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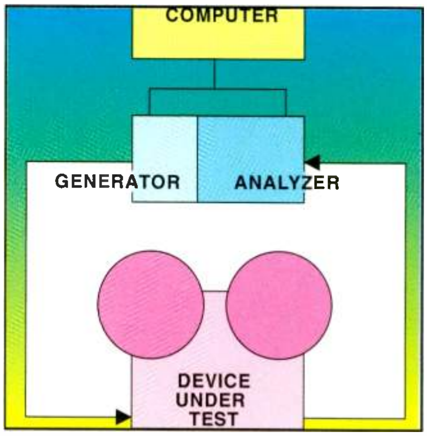

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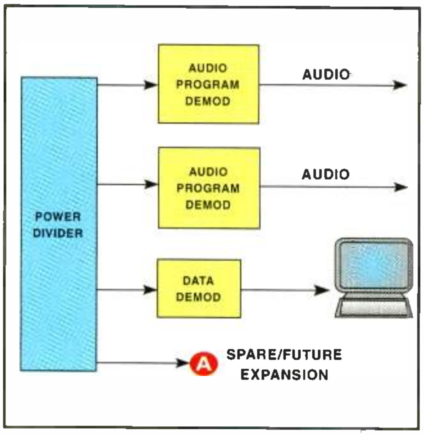

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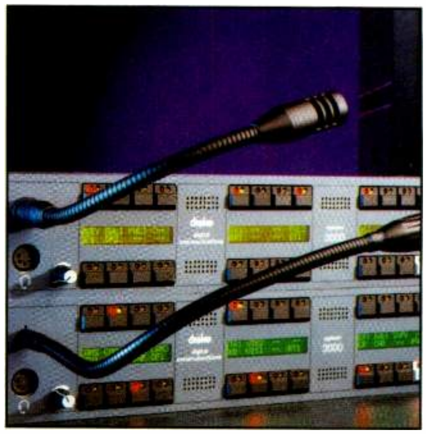

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10TH ANNUAL FACILITY MAINTENANCE REPORT:

Maintaining today's broadcast and production facilities requires a high level of human skill- and the right test equipment. Because audio and video hardware is sophisticated and complex, a DVM and single-channel scope may not be enough to get the job done. This month's features provide some practical answers to maintaining today's sophisticated production and broadcast hardware.

THIS MONTH...

DEPARTMENTS:

OTHER FEATURES:

ON THE COVER:

Maintaining today's sophisticated broadcast production hardware also requires equally sophisticated test equipment. Because downtime is extremely expensive, replacing a defective IC or board must take place in minutes — not hours. (Cover design: Erica Andrews.)

News

By Dawn Hightower,
senior associate editor

NATAS awards Technical Emmys

The National Academy of Television Arts and Sciences (NATAS) presented its 1992-1993 Technological Achievement and Scientific Development Emmy Awards on Oct. 5 in New York.

The awards were presented to 11 companies and one individual and they are as follows:

- *Advent Communications* and *Comsat Corporation* (joint award) for miniature lightweight and rapid deployment earth terminals for satellite news gathering.
- *Avid*, *EMC* and *Montage Group* (joint award) for enabling technology for nonlinear editing systems using digital images and sounds.
- *Sony*, *Tektronix*, *Thomson Broadcast* and *Society of Motion Picture and Television Engineers* (joint award) for in-plant digital serial interconnection technology for television.
- *Dr. Frank G. Back* for zoom lens technology for broadcast TV cameras.
- *Matsushita Electric Industrial Company* for pioneering developments in digital video production switcher technology.
- *Philips Electronics* for prism technology for color TV cameras.

Wireless cable demos digital compression technology

The first public demonstrations of wireless cable digital signal compression and 2-way capability were viewed by thousands of industry representatives from around the world at the Wireless Cable Association International Show, in August, in Orlando, FL.

American Telecasting, Inc. (ATI), an operator of wireless cable systems and operator of the wireless system serving Orlando, sponsored the show. The demonstration proved the viability of compression in wireless cable and the compatibility of transmission and reception equipment with advanced technology.

Several wireless cable equipment manufacturers participated. General Instrument supplied a 4:1 video compression system, and Scientific Atlanta contributed its CD-quality digital audio (10:1). EMCEE Broadcast Products transmitted all signals with fully synthesized 50W transmitters. Microwave Filter Corporation provided the channel combiners, and Conifer Corporation supplied the low-phase noise downconverter and receiving antenna. Zenith Electronics demonstrated Z-View, a real-time, 2-way, remote-ordering data system for pay-per-view.

The demonstration showed that wireless cable technology is capable of offering expanded channel and interactive services and is positioned to meet the demand for these services in the future.

FCC seeks comments on EBS technology

The second round of tests of emergency broadcasting system (EBS) equipment was completed Sept. 11-15 by the FCC in Pikesville, MD. These tests were conducted to select a new technology to replace the existing EBS.

The FCC wants to complete the evaluation process by the end of the year. Now that the second round of tests have been completed, the FCC is looking for reply comments from interested parties and manufacturers.

SCTE issues call for papers

The Society of Cable Television Engineers (SCTE) is seeking abstracts for technical papers to be presented at its 1994 Cable-Tec Expo, June 15-18 in St. Louis.

This convention/trade show will combine technical programs, hands-on training and technical workshops with instructional hardware exhibits.

Technical papers that are accepted will be presented at the society's 18th annual Engineering Conference. Proposed workshops should provide attendees with in-depth instruction on technical procedures that are used in everyday practice. Papers will be compiled into an EXPO Proceedings manual that will be distributed to attendees and available for sale through the society. Submissions must be sent by Nov. 22 to Bill Riker, c/o SCTE, 669 Exton Commons, Exton, PA 19341. Submissions must include an abstract of the proposed paper or presentation. For further information, contact SCTE at 215-363-6888, or fax 215-363-5898.

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BROADCAST ENGINEERING

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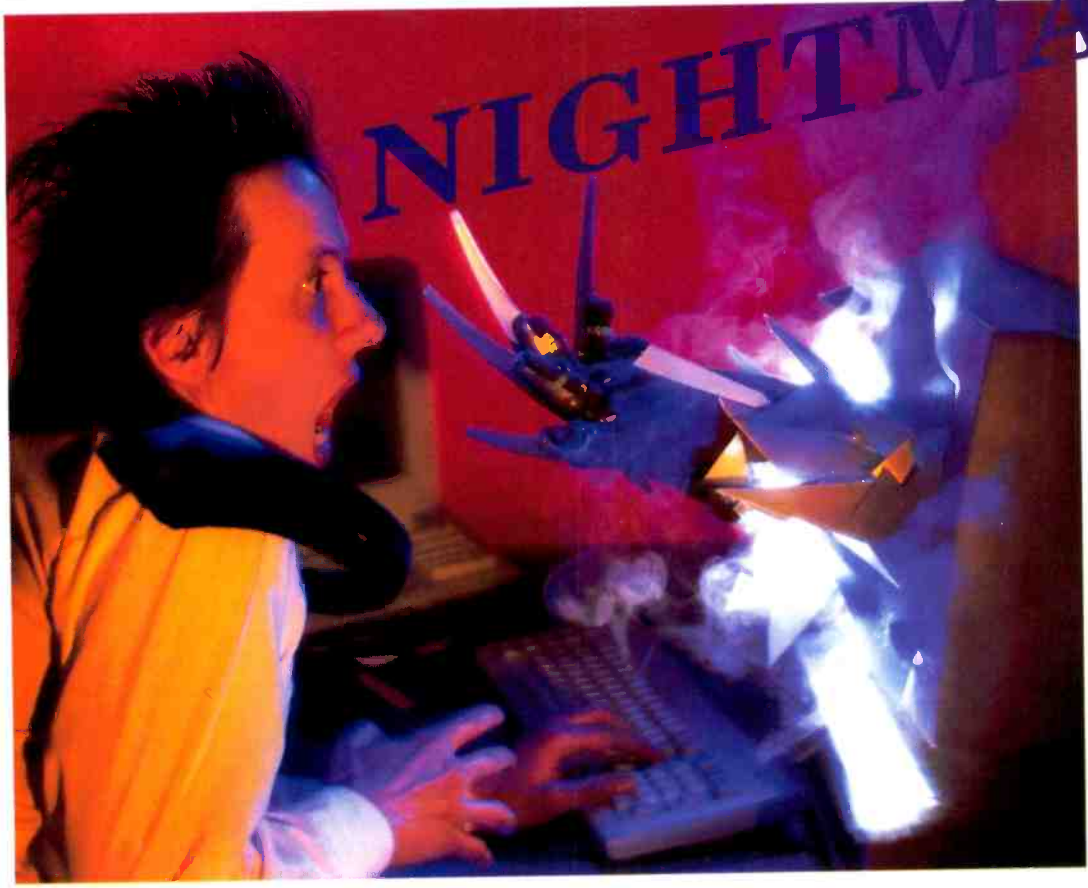

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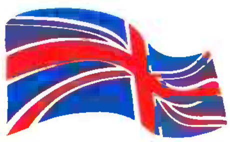

