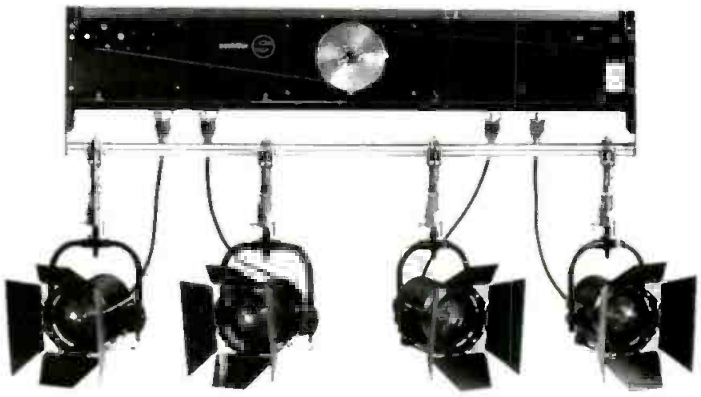

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Circle (13) on Reply Card

Strictly TV

HDTV field tests

By Steve Epstein, technical editor

The current TV standard, NTSC, is 50 years old, and some would say overdue for replacement. The system that is to replace it is the 8VSB system chosen by the Grand Alliance (16VSB for cable).

After a series of tests, a prototype of the system was tested in the real world last spring. It was tested under the sponsorship of the Field Testing Task Force of Systems Subcommittee Working Party 2 (SS/WP2). An objective of the field test was to determine if the HDTV system would provide satisfactory or superior service where NTSC service is available.

Test setup and procedures

After the field test plan was approved by the SS/WP2, PBS was selected to manage the testing. The Association for Maximum Television Service, Inc. (MSTV) was selected to provide data analysis. CableLabs was responsible for conducting performance tests of the 16VSB cable system and analyzing the results.

Signals were broadcast from a 1,337-foot tower near Charlotte, NC. Primary testing consisted of over-the-air reception measurements and observations at 199 sites. These included 128 locations on eight radials and 71 locations in five grids. The radials extended to about 55 miles and the grid areas were broken up into two large grids and three smaller grids (clusters). For UHF (Channel 53) the sample included all 199 locations, however, for VHF (Channel 6) only 169 locations were usable due to interference encountered on cable Channel 6. Along with the over-the-air tests, cable reception tests were performed.

To avoid interfering with existing NTSC stations, testing was done at a power level 10dB below the current maximum for NTSC transmitters. To provide the appropriate comparison NTSC and ATV reception, average ATV ERP was maintained to a level 12dB below the peak visual ERP of the NTSC systems. This level had been determined to provide an equivalence of NTSC and ATV service areas based on planning factors derived from laboratory tests. Throughout the test program, the peak NTSC ERP was 10kW on Channel 6 and 500kW on Channel 53. Average ERP during the ATV transmission was 0.63kW on Channel 6 and 31.6kW on Channel 53.

With ATV, the reception limit is defined when the bit error rate (BER) reaches $3x10^{-6}$. This number was determined by the Grand Alliance, and several times during the tests, it was exceeded with no apparent data degradation. This number is to be verified in future lab testing. For NTSC, however, the limits are harder to quantify. For these tests a CCIR impairment rating of 3, which is described as slightly annoying, or better was used as the NTSC criterion.

For these tests, the Grand Alliance modem equipment used was similar to that used in the laboratory. Interference (i.e. adjacent-channel and taboo-channel) with other TV broadcast signals (NTSC or ATV) was not investigated because it was not within the scope of these tests.

A truck was outfitted with the equipment for performing field measurements. Transmitter and field truck calibrations were done before and after each day's testing. At each receive site, field strength was recorded while moving the truck

Continued on page 93

RELATIVE SERVICE PERFORMANCE FOR NTSC AND ATV VS. DISTANCE* (CHANNEL 6)

DISTANCE (MILES)	NUMBER OF SITES MEASURED	% OF NTSC SITES CCIR 3, 4 OR 5	% OF ATV SITES BER < 3 X 10^{-6}
0-9.9	27	67	96
10.0 - 19.9	38	68	97
20.0 - 29.9	33	42	94
30.0 - 39.9	28	14	89
40.0 - 49.9	28	18	57
50.0 - 56.0	15	0	20
TOTAL	169	40	82
(CHANNEL 53)			
0 - 9.9	32	88	97
10.0 - 19.9	38	97	97
20.0 - 29.9	51	88	98
30 .0 - 39.9	34	59	91
40.0 - 49.9	28	64	86
50.0 - 56.0	16	25	56
TOTAL	199	76	91

* NTSC peak power was 10dB below maximum allowable power.
The ATV average power level was 12dB below NTSC peak power.

Table 1. The data illustrates that the service performance vs. distance is better for ATV than NTSC. This could translate to some additional service area gain for ATV transmission.

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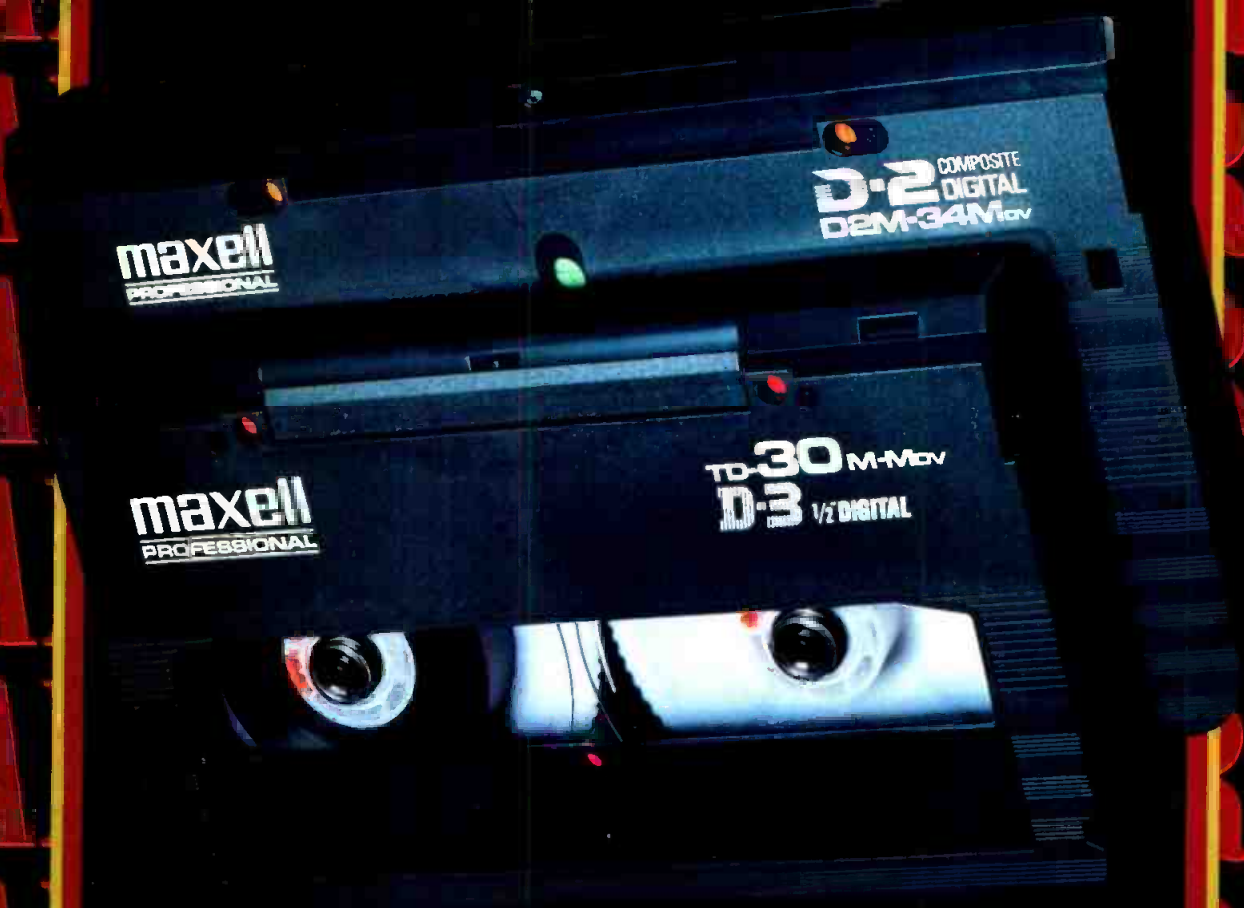

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Part 2

Management

Employee training

Implementing an employee training program

By Rick Morris

As an engineering manager begins to implement an employee training program, several steps need to be followed. First, the needs of the employees and the factors that motivate them need to be determined. Next, the needs of the station and the resources available should be identified. Then, of course, comes the training. Finally, an evaluation feedback mechanism needs to be instituted.

Identify employee training needs

In order to determine what training is needed for employees, their strengths and weaknesses need to be assessed. Many employees probably have not been asked about their job skills since their initial job interview, and there may be changes due to on-the-job training, college study or outside work experience.

Also, employees may have skills that have not been realized or taken advantage of. These skills can be identified by having employees fill out a self-report form and by taking a skills test. Also, identify their interests; find out what other jobs they would like to learn. Showing interest in employees' career development is an important motivational tool. They will perform better if they are doing jobs they like and are suited for.

Identify operations strategies

The second step is to identify the station's needs. Which jobs have not been filled? What crucial positions need to be covered when employees go on vacation? How many people are trained to do each job? Are there any jobs that need additional or different creative talent? Can positions be combined? What are the long-term needs of the station? What kinds of equipment are being considered in long-term capital plans? What are the needs of other departments now and in the future? After addressing these questions, match employee resources and interests to the station's needs and plans.

Morris is an assistant professor of radio/TV/film at Northwestern University. He is a former chief engineer and a former manager of engineering and maintenance for a major TV network.

Identify training resources

Are resources available for in-house training? For operational training, the likely answer is yes; in the case of maintenance training, the likely answer is no. In between is a broad spectrum of choices.

In-house preparation for training involves finding experts in the area who are good communicators. The trainer needs to develop the lesson plans and prepare the training materials. Diagrams and text are important. Written materials are vital because they can be referred to by employees later on when they are operating or repairing equipment.

For the training site, find a quiet area that is well lit, with comfortable seating and a blackboard. If the equipment is portable, have it available at the training site. If the equipment is not available, schedule one for downtime so the employees can get hands-on experience.

Schedule employees for training time. Training is an important and costly investment, so they need to get the most out of it.

If training is done out-of-house, the engineering manager needs to schedule employees for training and assess the trainer's qualifications.

Implement the program

Select the employees to be trained and set up the schedule. Use this as an opportunity to provide positive feedback to these employees. Let them know their training makes them more valuable.

Once the employees complete the training, whether it is in-house or off-site, be prepared to schedule them for additional apprentice time. Have them work with an experienced employee. Or they can perform simple tasks involved in the job and progressively take on more responsibility until they are doing the whole job.

Keep staff current

Training is a waste of time if the employee doesn't get to use the training regularly. The retention rate for training declines rapidly. Therefore, if an employee is being cross-trained for a job that he or she normally doesn't do, make sure that the person can rotate through it regularly. For example, make sure that they do some of the vacation relief for the new job or rotate them into that job every couple of weeks to keep them sharp and prepared.

Managers should be concerned with whether learning was achieved and how it benefited the company.

Evaluate the program's success

As in all good management, no process is complete without feedback and adjustment. Engineering managers should be concerned with two factors: whether learning was achieved and how much it has benefited the company.

First, ask the question: Did the employee learn enough to competently carry out the new job? The employee can be evaluated through a written test and a hands-on demonstration. The engineering manager can observe the employee in action over time and in various situations. Some information on employee skills will be available and developed in periodic employee evaluations.

Also, the training needs to be evaluated. Can the program be improved? Did the training cover all aspects? Was the training applicable to the skills needed for the job? Were the course materials and handouts valuable? Employees themselves can provide feedback on the training.

Second, evaluate the business success of the training program. How much has overtime been reduced through cross-training? How much has productivity been increased? How much has absenteeism decreased? Engineering managers need to track this information because it is part of their record of success.

Effectively implementing employee training has many benefits. Well-trained employees perform their jobs better, are more efficient and more productive — and these results can definitely show up in the station's bottom line. ■

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Production

Production management roles

By David Leathers

The creative goal of a successful production is to entertain, inform and command the viewer's attention. The business goal is to provide the show on time and on budget, with a quality level as good or better than expected. Many factors determine how these goals are met, and the chemistry on the set can be affected by how these concerns are balanced.

Production manager

The role of the production manager is critical. This individual is responsible for the logistics of production through completion of principal photography. Typically the interface between management, cast and crew, this position requires a highly skilled, experienced individual with an in-depth knowledge of production, as well as a person with sensitivity, warmth and understanding.

Together with the producer, they finalize a detailed production budget and an economically efficient shooting schedule. The production manager is usually responsible for negotiating deals on behalf of the producer, as well as working with other key crew members on any management problems.

First assistant director

The production manager's work is also interrelated with that of the first assistant director. They both should be involved in pre-production as early as possible. The first assistant director is responsible for running the production on the set and ensuring everything remains on schedule. If conflicts arise between the shooting schedule and the director's wishes, it is up to the first assistant director to inform the director. If the director wishes to proceed at the expense of the schedule, the first assistant director must then negotiate with the production manager on behalf of the director. If the director's wishes cannot be accommodated within the budget and schedule, it is up to the production manager to enforce the planned schedule.

Leathers is president of Eye Square and director of *Broadcast Engineering* and *Video Systems* magazines' Digital Media Lab, Hollywood, CA.

While the production manager runs the logistics from the office, the assistant director is the key person in managing the set. The first assistant director must keep the crew informed and working efficiently and make sure everyone is in the right place at the right time. Cast and crew must be coordinated so everyone will be prepared for each shot at about the same time. Make-up and wardrobe must be scheduled such that the cast is ready for the first shot. When the whip needs to be cracked, the first assistant does the cracking.

Good production managers must care for the needs of the cast and crew.

Director's prep

Prepping the crew is an important first step that is often done by the director. It reduces production problems, contributes to an efficient work force and promotes morale. In-depth discussions with key personnel will establish a direction for the overall look of the production, and contribute to consistency and coordination.

Another way to improve understanding is to have the director walk through the sets and locations with key crew members. The information gained can make a tremendous difference in the efficiency of the production. Key crew members can make constructive suggestions for improving scenes and mention potential problem areas, which can be invaluable to the director for planning purposes. Involving the crew in walk-throughs helps the overall technical quality and can increase enthusiasm and involvement.

Craft services

It is important that the cast and crew be treated well. This means clean restrooms and comfortable changing facilities. The most obvious way to express concern for everyone's well-being is through the quality of the food. Meals should be hot and wholesome with a variety of beverages and should be served with silverware. There should always be comfortable seating, plenty of food and a dessert to top off the meal. Use catering services that appreciate the importance of appearance and half the battle will be over.

Make-up

The make-up artist can have a big influence on performance. Make-up is the last stop prior to going before the cameras. The better the talent feel, the better they will perform. In addition to a competent make-up job, make-up artists will contribute to the talent's morale and self-esteem. To do this, however, they must feel appreciated. Make-up artists will generate positive feelings to the talent only to the extent the producer generates positive feelings to the make-up artist. It is important to provide a comfortable place to work and allow them adequate time to do a careful job.

When the talent comes out of make-up, the crew should have completed preparations for the shot. Now it is time for the director and actors to polish the performance. The crew should then fine-tune their work. It may only take one or two walk-throughs before shooting. While the actors are walking through their final rehearsals, the director of photography can be fine-tuning the lights, double-checking the exposure, and making last-minute adjustments. The sound mixer and boom man can be adjusting levels and position, and the camera operator assistant and dolly grip can be practicing their moves and timing. Everyone works together to fine-tune their areas of responsibility and to focus on a mutual goal.

Summary

Good production managers must care for the needs of the cast and crew. At the same time they need to maintain the producer's budget and schedule. Doing this with style and confidence gains the respect of the cast and crew. The result is a smooth-running production with a minimum amount of problems. ■

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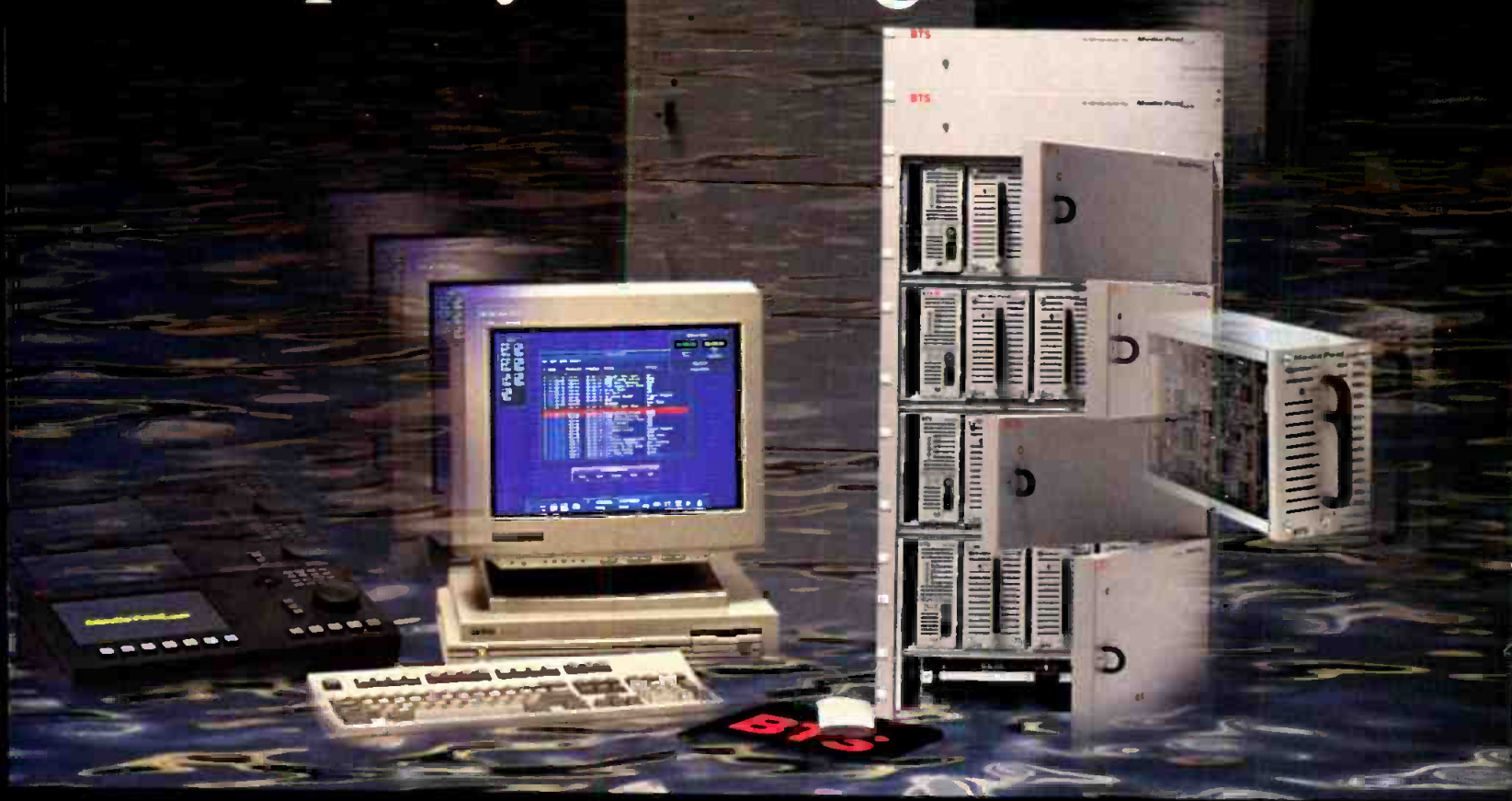

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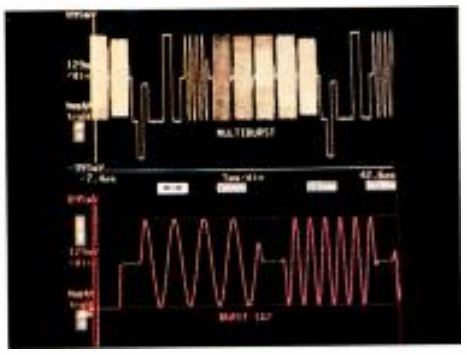
Part 1

Troubleshooting

Component analog video

So many standards



By Steve Epstein, technical editor

Component analog video (CAV) has been around for quite some time. Despite this, many facilities may not be completely familiar with it. Unlike the single standard for NTSC composite analog video (RS-170A), CAV for NTSC comes in several varieties. This is due, in part, to the evolution of various worldwide video standards. The CAV standard most engineers are familiar with is RGB. However, it is the color-difference standards that are most likely to be encountered. At least eight different CAV standards can be found in equipment. For the next two months, we will look at these various standards and some of the problems associated with their use in a facility.

Overview

Before getting into the different standards, a bit of history will help explain why the differences exist. Years ago, video and sync signals were distributed through facilities on separate wires. Video was distributed without sync as a 1V peak-to-peak (Vpp) signal. Black was 0V and peak white was 1V. Sync signals were distributed as 4Vpp. Both signals were usually clamped to establish a reference black level at 0V, peak white at 1V and sync tip at -4V. When video and sync signals were combined into a single composite signal for transmission, sync amplitude was reduced by a factor of 10. The resulting signal was 1.4Vpp with the sync tip at -0.4V. At this point, the precedent of a 10:4 video-to-sync ratio was established. Later, when the overall signal amplitude was reduced to 1Vpp, the 10:4 ratio remained.

It was the 10:4 ratio that left engineers with the fun of dealing with numbers like 714, 286 and 54. The IRE (Institute of Radio Engineers, later the IEEE) established a unit of measure for video signals that was 1/140 of 1V or 7.14mV. Using IRE units avoided some of the difficulty and confusion of working with those numbers, but not all. In Europe and other areas, these problems were avoided through the establishment of a 7:3 ratio.

In general, CAV standards fall into three categories, 2-wire luminance/chrominance (Y/C), 3-wire RGB and 3-wire color difference.

The 7:3 ratio translates to 700mV for video and 300mV for sync and leaves the peak-to-peak amplitude for the composite signals at 1V.

	SMPTE/ EBU N10	NTSC (NO SETUP)	NTSC (SETUP)	MII
MAX	700mV	714 mV	714mV	700mV
MIN	0 mV	O mV	54mV	53mV
RANGE	700mV	714mV	660mV	647 mV
SYNC	-300 mV	-286 mV	-286 mV	-300 mV
P-P	1V	1V	1V	1V

Table 1. GBR standards specifications.

Another difference that exists in NTSC and NTSC-related signals is the use of setup or pedestal for black level. Black level used to range from +5 to +10 IRE; later the standard was set at +7.5 IRE. Because the peak white was not extended, the black-to-white amplitude range was reduced by 7.5%. This is different from the SMPTE and European standards.

Various CAV standards

In general, CAV standards fall into three categories, which include: 2-wire luminance/chrominance (Y/C), 3-wire RGB and 3-wire color difference. The 2-wire version has come to be known as S-video because it is commonly used with S-VHS tape machines and related equipment. It is relatively standardized and trouble-free, although timing differences can exist between the two components.

Among the three wire standards is RGB (red, green, blue). Why the signals are listed in this order is hard to say. It may be based on the order of the prism outputs in color cameras: red on top, green in the middle and, finally, blue on the bottom. Lately, the term has been turned around and called GBR. This is because distribution systems normally put green on channel 1, blue on channel 2 and red on channel 3, which is consistent with the hookup of the color-difference standards.

Four different GBR standards are likely to be encountered. (See Table 1.) Two use 700mV video — one with setup, one without. The other two standards use 714mV video. Again, one has setup, the other does not. As you can see, the numbers are close enough that the systems can be interconnected. However, level differences are sure to cause some problems. When interconnecting systems that use these different levels, the differences need to be addressed in order to maintain signal quality.

Most non-NTSC systems have standardized on the 700/300mV video/sync signal. When the SMPTE/EBU component standard is transcoded into GBR, the resultant video is 700mV with no setup. For NTSC, 714mV signals exist with and without setup. Signals without setup are used in cameras and character generators. Most other NTSC sources provide signals with setup, including transcoded signals from the Betacam format. However, when MII is transcoded into GBR, the signal that results is 700mV video with setup.

Next month we will look at the various forms of the color-difference formats and some of the possible solutions to these compatibility problems. ■

Acknowledgment: The information presented in this column is based on the Tektronix booklet "Solving the Component Puzzle" Copyright 1990, Tektronix Inc. Used with permission

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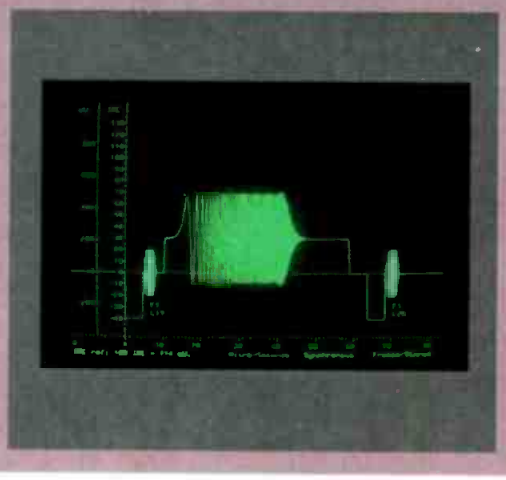

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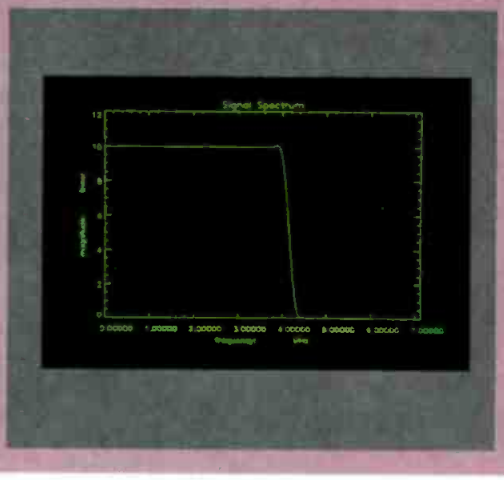

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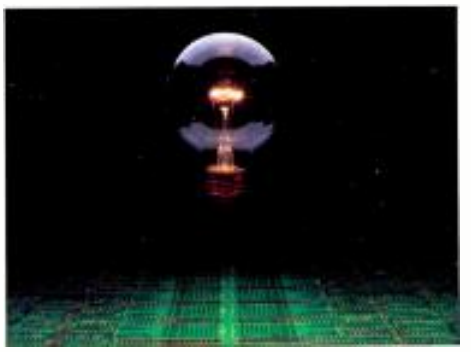
Technology News

Improving the screen



By Steve Rowell

For years broadcasters have heard the cries from viewers to improve the quality of TV sets. With the new interest in HDTV as well as computer flat screen technology, the cries have gotten louder.

The most accepted method to date of improving picture quality is to multiply the number of pixels in the screen area to increase the apparent resolution. The problem with this approach is no matter how small the pixels are they must be separated by some space.

Materials are the key

Willie Johnson, a British inventor, decided to get back to the basics. He chose to ignore quantity and concentrate on quality. He teamed up with Nick Phillips, a specialist in holography, and began to work on the mechanics of the display.