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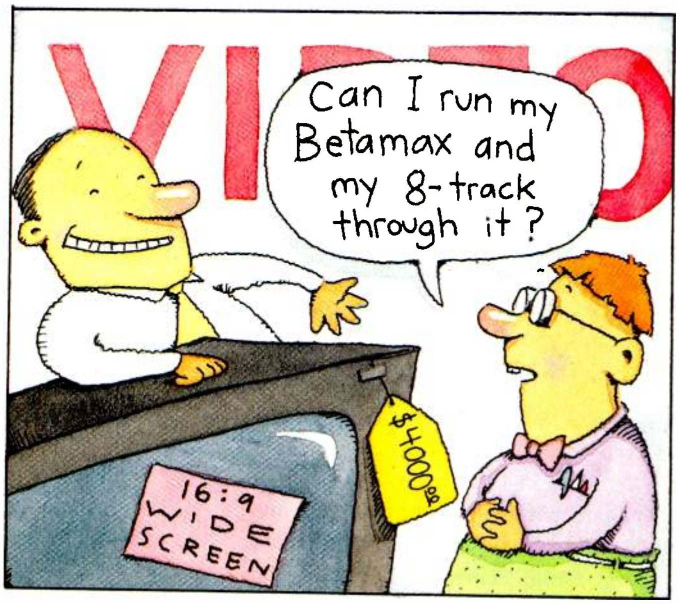
Editorial

8-track technology

I recently encountered the newest piece of equipment in the technical revolution that many of us have been talking about — the 16:9 widescreen TV set. Although I'd seen plenty before, this one was for sale in my local video store.

I quickly grabbed the store manager and began asking him questions. How much did it cost? How did it display 4:3 images? What types of inputs did it accept? What about audio, stereo, mono, surround sound? All the typical semi-technical questions were quickly answered. Now, on to the hard stuff. How does a 16:9 set display 4:3 images?



The set provides four modes of image display. The first mode provides the standard 4:3 image displayed on the 16:9 screen. The only problem is the two black bars on each side where the screen is blank. It looks funny, but I suppose for $4,000 I could get used to it.

In the second and third modes, the video image is spread to fit the horizontal width of the screen (with different expansion schemes). Oops! Once again there is a small problem. Because the total image has been expanded to fit the horizontal dimension, the top and bottom portions of the transmitted picture can be cut off. Oh, well, unless you really want to see the actors' feet (or heads) or the scrolling football scores or weather warning crawls, it won't matter.

Finally, we get to the set's real purpose: to display those 16:9 images. Once again, we have a small problem. Those types of images are not readily available.

To get widescreen, you have to use S-VHS tape or laser disc equipment. That means you need an S-VHS signal. Does your VCR have an S output? If not, then you can use your laser disc player that provides the 16:9 images on an S-VHS output. No laser player? Well, tough luck. I guess you'll have to watch your movies and the local news like everyone else — in 4:3.

Don't be too hard on the set manufacturers. After all, they're just trying to make a buck (lots of bucks). However, in my admittedly unscientific research for this editorial, I did spend time visiting with salespeople who make their living selling video equipment. Do you want to know what I learned?

- Few customers express any interest in the widescreen televisions.
- Those who do express interest are "techno-geeks" who are only looking and don't buy anyway.
- For the cost of a widescreen television, you could buy a $2,000 projection television and a complete home theater sound system.
- When presented with this option, almost 100% of the customers opted for a traditional 4:3 projection television and added the audio to build a home theater.

The next time you're in the local video store, look at that widescreen television. Impress the salesperson with your knowledge. Then, like everyone else, leave without buying it.

If you do decide to plunk down $4,000 for the television, at least you'll own one of the first pieces in the coming techno-revolution.

Be careful though. Being first with that widescreen set could be déjà vu. Recall when you proudly drove home that brand new Ford Edsel, and when you purchased that 8-track tape player. Remember, new ideas aren't necessarily good ideas.

Brad Dick

Brad Dick, editor

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FCC Update

Inquiry into definition of aural modulation limits

By Harry C. Martin and Andrew S. Kersting

The FCC has initiated an inquiry to explore policies that concern the definition and measurement of aural modulation limits. The agency is looking for information that will enable it to establish modulation limits on peak amplitude, peak duration, peak recurrence rates and the time interval over which the peaks are to be counted.

The FCC also will examine whether emission limitations can replace modulation limitations. The agency requested information on the application of this alternative to modulation, modulation measurement, and the control of interference, as well as its implications for broadcasters, equipment manufacturers and the FCC's enforcement efforts.

Proposal to amend distance computation on FM short-spacing

The FCC has proposed to modify its technical rules to specify the way in which applicants for FM facilities may round distances when computing the extent to which they are short-spaced.

Section 73.208(c) requires the computed distance between two reference points to be rounded to the nearest kilometer. The agency believes its policy of controlling spectrum crowding would be enhanced if distances were specified with greater precision than one kilometer in evaluating short-spacing waiver requests pursuant to Section 73.207(a) of the rules.

The FCC also proposed amending Section 73.208(c)(8) to restrict rounding of distance separation calculations to the nearest hundredth of a kilometer. This would occur where an applicant is not in compliance with the minimum distance separation requirements. This rounding yields 10 meters, which conforms to the degree of precision associated with the requirement that transmitter site coordinates be specified to the nearest second.

Proposal to extend broadcast hearing holding to three years

The FCC has proposed to require that applicants in comparative proceedings operate their stations for three years before becoming eligible to transfer them. This would supersede the requirement that stations be held for one year.

The FCC requested comment on the following questions: 1) whether the one-year holding period should be increased to three years (or more) for applicants in comparative proceedings; 2) whether the one-year holding requirement should apply to authorizations granted pursuant to settlements in comparative proceedings; 3) whether and how the reporting requirements concerning adherence to comparative proposals should be amended in light of any modification in the required holding period; 4) whether an increase in the holding period should be applicable to all existing and future authorizations obtained through the comparative process, and 5) whether the FCC should start a proceeding to inquire whether service continuity requirements should be imposed on facilities not acquired through the hearing process.

Increased sanctions for EEO violations

The FCC has imposed short-term renewals, reporting conditions and fines of up to $50,000 for EEO violations. The licensee of two Alabama stations was fined $50,000 for negligence and carelessness in providing the agency employment data. Similarly, two Arizona stations were found to have made inadequate recruitment efforts for 49 of 72 positions during its 1984-1990 license term. The licensee was fined $25,000. The FCC stated that the Arizona licensee's hiring records were seriously inadequate as to constitute an absence of an EEO program. The agency imposed the fine against the Arizona licensee, despite the fact that its employment had dropped from 72 employees in 1987 to 44 in 1990 and that the stations had experienced serious financial difficulty. These EEO decisions show that the FCC is taking EEO violations more seriously and that fines for EEO violations are increasing.

Licensees generally have been able to avoid sanctions by employing minorities and females at 50% of their respective percentages in the workforce. However, the FCC has adopted an "efforts-oriented" approach in determining whether a licensee has an effective EEO program. In order to avoid sanctions, a licensee must keep an accurate record of its affirmative action efforts. Licensees must provide information concerning every recruitment source used and the resulting referrals (including gender and minority status) for every employment opportunity during the past license term.

If a licensee has made efforts to attract minority and female employees, and has an accurate and detailed record, the FCC generally will discount any statistical disparity between the number of minorities in the local workforce and those on the licensee's full-time staff. In light of the agency's increased efforts to enforce its EEO rules, licensees that cannot provide documentation of their EEO efforts can become subject to FCC sanctions.

Changes in renewal reporting requirements

The FCC amended its rules to require licensees of full-power commercial AM, FM and TV stations to report in their license renewal applications whether their stations are on the air or have discontinued service. ■

Date line

As a reminder, on Dec. 1, 1993, annual ownership reports (or ownership certifications) are due for all radio and TV stations licensed to communities in the following states and territories: Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota and Vermont. TV stations in the following states and territories must file their renewals by Dec. 1: Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island and Vermont. Minnesota and North Dakota LPTVs also must file their renewals by Dec. 1. In addition, issues/programs lists for the October-December quarter must be placed in the public file of all broadcast stations by Jan. 10, 1994.

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

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Part 11

Strictly TV

Strictly HDTV

More information on the superhighway

By Curtis Chan

Earlier in this series, we discussed the information superhighway. As the National Information Infrastructure (NII) is being built, several congressional members have emerged to champion the cause. One member is Chairman of the House Science, Space and Technology Committee, Rep. Rick Boucher, D-VA.

According to Boucher, this means huge profits for the players, including telephone and cellular companies, cable companies, broadcast, computer and software companies.

Boucher introduced the High-Performance Computing and High-Speed Networking Act, or HR-1757, earlier this year. The bill provides for research and development designed to tie the infrastructure to the skeleton of the superhighway, Internet and NSFnet. With the aid of federal grants, Boucher hopes that tying schools, libraries and medical centers into Internet will encourage private industry to advance the system into a user-friendly data network.

He also has introduced three companion bills, hoping to further encourage competition in the development of the NII. Of the three bills, the third bill (The Communications Competitiveness and Infrastructure Modernization Act, or HR-1504) will allow telephone companies to get involved in cable services and cable companies to offer telephone services.