At the time, Johnson was working for an oil company attempting to develop heat-reflective smoke hoods. His work with heat reflection gave him ideas on light refraction. He was using a material called "sputter" film to diffuse heat and decided to apply the process to light.

Johnson searched out a cheap photopolymer that would remix the light as it is projected from the screen to the glass. He developed Microsharp, a coating that works as an array of millions of microscopic lenses that bend incoming light to make the spacing between the pixels disappear.

Johnson's Microsharp process has won two out of the three leading awards and seven medals at the International Salons des Inventions in Geneva, Switzerland. Johnson then proceeded to Tokyo where more than 30 consumer electronic companies were given a demonstration of the coating process.

The Microsharp patent is being co-developed by Microsharp UK and the Nashua Company in New Hampshire. Nashua is using the technology it has amassed in the creation of toners, coated paper products and hard disk substrates to further the development of the coating process.

Microsharp is a thin (50-100μm thick) flexible polymeric film with a graded refractive index microlens. The film can be laminated on almost any backing. The material can be custom designed for front, rear or backlit applications. Once applied it has a life expectancy of 20 years or more.

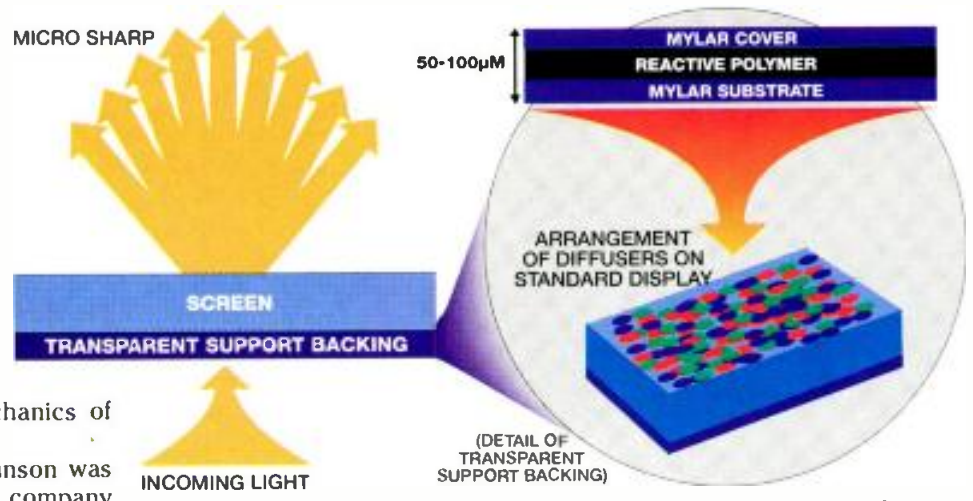


Figure 1. Microsharp is a thin, flexible polymeric film incorporating graded refractive index microlenses.

The refractive index range of the application is 0.0-0.06 depending on the use. The maximum tested display size is 10"x10" with a nominal focal length of 25μm.

How it works

The key to the Microsharp process is that the optical properties are a derivative of the refractive index variations inherent within the material. Modifications take place in the manufacturing process that alter the chemical structure of the film optimizing it for its intended application. The Graded Refractive INdex (GRIN) lenses are normally about 5μm and are mounted perpendicular to the surface, as opposed to conventional surfaced embossed lenses that are typically 250μm across. Size and shape of the lenses are altered to develop a family of microlenses and microdiffusers to suit the application.

During the make up of the product a balance must be maintained between randomness and array. Too much randomness diffuses the picture and creates a loss of apparent resolution. An over-regulated array will produce diffraction and moiré effects. In precise applications the GRIN lenses are supplemented with a second set of lenses mounted on the existing lens structure.

The Microsharp process does not alter the original color, hue or saturation of the original transmission. The material is flexible andeasily integrated into an existing display. The inherent randomness of Microsharp eliminates the need for critical registration and alignment.

Application

The process is being developed in two standard arrays. Symmetric microlens arrays coated onto aluminized mylar are being developed for front projection screens. An asymmetric microlens array is available and used in products where an increased viewing angle is desired.

Both lens arrays can be laminated to glass, acrylic, polycarbonate or any other manufacture-determined screen material. In flat screen, an application-specific depixellator is developed to eliminate the pixel pattern without losing image quality.

Microsharp is being produced for rear and front projection use. Flat screen television enjoys increased brightness, resolution and contrast. Viewing in high ambient light conditions are overcome by the screen's increased brightness. This allows Microsharp LCD screens to be compared to CRT quality. The even diffusion of light has also eliminated LCD hot spots. Motion picture contrast is improved with the process as well as an increase in the viewing angle without loss of picture quality.

Rowell is assistant chief engineer at WOFL-TV, Lake Mary, FL.

Editor's note: Microsharp U.S and Microsharp UK are trademarks of the Nashua Company, New Hampshire. ■

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SBE Update

Building a stronger chapter

By Paul Montoya

My first SBE chapter meeting was in 1977 in Denver. My boss had invited me to a meeting that was being held in the conference room of one of the local TV stations. I don't remember who chaired the meeting; the important thing was the fellowship of the engineers present. Sometimes it was a place to share miseries and joys of the job with other engineers. But more than that it was a place to exchange ideas with other folks that loved the broadcast industry as much as I do.

Community chapters

An SBE chapter is not and cannot be a branch or division of the headquarters in Indianapolis. It must be the people — the engineers — in a local community. We may increasingly exchange ideas on a more global level, after all, we now share the same concerns that many engineers in Mexico or Asia do. But the real value is the interaction on a face-to-face local level relating to local issues.

Much of the nuts and bolts of chapter life is laid out in the "SBE Chapter Manual," which was released in June. (Call the SBE national headquarters at 317-253-1640 if your chapter has not received a copy.) The manual strives to help in setting up a structure for your local chapter. It provides an overview of officers and their duties, frequency coordination committee set-up, certification program activity and more issues. The plan is for the board of directors and executive director to review the manual on an ongoing basis and supply chapters with updates.

One item that keeps coming up is the question of whether a local chapter should incorporate within their given state. Many chapters have taken this step and have been incorporated for many years. It is inexpensive ($35 to $60), and it takes little time to create the necessary paperwork. A sample of the bylaws for one incorporated chapter is in the chapter manual. Incorporation aids in the protection of your local chapter and its officers. Chris Imlay, SBE legal counsel, recommends that chapters be incorporated.

Montoya is former chapter liaison committee chairman and president of Broadcast Services of Colorado.

Participate as a chapter officer

The role of local officers is the key to any chapter's success. This team is normally the core group of the chapter, so if this group fails, the chapter is at risk. One major reason for some chapter failures is the continued re-election of the same officers, especially the chairman. This may seem unusual, but by not "freshening the leadership" on a regular basis can build complacency within the chapter with members always relying on the same small group for support; it can burn out your officers, even to the point of disassociation with the group; or create group division of the perceived "A" group vs. the "B" group. If you're an officer, keep an eye out for leadership potential within your chapter. If you're not an officer, consider it. You owe it to your peers. I've heard all of the excuses for not becoming a chapter officer. Here are some of them.

• *I'm just too busy.* Who isn't! Some of our chapter chairmen and national leaders are the busiest people I know. Make some time to be an officer. This may also be a good exercise for personal management. Many officer positions can take less than a couple of hours a month of your time.

• *I'm just not a good leader.* Your peers are not asking you to serve as a CEO. Many chapters have less than 20 members and their leaders are probably as insecure about their leadership abilities as you are. One awkward point in any chapter comes at election time when the chapter chairman or secretary poses the question, "Who wants to run for office this year?" Naturally, you don't want to raise your hand. (Humility can sometimes hurt a chapter.) I'd like to suggest that before the meeting you ask a friend or one of the existing officers to nominate you. Most people are surprised at the support their peers will give them when they are willing to be an officer.

• *Bob's doing such a good job, let's keep him in.* Again, the long-term success of your chapter depends on your participation. Don't attend to be entertained, but to join in. We owe something to our industry. Becoming an officer in your chapter may be a good step.

Support your local chapter

Keep an eye out for projects (large or small) that your chapter might participate in. Some of the strongest chapters are the ones that have put on regional shows and seminars, created new videos for the SBE Video Library, collectively experimented with new technologies or sponsored other local projects. It builds a real kinship to work together with other engineers on local projects.

Encourage the engineers in your area to participate in your chapter. This helps increase membership, and more importantly, builds good communication lines within your engineering community. That engineer that's been in town for a year may be waiting for an invitation from you to come to your next chapter meeting.

Steve Brown, SBE member from Minneapolis, shares his thoughts with other members during the SBE Annual Meeting Oct. 13 in Los Angeles.

Like all "wild and woolly beasts" your chapter needs some tender care and feeding to continue for years to come. Size of the group isn't the important factor, rather longevity of your chapter providing a useful resource to the broadcast community in your area should be your goal. ■

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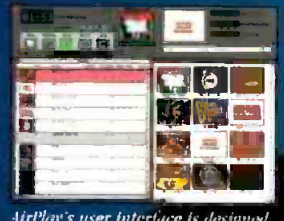

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Test & measurement

Keeping your skills sharp and up-to-date with the new technology is key to your future.

A national survey of personal computer companies showed that 35% to 42% of all parts sent in for repair were fully functional. In recent years, the trend has worsened, as the expertise of field technicians decreases relative to the sophistication of desktop computers. Technology continues to move forward, sometimes faster than do the skills of those charged with maintaining it. The result has sometimes been the loss of jobs for those not qualified to maintain the newer equipment.

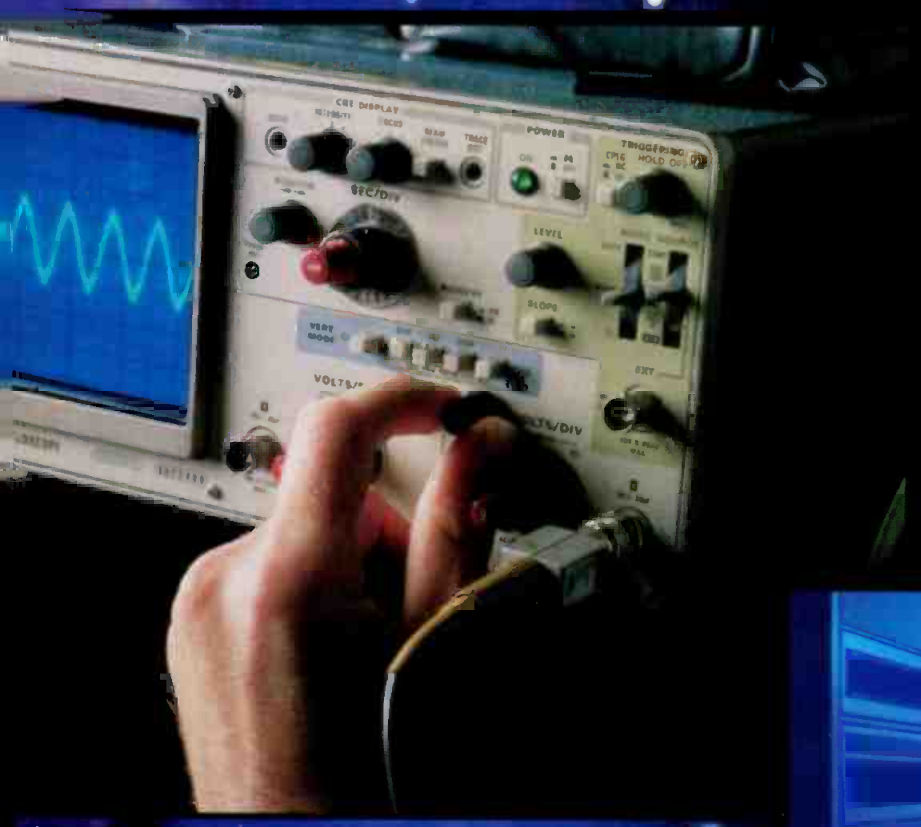
A similar shakeout has already occurred in the broadcast industry. With the demise of the first-class license, we've seen many engineers lose their positions at radio stations as owners and managers sought ways to cut costs. The short-term gain was sometimes accompanied by some long-term pain as the broadcast systems began to fail.

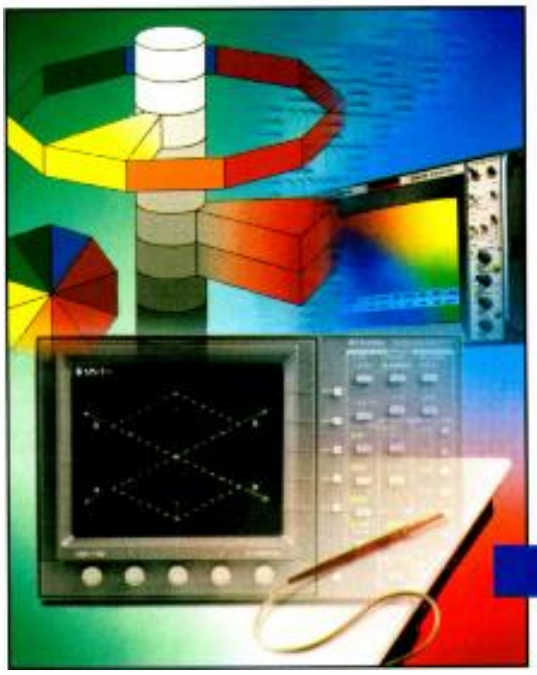
There is now a whole new group of entrepreneurs making a living as contract engineers. They recognized the need for trained and qualified maintenance personnel. Even if each station couldn't afford to have their own, there was, and always will be, the need for personnel that can repair the hardware required to be a broadcaster.

This month's issue is devoted to helping you better understand the state of technology you'll face. Whether it's as an in-house systems engineer or as a contract engineer, your future depends upon knowing how to repair today's and tomorrow's digital and RF systems. Be assured that *Broadcast Engineering* magazine will be your guidebook to keeping your skills sharp — and you marketable.

Brad Dick

Brad Dick, editor





Measuring serial digital signals

Quality test equipment is a must.

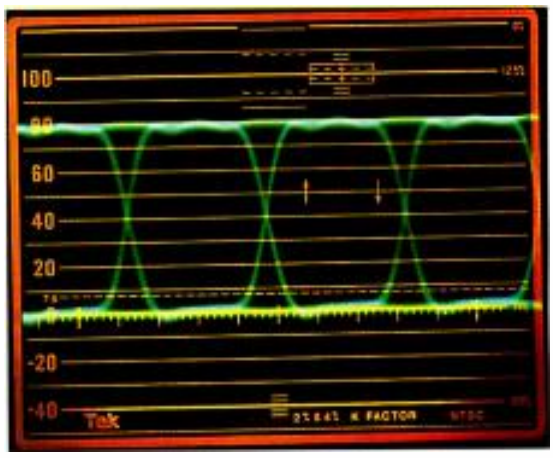
By Steve Epstein, technical editor

The Bottom Line

The change to digital equipment brings with it the additional challenge of distributing the digital video signals. Although the video carried in the datastream is somewhat immune to traditional problems, the datastream itself is not. New test equipment and troubleshooting techniques are required to effectively and reliably handle serial digital video throughout a facility.

Engineers are facing new challenges from many directions. One of these is the reality of serial digital video. Those who thought digital distribution was problem-free have learned the hard way that serial digital brings with it some old problems along with several new ones. Once again we are reminded that repealing the laws of physics is impossible.

Several different standards are used to distribute serial digital video. One of the most common is SMPTE 259M. This 270Mb/s standard is defined for component and composite signals and includes provisions for embedded digital audio. This article looks at the basics of serial digital signals as well as the parameters involved in their measurement.



Scope trace of a serial digital datastream displayed on a waveform monitor. This signal is the correct amplitude and shows minimal jitter. (Courtesy of Tektronix.)

Serial digital video is distributed via a single coax, which requires that the receiver must recover clock information from the signal itself.

Digital basics

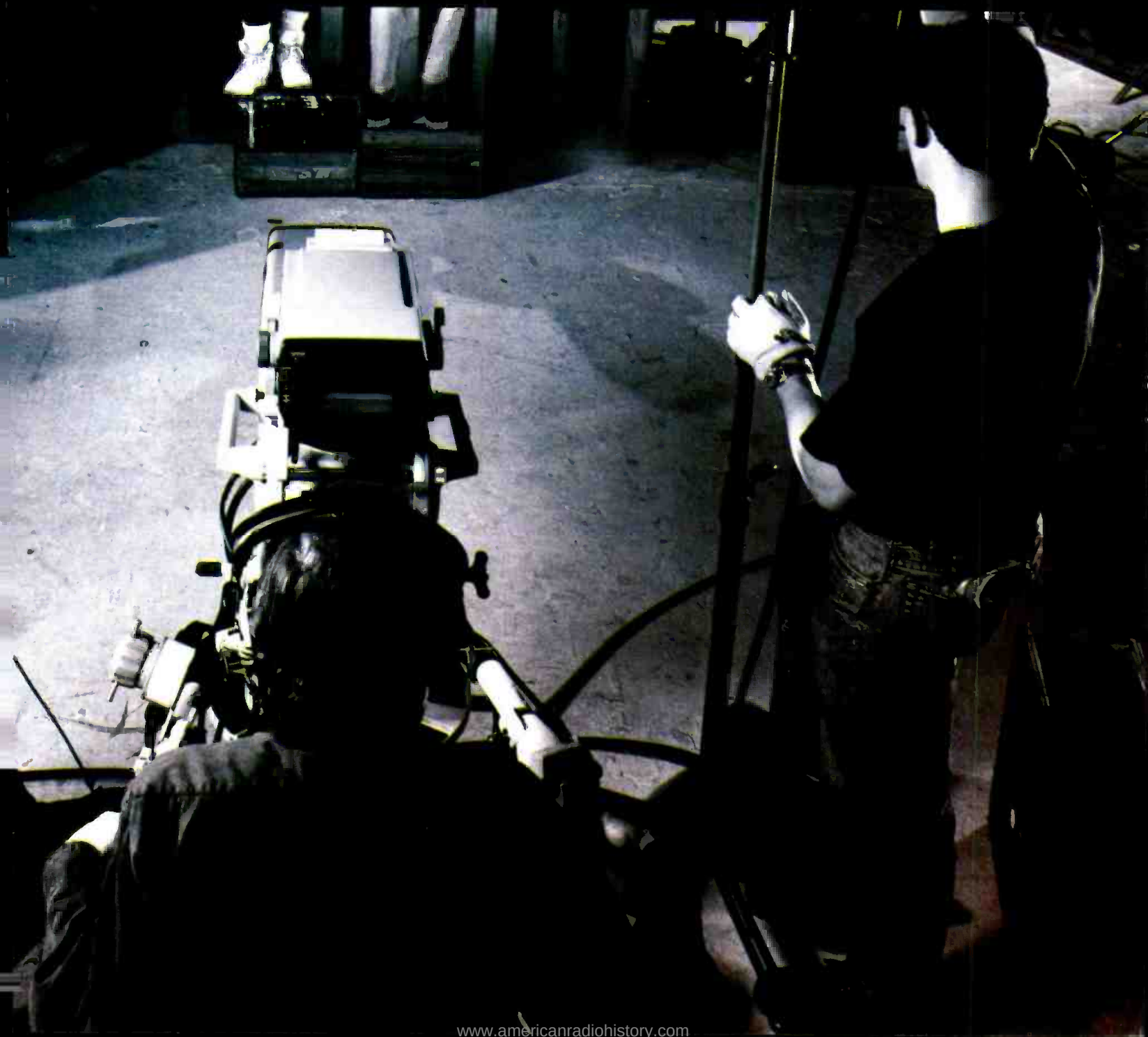
In analog systems, signals are represented by continuously variable levels that are representative of the source. For digital, the analog waveform is *sampled* and *quantized* into numbers that can be reassembled into the original waveform. Sampling divides the waveform into a specific number of pieces per unit time. For SMPTE 259M there are more than 27 million samples per second. *Sampling rate,* therefore, is the frequency at which samples are taken. Quantization is the process of assigning a numeric value to each of those samples. Each sample is assigned a value from 0 to 255 for 8-bit systems or from 0 to 1,023 for 10-bit systems. Only whole numbers (no fractions) are used.

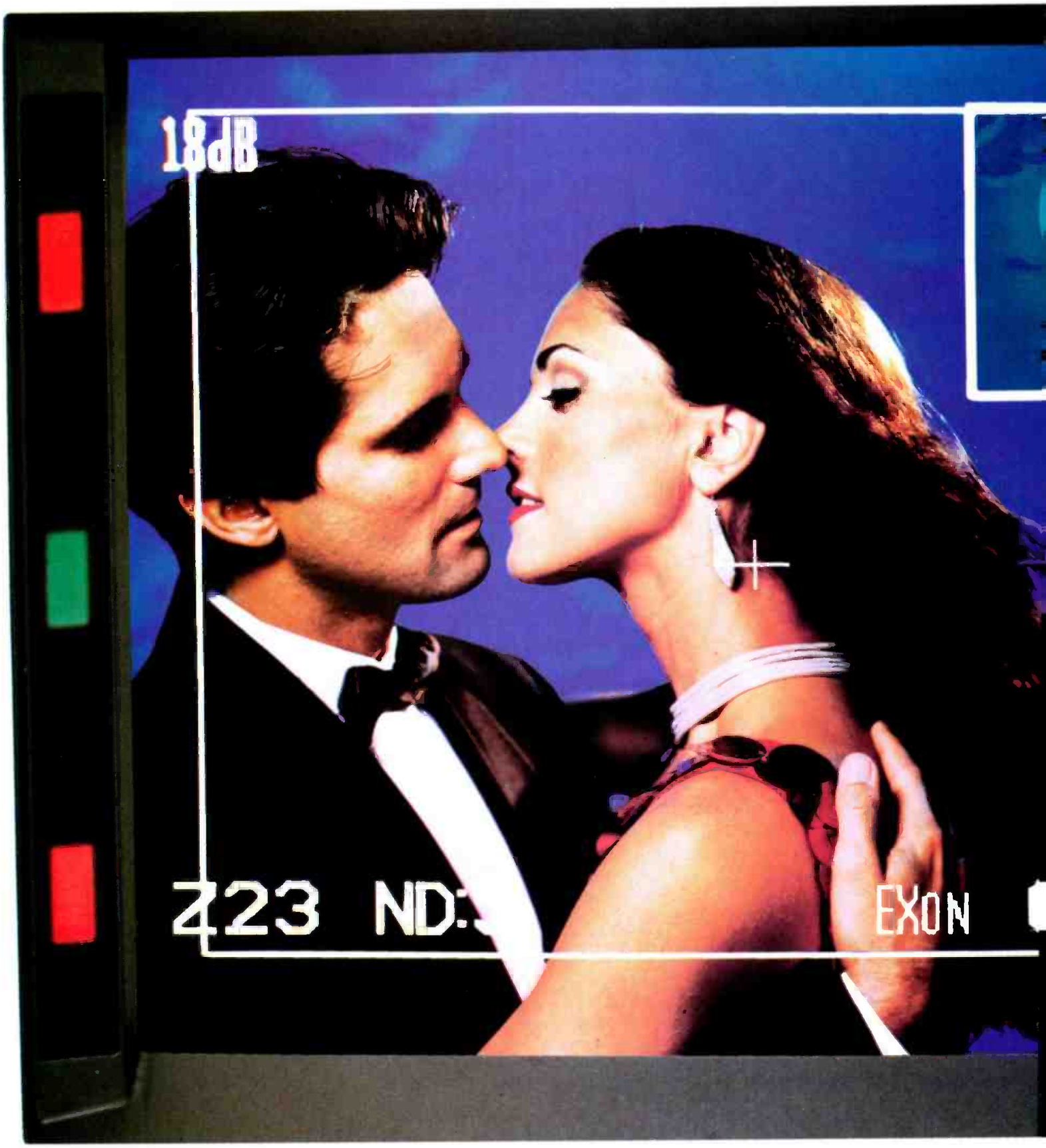
The resulting set of numbers can be copied repeatedly, and assuming there are no errors in the process, the copies are identical to the original. Therein lies the beauty of digital. Once the signal is converted to the number set, the number set is immune to hum, crosstalk and noise.

To use these number sets effectively, however, requires moving them from point to point. SMPTE 259 and the other

Continued on page 29

SOME PEOPLE SEE THE WORLD AS IT IS AND ASK WHY.





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Continued from page 24

serial digital standards describe various methods of moving signals throughout a facility.

Signals are transferred one bit at a time using an NRZI encoding scheme. (See Figure 1.) NRZI (non return to zero inverted) encoding calls for a transition (high to low or low to high) when sending 'ones' and no transition for 'zeros.' Because of this encoding scheme, the signal is immune to polarity reversal.

With NRZI a datastream of all 'ones' produces a transition at every clock interval and the resultant signal is a square wave at half the clock frequency. Signals with all 'zeros,' however, produce only flat lines.

Serial digital video is distributed via a single coax that requires that the receiver must recover clock information from the signal itself. Long strings of zeros make clock recovery difficult, hence the need for some form of scrambling to keep lengthy zero strings to a minimum. An algorithm scrambles the signal as part of the encoding process in the transmitter. A complementary algorithm in the receiver descrambles and decodes the signal. Lengthy strings of either zeros or ones stress systems in different ways. Because of this both can be used as effective diagnostic tools. Strings of zeros stress the receiver clock circuits, strings of ones produce high-frequency square waves that can be degraded by long runs of cable.

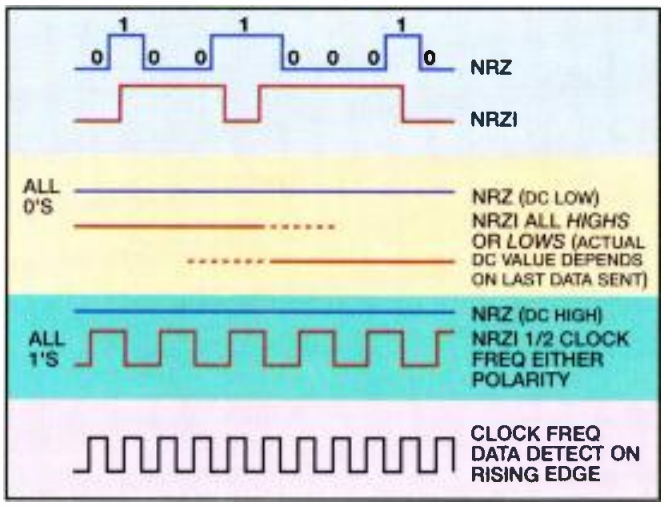


Figure 1. The difference between NRZ and NRZI encoding. With NRZ, the signal's DC value corresponds to the value of the data. With NRZI, no transitions occur when the data is a zero, transitions occur when the data value is a one.

Signal parameters

With SMPTE 259M, the serial datastream is distributed as an analog signal with a peak-to-peak value of 0.8V+/-10%. (See Figure 2.) Rise time (20% to 80%) is specified as 0.75 to 1.5ns and jitter must be less than 0.5ns peak to peak. These specifications have been interpreted differently by the various manufacturers and therefore, not all equipment that "meets spec" can be interconnected without encountering problems. Another thing to be aware of is that these are the transmitter output

Jitter is a difference between when a data transition occurs, and when it should occur.

specs; cable attenuation, connector problems and dirty patch panels can all contribute to a less than ideal signal at the receiver. This is where all of the factors and experience that contribute to a quality analog distribution system can affect digital distribution. Digital systems work well — to a point. This point has been accurately described as a digital "cliff." Knowing whether a system is close to the edge is critical to maintaining a reliable facility.