Also, a newly created Fibre Channel Association is promoting an innovative way to interconnect local groups of computers. The channel offers 2-way communications and is ideal for sending full-motion video. The Fibre Channel Network proposes using existing twisted pair copper wires or coaxial lines over short distance runs.

ATTC and CRC to stay open

In late August, two pacts were signed with the ATTC and CRC (Communications Research Center) in Canada to keep their respective doors open through the next testing phase in the upcoming year.

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

The two agreements (not finalized at the time of this writing), which the alliance negotiated separately with the parties, will provide financing to help the labs remain open while the alliance builds its system during the next nine months.

On scanning formats, the alliance favored an unregulated migration from interlace to progressive scanning.

The funding came at a crucial point, given the financial concerns that became evident last spring as the labs approached a second round of proponent testing. As part of the agreement, the standby costs from May to June would be paid by the alliance. Alliance participants also would pay testing fees to both labs once they complete a prototype next year.

On research progress

Responding to a long list of questions submitted to the committee's Technical Subgroup in June, the alliance has prepared answers to commonly asked questions. Concerning the issue of the system scanning format, the proponents noted that their standard is designed as an HDTV-only system, but the modulation subsystem would support uses for the 20-25Mb/s data capacity. According to the alliance, the HDTV standard under consideration does not embrace digital 525-line systems or NTSC (except in its spectrum compatibility requirements).

Also, the alliance was asked numerous questions concerning 525-line digital video and widescreen receivers. The alliance said there were no plans for multiplexing 525-line pictures and that the multiplexed 525-line TV wasn't within the scope of the FCC's mandate for the Advisory Committee or for HDTV proponents.

In response to the question on the ability of ATV receivers to display NTSC pictures, the alliance felt the ability to decode and display NTSC be a receiver option driven by marketplace forces.

What price to pay for progressive

On scanning formats, the alliance favored an unregulated migration from interlace to progressive scanning, although it did favor non-regulatory incentives for encouraging the adoption of progressive scanning. The group defended its argument by acknowledging the inclusion of both interlace and progressive scanning in the system, saying that each approach carries attributes rendering it superior for certain applications.

"The issue is not one merely of performance, but (one that) involves the relative commercial effects on different industries that have different applications and markets," said the alliance.

To cover its statements, the alliance further maintained that the initial sets will not become obsolete once the industry migrates to the progressive format. The group added that the consumer products would be able to support the interlace and progressive scanning formats. They expect that a given receiver will have a native mode display format optimized for the receiver's intended market and that the receiver will convert whatever signal is decoded into its native display mode.

Receivers could cost-effectively incorporate a menu of conversions.

MIT proposes a new path to progressive

MIT's Jae Lim recently offered a basic proposal and three specific methods for moving the advanced TV standard from an early format to one providing a higher resolution. The paper proposed that enhancement bits should be added to the datastream as compression technology evolves in order to allow for the extra information.

The effectiveness of the added bits, according to the paper, would depend on the number of bits allocated for enhancement and the efficiency of the enhancement method. An earlier paper, pending submission by Glenn Reitmeier of the David Sarnoff Research Center, also addressed a similar approach. ■

Re: radio

Considering AM expansion

By John H. Battison, P.E.

The brave new AM world of 1,610kHz to 1,710kHz is slowly growing closer. The emphasis is on *slowly.* This past summer, the FCC invited potential applicants for the expanded band to send letters of interest to the commission. Approximately 1,000 responses were received. Of these, around 250 were dismissed. Approximately 500 were potentially accepted as future applicants, and the remainder were sent letters of inquiry.

One of the main objectives of adding the new band was to reduce interference and improve quality. The first applicants to receive CPs in the expanded band will be those stations that presently cause and receive the greatest amounts of interference. From there, the awards will go down the list of deserving applicants. Presumably, any unapplied-for channels will be available for daytimers to request.

Daytimers and directionals

One rule that I think is unfortunate is the general denial of full-time operation in the new band to existing daytime-only operations. Notice I did not call this *unfair,* although some have used that expression. If I were a daytimer, I might feel differently, but all of the operators who opted for daytime-only knew it was the only way to get on the air and provide a needed service. There was always the hope of night operation in the distant future, and this did come about a few years ago, thanks to the Daytimers' Association. In many cases, the allowable high power is minimal — in the range of 4W to 30W, or a little more in some cases, but from this has sprung some hope, expanded-band limitations notwithstanding.

This seemingly useless low power is creating a new breed of night broadcasters. For a change, licensees of *directional* stations enjoy an unexpected benefit.

Consider a non-DA station with a night power of 30W. Radiated uniformly around the station, 30W will not generally provide much in the way of night coverage, even with high conductivity. As a result, some broadcasters have not implemented nighttime operation.

Now consider a DA operator with a cardioid or tighter pattern. With any kind of gain in the major lobe, that 30W can become the equivalent of 100W or more.

> **Adding 100kHz will give us 10 new channels and more "new" stations nationwide.**

Typically, the daytime DA is normally directed toward the city of license, so this nighttime power is placed where it can do the most good locally. A number of stations so situated have been able to develop a financially useful night audience from a handful of watts. Good engineering practice is essential, because when the power level is low, every milliwatt helps. Many broadcasters have been surprised by the results that can be produced at night with low power.

There also has been an easement in some relevant FCC rules. When low-power night operation was first approved, licensees had to operate from their standard daytime antenna system. Later, the rules were relaxed to permit operation from a separate antenna system at night, provided several requirements were met. This meant that a station whose antenna site was located several miles outside the city of license could provide at least a modicum of nighttime service with only a few watts of power by transmitting at night from an approved antenna at the downtown studio. Naturally, the regular interference rules apply and a proper technical showing must be made to demonstrate that the move of a few miles will not introduce interference.

Because the FCC contemplates simple DAs and lower powers for the new band, it may be possible to incorporate the now-developing new rules for directional antenna systems into this process. If these rules can be promulgated before the planning stages of the new band stations, we may see a new breed of simplified directional stations that were designed with new tools and constructed with new techniques. They also might operate entirely unattended, so beware, DA-station engineers and operators.

Also consider the need for stations to maintain two separate transmitting installations. Because most of the new band's stations will be directional, it is likely that existing transmitter sites won't suit the new allocations. Therefore, a new site will be required, probably implying the installation of a second transmitter.

It's happened before

The upper expansion of the AM band is reminiscent of the *lower-end* extension in the 1940s. Old-timers will recall that once upon a time, the U.S. AM band started at 550 "kc" instead of its current 540kHz. (There was a Canadian station on 540kc in Watrous, Saskatchewan, but that was a special allocation at the time.) The upper end was still 1,600kc (actually 1,605kc to allow for modulation).

In late 1945, the company I had just joined was considering the establishment of a new station at the low end of the band (550kc), and this was thought to be a bold move. There was considerable doubt that many car radios would tune satisfactorily down that far. One of my jobs was to go around to as many cars as possible and see whether the dial extended down to 550. If so, I had to verify that the radio worked properly at this frequency.

Back then, only 10kc was added to the low end of the dial. Today, we are adding 100kHz to the upper end. Adding 10kc gave us one additional AM channel. Adding 100kHz will give us 10 new channels and, of course, many more "new" stations nationwide.

When the single new channel was added in the 1940s, the industry promptly took it and sewed it into as many markets as possible, producing the attendant sideband problems. Having learned from our earlier mistakes, the FCC has planned a better use for this round of growth in the AM band. ■

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

Management for Engineers

BE answers your questions

By Judith E.A. Perkinson

This month's column will answer some of the management questions that *Broadcast Engineering* has received from its readers. We tried to select questions that seemed to represent common concerns. Keep sending in your questions. Remember, the "Management for Engineers" column is here to serve your needs.

Q. My GM is too involved with my engineering department. He doesn't allow me sufficient latitude to make decisions on my own, and he constantly second-guesses me. He treats me like a child. I resent his interference. I am a capable manager, but how can I prove it to him?

A. You are the victim of a micro manager. A micro manager is someone who cannot delegate authority. Micro managers usually fall into two categories.

1. Bright and talented.
2. Insecure and unsure.

Micro managers tend to be autocratic. They are frustrating to work for and can lower a person's feelings of self-worth.

You probably already know which type of manager you have. Let's examine the different approaches to dealing with this kind of supervisor.

• *Bright and talented.* The reason this type of manager has so much trouble delegating authority is because he doesn't believe anyone can do the job better than he can. The key to getting this type of manager to loosen his stranglehold on your department is to build trust and confidence. You must show your manager that you can handle a project.

The best approach is to break the task into pieces and begin reclaiming your department. Negotiate with your manager for the lower-level responsibilities. When he agrees, complete the job (ahead of schedule, if possible) and report on your success. Next time, do that task and one the next level higher. Take the work to your manager for his review and approval. Once he has confidence in your ability, timeliness and thoroughness, the bright and talented micro manager will back off.

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

• *Insecure and unsure.* This type of manager is tougher to handle. Many GMs are not confident in their knowledge about the technical side of broadcasting. They often feel vulnerable because they don't understand the technical language used by engineers. This can lead them to second-guess their engineers.

Follow the same tactic used with the bright and talented micro manager. It is important that you make this person feel comfortable. One secret is to make him think that the solution was his idea (make sure you share the credit). Feed his ego while assuring him that you will make him look good.

Micro managers are difficult to work for, but they can be reformed.

Q. I am a technical director. Although I agree with and embrace the participative management approach, my director of engineering does not. I am frustrated by his autocratic practices. How can I effectively influence him without creating undue strife and insecurity?

A. The transition from autocratic to participative management is not easy and far from complete at most companies. Many managers in every kind of industry are struggling with the same question. Experience has taught us what we can and cannot do to influence the system. Today, it is popular to play the participative game.

In reality, not everyone who is talking is doing, and not everyone who is doing knows how to make it work. As a technical director (middle manager), you must understand how much and what kind of influence you have.

First, you have the ability to determine how you will manage the people under you and how you relate with your peers. Establish a "sanctuary of sanity." This means that you create a participative environment for your subordinates and insulate them from the autocratic world above you. It is possible to make a participative environment successful.

Next, you must realize that it is not always possible to "manage up" in a company. If your director of engineering claims he believes in the principles of participative management, then use your department as an example of how well it can work. Show him that this theory is practical in day-to-day use. If your supervisor is a confirmed dinosaur, you may have to be satisfied with your sanctuary of sanity. The good news is that dinosaurs are finding it harder to hide behind rhetoric and are dying out.

Any management questions?
Have your management concerns addressed in upcoming columns. Send your questions to:
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913-967-1905
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Q. My GM never says "thanks" for a job well done. I don't feel that my efforts are being recognized. How can I be sure she values my contributions?

A. Everyone has different styles of management, and not all of them are good. Some managers believe that successful completion of a job is expected and that people should not have to be thanked for doing their job. Usually, this type of manager is quick to let you know when you are not meeting her standards. If she jumps on you when you make a mistake or do not perform as expected, then you can take her silence for approval.

Most of us need positive reinforcement to feel good about what we are doing. It is difficult to work for a person who does not give positive reinforcement. When faced with this situation, you must provide your own sense of pride. If you are doing a good job, then give yourself a pat on the back once in a while.

If you never receive any feedback, positive or negative, then you may have a GM who does not know what a good job is. It is not uncommon for a GM to be uninformed about the workings of the engineering department. If this is the case, you should begin educating your boss. Only then will you be on the road to more effective communication. ■

INTRODUCING THE

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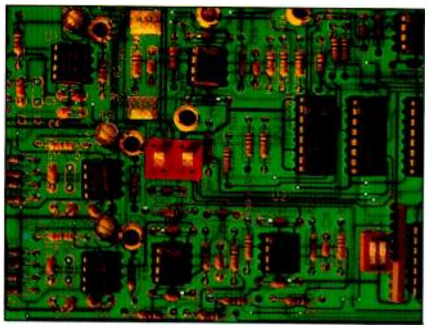

Digital audio via telco

Leased services

By Jack Kelly

Typically, broadcast engineers have been responsible for the selection of the most advantageous signal transport facilities while maintaining cost control. The digital advances in studio equipment are now being matched in the telco network. Digital audio transmission services are widely available, often at low cost. Broadcast engineers need to rethink the applicability of these services for their station's signal transport requirements. This 2-part series explores wired digital transmission and the various services offered by the telephone companies (carriers) to the broadcast industry.

Consider what occurs when an analog signal travels over distance: Attenuation from path losses requires the signal to be amplified (perhaps repeatedly), a process that inherently adds unwanted noise to the signal. Digital signals are attenuated by the same losses over distance during transmission. However, because the signal in this case is a binary bitstream, it can be repeatedly *regenerated* with a high degree of faithfulness to the original transmission and no additive signal degradation.

In the wired world, digital bandwidth often can be obtained in precisely the incremental amounts necessary for the application. As a result, new levels of efficiency can be achieved through the enabling technology of digital transmission.

Kelly is vice president of marketing at Intraplex, Westford, MA.

Leased service

Several options are offered by telco carriers for digital communications between two or more places on a permanent basis. The most flexible is called T-1, which has been the primary digital backbone technology of the carriers since the 1960s. T-1 was made available for commercial customers in 1983 after the breakup of the Bell System. It has gained enormous popularity in the business world because it is flexible, cheap and ubiquitous. T-1 transmits 1.544Mbit/s and is useful to the broadcast engineer because it is capable of carrying high-quality audio without data reduction. (CD-quality stereo — 44.1kHz sampling using 16-bits/sample per audio channel — requires approximately 1.4Mbit/s.)

Data reduction can allow a T-1 circuit to carry multiple stereo signals. Because a T-1 circuit is composed of 24 subchannels of 64kbit/s each (called DS0s or *slots*), many applications can share the same T-1 line. (See Figure 1.) This means that conventional voice, 15kHz audio, 7.5kHz audio, personal computer data, transmitter monitoring and more can travel between the same two locations on the same line without interference.

Individual digital audio channels are assigned to a single or multiplexed group of DS0s, which are used as 64kbit/s building blocks to create a channel of the required data rate. For example, a voice-grade circuit uses a single DS0, but a data-reduced (4:1) 15kHz stereo circuit takes four DS0s (256kbit/s). Reconfiguring these mixed channels is accomplished when the user simply switches out cards in the terminal racks at each end. No carrier intervention is required.

In some cases (generally long-haul circuits only), if a full 1.5Mbit/s channel is not required, *Fractional T-1* service may be available, in which only the number of multiplexed DS0s required to provide an adequate data rate for the application at hand (for example, six DS0s to provide 384kbit/s) is leased between two points and priced accordingly at reduced rates.

Perhaps most different from analog telco program circuits is T-1's bidirectional nature. Full duplex operation provides another 1.5Mbit/s of bandwidth on the return path. This is suitable for STL/TSL applications, among others. The two directions' configurations need not be identical. In other words, the line can carry a few high-quality audio signals in one direction while it carries many voice-grade and data channels in the other direction. ■

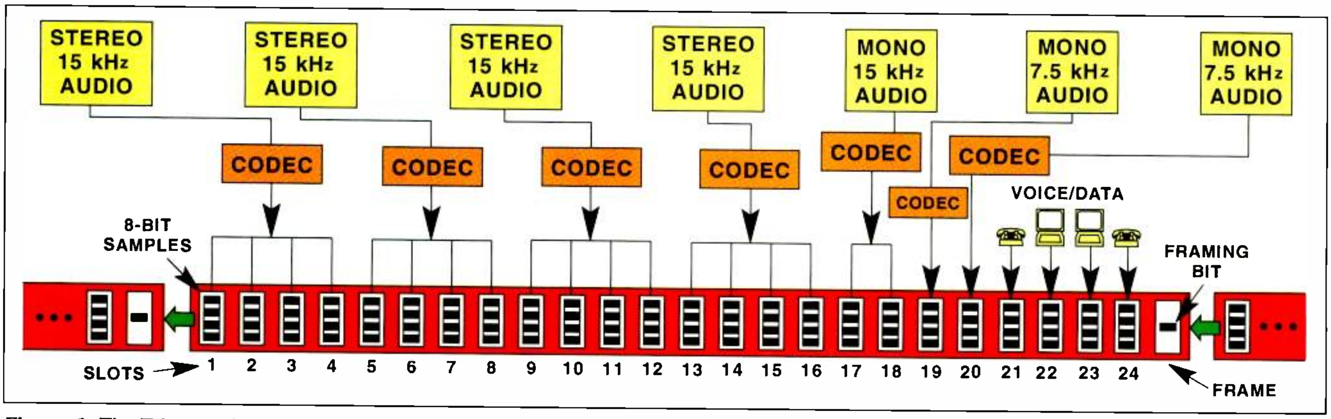

Figure 1. *The T-1 circuit's 24 DS0 slots each operate with 8kHz sampling and 8-bit resolution, providing a 64kbit/s data rate for each slot. Samples fed to these slots are serially assembled into frames, each containing one 8-bit word for every slot plus a single framing bit. Thus, each frame holds 193 bits (24 x 8 + 1), and T-1's frame rate of 8kHz brings the total data rate to 1.544Mbit/s.*

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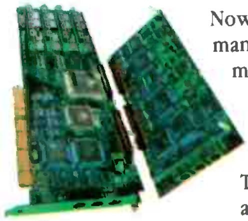

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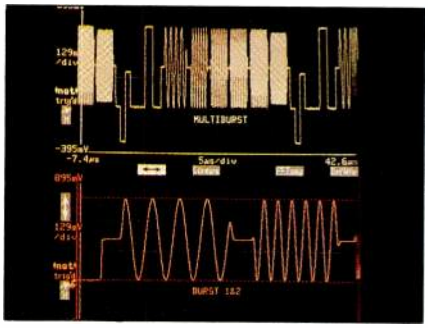
Part 1

Troubleshooting



Understanding crosstalk

Sources and measurement

By M. Raymond Jason

Crosstalk is the unwanted transfer of an audio signal from one channel to another. Any multichannel analog audio system — from a single tape machine to a network distribution center — exhibits crosstalk among its channels. Even as digital audio widens the dynamic range of broadcast audio systems, it also can reveal itself crosstalking into the analog portions of mixed digital-analog environments. Therefore, crosstalk mitigation has taken on increased importance.