Lengthy strings of either zeros or ones stress systems in different ways.

With serial digital video, research has shown that as the digital cliff is approached, the difference between a signal that can be recovered and one that cannot can be 100 feet (30 meters). Common testing techniques add 50 or 100 feet of cable or the equivalent of cable to determine whether the system is operating close to the edge. These tests assume if 50 feet of cable can be inserted without causing receiver errors, the system is operating within a reasonable safety zone. At this point measurements, both with and without the additional cable length, should be taken and logged. As part of regular maintenance, these readings should be checked periodically to verify that the signal paths have not degraded.

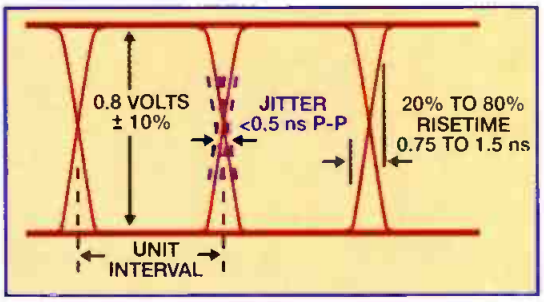


Figure 2. *The "eye" pattern, along with signal specifications for SMPTE 259M.*

Jitter

Jitter is a difference between when a data transition occurs, and when it should occur. Transitions can occur before and after the expected time. Although each bit in the datastream is important, when viewing the signal on a scope, the display appears much like the waveform in Figure 2. With this type of display, individual bits are not recognizable, but rather an eye pattern is formed that shows that transitions are occurring. As the amount of jitter in the signal increases, the "eye pattern" begins to close. As it closes, the signal approaches the cliff referred to earlier. Receiver specs will determine how much jitter is allowed before the signal is unusable. To measure jitter effectively, the test scope must have a bandwidth of approximately 2GHz.

Although a small amount of jitter is not a problem, it can become more serious as cable lengths increase. Cable attenuation causes the signal amplitude to decrease, and since attenuation increases with frequency, signal risetime increases and the corners of the waveform are flattened. As this happens, the non-ambiguous flat portion of the waveform is shortened. Cable equalizers in receivers can correct for this, but at some point the jitter overcomes the correction ability and the bit error rate increases dramatically.

To test serial jitter, gray patterns with the following values, Y=127(511 for 10 bit) and C_R &C_B =128 (512 for 10 bit),

result in patterns with concentrated high-frequency energy that stress serializer circuitry, causing increased jitter. Other patterns that can be used to stress systems are described in SMPTE RP 178 and are called the serial digital check field or SDI patterns.

On the other hand, errors that occur randomly could be related to jitter and could indicate that the system is approaching the edge.

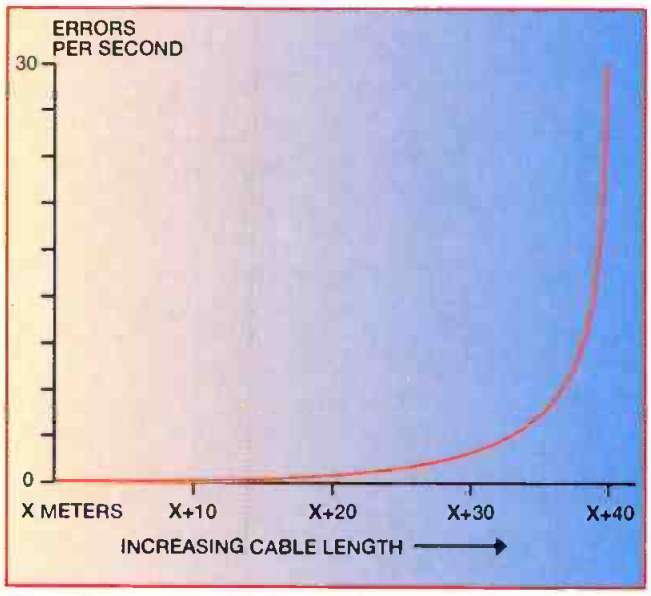


Figure 3. *As cable length increases, the number of errors per second remains virtually constant—to a point. Within about 20 meters of cable, error rates increase dramatically. Under ideal conditions, this occurs around 270 meters of cable. Less than ideal conditions can cause it to occur on shorter cable lengths.*

In addition to the problems just described, incorrect or improper data within the datastream can cause problems. Certain values are reserved for identification purposes. If these values occur during active video, the receiver may process the codes as sync, destroying image integrity. The improper use of reserved codes in the datastream can occur either at regular or random intervals. Codes that remain in the same screen position are regular errors, and usually indicate improper setup or some type of equipment failure. On the other hand, errors that occur randomly could be related to jitter and could indicate that the system is approaching the edge.

Conclusion

As you can see, digital video is not the problem-free solution it once appeared to be. Numerous pitfalls exist when converting an analog facility to digital. Despite these pitfalls, serial digital video can simplify facility wiring, routing and distribution. Having proper test equipment, using it on a regular basis and keeping good records can go a long way toward building and maintaining a reliable system. ■

➡ *For additional information, circle (303) on Reply Card. See also the "Test & Measurement" section on p. 72-74 of the BE Buyers Guide.*

Testing fiber systems

The basics of maintaining and testing fiber.

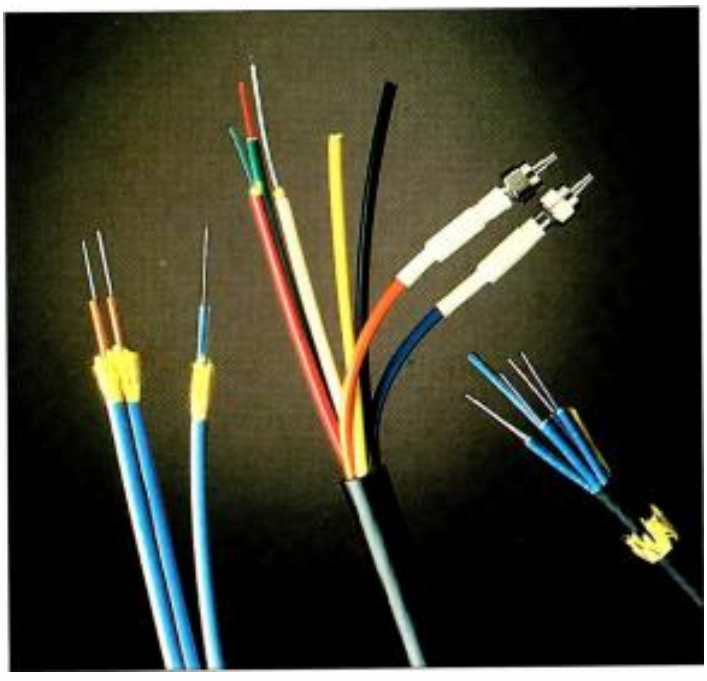
By Jim Hayes

The Bottom Line

For facilities that are now implementing fiber for wideband applications, it's time to get down to basics. Testing fiber requires a whole new set of skills. From fiber splicing to data-error rates and troubleshooting, this article provides an important base of instruction.

Fiber optics has been used in the broadcast industry for more than 10 years. One of the first applications involved portable cameras operating out of mobile facilities, where dragging a giant cable behind the camera was difficult. A small, lightweight fiber-optic cable and transmitter/receiver electronics made the camera much more portable. It also was more reliable because optical fiber was capable of surviving after being run over by a truck, which would have been fatal to coax cable.

Hayes is president of Fotec Inc., Boston, MA.



A fiber-optic cable.

Breakthrough in fiber optics

With early optical CATV systems, special FM optical links were used to remote antennas from head-ends. A few digital links were also used, but the digital bit rate was extremely high without compression, about 100 millions bits per second per channel, making digital transmission expensive. The breakthrough in fiber optics with CATV systems came about by using special lasers that allowed direct AM conversion of the electrical signal. These links are capable of transmitting 60 or more channels and are cost effective for most systems.

Now we are looking forward to compressed digital signals sent over fiber optics that do not suffer degradation, no matter how far the transmission distance. Just imagine an MSO distributing signals to every system in the world over terrestrial fiber-optic cables that could carry digital data and voice signals simultaneously.

Making up the link

A typical fiber-optic transmission

Continued on page 41

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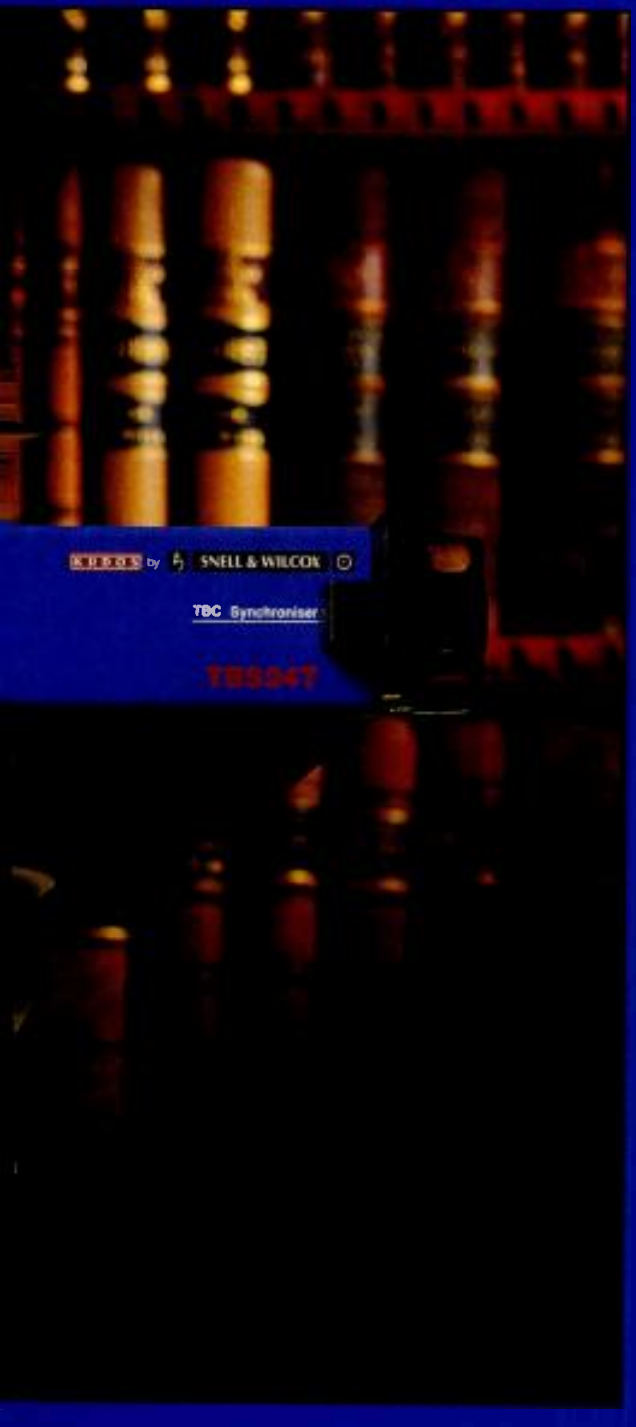
I sync, therefore I am



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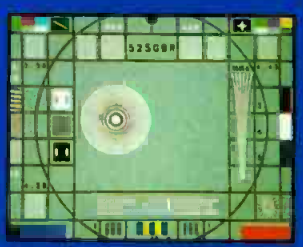

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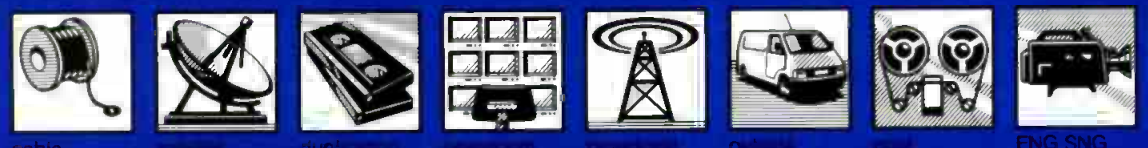

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Continued from page 32

link, regardless of the type, is shown in Figure 1. The link is comprised of a transmitter, which converts an electrical signal to the optical signal, an installed fiber-optic cable plant, and a receiver that converts the optical signal back to the electrical domain, and is compatible with the equipment being used in the network. A properly operating link will transmit the signal with a minimum amount of distortion and noise contribution.

This sounds just like any other transmission medium, and should be considered such in the testing and troubleshooting process where standard test instruments are used in the electronic domain on either end of the fiber-optic link. The performance of the link is dependent on signal strength as shown in Figure 2. Higher power at the receiver means a better signal-to-noise ratio for the signal, until the receiver saturates and performance degrades quickly. Low signal levels mean more noise problems, just like in the electronic domain. For a given fiber-optic link, the transmitter power output level and receiver input level requirements determine the amount of optical loss that can be tolerated in the fiber-optic cable plant, which is called the *optical margin*.

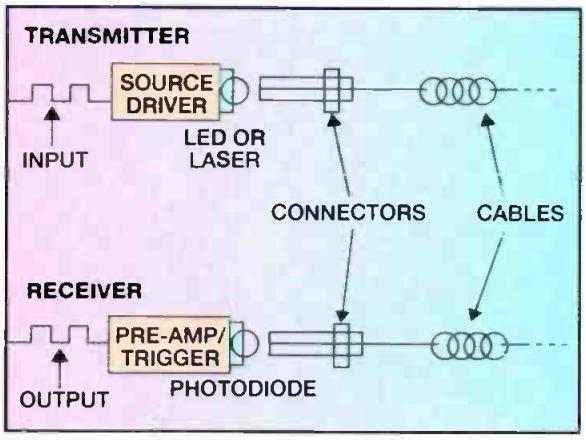

Figure 1. Typical fiber-optic link.

Higher power at the receiver means a better signal-to-noise ratio for the signal, until the receiver saturates and performance degrades quickly.

Installation and maintenance

The installation of the fiber-optic cable plant is usually subcontracted to experienced technicians familiar with the processes unique to optical fiber installation. The transmitter and receiver may be installed by anyone familiar with basic electronics. The complete system is then tested in the electrical domain using standard test instruments.

Once the installation is complete, the cable plant tested, and the network equipment is running smoothly, what is likely to go wrong in a fiber-optic network? Fortunately, not much. One of the biggest selling points for fiber optics has been its reliability. In fact, the best thing to do is absolutely nothing. Fiber-optic links do not require any periodic maintenance. Even opening fiber-optic connections may allow these microscopic particles of

dirt to settle on the ends of connectors. This can cause increased optical loss or back reflection that may adversely affect transmission. However, potential operational problems can be addressed by the end-user to speed the troubleshooting and repair process.

Within the fiber-optic link, the most likely component to fail is the laser transmitter because it is the most highly stressed component in the link. Lasers are feedback stabilized to maintain a constant output power, so they tend to fail catastrophically, but the time frame is quite long, 100K to one million hours. Under any circumstances, the repair of the system will be limited to finding the failed part and replacing it, or in the case of the fiber-optic cable plant, calling in a trained technician to find and fix the problem.

Troubleshooting

Power in a fiber-optic system is measured by a fiber-optic power meter, which uses a solid-state detector and electronics to measure the average optical power in the fiber. The meter is calibrated at several different wavelengths, usually 1,300 and 1,550 nanometers for CATV and video systems. The meters used with AM CATV systems require special detectors for measuring the high-power levels emitted by the special lasers used in the AM transmitters.

A properly operating link will transmit the signal with a minimum amount of distortion and noise contribution.

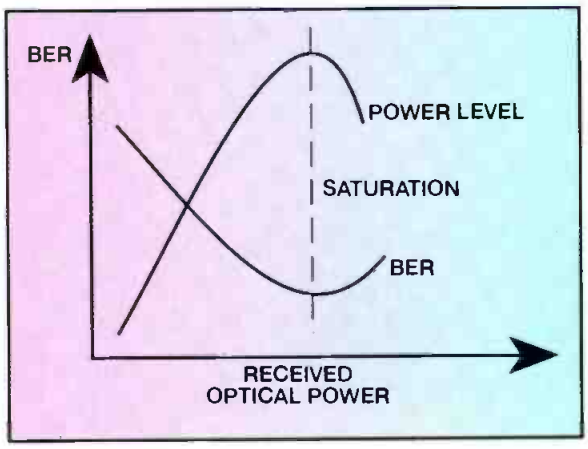

Figure 2. Signal strength of fiber-optic system.

Troubleshooting begins with the power meter, testing the optical power level at the receiver. (See Figure 3.) If there is no power at the receiver, the next place to check should be the transmitter LED or laser, just to isolate the problem to either the transmitter or the cable plant. Receivers are low-stressed devices and are highly reliable. But the electronics behind them can fail. If there is receiver power but no communications, an electronic test is necessary to see if the receiver is working.

With the cable plant, the biggest problem is what the telcos call *backhoe fade*, a graphic description of what happens when someone mistakenly cuts or breaks a buried fiber-optic cable. Although this

Continued on page 46

If you've been quietly suppressing a monumental *urge* to smash the living *HECK* out of every single noisy, clumsy **CARTRIDGE** that's been jamming up your carts for the last *umpteen* years, NOW would be an *extremely opportune* time to *VENT* all that pent-up Rage!

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Continued from page 42

most often happens when an underground cable is dug up, it can happen when an electrician is working on other nearby cables inside a building. Aerial cable is usually wrapped on a messenger or installed coax in an overbuild system, so it is at the mercy of vehicular accidents, weather and target-shooters.

Outdoors, the best defense is to mark where cables are buried and/or bury a marker tape above the cable, which will hopefully be dug up first. Orange or yellow jacket cable should be used inside buildings instead of black or gray, because these colors will make the fiber cable more visible and distinctive to those working nearby.

Outside cable faults are often hidden and are best found by using an optical time domain reflectometer.

Outside cable faults are often hidden and are best found by using an optical time domain reflectometer (OTDR) to localize the fault, just as TDRs are used in copper wire. Then have personnel scout the area indicated by the OTDR to look for obvious damage.

Inside buildings, the short distances make OTDRs unusable, so a visual-fault locator is necessary. The visual-fault locator puts a bright visible light, usually from a laser, into the fiber. Breaks in the fibers become visible, even through the cable jackets that are normally used for indoor cables. Another problem is breaking the cable just behind the connectors in patch panels. This is a difficult fault to find and a visual-fault locator is often the only way to find it.

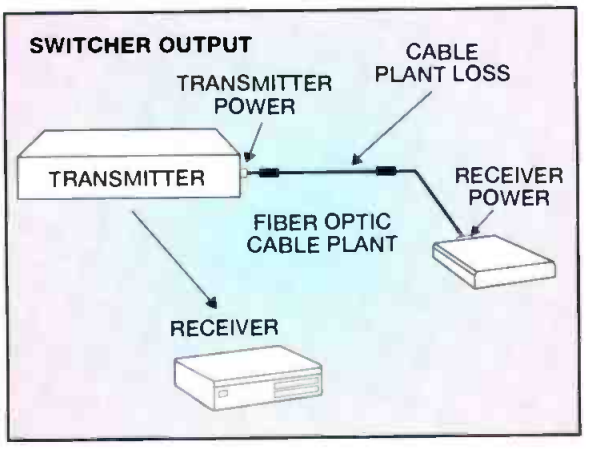

Figure 3. Troubleshooting a system using a power meter.

Fiber-optic links do not require any periodic maintenance.

In most cases, a fiber-optic system is not likely to be the cause of significant maintenance problems. A simple, inexpensive troubleshooting kit, consisting of a fiber-optic power meter and visual fault locator, will suffice for troubleshooting most problems, but a good outside plant installer needs to be available when serious cable plant problems occur. ■

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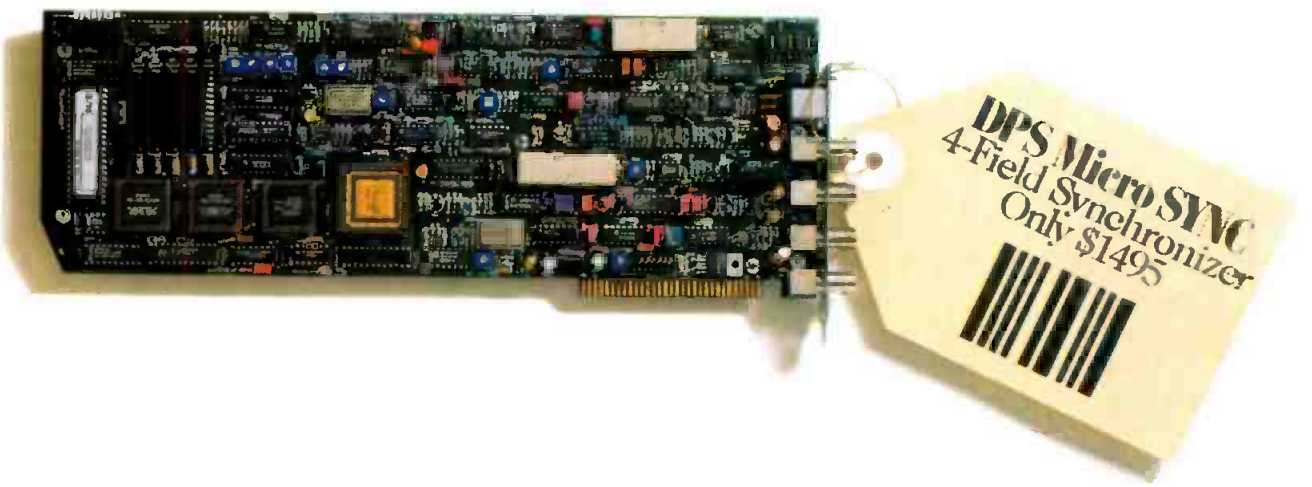

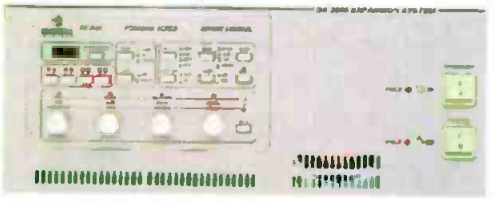

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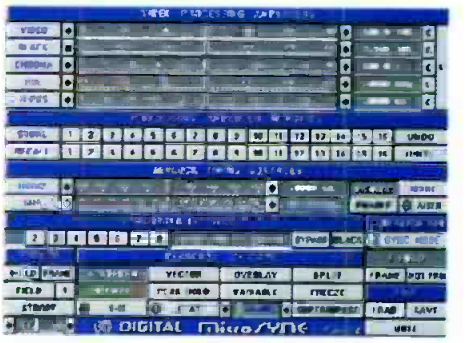

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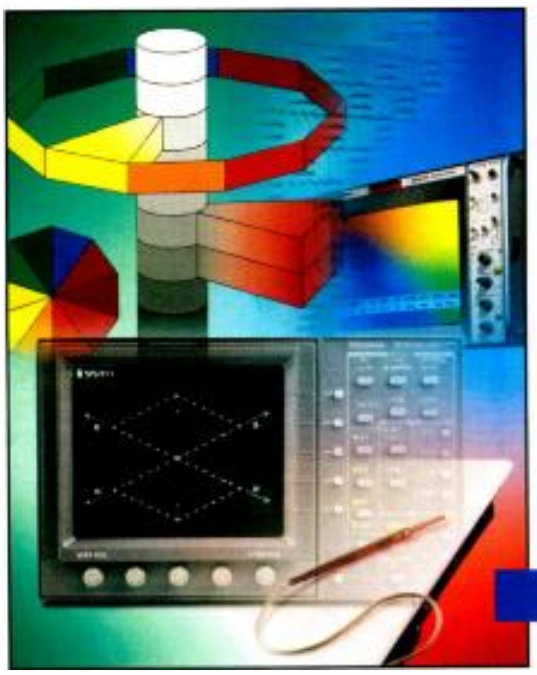

Monitoring digital audio/ video signals

With digital systems, the details are critical.

By Curtis Chan

The Bottom Line

The integration of digital audio and video signals into the broadcast facility has come a long way since the introduction of the first D-1 VTR. The need to understand, plan and measure digital signals continues to grow and change. It is important to know the system design requirements for correct implementation of digital audio and video, including proper monitoring of serial digital signals and equipment status.

$

Although hybrid analog/digital broadcast facilities still proliferate, the emergence of the all-digital studio is now becoming commonplace within the industry. This has brought about the following realities in the broadcast environment:

- Expanded integration of component analog video distribution and monitoring
- Component/composite digital video and AES/EBU digital audio distribution and monitoring
- Multiplexed digital video, audio and ancillary data
- Reduced dependency on analog NTSC format and monitoring
- Composite and component analog and related equipment coexisting with digital
- New operational and monitoring methodologies

To integrate these points effectively, many precautions must be taken into account when designing or retrofitting a facility for digital. The following are some key points to keep in mind.

What standards?

When is a standard not a standard? When it's still a proposal or recommended practice. This means that although the intent is there, many manufacturers' products are still not adhering (or only partially adhering) to standards. The track record to date for all-digital facilities is also short. Therefore, systems integrators, engineering staffs and manufacturers are going to have to work together to get the details right. With digital systems, the details are critical — in many cases, it takes very little to turn a system that's working perfectly into one that doesn't work at all.

Don't let monitoring of the digital TV signal be an afterthought in your facility's conversion plans.

Take care in *matching* digital components. For instance, digital distribution amplifiers may not all be similar — while one is acquisition-level dependent, another may be rise-time dependent. Also, earlier serial component chip set designs differed greatly in their implementation, so be careful when matching different manufacturers' products. With signals of up to 360Mb/s, dynamic and interdependent signal characteristics must be taken into account, such as input/output return loss, launch-signal waveform integrity and jitter performance. For this reason, cable runs of less than 200 meters are often recommended, along with a minimum number of active devices and connections on each run.

Embedded audio is another critical issue. Make sure that any hardware you're considering properly encodes and de-

Chan is president of Chan and Associates, a marketing consulting service for audio, broadcast and post-production in Fullerton, CA. Respond via the *BE* FAXback line at 913-967-1905.

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CABLE LENGTH (M)	BER	S/N (dB)	S/N (V RATIO)	ATTN @ $1/2f_{CLK}$ (dB)	TIME BETWEEN ERRORS
<338	$2X10^{-18}$	21.8	150	25.3	1CENTURY
350	$3X10^{-15}$	20.9	122	26.2	1 MONTH
356	$8X10^{-14}$	20.4	109	26.7	1 DAY
374	$1X10^{-10}$	19.0	80	28.1	1 MINUTE
387	$7X10^{-9}$	18.1	64	29.0	1 SECOND
400	$2X10^{-7}$	17.1	51	30.0	1 FRAME
418	$7X10^{-6}$	15.8	38	31.3	1 MS
484	$7X10^{-3}$	10.8	12	36.3	1 μs

Table 1. Theoretical values for BER, S/N and attenuation at one-half clock frequency in serial digital NTSC signals, when passed through various lengths of Belden 8281 coax cable. (Assumes scrambled NRZI channel code and Gaussian distributed noise.)

codes embedded audio in the serial bitstream. This is especially true if you are routing embedded audio through DVTRs, digital disk recorders (DDRs), multiplexers and switchers. Several major manufacturers have cited this as the most problematic area of serial digital video today.

Cable, connectors and patch panels

Most facilities use coax cables exhibiting low losses up to 10MHz, and with proper equalization, serial digital runs extending to 360Mb/s shouldn't pose a problem. Keep in mind that the most important characteristic of coax for serial digital is its loss at one-half the clock frequency of the transmitted signal.