In some cases, objectionable crosstalk appears suddenly. The culprit may be a wayward strand of wire that provides unwanted contact between adjacent-channel conductors, or a broken connection causing the loss of a ground reference or the loss of one side of a balanced pair.

This 2-part series will discuss how to minimize the chronic, built-in crosstalk that is present in every piece of analog equipment and every audio facility.

Sources of crosstalk

Any electrical signal generates a field that, if close enough to another conductor, produces an image of the original signal in that conductor. The field's electrical component couples capacitively; its magnetic component (which is generally weaker in voltage-based audio circuits because of the low currents involved) couples inductively.

A reasonable first approximation, therefore, ignores the magnetic/inductive component of coupling. In practice, crosstalk usually increases with frequency, as would be expected with capacitive coupling. Crosstalk in ATRs, however, includes a low-frequency inductive component because of the involvement of tape heads. (See Figure 1.)

Increasing the distance between alternate-channel conductors reduces capacitive and magnetic coupling at the rate of 3dB per doubling of distance. Crossing channels at right angles (as opposed to running them in parallel) minimizes electrical coupling and eliminates magnetic coupling. Placing a ground plane adjacent to a conductor or enclosing it in a grounded shield greatly reduces the extent of the electrical field but does not affect the magnetic field. These facts are especially useful for installations and equipment design, but more difficult to apply to purchased equipment and existing installations. Fortunately, some simple changes to the interconnections within and between equipment can sometimes produce a measurable reduction in crosstalk. (See Part 2.)

Jason is an electronics engineer at National Public Radio, Washington, DC.

Measuring crosstalk

Audio crosstalk in a system is typically expressed as a (negative) decibel voltage ratio between the level observed on an undriven channel-under-test and the level supplied to a driven channel in the system. For example, if one channel of a system is supplied with a +4dBu sine wave and another undriven channel in that system is measured to have a -45dBu signal, the crosstalk to the undriven channel from the driven channel is -45 - (+4) = -49dB.

However, such a measurement isn't complete. Because crosstalk varies with frequency, measurements must refer to the frequency of the test signal (e.g., -75dB at 10kHz). Even more useful is a crosstalk spectrum built from a series of measurements. Standard practice is to plot (negative) decibels down the y-axis with 0dB at the top, and to plot logarithmic frequency from left to right across the x-axis over the bandwidth of interest, as shown in Figure 1.

Perform crosstalk measurements with a narrow bandpass filter to exclude off-frequency energy. The goal of a crosstalk measurement is to find the attenuation of a signal as it couples from a driven channel to an undriven channel. Measurements made with unfiltered voltmeters show less attenuation than actually exists, because the noise energy across the voltmeter's bandwidth is measured along with the coupled signal energy.

Because bandpass filters exhibit attenuation even at their center frequency, take that attenuation into account by measuring the driven and the undriven channels with the filter in place. If available, take advantage of the automated test equipment's ability to subtract noise, including its own inherent crosstalk, from your measurements.

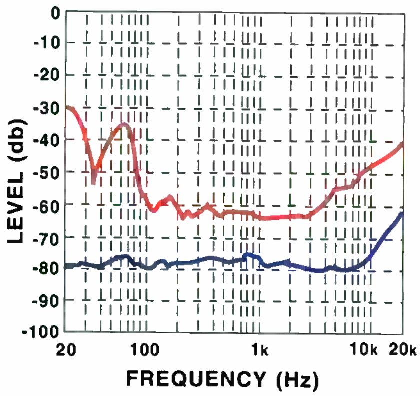
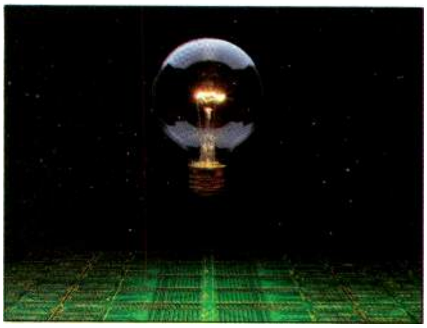


Figure 1. *Upper trace shows a typical 2-track analog ATR's crosstalk between channels on a full, end-to-end pass-through machine, including a tape generation (i.e., record plus playback crosstalk). Lower trace shows the same ATR's crosstalk measured at the deck's output with monitor in input mode (i.e., I/O electronics' crosstalk only).*

The test signal may be distorted as it travels into the undriven channel-under-test and will be mixed with that channel's noise. To ensure an accurate rms (root-mean-square) reading, use a true rms voltmeter. The rms-calibrated average-responding voltmeter provides rms measurements when responding to clean sine waves, which a crosstalked signal is not.

Some input circuits intermodulate out-of-band energy with in-band signals. For this reason, make crosstalk measurements to as high a frequency as your test equipment allows, especially where digital or time-code signals exist alongside analog. You also may find useful a worst-case or *all-hostile* crosstalk measurement. This is when one channel is selected to be undriven as usual, but all other channels in the system are driven in parallel by the test sine wave.

For any crosstalk measurement, terminate both ends of the channel-under-test with impedances equal to those of normal operation. Next month's column will explain why this is important. ■



Real time video compression

By Curtis Chan

The recent completion of the MPEG 2 video standard has prompted a flurry of product and strategy announcements from MSOs, cable equipment producers and semiconductor manufacturers who want to make a name for themselves. This may be premature, however, because the audio and system subsets have not yet been finalized.

Digital compression allows from four to 10 video programs to be transmitted in the same bandwidth as a single analog program with error correction that ensures the data arrives intact. One company with a new generation of MPEG compression chips is C-Cube Microsystems. Its latest entry into the compression arena is a set of video RISC compression chips, the CLM 4500 and 4600. The chips are aimed at real time compression of digital video, and they support MPEG 1 and 2, P*64(h.261), JPEG and other possible proprietary algorithms.

Chip details

Applications for the chips are widespread, with the CLM 4500 handling resolutions around the 352x240 range and the CLM 4600 handling up to 704x480. The CLM 4500 MPEG 1 encoder offers real time MPEG 1 Standard Industry Format (SIF) support with video CD resolution. This allows affordable real time multimedia and digital video authoring of CDs. The 4500 has a CCIR 601 input and an MPEG 1 SIF output. The encoder fits on an IBM PC plug-in board, is programmable with digital noise reduction, and includes such features as rate control and automatic scene change detection.

The CLM 4600 is the first real time MPEG 2 encoder with resolutions of 704x480 for NTSC and 704x576 for PAL. Like the 4500, it has CCIR 601 inputs and MPEG compressed outputs. It uses eight processors for real time NTSC compression and nine processors for PAL. It can support several horizontal resolutions and inverse telecine support.

Both chips and the upcoming decoder counterparts will be programmable, as opposed to fixed function. Benefits include improving the quality of encoding algorithms on a continual basis, adding custom features and the possibility of executing more than one DCT-based standard. In most cases, hard-wire fixed-function codecs offer none of the advantages and only cost slightly less to produce.

The chips can support several horizontal resolutions and inverse telecine support.

The chips comprise approximately 1.2 million transistors each, using CMOS 0.8 micron fab technology at 3.5W rated power drain. The surface-mount package samples should make their debut before the end of the year.

A typical broadcast-quality encoder would functionally resemble the figure and use multiple video RISC processors. In a scaled operation using the first two generations of chips, multiple VCPs (eight to 14) would be used to divide an image into overlapping segments so the video can be dealt with in real time. Unfortunately, it is still too large for use in ENG cameras and digital videotape recorders.

DRAM would be used for buffering and would be connected to each VCP via a 32-bit bus. A 32-bit host bus would allow connection to other VCPs, and the video bus would be either eight or 16 bits wide. Current real time solutions cost between $100,000 to $500,000. The Video RISC Compressed Architecture (VCA) would reduce size and cost dramatically. Later generations would shrink chip counts to one or two and also could operate as a decoder to allow playback of recorded compressed video.

MPEG 2 status

The main reason to discuss MPEG 2 is because of the growing support base for the evolving standard. Broadcasters and equipment suppliers have indicated that they will support and use the MPEG standard, with GI announcing that DigiCypher 2 will be MPEG 2 compatible. Consequently, many companies are touting MPEG-based systems under development.

The standard has three elements: video, audio and system. The video element defines a syntax for compressed video and gives the outlines of the techniques that can be used to compress video into that syntax. The audio element defines a syntax for compressed audio, and the system element describes the mechanism for combining and synchronizing the video and audio elements in a single datastream. Neither of these last two syntaxes are frozen, but semiconductor devices are available to implement these elements. However, they do not exist for the video portion.

MPEG 1 and MPEG 2 differences

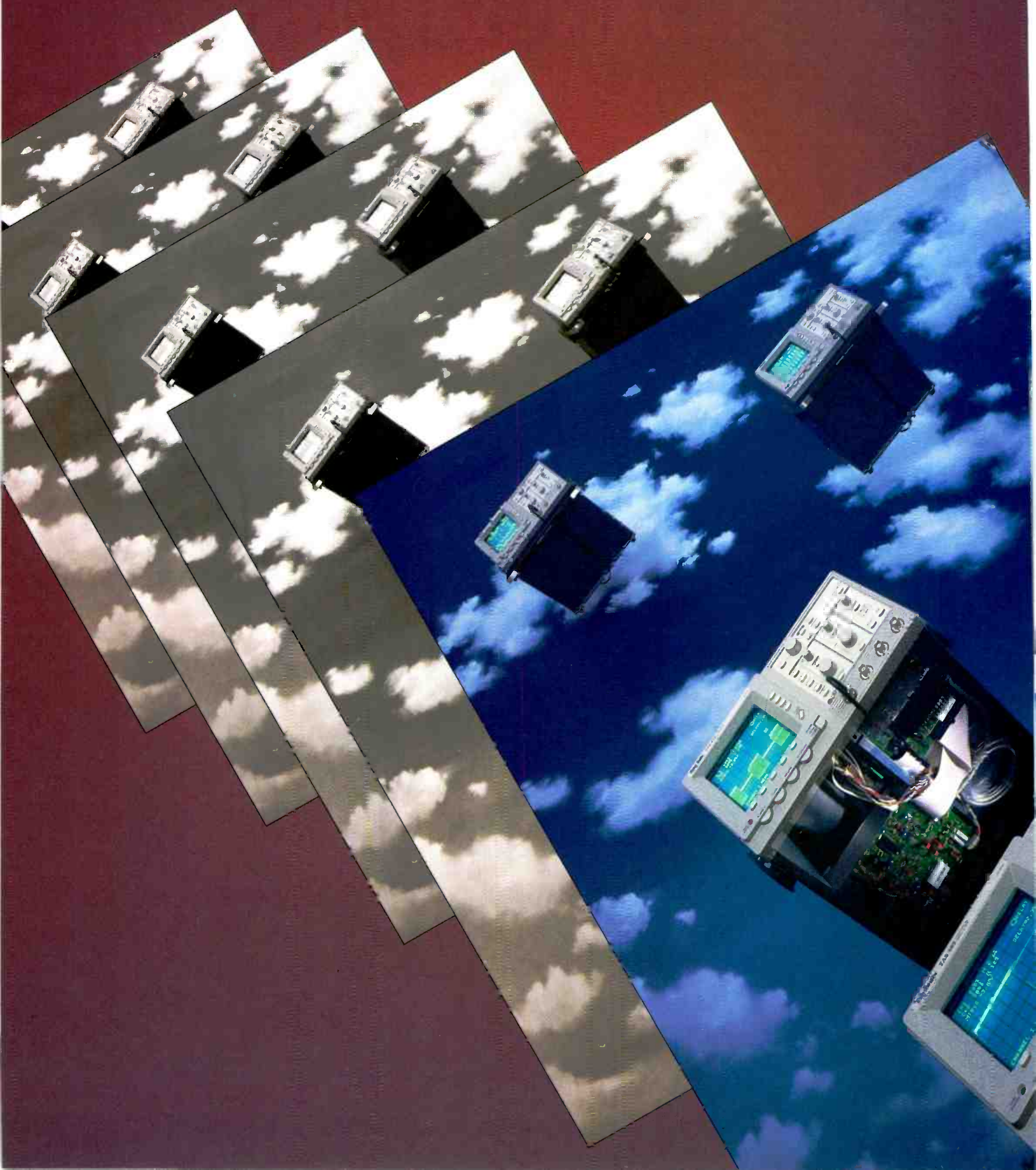
When the MPEG 1 committee began the task of specifying a syntax for compressed digital video, its goal was the delivery of video onto a compact disc, using the 1.416Mbits/s data rate as a guideline. Aware that it was impossible to represent a CCIR 601 resolution image at such a low data rate, the committee specified a one-quarter resolution image (352x240 NTSC, 352x288 PAL) as the SIF. MPEG 1 was a frame-oriented syntax rather than a field-oriented syntax. When decoded, the SIF resolution video is expanded to fill a full TV screen, resulting in image quality similar to VHS.

The broadcast community recognized the potential of MPEG technology for increasing the channel efficiency of satellite transponders and cable networks, as well as the image quality. As a result, a second standard, MPEG 2, evolved for broadcast application designed to represent CCIR 601 resolution video (704x480 NTSC, 704x576 PAL) at data rates of 4Mbits/s to 8Mbits/s.

Additionally, MPEG 2 provides support for interlaced fields, 16:9 ratio, multiple video channels in a single system stream and extensibility to HDTV. Also, MPEG 1 is a subset of MPEG 2, allowing any MPEG 2 decoder to decode MPEG 1 syntax video. ■

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

10th annual



facility maintenance report

It still takes a knowledgeable person and the right test equipment to repair modern electronics.

Recently, my VCR quit working. Undaunted, I pulled the unit from the equipment rack and proceeded to the shop, where I fully expected to repair it. Off went the cover, in went the tape, and I pressed play. Result: No video output.

Four layers of circuit boards and 100 screws later, I began to realize that despite my knowledge and experience in electronics, I had little chance of repairing my VCR. I had no test equipment.

The sophistication of consumer hardware pales in comparison to the professional equipment *BE* readers service every day. This means that today's sophisticated broadcast and production hardware cannot be repaired without adequate test equipment. We're a long way from the days where you had at least a 50% chance of repairing a piece of gear simply by replacing the tube that wasn't glowing. Without the proper oscilloscope, signal generator and other test equipment, today's electronics simply cannot be repaired.

Although digital processing has increased the performance and capability of our hardware, it also has greatly increased the complexity. Even with automatic diagnostics and self-testing features, it still takes a knowledgeable person and the right test equipment to repair modern electronics.

This issue of *Broadcast Engineering* is devoted to reviewing some of the latest technology in test equipment. Whether you're involved in the maintenance of audio, video or computer-based equipment, having the right test equipment is a necessity.

The lineup

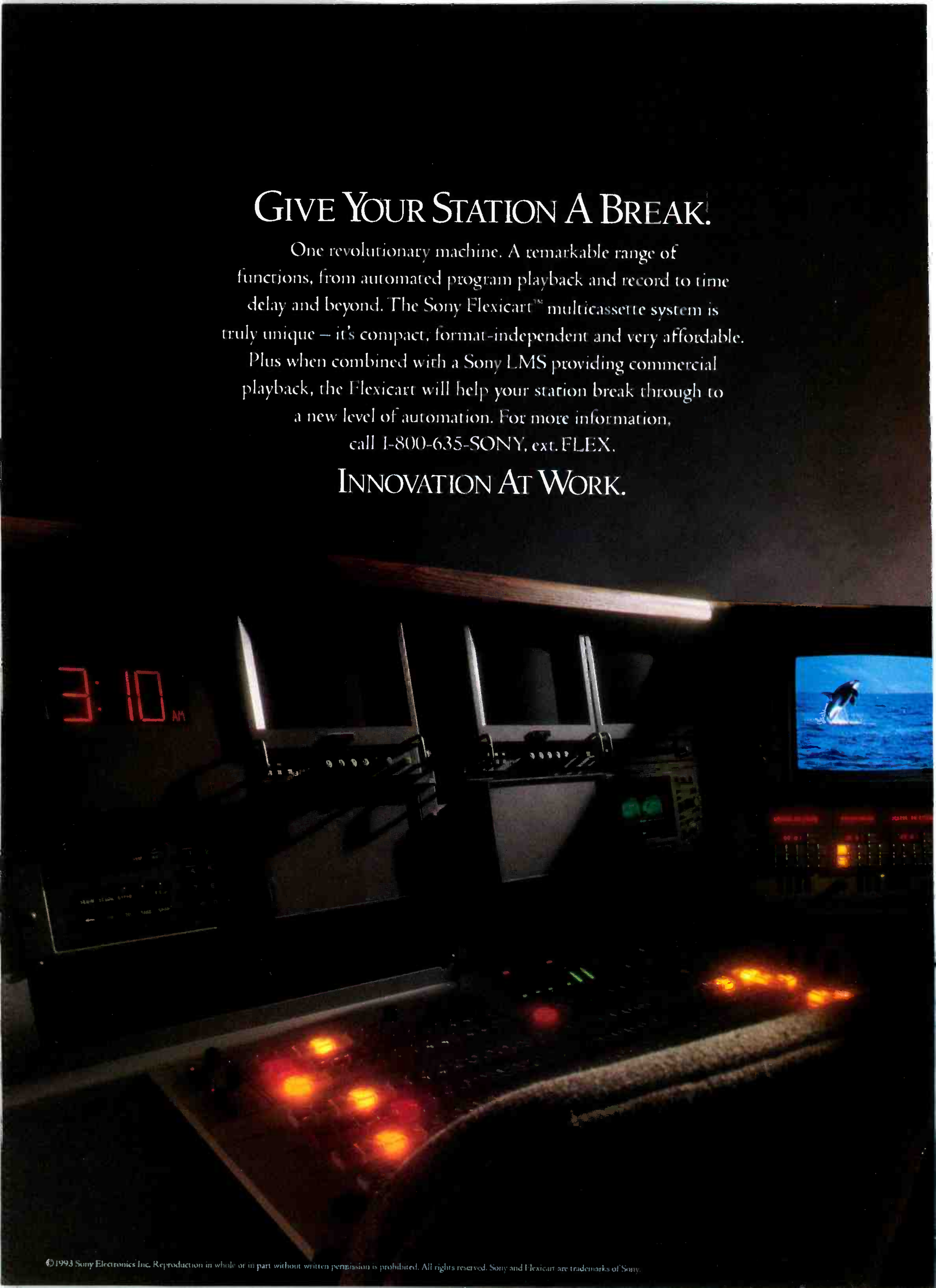
One drudgery that audio engineers must perform is frequency response measurements, especially on tape recorders. This and many other tests are now made infinitely easier by automatic audio measurements. Connect the inputs and outputs. Select the type of test needed and press start. That's all you have to do with many of today's audio analyzers. Similar automatic performance and features are available for video equipment. Learn about the latest in automatic measurements from "Testing Audio — Automatically" and "Automated Test Equipment for Video."