Although 50Ω BNCs are still the norm, 75Ω connectors are turning up more frequently of late. In most analog applications, the impedance mismatch between these connectors is of little consequence, but in the case of interfacing serial digital devices, the need to match impedance becomes more critical. Therefore, it is recommended to use 75Ω components wherever possible for serial digital applications.

The same holds true for patch panels, which should have a characteristic impedance of 75Ω to avoid reflections caused by impedance mismatches. It may not be necessary to replace all of your existing 50Ω patch panels overnight, but you should certainly plan to upgrade soon if your facility plans to implement serial digital video.

Terminations and loop-throughs

The serial digital standard specifies that terminations should be 75Ω with no significant reactive component to 270MHz. This specification is more important at short cable lengths than at long lengths where the reflected signal is more attenuated. Also, most of today's digital receivers are terminated in order to avoid return loss problems.

The signal regeneration of active loop-throughs helps isolate the input from the output — as long as power stays up. On the other hand, passive loop-throughs make it possible to monitor the actual signals being received without substitution. This is especially helpful for serial transmitters with multiple outputs, because they usually have separate active devices on each output. Monitoring one output doesn't necessarily indicate the quality of any other.

Signal distribution and synchronization

When distributing serial digital signals, consider the analog distortions that may affect the signal, such as rolloff, phase distortion, noise, jitter and baseline shift due to AC coupling.

Serial regeneration is the simplest solu-

tion to these. However, the signal can't be regenerated indefinitely because of cumulative oscillator jitter and the fact that the clock is extracted from the incoming signal. On the other hand, parallel regeneration can reduce jitter because of its low loop bandwidth, but at the expense of complexity. The best approach is to use a *house reference* clock to synchronize all regenerated outputs.

One of the newer ways to make NTSC and serial 4:2:2 compatible is to use a *digital frame synchronizer*. This device digitizes all incoming analog signals, serializes them, and then synchronizes them to the house timing reference.

Monitoring and measurement

In addition to a program signal display and traditional TV system measurements, monitoring devices for serial digital signals also will need to quantify the many parameters associated directly with the digital serial waveform. The result is several new categories of monitoring and measurement methods: program signal analysis, data analysis, bit- and format-error displays, transmitter/receiver operation, format verification and fault tolerance reporting. For most facilities, a transitional approach in adding appropriate equipment where needed instead of a complete retrofit seems to be economically viable.

Embedded audio has been cited as the most problematic area of serial digital video today.

Another type of testing is required to cope with the so-called *cliff effect* that most digital systems exhibit. This refers to the capability of digital systems to perform well nearly to the point of failure — unlike analog systems, where gradually degrading performance alerts the user to a growing problem with plenty of notice. In order to know how much margin is available before reaching the edge of the cliff, it's necessary to take a digital system out of service and add stressing parameters to the signal until it crashes. One way to do this is simply to add lengths of cable to a signal path.

Measuring serial digital video signal timing

Relative timing between serial digital video signals can vary tremendously in a TV environment. To measure effective timing differences, you can use an *active picture timing test signal* (previously known as the *digital blanking test signal*), which is available on many new digital component generators.

The first and last full active analog field lines of this signal have a white (luminance-only) bar with nominal blanking edges (lines 21, 262, 284 and 525 for 525-line systems). Use of these full lines ensure that the complete signal will be visible after D/A conversion. All other active picture lines have a 1-sample, half-amplitude word in four locations: the first and last active digital sample, and the first and last sample at the 100% point of a nominal white bar.

Studio digital video transmission systems

Signal-to-noise ratio (S/N) is an important test parameter in transmission systems. Although SMPTE 259M (the serial digital video interface standard document) doesn't specify S/N ratios, a typical recommended value would be 40dB or greater at the transmitter. Errors will occur if the S/N at some location in the system reaches a low enough value. Although an automatic equalization circuit in the receiver can compensate for high-frequency losses that increase with ca-

ble distance, overall signal level losses due to coax attenuation will cause the S/N at the receiver to decrease, thereby increasing the possibility of errors.

Table 1 compares the bit-error rate (BER), attenuation and S/N for digital video on a variety of cable lengths. (BER is the ratio of bits in error to the total number of bits transmitted.) Note that a 4.7dB increase in S/N changes the BER result from one error per frame to one error *per century*. In general, the expected operational distance of a serial digital signal is dictated by the length of coax cable that attenuates a frequency of half the clock rate by up to 30dB. Table 1 indicates that this occurs at a cable length of 400m, and produces a BER of roughly one error per frame.

Good engineering practice suggests a 6dB margin above this attenuation figure (equivalent to about 80m of cable), setting a practical maximum operating length of roughly 320m for NTSC. (All length values based on Belden 8281 cable). Use of properly equalized and re-clocked distribution and routing equipment at such intervals with adequate margins will help ensure long transmission distances with sufficiently low error rates.

Measuring bit error rates

Although random bit errors should be kept below problematic rates if proper S/N margins are observed, *burst errors* due to interfering signals, such as noise spikes, crosstalk, connector problems and other electrical or mechanical problems are still likely to occur. Because of the intermittent nature of burst errors, data recording and communications engineers have defined another error measurement: the *errored second* — simply a notation of each second of data that contains an error. Under this scheme, error detection data is generally presented as the number of errored seconds over a period of time, and time since the last errored second.

This is a better measure of fitness for service than straight BER for links that are subject to burst errors. A BER measurement could give the same value for a single, large burst as it does for several shorter, scattered bursts. But if each of the shorter bursts results in momentary sync failure, the subjective effect is more damaging to the viewed picture than that caused by the single burst. The errored second method counts the *occasions* of error in integer fashion, thus providing some statistical information about the simple occurrence of *any* error, including the more likely burst errors, without qualification of the number of bits lost in each case or in total.

Note also that BER tests require specific test signals that use a variety of pseudo-random sequences at various bit rates. This means that testing must take place during out-of-service periods, whereas errored-second counting can take place continuously during regular usage. Furthermore, some TV equipment won't properly process the BER test signals (none of the sequences are similar to the serial digital video bitstream), so results may be misleading and difficult to conduct with all normal equipment in line. Finally, pure BER measurements simply don't provide meaningful data when the system under test is basically noise-free but subject to burst errors, so the errored second technique is clearly preferred for serial digital video transmission testing.

Figure 1 describes an error measurement system devised by Tektronix, which has been approved for standardization by SMPTE. The method is based on making cyclic redundancy check (CRC) calculations for each field of video at the serializer. Separate CRCs for the full field and active picture, along with status flags, are then sent with the other serial data

Continued on page 57

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Digital Switcher - Analog Price

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16:9

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** Off screen shots

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Continued from page 52

through the transmission system. The CRCs are recalculated at the deserializer and, if not identical to the transmitted values, an error is indicated. Error reporting is presented in errored-second form.

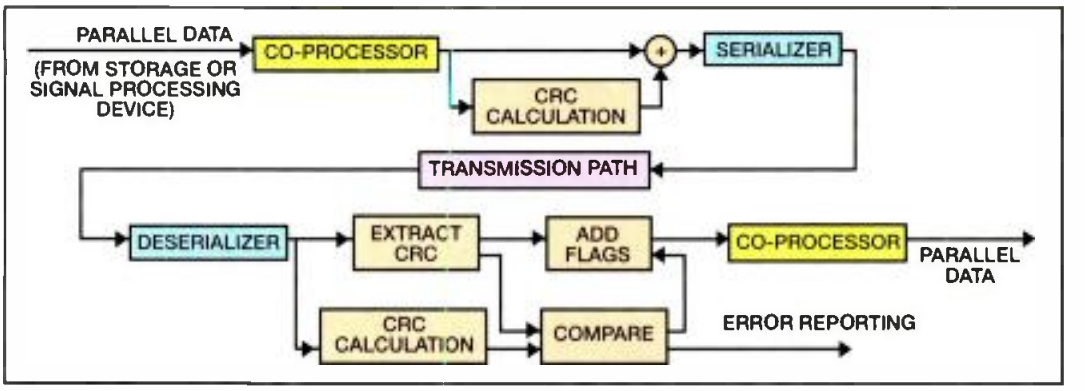

Figure 1. *Proposed error-measurement system for digital video signals, based on cyclic redundancy check (CRC) comparisons.*

Recent standardization activities

SMPTE has issued several recommended practices (RPs) and standards documents that address digital video testing and monitoring. The first is "Error Detection Checkwords and Status Flags for Use in Bit-Serial Digital Interfaces for Television" (SMPTE RP 165). It defines a CRC code that a sending device can embed in the serial digital signal's ancillary data space, to be used by the receiving device to verify signal integrity. Another is "Serial Digital Interface Check Field for 10-Bit 4:2:2 Component and 4fsc Composite Digital Signals" (SMPTE RP 178), which describes a test signal designed to stress the receiver during out-of-service envelope testing.

In the area of fault reporting and status monitoring, a recently approved standard, "Television: Fault Reporting in Television Systems" (SMPTE 269M), defines a simple, inexpensive interface through which any active device in a TV system can report its operating status. For more complex hardware like production switchers and VTRs, another standard, "Status Monitoring and Diagnostic Protocol" (SMPTE 273M), has been proposed (but not yet approved). It would allow more sophisticated devices — which may have their own internal diagnostic processors — to communicate with a central status monitoring system.

Work is still under way in the critical area of monitoring digital video signals. Nevertheless, much has been established and standardized, and appropriate monitoring hardware and systems are available, or will be soon. Therefore, it's a good idea for TV professionals to familiarize themselves with where things stand today, and to stay in tocu in touch with the remaining issues as they unfold. Don't let monitoring of the digital TV signal be an afterthought in your facility's conversion plans. ■

Editor's note: The author wishes to thank Tektronix for material from "A Guide to Digital Television Systems and Measurements." Thanks also to William C. Miller of Capital Cities/ABC, chairman of the SMPTE Working Group on Monitoring in Diagnostics in Digital Television Systems, for information on SMPTE standard activities.

➡ *For more information on monitoring digital video signals, circle (312) on Reply Card. See also "Analyzers, Video System" and "Digital Diagnostic Systems," p. 72 of the BE Buyers Guide.*

Maintaining power tubes

Keeping transmitters healthy starts with a carefully planned maintenance program.

By Heinz Bohlen and Don Peters

The Bottom Line

To broadcasters, there are few things worse than unscheduled off-air time. Extended time spent off-the-air not only reduces revenue due to missed commercials, but can affect future revenue because of a smaller audience. Proper transmitter care and operation can extend tube life, reduce downtime and increase profitability.

The old adage, "An ounce of prevention is worth a pound of cure," is especially true in today's competitive, revenue-driven broadcast markets. Stations live or die by staying on the air. An unscheduled system failure, or the unbudgeted purchase of a new replacement tube, can be the kiss of death.

How do you reduce the chance of catastrophe due to tube failure? How can you extend tube lifetime to approach the designed longevity? For years, station engineers have used various tricks to get longer operating life, with varying degrees of success. Success can be maximized, however, by understanding the factors affecting tube life and implementing a proactive tube management program.

Read the manual again and again

Study of the manual is basic, but often overlooked and underrated. Broadcast transmitters and tubes are designed to work in a particular way. If you follow the manufacturer's guidelines, you'll avoid many of the problems caused by pushing equipment beyond its performance limits. Data sheets are available from most companies, and most tube manufacturers have an application engineering department to assist in evaluating tube performance for a given application.

Inspect regularly

No matter the type of transmitter or tube — whether for radio or television, power grid tubes, klystrons or inductive output tubes — a regular, visual inspection is extremely useful. It can reveal any number of potential problems, such as loose connections and screws, leaking water, dirty filters, and discoloration caused by overheating. These are early warning signs. Watch for them, and address any related problems immediately.

Checks should be done at least quarterly. With new tubes, a daily check is a good idea. It offers an opportunity to become familiar with what to expect, and provides a baseline for future inspections.

Specifics for air-cooled tubes

Several things can be done to extend the life of air-cooled tubes. They include the following:

•*Avoid shortcuts*: They aren't worth it! For example, safety interlocks and tube protection circuits, such as vane switches, grid and plate overload circuits, should be checked as part of regular maintenance. Look for burned resistors, which could indicate inappropriate neutralization or bypassing. Make sure the voltage standing wave ratio (VSWR) detector is set and checked against the manufacturer's recommendations, and not modified. Bypassing relays can have disastrous consequences.

•*Manage filament voltage*: When filament voltage is too high, a power tube loses emission rapidly and normal operating life is not achieved. Filament voltage management programs can extend tube life. Check with the tube manufacturer for information about establishing a filament voltage management program. (For Varian power grid tubes, ask for Application Bulletin No. 18.)

•*Maintain sockets*: A simple inspection of the tube socket can be revealing. Look

Continued on page 62

Bohlen is engineering manager and Peters is senior scientist for Varian Associates, Palo Alto, CA.

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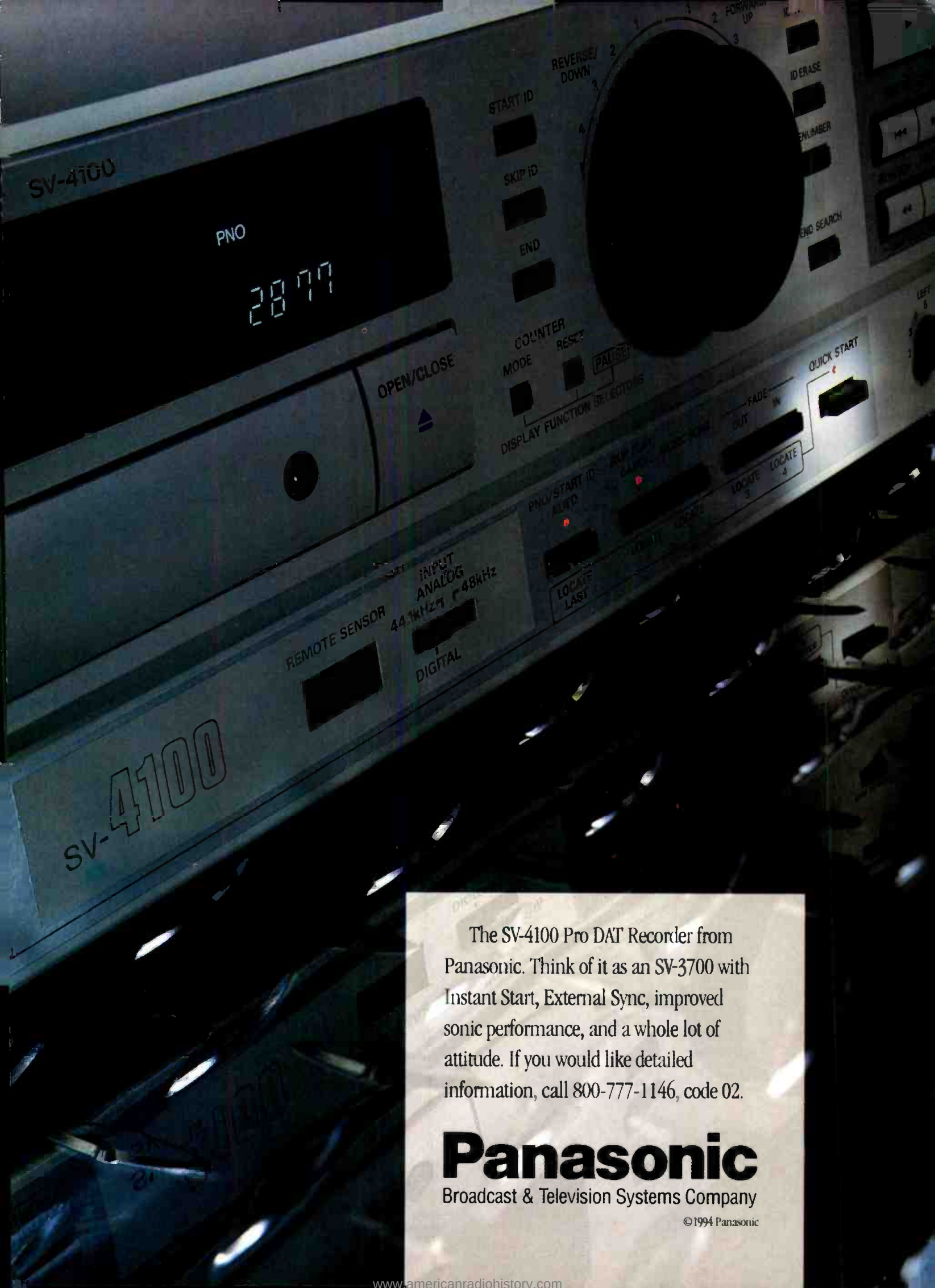

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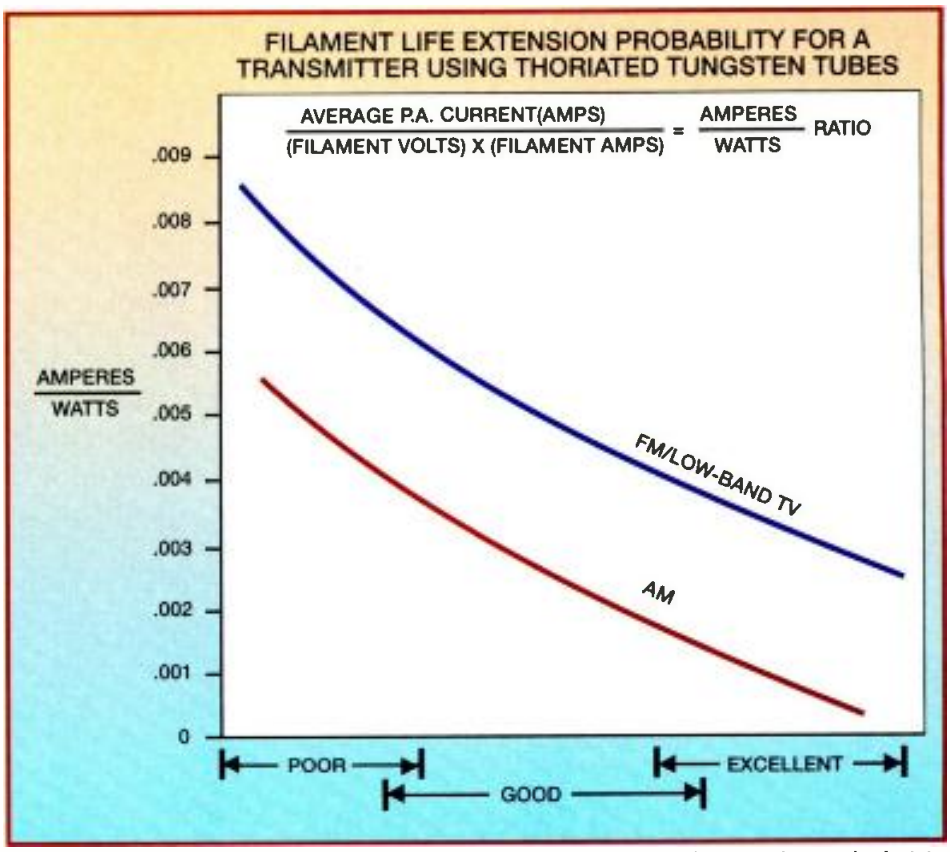
Continued from page 58

for broken or missing contact fingers and burns on the filament collet. These are early signs of degradation that could impact reliability and result in possible tube loss or sudden failure. Replacement parts and kits are readily available from manufacturers. When checking the tube sockets, it's critical that the tube be properly removed and re-inserted in the socket. Use the proper tools and techniques as described in the manufacturer's manual. How often tubes should be pulled out and checked remains a much debated issue. In dirty, dusty environments, it may need to be done every six months or even more frequently. If the environment is clean and well-controlled, once a year may suffice.

•*Do blower maintenance*: Blowers and air-cooling fans play an important role in keeping the tube cool. Make sure they are checked regularly and any dust, dirt and insects that have collected are removed. Also, check air filters regularly, because airflow will be reduced if filters are plugged.

Specifics for liquid-cooled systems

If you're looking for ways to keep liquid-cooled transmitter tubes in good health, here are some helpful tips.



To determine the probability of extended tube life, determine the amps/watts ratio then look right to determine where it intersects the appropriate frequency curve. From that point, look down to see where it falls on the x-axis.

•*Cooling systems*: The high power levels of present-day microwave tubes require that careful attention be given to the design and operation of cooling systems. In some cases, inadequate or improper cooling because of scale or corrosion may be the limiting factor in tube life. Although the manufacturer's recommendation should be followed in maintaining the cooling system as a whole, the following list of adjustment and routine maintenance items may help provide the longest possible tube life.

Keep the coolant temperature constant and as low as ambient weather conditions and other total system requirements will allow.

Use clean, demineralized water for original flushing, final filling and make-up.

For cooling systems without ion-exchange cartridges, use commercial glycol mixtures with inhibitors only, such as Dowcal 10 or Dowtherm SR-1. Do not use technical-grade, uninhibited ethylene glycol; it can cause corrosion that will damage the transmitter cooling system and tube(s).

Because transmitter cooling systems are not sealed, ingredients oxidize over a period of time and need to be replaced. Annually, drain the cooling mixture and flush the system once or twice with demineralized water before refilling it with new cooling mixture.

In systems with ion-exchange cartridges, uninhibited ethylene glycol must be used. Monitor the condition of the ion-exchange cartridge. Rapid exhaustion of the cartridge may indicate a source of contamination, electrolysis, the use of inhibited glycol, or because the purification loop lacks sufficient capacity for the bulk coolant being processed. Follow the purification loop manufacturer's instructions with respect to replacement procedures for filter membranes and cartridges.

Keep the main loop and branch filters clean by routine inspection and cleaning or replacement as required. Don't allow the differential pressure to increase by more than 25% above the original value at the equivalent flow rate.

Take care when repairing a leaking liquid cooling system. If possible, use the same materials that the manufacturer originally used. Specifically, do not use brass or soft soldering, which can cause severe corrosion. In a vapor-cooling system, avoid any parts made from silicon rubber. Silicon is leached out by demineralized water and has the tendency to film coat the systems' "hot parts," such as the collectors and anodes. This results in the so-called *Leydenfrost phenomenon*, in which the electrodes become covered with a thin vapor skin, interrupting heat exchange with the cooling water. This can cause the sudden death of a tube by overheating.

•*Arc protection*: The arc detector or photo cell is essential to protect a klystron, or inductive output tube, and keep it from becoming a fuse. However, arc detectors have a tendency to fail sooner than the tubes they protect. To be safe, verify proper operation at least every three months. Some transmitters have automatic controls, which makes the job easier. If your transmitter does not have a controlled circuit, or if you question whether the detector is operating, expose the sensor to artificial light to determine if everything is in proper order. Check with the tube manufacturer if you have questions or concerns.

•*VSWR or RF reflection indicator*: Excess reflected power from the antenna to the transmitter can have nasty effects on power tubes. The reflected power indicator is critical to alerting operators to any potential problem in this area. On a quarterly basis, check the indicator to ensure that it's functioning properly.

•*Proper shutdown*: Powering up and shutting down transmitter tubes requires some care, especially with remote-control operation. Improper procedures can destroy tubes quickly. Check the manufacturer's equipment manual to be on the safe side.

•*Safety checks*: Don't rely on any of the interlocks to be infallible. It's important to check proper function regularly, and especially after lightning has struck the

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tower, antenna or transmitter building. A damaged interlock does not always prevent you from switching on the transmitter, and the result can be devastating.

Watch for performance shifts

As tubes age, their characteristics may change. These shifts can cost money if you are not running efficiently and more power is going into the tube and less into the antenna. To check for tuning and efficiency, look at the power out and collector current levels. Frequent checks of tuning are simpler today with new transmitters that feature telemetry via digital modems. Note any major changes because they may signal the need to retune or optimize the tube. If that's the case, check the manufacturer's manual.

Treating spares properly

If you have spare tubes, be sure they're kept in a dry, dust-free, temperature-controlled place. Also, verify that any water lines are drained thoroughly. Water, even demineralized water, remaining in a tube's cooling passages over extended periods can cause corrosion. The last thing you want is to plug in your spare and find out that it doesn't work due to corrosion. It's a good idea to test the tube for vacuum integrity approximately every 90 days. Check the manufacturer's manual for a test description or, if the tube has an ion getter pump, use that to read the current.

Maintenance logs are a must

Don't leave tube maintenance to chance. Keeping a log of repairs or adjustments, preventive maintenance checks, unusual operating conditions and dramatic weather shifts, such as major temperature changes or lightning, can provide important information in preventing and diagnosing performance changes. Keep it in a convenient location so it becomes a handy reference and is easily updated.

With a well-balanced diet of checkups and preventive maintenance, a tube's chances of a long, healthy life are greatly enhanced. That's the bottom line for you and your station. ■

Filament voltage management for thoriated tungsten tubes

A sample checklist for visually inspecting your tube.

____ All connections and screws tight
____ No water leaks
____ Filters clean
____ No discoloration (overheating)
____ Interlocks working properly
____ Maintenance logs up to date
____ Inspect fingerstock
Notes:_____

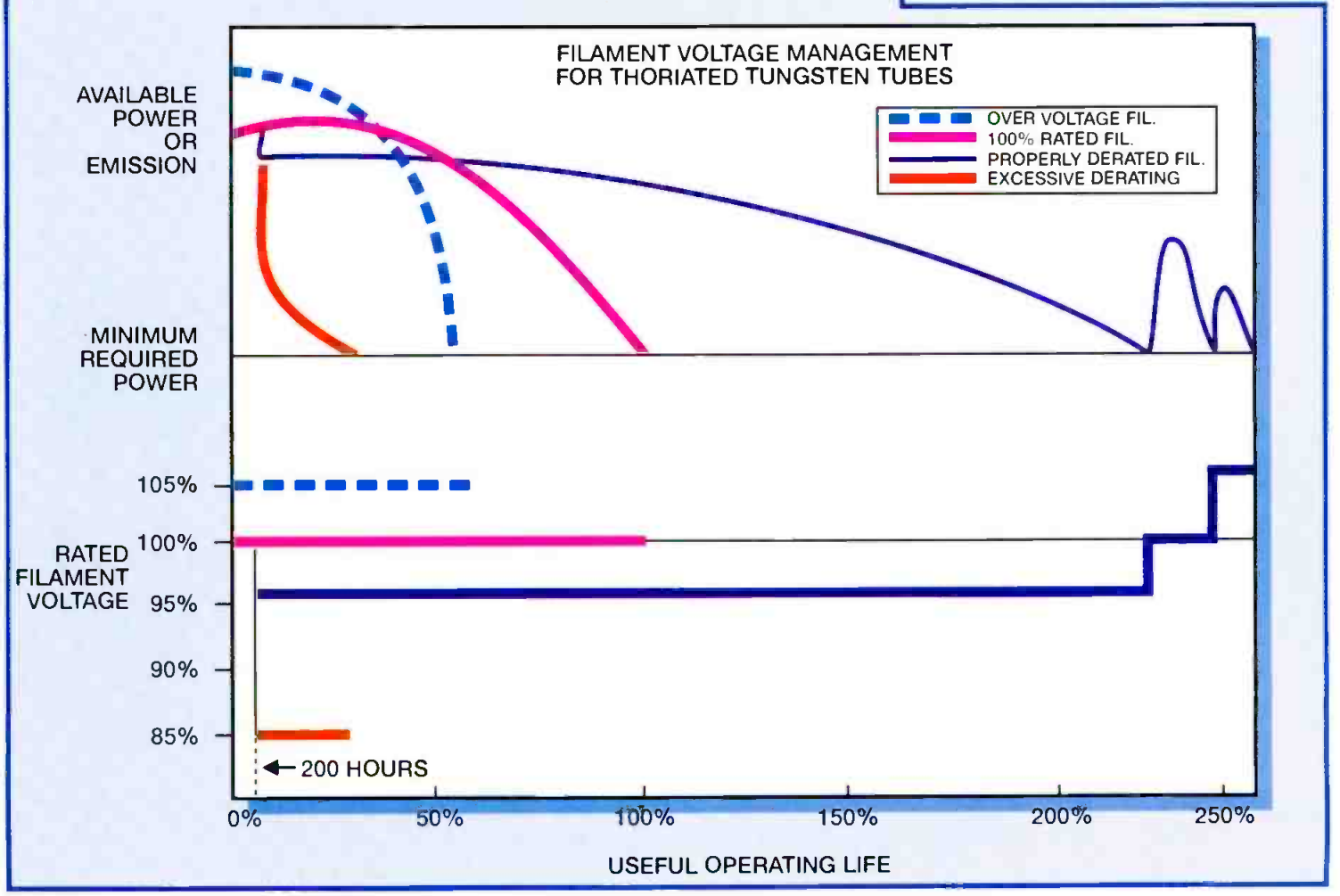
_____

_____

Date: _____ Time:_____

Inspector: _____

Filament voltage management allows extended tube life when accompanied by a continuing housekeeping program. When the filament voltage is too high, emissions decline rapidly and the normal life expectancy is not achieved (blue line). At the proper setting, normal life span happens in the majority of cases (magenta line). With a filament voltage management program, extended tube life may be achieved (purple line). When the minimum required output power level is finally reached (right-hand part of the curve), the filament may be raised to the rated value or above to achieve additional useful operating life. However, if the filament is run cool, an extremely short life will result (orange). Note that the filament voltage management program does not take effect until about 2,000 hours of operating time have passed. If a program of this type is not undertaken, the tube should be operated at the rated filament voltage. ❑



➡ *To receive Varian Application Bulletin No. 18, circle (300) on Reply Card.*
For more information on transmission tubes, circle (301) on Reply Card. See also "Tubes, RF Power and Microwave" on p. 70 of the BE Buyers guide.

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TP17A1 Moving Test Pattern Generator

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Digital Video Test Generator

The TG76 is a high-stability, modular, multi-format Digital Video Test Generator. It is ideal for both broadcast-quality digital equipment evaluation and R&D applications.
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- Primary oscillator fsc accurate to +/- 1 Hz.
- Standard analog formats (12 bit D/A converter) NTSC-M/PAL-B, -G, -D, -I, and component 525/60 and 625/50 video.
- Optional digital video/audio generation, 10-bit 4:2:2 component digital signal out put, 4fsc NTSC composite digital signal out put, AES/EBU digital audio output.
- All optional signals can be generated simultaneously.

NTSC/PAL Signal Generator

Created for use in TV and VCR manufacturing facilities and R&D applications, the TG21A is a modular source of NTSC/PAL television signals. A monoscope pattern is available as an option.
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- Optional monoscope pattern, component video, Y/C separate video, and black burst output.
- Each signal can be generated simultaneously.
- Genlock and GP-IB interface.
- 16:9 test patterns available.

Moving Test Pattern Generator

The TP17A1 is a programmable moving image test generator designed for testing video compression hardware and transmission systems for compressed video
Features include:

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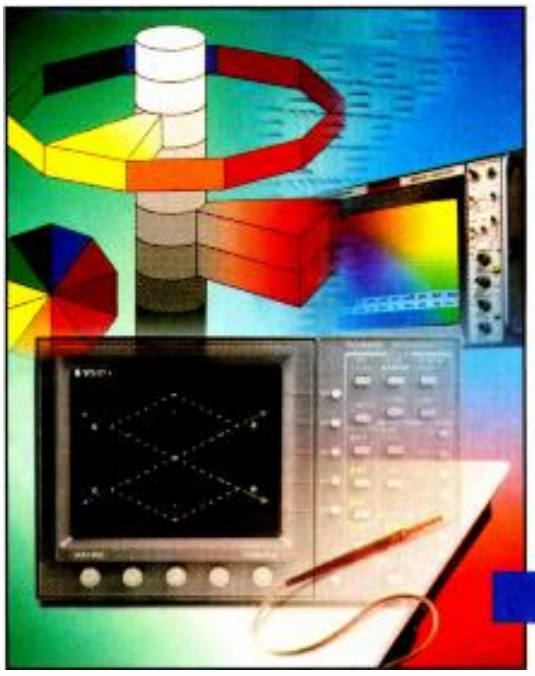

Standards converters

One critical element is motion compensation.

By Phil Hejtmanek

The Bottom Line

Standards conversion is a process that has been largely ignored by the majority of U.S. broadcast engineers. This is mainly because it has been traditionally used in translating foreign TV program material to the local standard for broadcast. In the future, as the specter of HDTV looms, engineers will need to familiarize themselves with the concepts and hardware of standards conversion. It is likely that a station's first step into the world of HDTV will be the current NTSC program feed, routed into a standards converter and then into a new HDTV transmitter.

With the advent of the new distribution modes for TV programming (DBS, cable, multimedia) the world's appetite for TV program material is rapidly expanding. Unfortunately, the fact that there are at least eight major TV standards in the world today is a barrier to the simple interchange of foreign programs and sporting events. Fortunately, these difficulties can be solved using standards converters.

Standards conversion is the process of changing the line and/or field rate structure of the TV signal. Ideally this is done with a minimum of *judder*, an artifact in which smooth motion is portrayed in an irregular way. An example of standards conversion would be converting program material from the NTSC 525 line/60Hz (really 59.94Hz) field rate standard to the PAL system, which has 625 lines and a 50Hz field rate.

Standards converters are also used in telecine applications, where film, running at 24 frames per second, is transferred to video, at 50Hz or 60Hz field rates. Traditionally, this process had been accomplished through the use of the 3:2 pull-down shutter on an NTSC telecine. In the case of 50Hz standards, it is accomplished by simply scanning each film frame twice at a slightly faster rate of 25Hz vs. 24Hz. Both of these schemes introduce visible artifacts to the program material. There is also an emerging application to convert standard definition TV (SDTV) formats to high-definition television and vice versa. These devices will become important as the United States moves toward HDTV broadcasting.

The standards conversion process can be considered as two parts. The first is the conversion of the line rate. The second is the conversion of the field or frame rate. Of course, standards converters designed for telecine or SDTV/HDTV conversion have different line and frame rate parameters, but the basic process is similar.

Standards conversion is best accomplished in the digital domain, on digital component video signals. The advantage of digital processing revolves around the ability to form Finite Impulse Response (FIR) filters with precise characteristics in the digital domain. Decreases in the cost of RAM have made the digital processing of multiple fields of video economically feasible. The increases in computer processing power also allow for the use of more complex algorithms.

Standards conversion is best accomplished in the digital domain, on digital component video signals.

Once the incoming video is converted to digital component form, the three components (Y, R-Y, B-Y) are applied to interpolator stages, which serve to estimate the picture content on a line or field somewhere in between the incoming line or field. The output of the interpolator forms the standards converted picture that is encoded into the appropriate an-

Hejtmanek is director of technology for Southern Illinois University's Broadcasting Service, Carbondale, IL.

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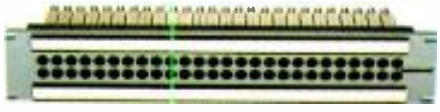

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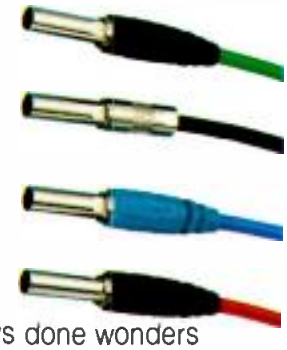

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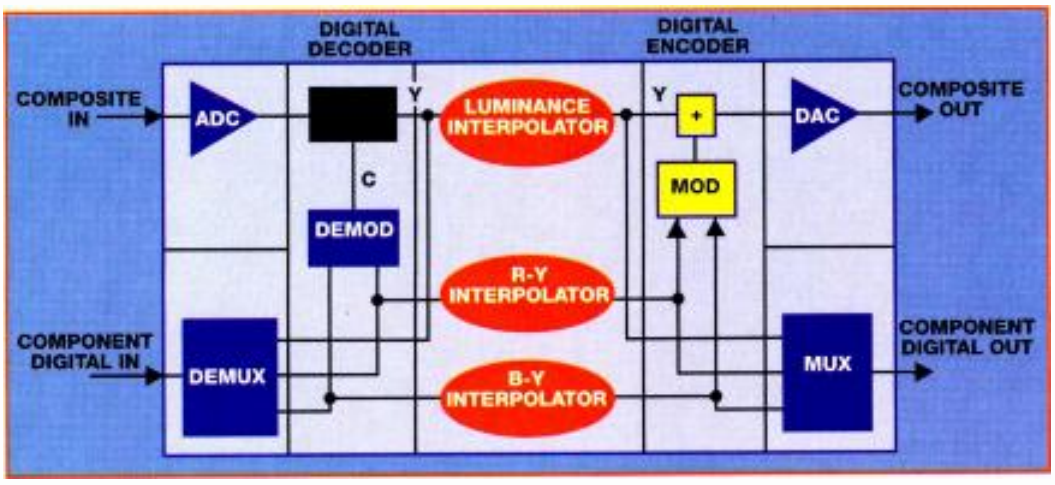

Figure 1. Basic block diagram of a standards converter that uses component video in the digital domain for the conversion process.

alog composite format and output. Figure 1 is a block diagram of the typical digital standards converter.

The interpolation function is actually quite complex. The most difficult problem addressed in the interpolation process is the need to smoothly represent the motion of objects in the output picture. The fact that video is interlaced adds an additional difficulty in that, on stationary scenes, the lines pair up to give full vertical resolution, but when motion occurs, vertical resolution drops to one-half and aliasing can result.

Because video really represents a series of samples of the picture at a combination of rates (pixels per line, lines per field, fields per second), the process of standards conversion can be considered to be a case of multidimensional sample rate conversion. In practice, the number of pixels per line is the same (except, of course, in the SDTV/HDTV conversion process), so the bulk of the processing in a standards converter involves the vertical and temporal axes. Typically, a 4-line by 4-field, 2-D filter created in the digital domain is sufficient to suppress vertical and temporal artifacts from the sample rate conversion process. However, special processing is required to preserve the smooth continuity of the motion of objects in the picture. More information on the basics of digital standards conversion can be found in "Inside Standards Conversion" in the November 1992 issue of *Broadcast Engineering*.

Motion compensation

The human eye consists of a retinal array of discrete light-sensing cells, not unlike a CCD camera, which dictates the level of visual resolution. There is also a temporal response known as persistence of vision, which tends to blur rapid motion. The fixed eye has poor resolution of moving objects, but can move to follow an object, thereby making the object stationary in relation to the eye and overcoming the lag of persistence of vision.

The human eye consists of a retinal array of discrete light-sensing cells, not unlike a CCD camera, which dictates the level of visual resolution.

Standards converters analyze incoming video fields at one sample rate and create intermediate fields through interpolation, at the sample rate of the output standard. It is the job of motion compensation to compute where a moving object will be in an intermediate field and then shift the object to that position in each of the source fields. Thus, when these source fields are interpolated, the resultant output fields portray the motion smoothly, with a minimum of artifacts.

Another way to visualize the process is shown in Figure 2. A conventional standards converter only interpolates along the time axis, resulting in visible judder (See Figure 2A.) Motion compensation allows the interpolation axis to differ from the time axis. Each object is no longer moving with respect to its own interpolation axis, so temporal aliasing, or judder, cannot occur. (See Figure 2B.) Figure 3 on page 77 shows the basic components of a motion-compensated standards converter.

The motion estimation subsystems measure the motion of objects over the 4-field sample and generate motion values which, when correlated to

Continued on page 77

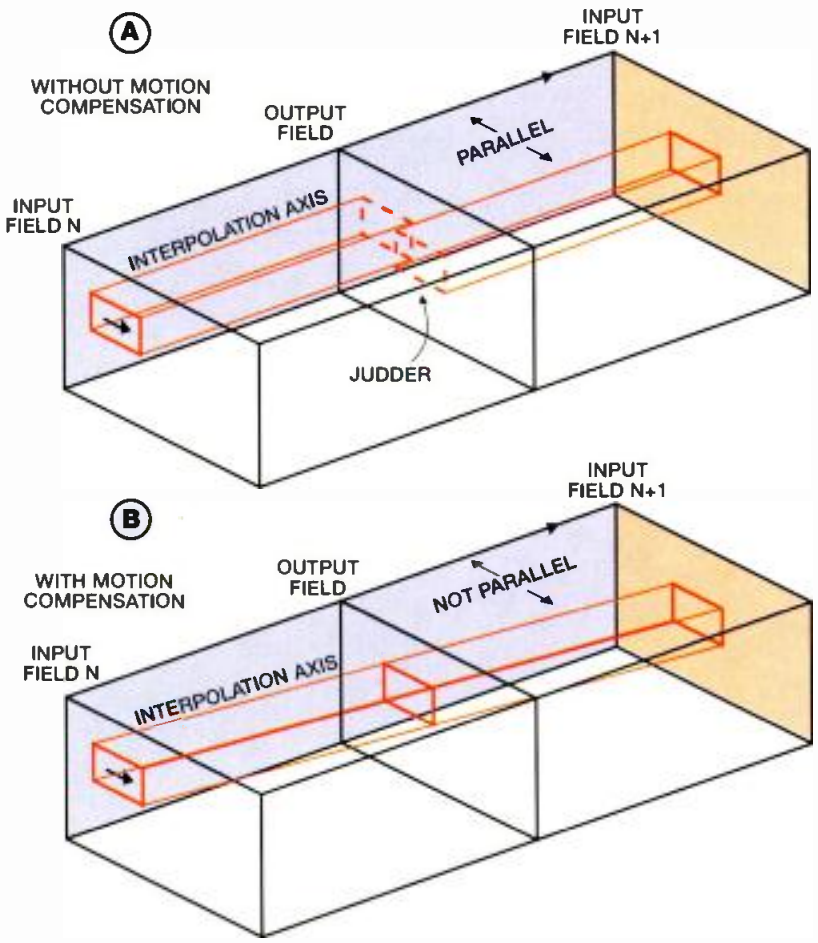

Figure 2. Without motion compensation, the interpolation axis is parallel with the temporal axis, potentially causing judder. With motion compensation, the interpolation axis is aligned parallel to the motion axis.

Standards conversion from the manufacturers' point of view

As was done in 1992, standards conversion manufacturers were asked to comment in regard to conversion processing, in addition to the following questions:

1. **What video attributes, if any, are being compromised in your approach to processing?**
2. **At what level of correction does your conversion method fail?**
3. **What preparations have been or are being made to implement the bidirectional conversion between NTSC, PAL and/or SECAM to HDTV and ACTV?**

The following responses were received:

AVS/Tekniche

AVS standards converters comprise the major component in the product range offered by the newly formed Tekniche Inc. The rest of the product line includes digital and analog format conversion and interfacing equipment.

CYRUS and CYRUS PRIME, AVS' top-of-the-line converters, were designed to accommodate high-end, post-production facilities, cable networks and broadcasters.

In its standard form CYRUS represents the state-of-the-art in linear 4-field, 4-line motion interpolated standards conversion. The decoding system employed prior to the standards conversion process is a key element to the transparency of the conversion process. In CYRUS an innovative 10-bit sample rate conversion process employing high-complexity FIR filters is embodied to provide a performance so precise that special test equipment was developed to detect any deviation in the frequency response.

CYRUS operates bidirectionally between all world standards and with all analog and digital tape formats. CYRUS' unique digital capabilities are further illustrated by being the only converter available to operate directly with digital component (D-1, DCT, D-5) or composite (D-2, D-3) signals in either parallel or serial.

CYRUS PRIME provides motion-compensated conversion through the addition of the PRIME motion compensation unit. PRIME, based in the Predictive Hierarchical Advanced Motion Estimation (PHAME) algorithm, analyzes the moving parts of the picture and then uses the information to predict the position of the object in the next frame. The problems of judder and smearing traditionally associated with standards conversion are therefore eliminated. No compromises are made with CYRUS PRIME and the system produces seamless, smooth and judder-free signals.

The TK3:2, recipient of a 1994 Emmy Award, is a converter specifically designed for film-originated material that has been transferred to tape using the 3:2 pull-down sequence. The TK3:2 eliminates the third field in the "3" cycle and thereby provides a modified PAL output with 24 frames; each video frame representing an original film frame. The resultant signal is recorded on a modified videotape machine and when replayed will be 4% shorter than the original film material. The modification kits for videotape machines are provided with the TK3:2 and are configured to switch between the modified 24-frame PAL signal and normal 25-frame PAL.

EOS, a high-grade, economical 4-field, 4-line linear converter, provides bidirectional conversion between all world

standards. EOS is presently configured to operate with analog sources in composite and component and provides a comprehensive range of video controls. EOS is in operation in satellite facilities, cable networks, duplication facilities and post-pro-

Quantel

Quantel is unique because it offers standards conversion as an automatic and standard facility in all its graphics creation, storage and presentation devices. Quantel systems already handle conversions between all major standards on a regular basis. To meet the requirements of broadcast graphics, the process is high quality, flexible and fast.

This performance is achieved by storing all images on disk at their original recording resolution and converting on replay (automatically and at a speed transparent to the operator) using dedicated custom hardware. In use, a Paintbox, Paintbox HD or Picturebox can therefore contain a mixture of images at virtually any resolution and aspect ratio, including 525, 626, all proposed HDTV standards and beyond.

Because the process is completely bidirectional and all Quantel systems are internally digital component, the only potential compromises are imposed by the source and replay formats. Even here, the user is offered as much flexibility as possible. For example, a 525 unit can replay a full HD image at lower resolution (re-aspected or letterboxed) or a user-defined section of the image at its original resolution.

Thomson Broadcast

Current motion prediction techniques are in their first generation, and are far from attaining the highest possible performances. Algorithmic research is currently under way. Future algorithms will allow more accurate, more reliable and more complex motion prediction that can also be used for slow motion.

Our current model, the TTV 7810, has a motion estimation system that makes use of a recursive technique. To reach a high level of performance, the motion estimation is pixel based, which means that a motion vector is derived for every pixel in the picture. The motion estimation and the motion-compensated interpolation handle fast displacements: + 31 pixels per field horizontally and +15 pixels per field vertically.

The equipment is composed of four units, the A/D and D/A converter, the standards converter, the power supply and the remote control. The next generation product is in preparation. It will include new algorithms,

more interfaces (digital, component, composite) and will be more compact.

Video International

Until now the conversion of video material between the different world broadcast standards has been a complicated and cost-intensive task. This was especially true for the conversion of picture frequency and number of lines (i.e. PAL 625/50 to NTSC 525/60). Currently, users have a choice between two types of converters, vector converters and linear 4-field converters.

The vector converter calculates the apparent motion from the source material and then interpolates using those calculated vectors. The calculations necessary for this operation are immense and the appearance of undesirable artifacts during certain situations is a possibility. These converters are limited to use during events with special considerations (i.e. international sports events) because of their high cost.

The linear 4-field converter represents the current state of technology for standard conversion. It delivers good and predictable results (if provided with optimized interpolation curves), which will suffice in most applicable situations. A well-functioning 4-field converter is still a stand-alone unit with sophisticated technology and still relatively costly. All known attempts to change this fact through the use of reduced hardware have resulted in compromised picture quality and therefore were not satisfactory.

Video International Development Corporation offers both types of converters. The model DTC 4600 uses a proprietary process of motion vector estimation interpolation to achieve near transparency. The DTC 1600 series 4-field/4-line converters are based on our exclusive SCOG converter ASIC, which conforms to the 13.5MHz./4:2:2 standard according to the CCIR 601 directive. They also represent the state-of-the-art at the lowest possible price to the customer. Interfaces for bidirectional conversion of all world broadcast standards as well as most analog and digital formats are available.

Vistek

The Vistek Vector VMC was the first commercially accepted motion-compensated standards converter, which was launched in 1991. It received three major awards for technical achievement including an Emmy during the past two years.

The accurate use of motion compensation dramatically reduces the compromises present when using a linear interpolating converter. Effects, such as smearing, picture softening and rip-

ple or judder, inevitable when interpolating moving images, are eliminated by the Vector VMC. Signal integrity is always maintained.

This does not mean that standards conversion is now a perfect process because there are still limitations with any motion-compensating system. Careful and full evaluation of the available and emerging technologies at the design stage (including nearly two years of joint development of the BBC Phase Correlation system) allowed Vistek to select the best technology for the specific task.

A hierarchical spatial correlation system based on the Predictive Hierarchical Advanced Motion Estimation (PHAME) algorithm developed in conjunction with Digital Vision AB (Sweden) was found to be the optimum solution.

This provides the most robust and accurate system for the specific, and critical, demands of standards conversion. It combines all the prerequisites of high tracking range (maximum measurable velocity), precision (resolution of velocities), resolution (accuracy of boundary definition). vector quantity (number of different motions measurable) and low error rate.

One of the main areas of difficulty for a motion measuring system is where an object appears or disappears behind another object. This gives a situation where a motion has no past or future to measure against. It is particularly in this area that the ability of the system to recognize measurement errors and modify its operation smoothly becomes of paramount importance.

Much of the development of the Vector VMC, since its launch, has been in this area. A sophisticated system of error measurement and progressive fall back toward linear operation has ensured that material that cannot be reliably compensated does not cause aberrations to become visible to the viewer.

Development of the Vector VMC system is an ongoing process with upgrades periodically being made available to new and existing customers. Vistek continues to pursue the goal of perfect standards conversion to maintain the market leadership enjoyed since the product launch. The Vector VMC can be provided with all current analog and digital interfaces and converts between all standards.

Prime Image

Bidirectional standards conversion for all world standards has been taken off the rack and placed on a circuit board by Prime Image of Saratoga, CA, with the introduction of the STD-CON/PCB standards converter.

In addition to the full line of standards converters and other video processing equipment the company manufactures for the broadcast, cable, production and "prosumer" markets, Prime Image recently brought to market the STD-CON/PCB standards converter. The product meets or exceeds the requirements of the broadcast market and puts high-performance, digital standards conversion within reach of other market segments. The full converter resides on a single plug-in circuit board. The combination of price, size and power consumption makes the STD-CON/PCB applicable for the desktop production market, where video and personal computers are teaming up at an ever accelerating rate. The STD-CON/PCB also synchronizes and time-base corrects video signals. Pass-through interpolation alleviates the blurring caused by conventional averaging techniques.

Continued on page 76

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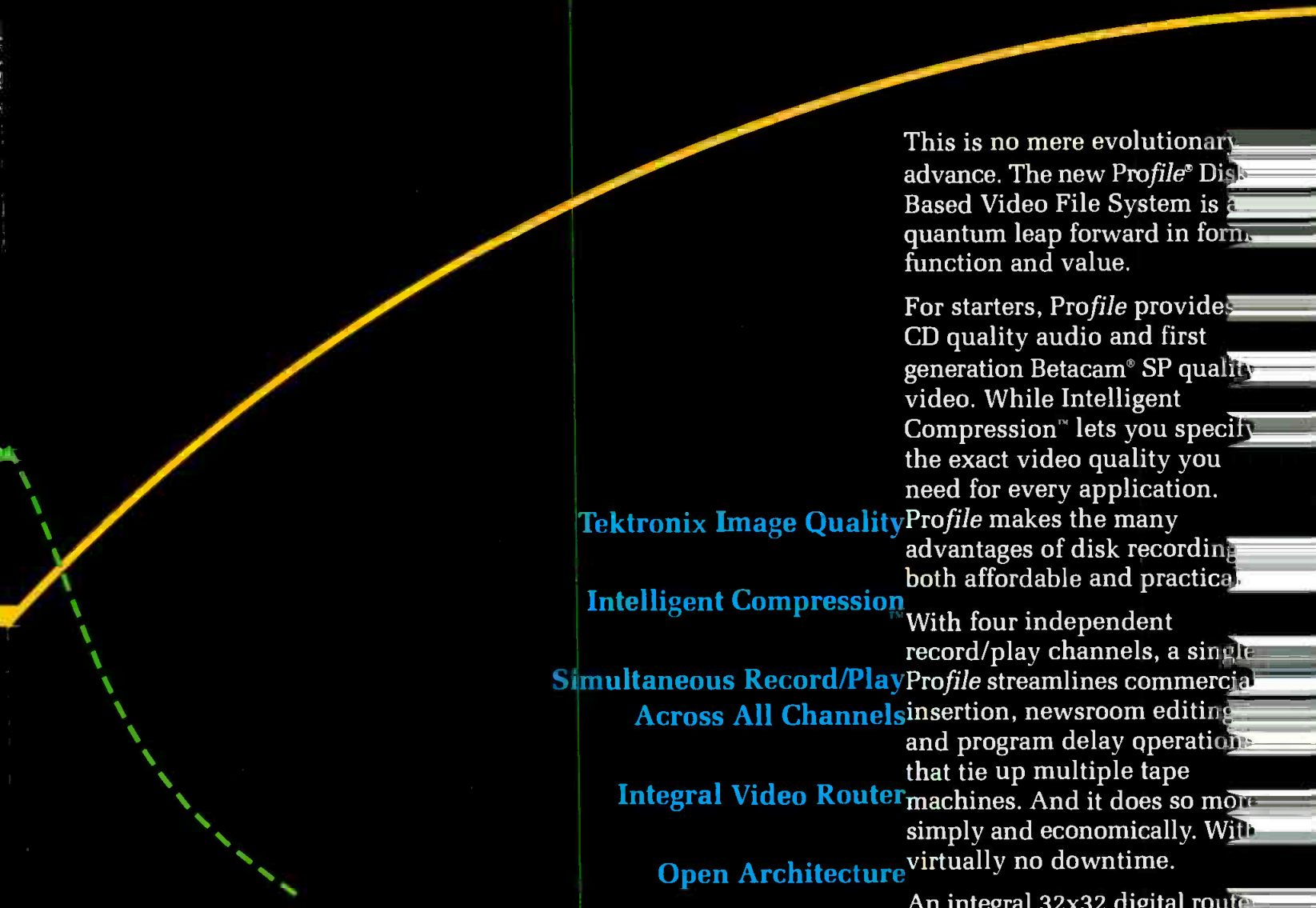

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Tektronix

Continued from page 72

For traditional video applications, the Prime Image SC 8000 provides cost-effective, high-quality standards conversion. Fully digital for smooth, no-drift performance, this 4-field bidirectional NTSC/PAL converter conforms to the most demanding broadcast standards. Bandwidth of 5.5MHz, motion-adaptive ED-framing interpolation, 4:2:2 sampling, and 4+ field conversion are performance features of the SC 8000 converter. The unit accepts signals that haven't been synchronized or time-base corrected with input/output for composite or Y/C video. Several other converters are available in Prime Image's SC series.

Snell & Wilcox

Snell & Wilcox designs and manufactures a complete range of standards converters: 2-field, 4-field, motion compensated, film and HDTV models. Prices range from about $5,000 to $500,000. When discussing compromises in video quality it is necessary to separate out the application, quality level, formats required, and of course, linear converters from the motion-compensated models.