New oscilloscope technology brings power and ease of operation to the maintenance staff. Having the right scope isn't an option. One of the first decisions that has to be made is whether to select an analog or digital oscilloscope. That choice is not as easy as it may seem. "Choosing a Scope: Analog or Digital" will help ensure that you select the best type of scope for your particular application.

Finally, with the widespread use of PC-based equipment, don't be surprised if you're called upon to service it. Learn some of the keys to successfully repairing computers in "Troubleshooting PC-Based Equipment" before you're put on the spot.

Brad Dick

By Brad Dick, editor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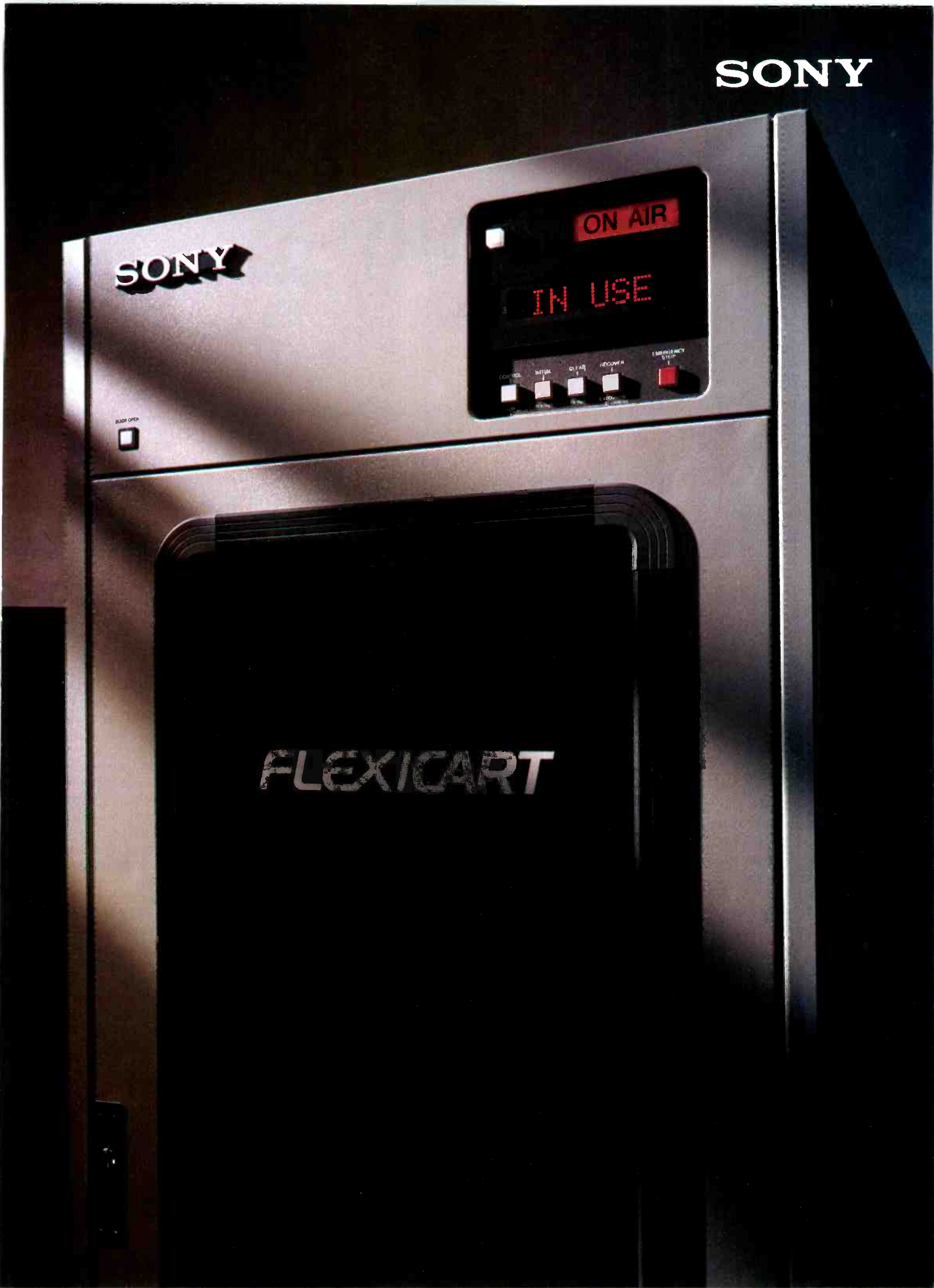
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Testing audio - automatically

Automating the testing function can reduce maintenance costs.

By Bob Metzler

The Bottom Line

Like any other area of station operations, the equipment maintenance process can benefit from computer assistance. Keeping track of audio performance with an automated testing system may significantly improve the maintenance engineer's efficiency and detect problems before they cause costly failures. Station proofs also can be performed without down time. In an environment of increasing consolidation, such efficiencies become critically important. As a result, the cost of automated test equipment can be quickly recovered.

The hour was 3 a.m. — nobody's time of peak operating efficiency. One engineer sat at the studio running the oscillator and another was at the transmitter watching the modulation monitor, operating the analyzer and writing down numbers. The two talked on the intercom. "Change to 5kHz. Bring the level down a few decibels. Down a little more. Back up a little. OK, hold it there and read me the attenuator settings. Now, wait while I set level and null the analyzer." On and on it went in similar fashion. A radio station's full stereo proof-of-performance could easily require two hours to make the measurements, and another hour or two the next day spent with a French curve graphing the results.

In contrast, with today's latest automated audio testing technology, the proof signal can be a quarter-second multitone burst. It comes from a CD player or DAT cassette, just like a lot of the station's normal programming. No engineers have to be present at either the studio or transmitter. The graphs are automatically generated and printed or saved to computer disk. Listeners don't even know a test occurred — they just hear a beep, which could be used as a time signal or part of a station ID.

At the leading edge, that's what automated audio test technology can do for you.Conventional automated techniques use a series of sine wave tones, take from 30 seconds to three minutes, and provide the same kind of automated print-out.

Metzler is president of Audio Precision, Beaverton, OR.

The hardware

The basic requirements for this kind of testing include computer-controllable audio test instruments, a host computer and appropriate software. Some manufacturers build the test instrument and computer into the same box. Others make only the audio test instrument, which is then controlled from a standard computer, such as an IBM-compatible PC.

The audio-generating instrument may be as simple as a conventional sine wave oscillator with computer "handles" on the frequency and amplitude controls, or as complex as a DSP-based device that generates a large number of sine waves simultaneously, each with controllable frequency and amplitude.

The measurement instrument may range from an audio voltmeter and distortion analyzer with digital outputs feeding a computer, to an FFT spectrum analyzer with sophisticated post-FFT processing. The simpler automated instruments test in a conventional fashion with swept or stepped sine wave signals, thus requiring 30 seconds to three minutes for a complete proof. The DSP/FFT-based instruments take a more parallel approach by generating all necessary frequencies simultaneously and can reduce test time to a quarter second or less.

Beware of software

Computer-controlled audio test instruments have been available for more than 12 years. They have been used primarily by manufacturers with large test engineering departments full of experienced

Advanced wireless intercom system

Vega Q600

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

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

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

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

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

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

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

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EUROPE Marlow, UK (0628) 478833 ASIA Hong Kong (852) 5987118 JAPAN Tokyo (03) 5992-0621 programmers. Until a few years ago, almost no one in broadcasting did automated audio testing because of the large software development effort required. Writing the software for complete automation of tape machine alignment or an audio proof might take a competent programmer six months to two years — a time investment not likely to pay off for most broadcasters. Automated audio testing became practical for this industry only when test equipment manufacturers started providing high-level software that was as easy to operate for equipment testing as spreadsheets are for number crunching.