Most of today's linear standards converter designs are, in fact, based on a 14-year-old technology — the BBC's 4-field, 4-line approach. The interesting thing to note here is that different manufacturers make different types of compromises. These affect the quality of the output pictures in distinctly different ways — some stay sharp and produce judder, some use a technique called motion adaptive bandwidth reduction to keep the pictures smooth, but unfortunately, soft and blurred and some try to strike a balance between the two undesirable, yet unavoidable effects.

Even the latest motion-compensated converters are not immune from compromise. The theoretical limits of some less sophisticated systems have forced some designers to resort to the compromise of a hierarchical or recursive scanning approach to compensate for inaccuracy or unreliability caused by lack of processing power.

The Snell & Wilcox flagship motion-compensated standards converter, Alchemist Ph.C, makes no compromises. This is because Ph.C delivers a level of sophistication and processing power that is exponentially greater than any other techniques of motion measurement. Ph.C is the only technique that was designed for the stringent requirements of real-time broadcast video applications rather than less demanding applications, such as data reduction for teleconferencing. It has been designed to deliver an output good enough to be considered an original source. Alchemist was also developed in tandem with a motion estimator. This enables it to take full advantage of proprietary, predictive interpolation algorithms, designed specifically for motion estimation, to perform a non-linear, forward-looking write-side vector modification in order to build output pictures. Rather than applying vectors to the result (read side) of a conventional linear interpolator, Alchemist and Ph.C work together as a logical and coherent system.

All linear converters fail in some way on fast-moving images and/or fast pans. Motion-compensated conversion has been developed to deal with this problem, but some of the latest motion-compensated systems have trouble resolving certain types of complex motion, especially concealed and revealed objects, pans, zooms, rotations and large area displacement. This can result in smears, jerks, judder and breakup of the output images.

Alchemist Ph.C has been designed to avoid failure on complex motion — including fast movement, rotations, pans, zooms, rapid changes in luminance values and periodic structures. The massive processing power and subpixel accuracy of Ph.C enables it to track high velocities and resolve fine detail. To resolve revealed and concealed objects, Ph.C incorporates a proprietary bidirectional vectoring algorithm that projects objects either forward or backward in time, dependent on where the most infor-

Continued from page 68

mation in the original scene is detected.

All Snell & Wilcox standards converters designed for conventional definition formats are bidirectional. Most also deal with all six world broadcast standards.

Snell & Wilcox also design and manufacture studio-quality HDTV downconverters and upconverters. The HD2100 is an HDTV downconverter, while the HD3100 is a production cross-converter performing conversion between field rates as well as line rates. The HD5100 is a studio-quality HDTV upconverter that will provide an HDTV output in any current production standard from all world broadcast standards. ❑

➡ *For more information on standards converters, circle the following numbers on Reply Card. See also "Standards Converters" on p. 64 of the BE Buyers Guide.*

AVS/Techniche	**(304)**
Prime Image	**(305)**
Quantel	**(306)**
Snell & Wilcox	**(307)**
Thomson Broadcast	**(308)**
Video International	**(309)**
Vistek	**(310)**

the actual moving objects in the vector assignment subsystem, form the motion vectors that actually swivel the interpolation axis for each moving object. The process of motion estimation requires a large amount of high-speed processing power and the algorithm is selected to provide the best performance at the target price level and application of the converter product. As an example, converters optimized for sporting events will have a wider motion estimation range than those designed for dramatic programming. A converter targeted toward telecine applications will need yet another estimation range.

Motion estimation methods

Three techniques are commonly used to facilitate motion estimation. They are block matching, gradient approximation and phase correlation. Each of these methods has advantages and disadvantages, based upon the ability to accurately represent the object motion and the complexity involved in the process.

Block matching is the simplest process, whereby the input image is divided up into blocks of pixels and is compared with the same block area in subsequent image fields The block size can be fixed, or hierarchical, where a larger block is examined for evidence of motion and, if it is found, block size is reduced on the target area for higher resolution. Although simple in concept, block matching requires large amounts of processing overhead as the area of search widens beyond a few pixels.

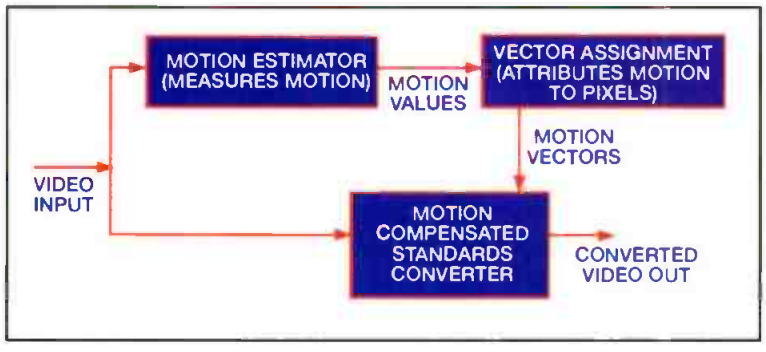

Figure 3. *Block diagram of the various stages used in a motion compensation system.*

Gradient approximation relies on the

characteristics of moving objects to detect motion. This system seeks to detect a blurred edge or gradient from field to field, which would tend to indicate motion. If the edges of an object are poorly defined, additional information is needed from successive fields to raise the confidence level. Certain types of motion are difficult for gradient approximation to detect, and the process does not handle cuts well.

Phase correlation performs a spectral analysis on two sequential fields using a Fast Fourier Transform (FFT). It then analyzes the phase differences between the spectra, generating a 3-D correlation surface. This surface has peaks corresponding to each moving object on the scene. The direction and magnitude of the motion of each object can be derived from the position of the peaks on the surface. It is a fundamental strength of this process that the speed and direction of moving objects are actually measured, and not estimated or extrapolated.

In order to reduce the computational overhead of the FFT, fields are converted to a group of overlapping blocks. The block size is selected to allow motion to be detected up to the judder visibility threshold of the human eye. Phase correlation within these blocks creates candidate motion vectors, which are then correlated with picture content to eliminate spurious vectors and raise the confidence level for the remaining vectors. Image correlation is a form of matching, which looks for similar luminance values in areas of successive fields that correspond to the motion vectors generated by the phase correlation function. Each motion vector is 2-D, in that it represents a vertical and horizontal displacement on the target field. For that reason, the motion compensated standards converter requires horizontal interpolation, as well as the normal vertical and temporal interpolation required by all standards converters.

Special processing is required to preserve the smooth continuity of the motion of objects in the picture.

When objects move, the background at the leading edge of the moving object will be obscured and at the trailing edge will be revealed. The motion compensator stage of the standards converter will have to effectively synthesize the background for the intermediate fields it is creating for the conversion. This function is also handled by the image correlator.

Valid motion vectors are applied to the interpolator stage of the converter, which then forms the output fields by manipulating the addressing values in the RAM buffer. This process of address mapping is similar to that used in a DVE system. The resultant digital data is applied to a digital encoder stage and finally a digital-to-analog converter, for output as composite video in the desired format.

Standards converter applications

Aside from the expected conversion from one broadcast TV standard to another, the standards converter is also frequently used to properly transfer film materials to video. Because film is a medium that has no interlace and is frame-sampled at the same instant, visible artifacts from a conversion to interlaced, line-sequential video are inevitable. Particularly noticeable are conversions to 60Hz standards, where a 3:2 shutter is used in the transfer process. If a film transfer video done at 60Hz is standards

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converted to 50Hz, these artifacts are magnified even more. A motion-compensated standards converter can be specially designed to sort out the 3:2 field sequence and discard the third repeated field. This results in an effective field rate of 48Hz, with each frame of film represented by two fields of video. This stream can be more easily converted to a 50Hz video standard, with minimum artifacts.

The conversion between HDTV formats and standard definition TV formats is more complicated than conversions among the SDTV standards. In addition to differences in field and line rate, the HDTV formats have a 16:9 aspect ratio, while the SDTV systems are 4:3. The downconversion process can handle the aspect ratio change by showing full picture height and cropping edges. It can also show the familiar "letterbox" look, where the picture is shown at full width, with a black bar above and below the displayed image. Downconverters must also filter the horizontal axis to reduce the bandwidth to a level allowed by the SDTV format. Upconversion involves the interpolation of horizontal information to fill in the wider horizontal lines.

Judging performance

There is no such thing as a perfect standards converter. There will always be some features in the source video that cannot be fixed by the converter. Rotational motion artifacts in the picture are one example. Thus, the effectiveness of a standards converter must be judged subjectively, by applying program material to the input and viewing the output.

When objects move, the background at the leading edge of the moving object will be obscured and at the trailing edge will be revealed.

Sports programming is frequently used to test and demonstrate standards converters. Ice hockey features fast pans and the small, fast puck, as well as high contrast, stark images that will reveal any judder. Certain backgrounds can work against successful evaluation of standards converters. Grassy areas are featureless in wide shots and will tend to mask artifacts. Scrolling captions are effective at testing image correlator algorithms, while stationary characters coupled with rapidly moving backgrounds test the ability of the converter to synthesize missing background information.

If the source of the test material was a tube camera, motion blur inherent to this camera type may conceal shortcomings in the converter. Typically, video recorded with a shuttered CCD camera is a better test. In this case, the sample time of each video field is short, resulting in sharper video, field to field. Any blurring that appears in the CCD camera video is more likely caused by the standards conversion process.

As HDTV looms on the horizon, standards conversion is an area that engineers will need to become familiar with. Having an understanding of the concepts involved along with the ability to critically evaluate these systems will be necessary as the transition to HDTV begins. ■

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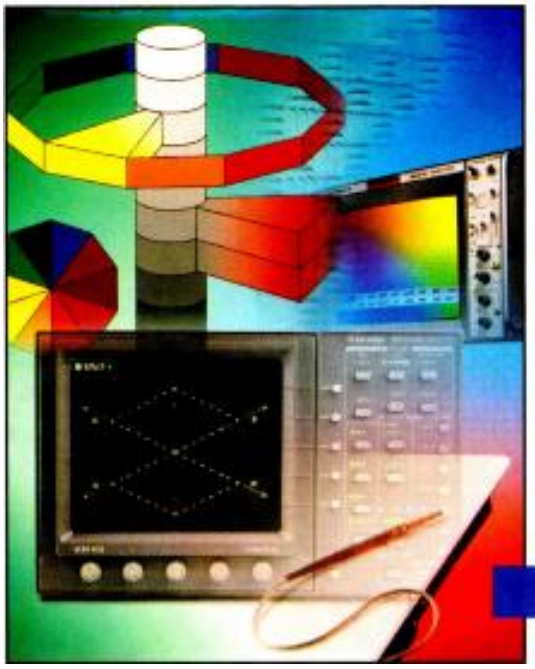

Getting the most from your battery

New battery chemistries and smart chargers can solve portable powering problems.

By Isidor Buchmann

The Bottom Line

The growing remote use of digital recording equipment and portable computers have stepped up broadcasters' needs for high-capacity, reliable battery systems. Fortunately, there are new technologies available to choose from including NiCad, NiMH, lead acid and rechargeable lithium batteries. Learn which battery will suit your application for optimum performance.

$

One of the common difficulties with battery-powered equipment is the gradual deterioration in battery performance after the first year of service. Although fully charged, a battery's charge may have dropped to half its original capacity by the time you use it, resulting in unexpectedly shortened lifespans.

It is always difficult to know the exact charge status of a battery. In many ways, a battery exhibits human characteristics: it needs good nutrition, it prefers a moderate room temperature, and in the case of the nickel cadmium (NiCad) battery, it requires regular exercise. This article considers the needs of different battery chemistries, what applications are suitable for each, and how to get the most out of them.

Nickel cadmium batteries

Among rechargeable batteries, the NiCad remains the most popular choice. Some of its distinct advantages over other battery chemistries are fast and simple charging, a high number of charge-discharge cycles (perhaps 30,000 or more, if properly maintained), excellent load performance (even at cold temperatures), simple storage and transportation, easy recharge after prolonged storage, and forgiving of abuse.

The NiCad is a strong and silent type. Hard work poses no problem. It prefers fast charge over trickle charge and pulse charge over DC charge. Improved performance is achieved by interspersing discharge pulses between charge pulses during the charging process. This charge method is commonly referred to as *reflex* or *reverse load* charge. The brief discharge currents promote the recombination of gases generated during fast charge, and results in a cooler and more effective charge than can be obtained with conventional DC chargers. Research has shown that the reverse load charge method adds 15% to the life of the NiCad battery.

The NiCad does not like to sit in chargers for days and then be used only occasionally for brief periods. In fact, the NiCad is the only battery type that performs best if periodically fully discharged. All other battery chemistries prefer shallow discharges. So important is this periodic full discharge that, if omitted, the NiCad gradually loses performance due to voltage depression or *memory* effects (more on this later).

Nickel metal hydride batteries

The nickel metal hydride (NiMH) has been heralded as the shining star that will solve many of today's battery problems. Although some of these claims may be overly optimistic, the NiMH has distinct advantages over the NiCad. For example, the NiMH is not affected by memory in the same way as the NiCad. Periodic exercise cycles may not be necessary. NiMH batteries also provide 30% more capacity than typical NiCads, and they are environmentally friendly.

Unfortunately, the NiMH lags behind the NiCad in several aspects: It is rated for only 400 to 700 charge/discharge cycles, and its longevity is directly proportional to the depth of discharge. The NiMH battery also does not lend itself to fast charge as well as the NiCad, nor does the NiMH provide as dependable a method of detecting full charge status. Finally,

Buchmann is the founder and chief executive officer of Cadex Electronics, Burnaby, BC, Canada. Respond via the *BE* FAXback line at 913-967-1905.

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the maximum allowable discharge current of the NiMH is considerably less than that of the NiCad. This may not be critical for applications requiring only a small load, but for video cameras and other devices requiring high power, the more rugged NiCad is recommended.

Both NiMH and NiCad are affected by *self-discharge*. The NiCad loses approximately 10% of its capacity within the first 24 hours, after which the self-discharge settles to about 10% per month. For the NiMH, the self-discharge is higher because hydrogen atoms try to escape. Countering this by choosing materials that improve bonding of the hydrogen ends up reducing the capacity of the battery, so designers must compromise between acceptable charge retention and high capacity.

Tests have shown significant variations in performance between different brands of NiMH batteries, and some industry leaders feel that NiMH chemistry is not yet fully defined. This, coupled with NiMH prices remaining about 50% higher than NiCad, has kept NiMH from becoming a strong contender for broadcast applications as yet.

PARAMETERS	NICD	NiMH	SLA	Li-ON
ENERGY DENSITY (Wh/kg)	50	70	30	100
CYCLE LIFE (TYPICAL)	1,500	500	200-300	300-500
FAST-CHARGE TIME	1.5h	2-3h	8-15h	3-6h
SELF-DISCHARGE	MODERATE	HIGH	LOW	LOW
VOLTS/CELL (NOMINAL)	1.25V	1.25V	2V	3.6V
PEAK DISCHARGE CURRENT	HIGH	MODERATE	MODERATE	MODERATE
COST	LOW	MODERATE	VERY LOW	VERY HIGH

Table 1. *Four popular battery chemistries compared. Energy density is measured in watt-hours per kilogram (Wh/kg). Cycle life shows typical number of charge-discharge cycles until battery capacity decreases to 80% of original maximum. Actual performance will vary with usage and maintenance habits.*

Lead acid batteries

Another commonly used battery is the lead acid type. The flooded version can be found in automobiles, but more appropriate for some broadcast applications is *the sealed lead acid* (SLA) battery.

The SLA is commonly used when high power is required, weight is not critical, and cost must be kept low. The typical current range of the SLA is 2Ah to 30Ah. Applications that fall into this category are wheelchairs, UPS units and emergency lighting. Some video cameras, transportable cellular phones and laptop computers also use SLA batteries.

The SLA is not subject to memory. No harm is done by leaving the battery on trickle or float charge for a prolonged time. If removed from the charger, the SLA retains the charge for a longer period than the NiCad and NiMH. The SLA is usually lower priced per Ah than other rechargeable batteries.

On the negative side, the SLA does not lend itself well to fast charging. Typical charge times are eight to 16 hours. The SLA must always be stored in a charged state. A discharged SLA will sulfate within hours. If left in that condition, a recharge is difficult or impossible.

Unlike the NiCad, the SLA prefers a shallow discharge. A full discharge causes extra strain and reduces the cycle count from its nominal 200-300. SLAs also provide a relatively low discharge current, which is further reduced at lower temperatures. Compared to other rechargeables, energy density is low, making the SLA unsuitable for devices that demand small size. Because of its high lead content, SLAs also are not environmentally friendly.

Rechargeable lithium batteries

The rechargeable lithium battery is the most talked-about battery chemistry in research labs today. One of its biggest advantages is high energy density. A lithium battery weighs less than half of an equivalent NiCad. Equally exciting is the fact that once charged, a lithium battery retains its energy for up to 10 years.

Nevertheless, lithium batteries share many of the same negative characteristics of the SLA. Charge times are a long eight to 16 hours and discharge current must be kept low. The cycle count is only 150 to 300 and is affected by the depth of discharge. Rechargeable lithium batteries also are fairly expensive and will likely continue to cost more than other types. In addition, disposal may cause some problems — not from toxic metal content but from the risk of explosion that can occur if corrosion allows internal elements to come into direct contact with moisture. Stability is another major concern, although new solid lithium polymers may solve this problem. Battery experts speculate that a practical rechargeable lithium battery will be readily available in three to five years.

Table 1 summarizes and compares the four types of batteries just discussed.

Memory and self-discharge

There is some misconception about the word *memory* as it applies to rechargeable batteries. Users blame memory for just about any battery failure that occurs. The term is derived from cyclic memory, referring to the phenomenon exhibited by a NiCad battery by which it "remembers" how much discharge was required on previous discharges. Improvements in battery technology have virtually eliminated this problem.

The difficulty with modern NiCad batteries is actually caused by *crystalline formation* within the battery. The active materials (nickel and cadmium) of a NiCad battery are present in crystalline form. When the memory phenomenon occurs, these crystals grow, forming spike or tree-like crystals that cause the NiCad to gradually lose performance. In advanced stages, these crystals may puncture a separator, causing high self-discharge or an electrical short.

Crystalline formation only presents a problem if the battery is left in the charger for days or if repeatedly recharged without a periodic full discharge. Such a condition is not uncommon with video cameras. It is not necessary to discharge a NiCad before each charge. A full discharge down to 1V/cell once a month is sufficient to keep the crystal formation under control. Such a discharge/charge cycle is commonly referred to as *exercise*.

If no exercise is applied for several months, the crystals ingrain themselves, making them more difficult to dissolve. In such cases, *reconditioning* is required — a slow, deep discharge that drains the cell to a voltage threshold below one volt per cell. Not all batteries respond well to reconditioning, however. Although some older NiCad batteries may recover to near original capacity, others may actually deteriorate further with reconditioning. If the latter occurs, the battery in question is a clear candidate for retirement.

NiCad and particularly NiMH batteries also have a relatively high self-discharge. If left on the shelf, a new NiCad normally loses about 10% of its capacity in 24 hours. The problem can worsen, however, reaching an untenable stage if self-discharge causes the battery to drain completely within a single day on the shelf.

Such high self-discharge is typically caused by a damaged separator. The separator is a thin insulator that isolates the positive and negative cell plates. (See Figure 1.) Once injured, the separator can no longer be repaired. External forces that harm the sensitive separator are uncontrolled crystalline formation (due to lack of exercise), poorly designed chargers that boil the battery, and aging of the battery.

A battery analyzer can be used to measure the self-discharge of a battery. First

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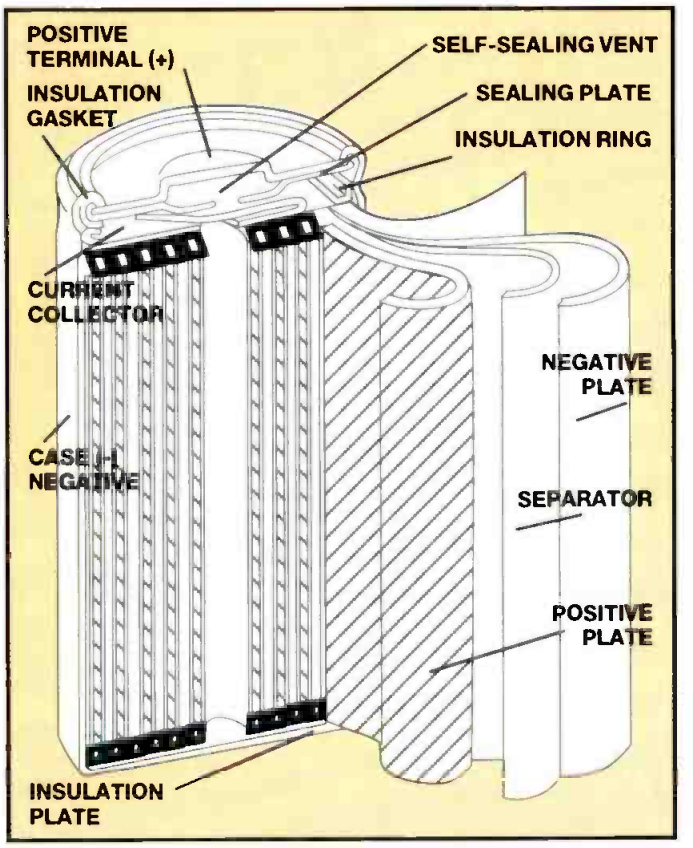

Figure 1. *Cutaway view of a typical NiCad battery. A nickel hydroxide positive plate and an active cadmium negative plate are placed on either side of a separator moistened with electrolyte, then rolled up together and placed into a metal cylinder. The current collector carries charges from the plates to respective terminals on battery case.*

the capacity of the fully charged battery is obtained by applying a discharge. The battery is then stored for 24 hours and the capacity is measured again. If the capacity loss is more than 30%, the battery should be discarded.

Battery analyzers can also be used to exercise and recondition batteries for prolonged service life. Analyzers are essential in identifying and weeding out weak batteries, as well. Most modern battery analyzers are smart devices. They have software that adapts to the type of battery under test, assesses its specific condition and implements the appropriate cycles to maximize performance safely and quickly. Computer and printer interfaces are typically provided by these analyzers to produce charge-time/date labels for batteries, and to generate service reports or database updates for tracking performance.

Slow but sure progress

Over the last 30 years, the rechargeable battery has not improved much in terms of increased capacity for a given size. When compared to advancements in IC technology, the battery lags far behind. If the size/performance improvements experienced by memory chips during this period were applied to batteries, a heavy-duty car battery of the 1960s would be the size of an apple seed today. But because today's batteries are still based on chemical processes, an apple seed-sized battery that can start a car is still a far-fetched dream.

Nevertheless, progress is taking place, both in the development of new battery chemistries and the refinement of battery analysis/optimization technologies for existing systems. As broadcasters' need for portable power continues to grow, battery systems are rising to the challenge. ■

➡ *For more information on rechargeable battery systems, circle (302) on Reply Card. See also "Batteries, Chargers, Analyzers, Reconditioners," p. 74 of the BE Buyers Guide.*

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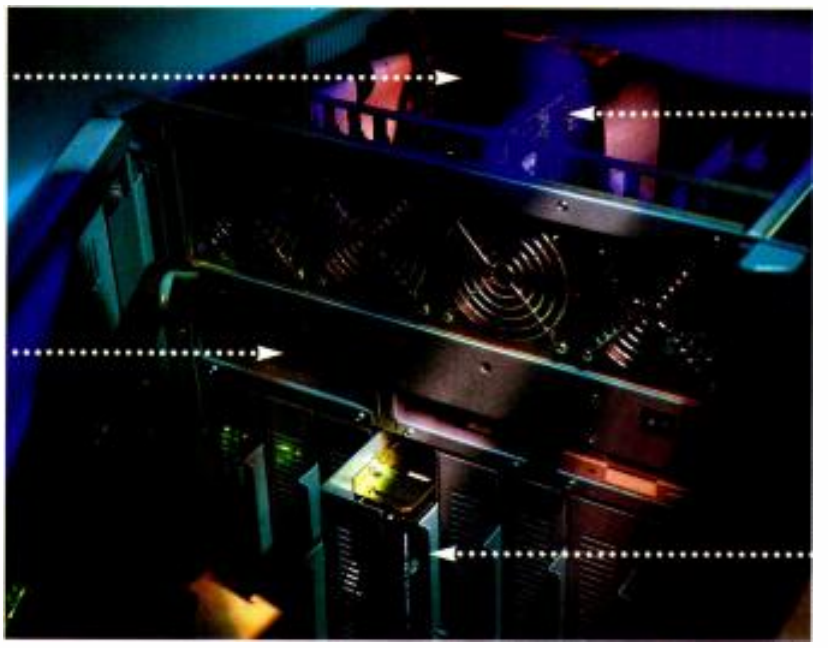

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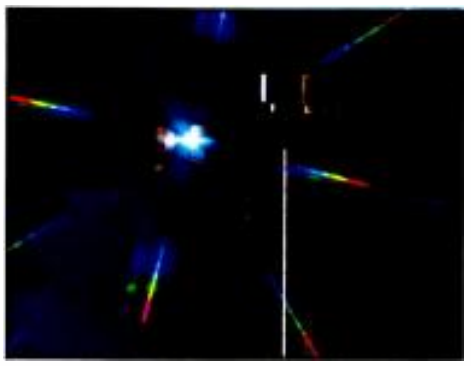
Color and the Diamond display



By Guy Lewis

Color video — they just don't make it like they used to. Now images come from a variety of sources, not just film or video cameras. Viewers have come to expect high-quality images with complex special effects and artistically manipulated color. These expectations have fueled a need in the creative environment for a simple, direct way to monitor video signals for validity. The Diamond display is a new component vector display that meets this need by detecting "illegal colors" before they show up in a finished product.

Although current technology appears capable of anything, in fact, the very effects it was designed to create can be hurt when color signals are not properly monitored. Traditional methods of monitoring the color signal, with waveform monitors and vectorscopes, cannot readily determine whether color signals are out of limits in a way that can cause distortions and undesired picture effects later in the signal path.

The Diamond display (see Figure 1, pg. 90) developed by Tektronix, is a newer tool that provides a reliable indication of color signal limit violations. Any time an RGB signal or color-difference component signal is out of gamut, (refers to the range of chromaticity available with certain colors or to the range of voltage signals relative to these colors) the trace on the Diamond display appears outside the boundaries of one or both of the two diamond-shaped elements of the electronic graticule. This Diamond display is useful for evaluating different aspects of color signals and making adjustments on cameras, telecines, color graphics generators, and other video sources.

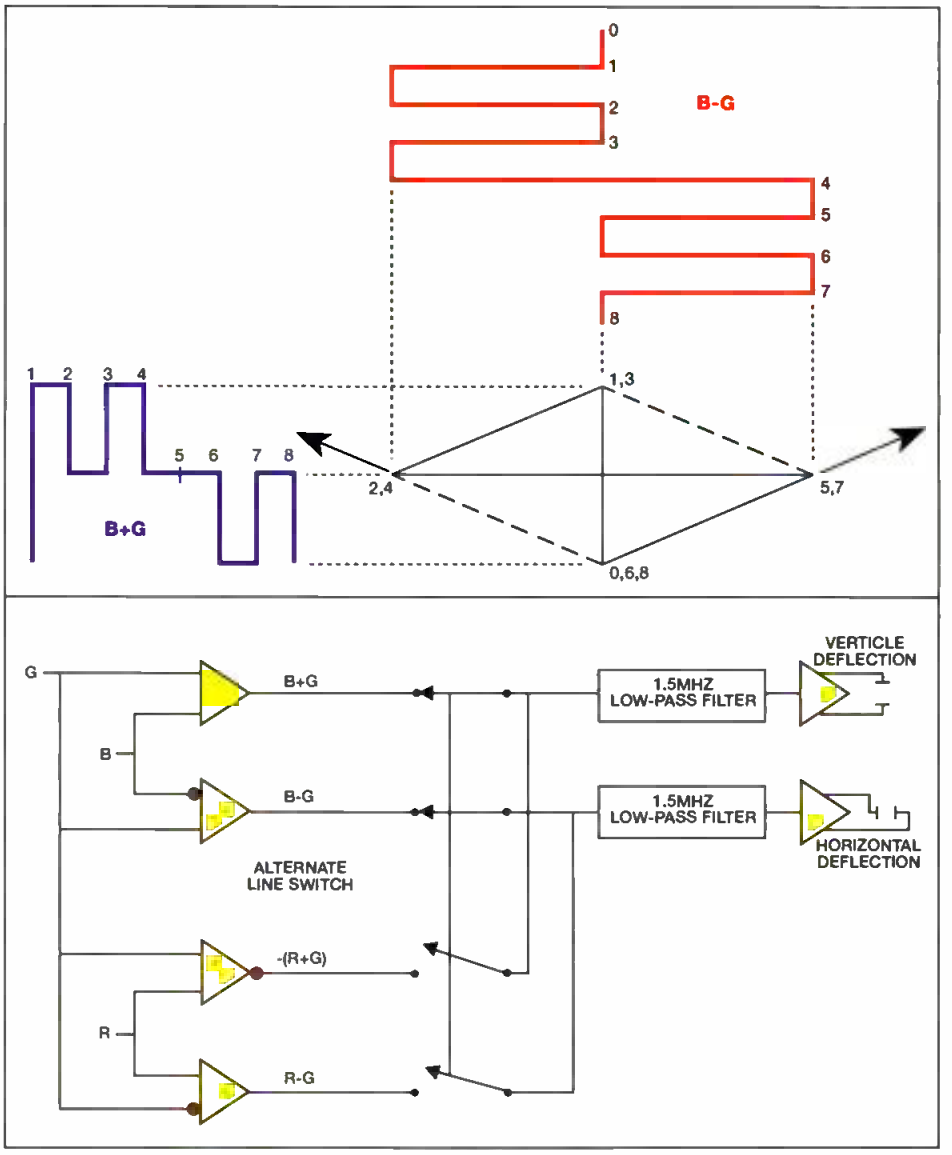


Figure 2. Block diagram of the Diamond display generator. Note the low-pass filters and switching.

Color TV signals

Color television takes advantage of characteristics of human vision to simplify the signals conveying images from place to place. Although many thousands of colors and shades of gray may be reproduced by a video system, the signals consist of only three channels of information — red, green and blue (RGB).

Lewis is product marketing manager for hand-held television products, Tektronix, Beaverton, OR.

In the RGB format, the signals may independently vary from zero to some maximum value in each of the three channels. Any possible combination of signals will produce a proper image as long as the signals do not exceed the upper or lower limit in each channel. If a limit is exceeded, there will almost certainly be distortion of the video — clipping of large signals or possible synchronizing problems with negative signals. A variety of these problems may occur depending on the equipment handling this overlimit (illegal) video.

If all video signals were processed through the system in basic RGB format, monitoring to detect the illegal signals would be quite simple — just ensure that the limits are not exceeded. It's not so simple when formats other than RGB are used. Most studio equipment and all broadcast systems use a different means of conveying the three signals needed to reproduce a color picture. In these sys-

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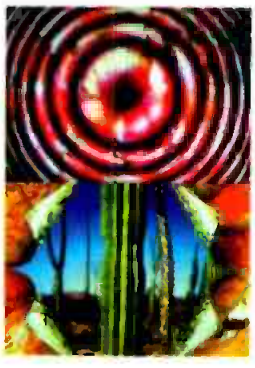

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tems, RGB signals are processed into a luminance signal (Y) and two color-difference signals (B-Y and R-Y). Broadcast systems would then encode the signal into PAL or NTSC.

There are set limits for signal amplitude in the three Y, B-Y, R-Y channels, too. In this form, a much more difficult constraint must be applied to the signals to prevent distortion. Y, B-Y, R-Y signals are interrelated. At a given time, the permitted range of signal in a channel depends on the signal level in the other two channels. You cannot look at one channel and determine whether system limits are being exceeded. Because the basic RGB format is needed in the picture monitor (or other display device) the color-difference signals are always translated back to RGB before viewing.

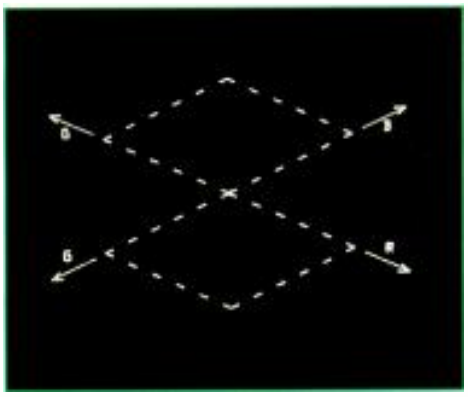


Figure 1. The Diamond display graticule.

Using the Diamond display

The Diamond display can help guard against distortion in a number of applications, for example, with paint boxes and character generators, which create a broad range of colors. Another example is when artificially created or modified video is passed through multiple stages of processing, generations of record/playback, or format translation before reaching the home viewer.

Either of these areas can create technical problems that are difficult to detect until the signals have been further processed. With the Diamond display the end result will not be distorted.

The Diamond display is generated by combining the RGB signals in certain ways. If necessary, other signals, such as color-difference signals, are translated into RGB before the display is generated. A signal deemed legal in the RGB format is also valid, which means it will remain legal when translated to any other component format. So, even though the Diamond display uses the RGB signal as its base, it can still work with color-difference signals. The exception is 100% amplitude signals, like NTSC, that may not be legal in composite formats. Some other method is needed to verify composite limits for NTSC transmission.

The upper diamond is formed by applying blue plus green (B+G) to the vertical axis and blue minus green (B-G) to the horizontal axis. (See Figure 2.) The lower diamond is formed by applying the negative sum of red plus green (-(R+G)) to the vertical axis and red minus green (R-G) to the horizontal axis. Switching at half the video line rate alternately creates the upper and lower diamonds.

The double diamond graticule shows the maximum allowable gamut of the three signals (R, G and B). Any portion of the signal trace outside the graticule limits indicates that particular portion of the signal is out of limits as well. Note the low-pass filter in the diagram in Figure 2. These filters limit the response speed of the deflection amplifiers so they will not indicate out-of-limit conditions that exist for only a short time (a fraction of a microsecond or less). Such short-term out-of-limit signals are often the product of combining the different bandwidths used in Y, B-Y, R-Y signal formats.

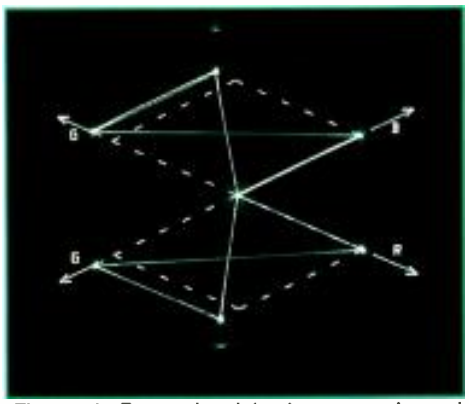


Figure 3. Excess level in the green channel moves the trace beyond the graticule in both diamonds. Note red

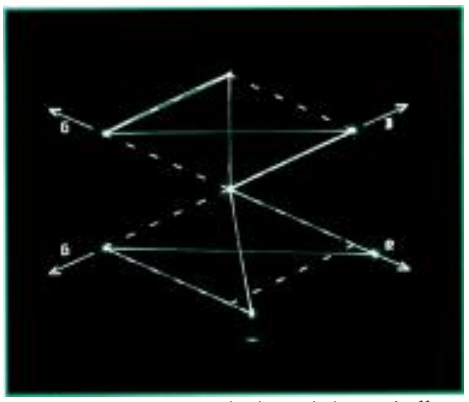


Figure 4. Excess level in the red channel affects only the bottom diamond and only in the red direction.

The low-pass filters in the Diamond display generator limit all signals to about the same bandwidth, so such transient errors are not displayed. This is helpful in practice because trying to eliminate such short-time errors would be a waste of time. Other gamut detectors, which are not bandwidth limited, may indicate a problem when none actually exists.

With the Diamond display it is easy to tell which channel is causing a gamut violation. Note in Figure 3 that the trace is out of limits in the green direction only. The green violation occurs simultaneously in both diamonds. Reducing the green signal will re-establish validity. Figure 4 shows a red overlimit condition. The trace is outside the graticule in the red direction only.

Evaluating the impact of gamut errors

An important benefit of the Diamond display is the ability it gives the operator to judge the importance of displayed errors. Compared to warning lights or other gamut indicators, this display shows both the amount of error and its duration. The amplitude of an error is indicated by the location of the trace —

further outside the diamond graticule means a larger error amplitude. An error that exists only for a short period of time will produce a relatively faint trace. An error that lasts longer will produce a brighter trace. With experience, users are able to use these characteristics to make good judgments about the need to locate and correct gamut errors.

An important benefit of the Diamond display is the ability it gives the operator to judge the importance of displayed errors.

Other uses of the Diamond display

Incorrect camera black balance is easy to detect with the Diamond display. If a signal contains actual black, the display will show a dot at the junction of the two diamonds. If black is not properly adjusted, the display dot will be stretched away from the junction toward the color component that is out of adjustment. Figure 5 shows a camera signal in which setup is too high in the red channel. The origin of the lower half of the display is moved to the lower right, toward red. This test is usually made with the camera lens capped, but the example shows even a live picture can provide useful information about black balance.

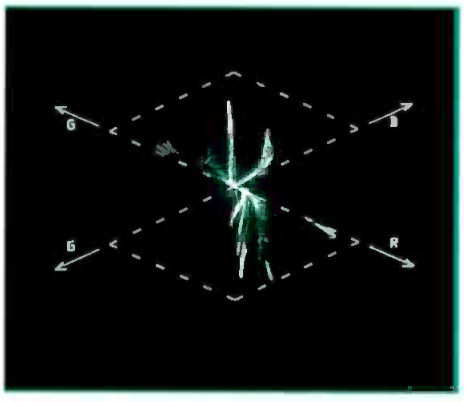


Figure 5. *Black balance errors are evident even while monitoring live video. Note the displacement in the red direction.*

Camera gamma adjustments may also be checked with the Diamond display. Although the display cannot indicate the gamma characteristic, it does show the gamma match among the three color channels. In Figure 6, the bowing of the traces indicates misadjustment of the red and blue gamma controls relative to the green channel. Adjusting the camera gamma controls for balance will straighten the trace so it falls along the vertical center line of the graticule. The camera must be viewing a monochrome image, such as a luminance chart, to obtain this display.

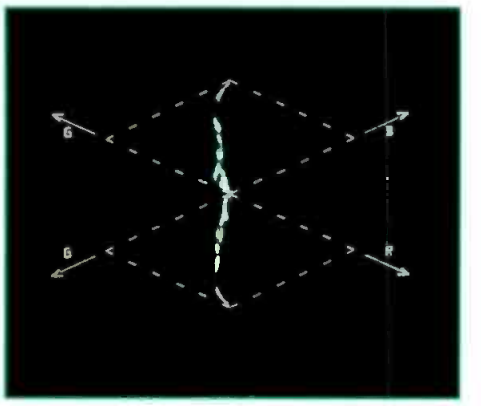


Figure 6. *This curved trace, when viewing a monochrome target, shows black balance problems. Correct adjustment will produce a straight vertical line.*

The advantages of RGB monitoring

Monitoring the color video signal with the RGB Diamond display offers several advantages. This is true even though most studio equipment, video recorders and broadcast signals are in Y, B-Y, R-Y format. Only in RGB is it easy to determine whether a signal is valid and likely to be handled without distortion throughout the system.

Furthermore, many operational devices have controls that operate in RGB color coordinates. Computer graphic workstations, paint systems and character generators usually use RGB controls, and these devices are frequent sources of illegal video. Cameras, color correctors and gamma correctors operate in RGB mode and are an obvious candidate of monitoring with the Diamond display.

The Diamond display meets the growing need in the creative environment for a quick, easy way to accurately monitor video signals for RGB validity. Whether the signals originate in RGB or color difference, the Diamond display lets you be certain the colorful, creative effects in your program will be properly reproduced for presentation to your audience. ■

Defining some TV terms

Several new terms have crept into our TV vocabulary over the past few years. Defining these terms will aid in understanding the Diamond display functions.

Gamut: Refers to a range, from a lower limit to an upper limit, usually of the voltage signals of certain specific colors used in a camera or display. Gamut can also refer to the range of chromaticity in relation to those colors.

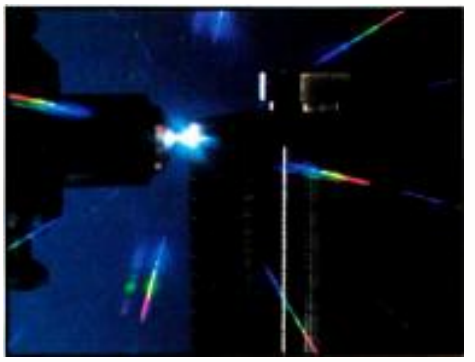
Legal/illegal: A signal is legal if it stays within the gamut appropriate for the format in use. A legal signal does not exceed the voltage limits specified for the format of any of the signal channels. An illegal signal is one that is sometimes outside those limits in one or more channels. A signal can be legal but still not be valid.

Valid/invalid: A valid signal meets two constraints: It is legal in the current format, and it will remain legal when properly translated to any other color signal format.

➡ *For more information on the Diamond display, circle (313) on Reply Card.*

Applied Technology

EMCEE TTU1000E



By Jim Zaroda

KPBI-TV, Fort Smith, AR, is bringing National Football League games to nearly 600,000 viewers in its sprawling, mountainous market. The station is doing this via strategic placement of one main LPTV transmitter along with six LPTV translators, manufactured by EMCEE Broadcast Products, Inc.

KPBI is the only low-power station in its market. This Fox affiliate is competing head-to-head with full-power stations affiliated with the three major networks. It is no easy task, because the market area is split down the middle by the 20-mile-wide Boston Mountains. The range includes Mt. Magazine, which is approximately 2,300 feet.

KPBI-TV uses high-gain broadcasting antennas and transmitters/translators to bring its programming to the entire viewing audience in this difficult market. One unit is installed on top of Mt. Magazine. The last four translators KPBI-TV has put on-line have been 1kW UHF units (TU1000E) manufactured by EMCEE. Most are located in remote areas of rough terrain and operated by remote control.

First Fox NFL broadcast

This is the first year Fox is broadcasting the NFL games, so the network has placed great importance on delivering its programming to the population centers in each affiliate's designated market area (DMA). Affiliates were urged by Fox to use translators and patterned antennas to focus the strongest signal on those areas where the maximum potential audience is living.

With its seven stations — the originating transmitter in Fort Smith, and six translators — plus selection of the optimum antenna patterns, KPBI-TV can reach every potential viewer in its geographical area. Because of translator placement, there is some signal overlap, allowing some viewers the choice of picking up the station on two or three channels. In addition, the translators enable the station to broadcast localized material to specific geographical areas within the market.

The EMCEE translators in use are the TU1000E series, which offer high performance, design versatility and space efficiency. Self-contained in a single cabinet, the unit is a complete 1kW UHF transmitter/translator, including modulator or receiver, solid-state driver, final amplifier and all required power supplies.

The EMCEE TTU1000E, a 1kW UHF tetrode transmitter, the translator version is the TU1000E.

Modular design and construction of the unit facilitates repair and maintenance, allowing field replacement of low-level stages by maintenance personnel. Timing and control functions use highly reliable digital circuitry, rather than being entirely dependent on electromechanical devices.

The amplifier assembly is available separately for use with an existing driver and features a ceramic tetrode with inherently low intermodulation products.

Lightning protection

The unit's interlock system, part of the digital control circuit, turns the translator on and off and helps protect it from damage by lightning or other harmful voltage fluctuations. Because the transmitter/translator is operated remotely, it is important that the unit be able to withstand variances in voltage, whether caused by lightning or other anomalies, without requiring service.

Often, power lines going up into the hills or mountains to remote locations are poorly regulated. Wide voltage fluctuations of ±15% may be encountered. The EMCEE unit is built to handle these fluctuations without performance degradation.

In the event of a problem, the interlock system will shut down the high-voltage circuits to prevent damage to the system. After about 15 seconds, high voltage is restored. If the problem continues, the control will shut the unit down for a similar period. After three tries, the unit is shut down completely. Transient problems are handled in this manner, making it unnecessary for service personnel to go to the remote location to reset the system due to problems of this nature.

The EMCEE transmitter/translator is relatively transparent, typical differential gain is 2% with typical differential phase of 2°. Careful component selection and design, along with provisions for overload means these units are highly reliable in the field.

Factory support

As with most on-air operations, factory support is critical. The EMCEE support staff is consistently available from 6 a.m. to about 10 or 11 p.m. Factory technicians offer over-the-phone assistance so any problems that do occur can be solved quickly. Although factory technicians are available for on-site service, most problems can be solved over the phone. After a major lightning strike, factory technicians were able to get the station back on the air by walking station personnel through procedures over the telephone.

The reliability of transmitter/translator equipment is one of the key ingredients to staying on the air, whether it is a low-power station like KPBI-TV or a full-power station with terrain problems. EMCEE is providing that ingredient and ensuring uninterrupted NFL programming is available to every one of KPBI's 600,000 potential viewers. ■

Zaroda is sales and marketing manager for EMCEE Broadcast Products Inc., White Haven, PA.

➡ *For more information on EMCEE transmitter/translator products, circle (311) on Reply Card.*

Continued from page 10

over a 100-foot path with the antenna 30 feet above the ground. Then the truck was returned to the center of the path and more measurements and observations were taken. Attenuators were used when necessary to avoid receiver overload. Data was recorded on log sheets, digital recorders and personal computers.

Channel 6 interference

The VHF testing was done using fewer locations due to interference with cable Channel 6. Complaints were investigated through a study organized by CableLabs. This study indicated that some interference was produced by off-air pickup on the cable system and some was produced by direct pickup in the TV receiver, however, the most common source was probably cabling that householders had installed to connect a VCR or some other purpose. In some instances the interference was reduced using higher-quality cable or if permitted, a set-top box.

Also, because there is no regularly assigned Channel 6 in the Charlotte area, there are no inhibitions against placement of non-commercial FM stations. Consequently, there are several stations in the 88.1-91.9MHz band. At a few locations, adjacent-channel interference was sufficiently high that Channel 6 could not be measured.

Results

The test results indicate that overall, the ATV transmission system performance was better than NTSC. (See Table 1.) For UHF, satisfactory reception was found in 91% of the locations tested, as compared with only 76% for NTSC. For VHF, despite fewer test sites, satisfactory reception was found in 82% of the locations, as opposed to only 40% for satisfactory NTSC VHF reception. The 8VSB system performed well under the real-world conditions of multipath, impulse noise, and other propagation phenomena. It also performed well under limited indoor reception. Cable tests were equally encouraging.

Acknowledgment: This information was taken from "Field Test Results of the Grand Alliance HDTV Transmission Subsystem" report, submitted Sept. 16, 1994.

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Industry Briefs

BUSINESS

Fotec, Boston, held the second Fiber Optic Installer's Conference, Fiber U, in Long Beach, CA. The conference offered hands-on fiber-optic training to approximately 500 attendees.

Broadcast Electronics, Quincy, IL, has purchased Marti Electronics, Cleburne, TX.

Nikon Electronic Imaging, Melville, NY, has extended its rebate program on TV-Nikkor ENG lenses to Dec. 31, 1994. The rebate offer applies to S19x8B1, S15x8.5B1, and S9x5.5B1 TV Nikkor zoom lenses purchased and shipped from June 15 through Dec. 31, 1994.

Ampex, Redwood City, CA, has sold a DCT 700d drive to Digital Network Television (D-Net).

Ampex will be closing its Betacam production facility in Hong Kong and will no longer sell Betacam recorders and systems.

Chryon, Melville, NY, has announced that Pesa Electronics, S.A., Madrid, has filed for receivership in Spain. The procedure is similar to a Chapter 11 reorganization under the U.S. bankruptcy laws.

Dielectric Communications, Raymond, ME, has been awarded a 5-year equipment contract from Fox Television to supply high-power waveguide, transmission line and other custom RF components.

Ultimatte, Chatsworth, CA, has sold an Ultimatte-7 digital to Capital Cities ABC, New York, NY, for its *One Life to Live* set.

Parallax has purchased an Ultimatte software license, and Pacific Title, Los Angeles, has obtained an Ultimatte CineFusion site license.

ASC Audio Video, Burbank, CA, and Newsmaker Systems have paired the Virtual Recorder and Electronic Newsroom to help make newsrooms more efficient.

Strassner Editing Systems, North Hollywood, CA, has sold two editing systems to High 5 Productions, Nashville.

Strassner and Videomedia, San Jose, CA, have signed a technology exchange agreement granting Videomedia the nonexclusive rights to use Strassner's EDL translation software. Videomedia also will be able to use Norm Strassner as a consulting resource on product plans.

Avid Technology, Tewksbury, MA, and Digidesign, have announced an agreement to merge through an exchange of shares.

Grass Valley Group (GVG), Grass Valley, CA, has finalized the sale of its Graphic's System Division to New Microtime, a subsidiary of Anderson Group Inc (AGI).

Computer Prompting and Captioning, Washington, has received the "1994 Distinguished Vendor of Accessible Technology Award."

Leitch, Chesapeake, VA, has opened regional offices in Irvine, CA, and Dallas.

Hewlett Packard, Palo Alto, CA, has announced that its German dealer, Delta-System GmbH, will be installing a broadcast video server for the RTL2 broadcast company in Munich.

Andrew, Orland, Park, IL, has been awarded a 5-year contract by Fox Television to supply custom Trasar UHF and high-band VHF TV broadcast antennas.

Andrew has won accreditation to ISO 9001 for its terrestrial microwave antenna products and accessories.

Harris Allied, Quincy, IL, has been chosen to design and build an all-digital video facility for The Golf Channel, Florence, KY. The satellite communications systems for the facility will be located in Orlando, FL.

PEOPLE

George Merrick has been named vice president and president of the display business for Dynatech, Salt Lake City.

Steve G. Kukla has been appointed director of new business development for Intelligent Resources Integrated Systems, Arlington Heights, IL.

Steven Schmidt has been named technical services representative for Intelligent Resources Integrated Systems, Arlington Heights, IL.

Dave Burns has rejoined Harris Allied, Quincy, IL, as radio studio product manager.

George Badger has been appointed president for Svetlana Electron Devices, Huntsville, AL. ■

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Statement of Ownership, Management and Circulation (Act of August 12, 1970; Section 3685, Title 39, United States Code)

1. Title of publication: *Broadcast Engineering*
1A. 0007-1794.
2. Date of filing: Sept. 28, 1994.
3. Frequency of issue: Monthly, except for additional issue in November.
3A. Number of issues published annually: 13.
3B. Annual subscription price: FREE TO QUALIFIED.
4. Location of known office of publication (street, city, county, state, zip code): Intertec Publishing, 9800 Metcalf, Overland Park, KS 66212-2215.
5. Location of the headquarters or general business offices of the publishers (not printers): Intertec Publishing, 9800 Metcalf, Overland Park, KS 66212-2215.
6. Names and addresses of publisher, editor and managing editor. Publisher: Dennis Triola, 9800 Metcalf, Overland Park, KS 66212-2215. Editor: Brad Dick, 9800 Metcalf, Overland Park, KS 66212-2215. Managing Editor: Tom Cook, 9800 Metcalf, Overland Park, KS 66212-2215.
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New Products

Highlights from World Media Expo

Function modules
By Microtime

• **DM series:** 10-bit digital video function modules designed as a system of modular video blocks; series features 10-bit plug-in circuit cards for video synchronization, format conversion, color correction and other digital video-related applications.

Circle (350) on Reply Card

Bargraph audio meters
By Logitek

• **Ultra-VU bargraph audio meters:** features expanded range of 64dB, 66 LED bargraphs and simultaneous display of loudness and PPM; other features include stereo image/phase display, high-resolution zoom mode and clipping indicator in decibels.

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Interactive display systems
By Tally Display Corporation

• **Interactive display models:** feature enhanced error detection capabilities; also includes alphanumeric source identification and status, tally and message capabilities, automatic change of source IDs and nine color display modes for cuing.

Circle (352) on Reply Card

Encoding system
By DiviCom

• **MPEG-2 digital broadcast system:** includes DMC 2 program encoder, DRMX 2 ReMultiplexer and DMS 2 system controller; provides sophisticated compression technology and a broad selection of formats and features.

Circle (353) on Reply Card

Cellular video and audio
By Baron Services Inc.

• **NewsFIRST Video:** uses TrueVideo technology to capture Betacam quality video and CD-quality audio from 1 to 30 frames per second; delivers video and audio to studio via cellular phone, land line or Satcom; weighs approximately 30 lbs and is compatible with all cameras.

Circle (354) on Reply Card

Fax system
By Dolby Laboratories

• **Dolby Fax System:** uses Dolby AC-2 coding system for one or two audio channels; also uses ISDN standards for digital telephone lines allowing high-speed transfer of data between locations without analog line degradation.

Circle (355) on Reply Card

Digital video effects systems
By Microtime

• **IMPACT series 5:** features up to 64 real-time, render-free polygons for enhanced True-3-D object resolution, along with three live simultaneous video inputs.

• **IMPACT series 5SC:** operation is similar to series 5; processes one live (A/B switchable) video input.

• **IMPACT series 5XP:** features 64 real-time polygons and three live simultaneous inputs; composes objects of up to 512 polygons, usually in less than 60 seconds for real-time playback with live video.

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Video synchronizers
By Pixel Instruments

• **VS2100:** family of synchronizers providing transparent synchronizing of satellite feeds and microwave links, or retiming of intersuite connections and in-house signal feeds; available in PAL and NTSC versions; input video is 10-bit oversampled at 40MHz, digitally filtered, processed and D to A converted at 12 bits.

Circle (357) on Reply Card

Integrated digital post-production system
By Grass Valley Group

• **Model 2200:** integrated post-production system also functions as a stand-alone production switcher and a 1- or 2-channel digital effects system; features 10-bit component processing, auto selection of 525/625 formats; supports 270Mb/sec 16x9 picture formats.

Circle (358) on Reply Card

CCD telecine
By BTS

• **FDL Quadra:** features dedicated color reproduction, full bandwidth 4:4:4:4 processing, extended color channel bandwidth, fixed pattern noise, extended sizing functions and speedy shuttle time; offers switchable 4:3 or 16:9 aspect ratio, switchable 525/60 or 625/50 line standards, advanced sizing control, Dolby stereo 35mm optical sound, full resolution up to 30% expansion and optical blocks for every commercial film format.

Circle (359) on Reply Card

Intercom system
By Telex

• **Advanced Digital Audio Matrix (ADAM):** about one-tenth the size of other systems with the capacity for more than 1,000 users; works with existing equipment; true digital Time Division Multiplex (TDM) architecture allows for linear expansion; features CD-quality input and output audio.

Circle (360) on Reply Card

New Products

Distribution amplifiers
By Grass Valley Group

• **M9136 and M9136-D:** multistandard serial digital distribution amplifiers; compatible with component and composite digital video systems; units provide auto-select of 143, 177, 270, and 360Mb/s; M9136 is single version with one input and eight outputs; M9136-D is a dual version with two inputs and four outputs.

Circle (361) on Reply Card

ENG/EFP lenses
By Nikon

• **S15x8.5B1-III:** standard ENG/EFP lens; compact lens offering zoom speed adjustment knob, user adjustable zoom torque and a 2.2x extender.

• **S9x5.5B1-II:** super wide-angle lens; features user-adjustable zoom speed and torque.

Circle (362) on Reply Card

Editing system
By BTS

• **Bravo VE virtual editing system:** Windows-based A/B/C roll system; features auto-match frame edits, slow motion edits, auto-assembly, audio/video split edits, record ripple, auto-cleaning of EDLs, and full search functions; standard DVE drivers include BTS Prism digital video effects system.

Circle (363) on Reply Card

Switcher
By DNF Industries

• **SW1x8:** RS-422 switcher allows ST200 and ST100 universal VTR controllers or any RS-422 VTR controller to control up to eights VTRs; allows user to control one out of eight VTRs, control a group of VTRs, or gang roll all eight VTRs.

Circle (364) on Reply Card

Video delay detector
By Pixel Instruments

• **DD2100:** continuously measures actual video delay by correlating active video content between delayed and undelayed video signals; can detect up to eight fields of video delays with overall range of detection selectable in one-field increments.

Circle (365) on Reply Card

High density CD
By Optical Disc Corporation

• **3.3Gbyte high-density CD:** HDCD used for prototype testing; mastered on an ODC series 500 mastering module; disc is being used in the development of players capable of playing up to 135 minutes of MPEG-2 video at data rates of up to 3.3Mb/s.

Circle (366) on Reply Card

Routing systems
By Dynair

• **System 2000:** family of high-performance, ultracompact video and stereo audio routing systems; modular 120MHz system routes high-resolution computer graphics video and encoded broadcast video including HDTV, NTSC, PAL and SECAM.

Circle (367) on Reply Card

Stereo audio router
By Dynair

• **Series 36:** 36x36 audio switcher in three rack units; features 864 crosspoints per RU; control features include actual switch closure and switch status verification from crosspoint, external control through Ethernet, source preview-before-take, MS DOS-based system control software programs and critical-function alarm.

Circle (368) on Reply Card

Compositing system
By Ultimatte

• **CineFusion with GrainKiller:** addition of GrainKiller feature allows user to hold even the finest foreground detail; GrainKiller filters screen area with almost no effect on the foreground image or its edges.

Circle (369) on Reply Card

Video noise reducer
By BTS

• **MNR11:** noise reducer for film-to-tape transfers; removes longitudinal scratches from film transfers, synchronizes video, converts between different formats and enhances contour or softens pictures; dirt filter conceals glitches for clean output signal.

Circle (370) on Reply Card

High definition recorder
By Recognition Concepts Inc.

• **HD video disk recorder:** works with

HD video using existing 4:2:2 equipments; HD disk is compatible with 1080- or 1035-line formats; records directly to D-1 and D-5 VTRs; portable version available.

Circle (371) on Reply Card

Slow motion controller
By DNF Industries

• **ST200-S/SM:** features vari-speed from +2.00 to -1.00 times play speed; varies playspeed while rolling tape or presets play speed with tape stopped; ability to store and recall up to 100 cue points.

Circle (372) on Reply Card

Digital audio D/A
By Grass Valley Group

• **M9422:** a 20-bit D to A converter for AES/EBU digital audio; dual unit features two AES/EBU inputs and four analog outputs; can mix and match with the Grass Valley MAX-900 and MAX-9000 products in the same 3RU frame; offers >110dB signal-to-noise ratio.

Circle (373) on Reply Card

PORTADAT

PERFECT PORTABLE DAT

Quite a claim, we know. But then these are no ordinary DAT recorders. Designed in consultation with representatives from all areas of professional audio recording by HHB, the World's leading independent suppliers of DAT technology, the PORTAOAT range has every detail covered. Compact, light and sonically superb, the PDR1000 features a rugged direct drive transport with 4 heads for confidence monitoring, 2 hour rechargeable battery life, 48v phantom powering, balanced analogue inputs, 44.1/48/32KHz sample rates, digital I/Os and a full range of indexing facilities. In addition, the PDR1000TC is equipped to record, generate and reference to time code in all international standards. But perhaps the most remarkable feature about the PORTADAT range is that for once, perfection doesn't cost the earth. For a free, 8 page color brochure on the PORTADAT, the future of portable DAT recording, call Independent Audio or mail the coupon today.

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Tel: 416 510 1347 · Fax: 416 510 1294

HHB Communications Ltd · 73-75 Scrubs Lane, London NW10 6QU, UK
Tel: 0181 960 2144 · Fax: 0181 960 1160

HHB

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DAT Digital Audio Tape

New Products
continued from page 96

Audio delay/synchronizer
By Pixel Instruments

• **AD2100:** high-performance stereo audio delay processor; corrects lip-sync errors caused by video-frame synchronizers, standards converters and other devices that introduce video delays.

Circle (374) on Reply Card

Universal VTR controller
By DNF Industries

• **ST30:** detects switch or contact closure at its input and outputs required serial command to place VTR in the selected mode; controls Sony, Ampex DCT and CVR, Panasonic, JVC, BTS and Hitachi serial VTRs.

Circle (375) on Reply Card

Recordable digital disc format
By Optical Disc Corporation

• **Super CD:** supports data rates up to 7Mb/s of MPEG-2 compliant video (will accommodate 15- to 18Mb/s data rates for HDTV); diameter measures 8 1/2-inch.

Circle (376) on Reply Card

Wireless ENG link
By TransVideo Systems

• **ShotMaster 200:** transmitter attaches instantly to any Betacam, MII, 8mm or S-VHS camcorder using Anton/Bauer Snap-on or NP-1 battery systems; features more than 1,000-foot line-of-sight range.

Circle (377) on Reply Card

Video server
By BTS

• **Media Pool server:** compression scheme can be adjusted from no compression with uncompromised 10-bit 4:2:2 video and gradually increased to levels in excess of 50:1 compression; features hot-swappable drive capabilities along with simultaneous multichannel operation.

Circle (378) on Reply Card

Image media manager
By Viewgraphics

• **Viewstore 6000:** provides computer workstations access to real-time, full-motion, super-high resolution digital imagery; programmable to any resolution up to a 360MHz pixel rate including super-high resolution 2x2K.

Circle (379) on Reply Card

Spot playback system
By Sundance Digital

• **Fastbreak:** integrates a flat-file database with traditional machine control for digitizing selected video onto hard disks; provides random-access non-linear playback of event lists that sequence the playback of spots, IDs, bumpers and promos.

Circle (380) on Reply Card

Continued on page 102

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TASCAM

DA-88 Multi-Track Recorder

The first thing you notice about the eight channel DA-88 is the size of the cassette - it's a small Hi-8mm video cassette. You'll also notice the recording time - up to 120 minutes. These are just two of the advantages of the DA-88's innovative use of 8mm technology.

- Intrinsic to the 8mm video format is the Automatic Track Finding (ATF) control system. This approach records the tracking control information, along with the program material, using the helical scan (video) head. Competing S-VHS based system record the tracking data with a linear recording head, independent of the program data. The S-VHS tape must be run at a higher speed (thereby delivering shorter recording time) to deliver control track reliability, and requires some form of automatic or manual tracking adjustment. Synchronization and tracking must be adjusted, either automatically or manually (just like on your home vcr) as the machine ages, or if the tape is played back on another machine.
- On the other hand, the ATF system ensures that there will be no tracking errors or loss of synchronization. The DA-88 doesn't even have (or need) a tracking adjustment. All eight tracks of audio are perfectly synchronized. What's more, this system guarantees perfect tracking and synchronization between all audio tracks on all cascaded decks - whether you have one deck or sixteen (up to 128 tracks!).
- Incoming audio is digitized by the on-board 16-bit D/A at either 44.1 or 48KHz (user selectable). The frequency response is flat from 20Hz to 20KHz while the dynamic range exceeds 92dB. As you would expect from a CD-quality recorder, the wow and flutter is unmeasurable.
- One of the best features of the DA-88 is the ability to execute seamless Punch-ins and Punch- outs. This feature offers programmable digital crossfades, as well as the ability to insert new material accurately into tight spots. You can even delay individual tracks, whether you want to generate special effects or compensate for poor timing. All of this can be performed easily on a deck that is simple and intuitive to use.

OPTIONS

- **RC-808** – Single Unit Remote Control
- **RC-848** – System Remote Control
- **MU-8824** – 24-Channel Meter Unit
- **SY-88** – Complete SMPTE/EBU Chase Synchronizing and MIDI Machine Control interface

Fostex

RD-8 Multi-Track Recorder

This digital multitrack recorder is designed specifically for the audio professional. Fostex has long been a leader in synchronization, and the RD-8 redefines that commitment. With its built-in SMPTE / EBU reader/generator, the RD-8 can stripe, read and jam sync time code - even convert to MIDI time code. In a sync environment the RD-8 can be either Master or Slave. In a MIDI environment it will integrate seamlessly into the most complex project studio, allowing you complete transport control from within your MMC (MIDI Machine Control) compatible sequencer.

- Full transport control is available via the unit's industry-standard RS-422 port, providing full control right from your video bay. The RD-8 records at either 44.1 or 48KHz and will perform Pull-Up and Pull-Down functions for film/video transfers. The Track Slip feature helps maintain perfect sound-to-picture sync and the 8-Channel Optical Digital Interface keeps you in the digital domain.
- All of this contributes to the superb sound quality of the RD-8. The audio itself is processed by 16-bit digital-to-analog (D/A's) converters at either 44.1 or 48KHz (user selectable) sampling rates, with 64X oversampling. Playback is accomplished with 18 bit analog-to-digital (A/D's) and 64X oversampling, thus delivering CD-quality audio.
- The S-VHS transport in the RD-8 was selected because of its proven reliability, rugged construction and superb tape handling capabilities. Eight tracks on S-VHS tape allow much wider track widths than is possible on other digital tape recording formats.
- With its LCD and 10-digit display panel, the RD-8 is remarkably easy to control. You can readily access 100 locate points, and cross-fade time is fully controllable in machine to machine editing. Table of Contents data can be recorded on tape. When the next session begins, whether on your RD-8 or another, you just load the set up information from your tape and begin working. Since the RD-8 is fully ADAT compliant, your machine can play tapes made on other compatible machines, and can be controlled by other manufacturers ADAT controllers. Your tapes will also be playable on any other ADAT deck.
- In addition to familiar transport controls, there are a number of logical, user friendly features. This is the only unit in its class with an on-board, back-lit variable contrast LCD display. It provides all of the information you'll need to keep track of offsets, punch points, generator functions and other pertinent data. Three function keys, combined with HOME, NEXT and UP/DOWN buttons, enable you to navigate the edit menus effortlessly. If you need to have access to the front panel controls, the optional model 8312 remote control gives you remote command of the most common functions.

SENNHEISER

RF SERIES CONDENSER MICROPHONES

Unlike traditional condenser microphones, the capacitive transducer in Sennheiser condenser microphones is part of a tuned RF-discriminator circuit. Its output is a relatively low impedance audio signal which allows further processing by conventional bi-polar low noise solid state circuits. Sennheiser microphones achieve a balanced floating output without the need for audio transformers, and insures a fast, distortion-free response to audio transients over an extended frequency range. The RF-design yields exceptionally low noise levels and is virtually immune to humidity and moisture. The comparatively low RF-voltage across the elements of the transducer also eliminates arcing and DC-bias creeping currents. Sennheiser employs RF-technology to control residual microphone noise. Optimizing the transducer's acoustic impedance results in a further improvement in low noise performance. Sennheiser studio condenser microphones operating according to this RF-principle have proven their superior ruggedness and reliability in the past decades under every conceivable environmental condition.

MKH 20 P48U3 Omnidirectional

Low distortion push-pull element, transformerless RF condenser, flat frequency response, diffuse/near-field response switch (6 dB boost at 10 KHz), switchable 10 dB pad to prevent overmodulation. Handles 142 dB SPL. High output level, ideal for concert. Mid-Side (M-S), acoustic strings, brass and wind instrument recording.

MKH 40 P48U3 Cardioid

Highly versatile, low distortion push-pull element, transformerless RF condenser, high output level, transparent response, switchable proximity equalization (-4 dB at 50 Hz) and pre-attenuation of 10 dB to prevent overmodulation. In vocal applications excellent results have been achieved with the use of a pop screen. Recommended for most situations, including digital recording, overdubbing vocals, percussive sound, acoustic guitars, piano, brass and string instruments, Mid-Side (M-S) stereo, and conventional X-Y stereo.

MKH 60 P48U3 (Short Shotgun)

Short interference tube RF condenser, lightweight metal alloy, transformerless, low noise, symmetrical capsule design, smooth off-axis frequency response, switchable low cut filter (-5 dB at 100 Hz), high frequency boost (+5 dB at 10 KHz) and 10 dB attenuation. Handles extremely high SPL (135 dB), ideal for broadcasting, film, video, sports recording, interviewing in crowded or noisy environments. Excellent for studio voiceovers.

MKH 70 P48U3 (Shotgun)

Extremely lightweight RF condenser, rugged, long shotgun, low distortion push-pull element, transformerless, low noise, switchable presence (+5 dB at 10 KHz), low cut filter (-5 dB at 50 Hz), and 10 dB preattenuation. Handles 133 dB/SPL with excellent sensitivity and high output level. Ideal for video/film studios, theater, sporting events, and nature recordings.

MKH 416 P48U3 Supercardioid/Lobe (Shotgun)

Transformerless, RF condenser designed as a combination of pressure gradient and interference tube microphones. Very good feedback rejection, low proximity effect, 128 dB/SPL. Rugged and resistant to changing climate conditions. Ideal for boom, fishpole, and camera mountings. A long-distance microphone for video, film, and studio recording. Excellent for interviewing for reporters, podium or lecture microphone.

MKH 816 P48U3 Ultra-directional Lobe (Shotgun)

Narrow-beam pattern, transformerless RF condenser microphone. Handles 124 dB/SPL and has high output voltage. Perfect for crowded news conference, movie sets, TV stages, sporting events and nature recording.

Fostex PD-2

Portable DAT Recorder

Now you can have all the benefits of digital recording in one small, flexible, portable DAT recorder. With the PD-2 the audio remains as pure and pristine as the instant it was captured, going from the location to post production with no noise, no distortion, no inter-generational loss or deterioration. What you do get is a wide dynamic range, the ability to record SMPTE/EBU time code along with your program, and the ability to store your material in any of the standard digital formats - all this in a tiny cassette that can record up to 2 hours of audio. Other features, like off-the-tape confidence monitoring, adjustable reference levels, the ability to store 35 sets of customizable setups, and flexible power options make the PD-2 an unbeatable portable digital audio recorder.

MULTIPLE SAMPLING - Provides multiple sampling frequencies, including 44.056KHz Video/F1/1630), 44.1KHz (CD), and 48KHz (DAT/D1/D2). All of the current DAT sampling rates are available for either recording, or playing tapes from other sources. The choice of sampling frequencies also assures compatibility with all other professional digital formats.

SELECTABLE REFERENCE LEVELS - There is a wide choice of reference levels (-12, -14, -16 and -18 dB). This gives you the flexibility to adjust the headroom for the maximum margin of safety to suit the production at hand. Simply adjust the reference level to suit your changing needs in the field.

FULL SUBCODE ADDRESS - The PD-2 has full subcode address capability in addition to its slate mic and tone generating functions. Sub IDs, such as start and end IDs, PNDs, blank search and error IDs mark areas of the tape for later recall. The start of a take, take numbering and questionable events are all easily identified. And, since the IDs are recorded on the tape, the information can be played on another unit with the IDs intact.

MUSIC TO YOUR EARS - A full complement of built-in limiters and filters helps you make the best location recordings possible. The limiters can be linked for stereo operation, or used with the individual channels. The compression ratio is 1:3 with 20ms attack and 200ms release times. Voice and music filtering is selectable by individual channel. Drawing from Fostex's extensive experience with recording, the filters have been set at 12dB/octave at 40 Hz and 80 Hz, and at 6dB/octave at 400 Hz. In addition, 15 & 30dB pads help prevent circuit overload in the presence of very loud signal sources. The PD-2's on-board tools are designed to help you get the cleanest possible signal on the tape.

RUGGED CONSTRUCTION - Has a tight gasket surrounding the tape compartment to protect against moisture and dust. Built-in head warmer permits operation through wide swings in temperature and humidity by preventing condensation from forming on the head drum. 4-Motor transport design eliminates the need for complex linkage and belts that go out of adjustment or break. The Fostex design affords smooth, quiet and reliable tape operation.

TIMECODE CAPABILITY - Built-in generator provides full timecode capability. It reads and writes all four International standard formats: 24 fps (film), 25 fps (PAL/SECAM), & 29.97/30 fps drop frame/ non-drop frame (NTSC). Full jam sync functions, timecode loop and output jacks, sync and word sync inputs and outputs.

POWERING OPTIONS - You can power the PD-2 in a wide variety of ways: all Betacam options, an NP1A type cell, GEL cells, power straps, or AC with the optional adapter. Multiple powering options give you the flexibility you need for location recording. The PD-2 can handle all the conditions you may encounter in the field.

PERSONALIZED SETTINGS - You can personalize your PD-2 to suit your recording technique to the situation at hand – set-ups for dialog recordings are different from those for music and sound effects. You can choose over 35 custom settings. These are "set and forget" parameters which define the operating configuration at power ON, and also 5 user registers where you can store different configurations of settings for the job at hand. The PD-2 adjusts to you – personally.

USE YOUR FAVORITE MICS - Offers a built-in phantom power supply so that in the field you can plug mics directly into the unit, without outboard power supplies. You have less to carry and fewer items that can malfunction. Mic inputs have individual 48V and T-12 power settings. To insure that you don't lose any of the stereo signal, Channel 2 has a phase reversal mode.

FLEXIBLE MONITORING - Multiple monitoring modes help you deal with almost any on-site requirements. You can listen in mono or stereo, to individual or ganged inputs. There's even a Stereo MS decoder you can monitor via headphones or the built-in speaker. And in the cue mode, you define the shuttle speed at which you want to monitor.

ERROR ALERT - The PD-2 has a unique error ID system which monitors all operating areas. When a deviation from the setup parameters is detected, the unit sends a mark to the tape, stores the location of the error and alerts you via the PCM LEDs and LCD, and even a tone over your headphones. No error can escape detection.

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SHURE

FP32A PORTABLE STEREO MIXER

This small and rugged portable mixer is well equipped to handle the demands of EFP, ENG, live music recording or any other situation that requires a low noise high performance mixer.

- High quality-low noise electronics, perfect for digital recording and transmission
- Three balanced inputs, two balanced outputs plus tape out and monitor
- Supports all types of condenser mics with internal phantom supply
- Inputs can be switched between mic and line level
- Each channel has own pan pot
- Each channel has illuminated meter and peak indicator
- Two units can be cascaded to provide six input channels
- Internal 1KHz oscillator for record and send level calibration
- Internal (2x9V alkaline batteries) or external power
- Switchable low cut filters

MACKIE

MicroSeries 1202
12-Channel Ultra-Compact Mic/Line Mixer

Usually the performance and durability of smaller mixers drops in direct proportion to their price, making lower cost models unacceptable for serious recording and sound reinforcement. Fortunately, Mackie's fanatical approach to pro sound engineering has resulted in the Micro Series 1202, an affordable small mixer with studio specifications and rugged construction. The Micro Series 1202 is a no-compromise, professional quality ultra-compact mixer designed for non-stop 24 hour-a-day professional duty in broadcast studios, permanent PA applications and editing suites where nothing must ever go wrong. So no matter what your application, the Micro Series 1202 is ideal. If price is the prime consideration or you simply want the best possible mixer in the least amount of space, there is only one choice.

CR-1604
16-Channel Audio Mixer

In less than three years, the Mackie CR-1604 has become the industry standard for compact 16-channel mixers. It is the hands-down choice for major touring groups and studio session players, as well as for broadcast, sound contracting and recording studio users. For them the CR-1604 offers features, specs, and day-in-day-out reliability that rival far larger boards. Its remarkable features include 24 usable line inputs with special headroom/ultra-low noise Unity plus circuitry, seven AUX sends, 3-band equalization, constant power pan controls, 10-segment LED output metering, discrete front end phantom-powered mic inputs and much more.

TASCAM

688 Midistudio

The 688 MIDISTUDIO is a compact, 20 input audio mixer combined with an 8 track cassette recorder system. Designed for the MIDI-based studio, this unit will work well for both the production facility and the individual artist. In the MIDI environment, sources can be selected, destinations assigned and routing designated, all from the remote MIDI controller. With its wide input range and ability to be remotely synchronized, the 688 can be the heart of a high tech, compact 8 track studio.

- Full featured 20 input mixer (10 balanced XLR inputs)
- 8 x 2 cue monitor mixer
- Built-in dbx noise reduction system (defeatable)
- Unique "Scene Display" system to monitor MIDI-controlled setups
- Gapless auto punch in/out and rehearsal modes
- Serial interface for external synchronization

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New Products continued from page 103

Frequency counter

By B & B Electronics

• **Model 232FC:** allows frequency measurements of TTL level signals; makes frequency measurements from 5Hz to 50MHz and duty cycle measurements from 5Hz to 50kHz; powered from RS-232 port handshake lines or a 12VDC external supply to power converter.

Circle (396) on Reply Card

TV modulator system

By Standard Communications

• **TVM550/550S series:** frequency agile heterodyne modulator with multistage conversion process; features six levels of filtering and is frequency agile to 550MHz.

Circle (397) on Reply Card

Converters

By EVS

• **ADA:** full range of broadcast A-to-D and D-to-A converters including composite to serial, serial to composite, RGB/YUV to serial, serial to YUV/RGB, parallel to serial, and serial to parallel; multistandard switchable in all encoding standards.

Circle (398) on Reply Card

Satellite TV receiver

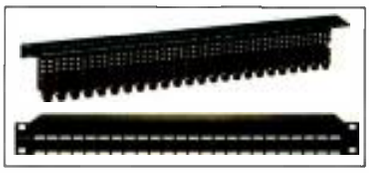
By Standard Communications

• **Agile Omni International Global VU series:** MT830IBR receiver features manual, automatic or computer remote control of vital functions and settings required for C-/Ku-band full/half transponder operation; meets RS-250C and CCIR-567 performance standards.

Circle (399) on Reply Card

Patchbay system

By Whirlwind



• **Quickpatch:** 48-jack,19-inch 1U rack-mount system; allows rapid use reconfiguration of each individual jack-pair from "half-normalled" to "not normalled" and back without soldering or cutting wires.

Circle (400) on Reply Card

Conductor mass connectors

By Whirlwind

• **Field-pinnable 122 and 176:** connectors with pins designed for crimping; extra-heavy metal housing can withstand severe environmental conditions; connectors are universal male/female and are compatible with previous versions.

Circle (401) on Reply Card

Player/recorder

By EVS

• **Live Slow Motion:** RAM-based player/recorder; double access allows recording during replay; features internal digital fader, split screen, and internal DVE; stills can be loaded from a 1.6 GB hard disk on a second output while slow motion is aired on the main output.

Circle (402) on Reply Card

TWT amplifiers

By EEV

• **Stellar:** state-of-the-art, self-contained amplifiers at 300W and 500W in Ku-band; feature universal voltage, comprehensive microprocessor control systems and extensive remote interfaces; compact unit weighs 50 lbs.

Circle (403) on Reply Card

Hand-held lens

By Fujinon

• **S14x7.5BRM:** 1/2-inch zoom lens; features a focal length of 7.5- to 105mm and a maximum aperture of F1.4 to 75mm and F1.8 at 105mm; MOD is 1.1m and 0.04 in macro mode; weighs 2.4 lbs.

Circle (404) on Reply Card ■

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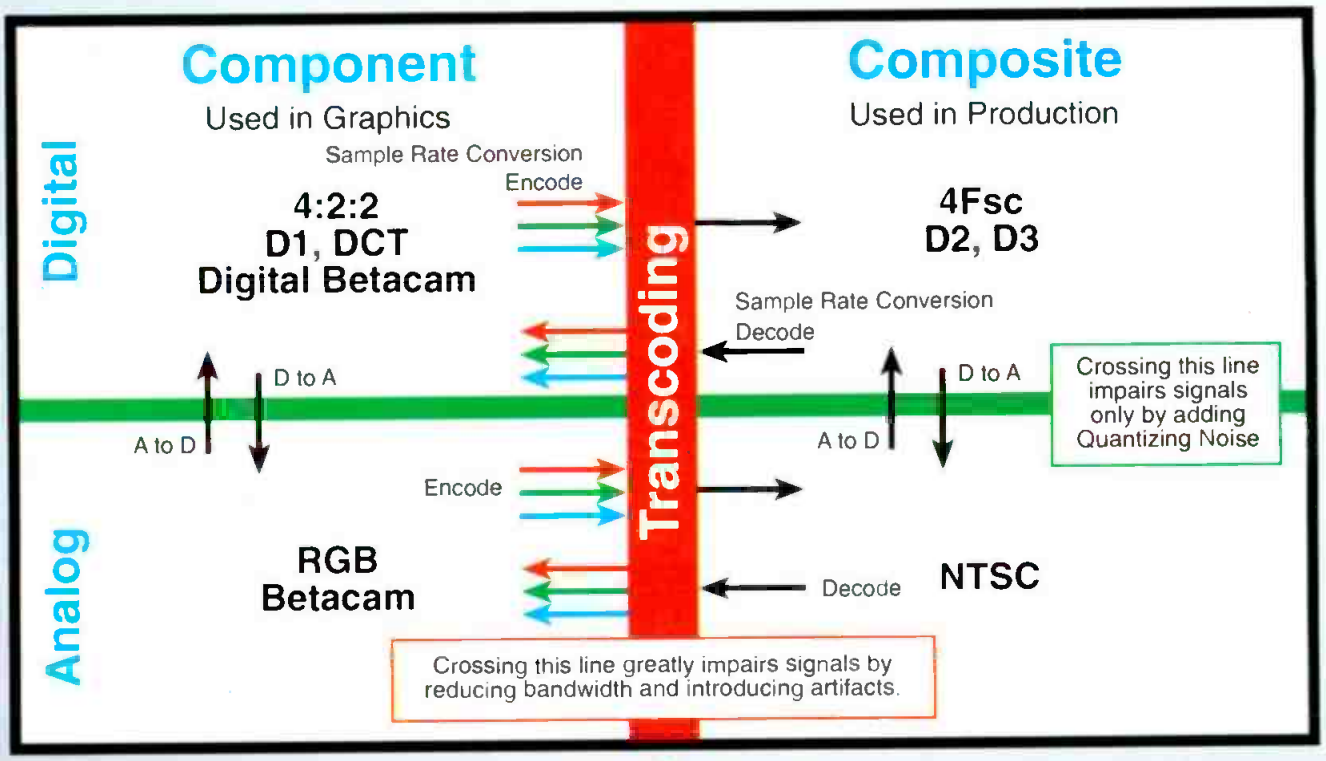

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