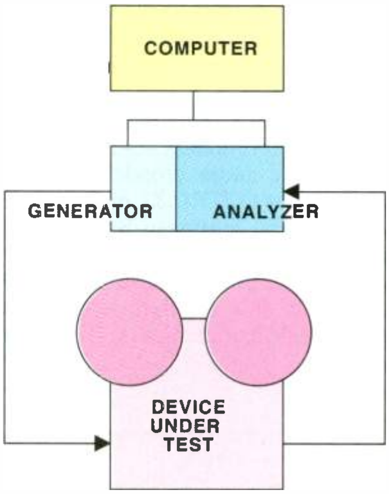

Figure 1. *Block diagram of the automated testing setup for a typical studio device, such as a reel-to-reel tape recorder, console or amplifier.*

Good software allows selection and running of alignment or proof procedures by pressing a single key so less-experienced personnel can perform operations that previously required more skilled operators. Good software lets machine performance be verified against manufacturer's specs automatically. Therefore, the most key element for a broadcaster to evaluate is how the software works. Is fluency in a computer language required, or are preset proof routines and menu-oriented procedures furnished by the manufacturer?

Split-site factors

Automated audio test equipment designed for factories assumes that the input and output connectors of the device to be tested are located within a few inches of one another. This also is often true when testing studio equipment, such as cart machines, consoles and distribution amplifiers. For a full station proof or for testing small networks (i.e., low-power repeaters), signal must be injected at a studio, but the analyzer normally must be at the transmitter site for adequate signal-to-noise ratio. Test equipment and software useful for proofs must provide for that physical separation.

If the testing is to be done by conventional sine wave techniques at constant modulation levels, the software must support a data communications path from transmitter (modulation monitor site) to studio (test oscillator location) in order to exercise real time control over oscillator level as the frequency is changed. The edge-of-the-art multitone burst techniques require that an analyzer at the transmitter site be able to recognize and trigger on the studio-generated burst when it appears during normal programming. With either measurement technique, the remote computer controlling the analyzer can either store data or send a fax of graphic and tabular data to any desired fax machine.

The CCITT O.33 standard

Only one international standard exists for automatic audio broadcast system testing. This is *CCITT O.33*, originally developed by the European Broadcasting Union (EBU) as *Recommendation 27.* Automated audio test equipment that tests according to this standard is available from several manufacturers. The technique was originally developed with a specific application in mind, namely a live event carried by a large number of broadcasters in many countries, all linked to the origination site via temporarily leased telco lines. (This is a fairly common European broadcasting situation.)

These remote broadcast circumstances typically allow only a brief line-testing period. CCITT O.33 is designed to let each broadcaster verify audio quality from the remote site or to equalize as necessary from a known standard test signal. The test signal sequence starts with one second of frequency-shift-keyed audio tones to trigger the distant analyzers and identify the originating agency. A standardized tone sequence of approximately 30 seconds follows, each tone lasting one second. The analyzer, knowing in advance what the sequence of the tones will be, makes the appropriate measurements of level, response, phase, distortion and noise against its stored reference signals.

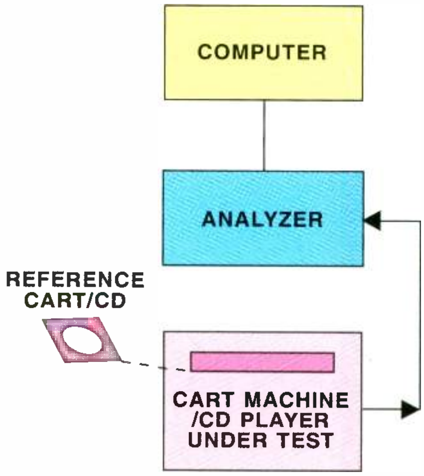

Figure 2. *Block diagram of the automated testing setup for a playback-only device, such as a CD player or cart machine.*

CCITT O.33 testing has had little usage in the western hemisphere, where studio and transmitter are normally both under control of the same management, and where network links are somewhat more permanent.

More than just proofs

Most of what has been covered thus far deals with the challenging full station proof-of-performance and split-site applications. However, broadcasters spend a much larger portion of their audio maintenance time aligning and testing cart and reel-to-reel machines, VTRs and oth-

er studio equipment than they do making station proofs. Automated audio testing can provide significant benefits in these areas as well. Tape machine alignment is greatly aided and accelerated by fast graphical displays. Some instrument manufacturers furnish software that works with standard reference tapes to simplify alignment and performance verification of the reproduce section of machines.

The standard ability of computers to store test data makes it easy to organize preventive maintenance programs. Routine tape machine performance-verification measurements, made monthly or quarterly over a period of time, can be graphically overlaid or automatically subtracted from one another to show trends in performance. Trend data in high-frequency response or wow-and-flutter levels is invaluable in predicting the need for head or motor/roller replacement before expensive and embarrassing on-air failure occurs.

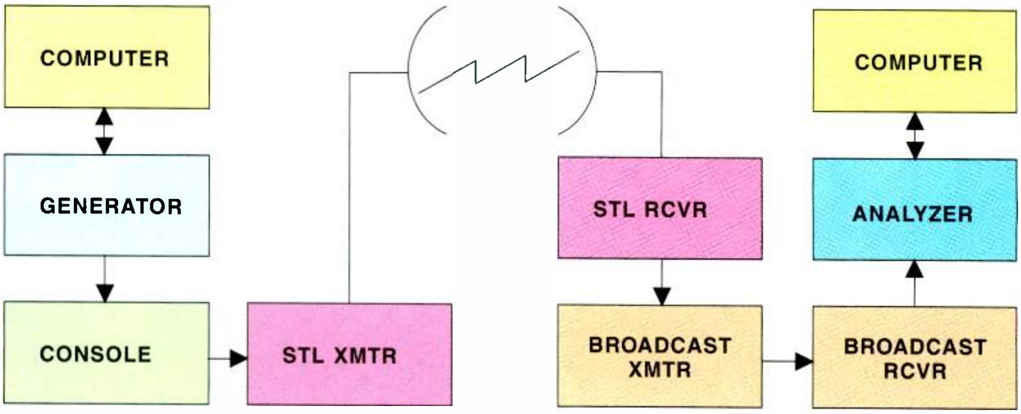

Figure 3. *Block diagram of the automated testing setup for a full end-to-end transmission system, such as a radio station, repeater or network.*

Audio quality can be maintained at higher and more consistent levels.

An interesting application of this technique has been developed by Mike Callaghan, chief engineer at KIIS-FM, Los Angeles. A special audio test bus that runs from each studio to the analyzer in the shop has been set up for this purpose. Because the station uses cart machines that recognize carts upon insertion by reading encoded labels applied to the cart shell, the switching of each cart machine's output to the test bus is accomplished automatically whenever an appropriately labeled test cart is loaded into a deck. The analyzer is constantly waiting for a test signal to appear on the bus. Engineering can therefore hand a test cart to any DJ and ask him or her to run it through each cart machine sometime during the air shift when that machine is not needed for on-air programming. The result is the automatic accumulation of data to verify performance and predict failures (with the test signal never appearing on the air). The test results are automatically compared to limits set by the station's engineering department, with warning messages generated whenever a cart machine moves outside acceptable limits.

Cost considerations

Automated audio test instruments, even those doing conventional single sine wave testing, involve many circuit elements that are not present in manually operated instruments. For example, generator frequency, level, waveform selection, impedance selection and other parameters must be set via digital connection from a computer rather than simple front-panel pots and switches.

The distortion analysis circuitry must be able to set level, null out the fundamental signal, set the proper range and provide a digital version of the reading, in addition to providing function and mode selection. If the instruments also can be operated manually (rather than being exclusively computer-controlled), the manufacturer has to include redundant circuitry to permit both front-panel and computer access to all the selectable and variable functions. If a user-friendly software package is included so that the broadcast engineer doesn't need to be a computer jock, that software must have been developed by a computer jock working for the instrument manufacturer.

All of this costs money. The lowest-priced automated audio test instruments readily available in the United States start at approximately $5,000. Instruments with software to easily accomplish proofs and other common broadcast tests by conventional single sine wave techniques start at approximately $8,000. The sophisticated DSP-based equipment that can do comprehensive audio measurements with only a quarter-second interruption of programming costs about $12,000. Some high-end and specialized automated audio test equipment produced abroad runs in the $25,000 to $30,000 range.

Some manufacturers build generators and analyzers as two separate packages while others make an integrated generator/analyzer. Among the latter, some companies may be able to furnish them as two separate packages for split-site operation for an additional $1,000 or so. If the instrument requires an external computer for control, add another $800 to $1,000 for a 386SX-based (or better) machine.

The reference price for today's minimum professionally acceptable, manually operated audio test instrument set is around $4,000. There really isn't anything cheaper that works to broadcast standards, including proper generator impedances, balanced input and output, levels high enough to drive telephone lines and so on. Compare that to approximately $8,000 ($9,000 in separate packages for split-site) for an instrument, plus $1,000 for a PC, for the lowest-cost *automated* system, including proof and tape machine maintenance software (the latter eliminating any need for programming experience by the broadcaster).

Is the cost difference of at least $5,000 to $6,000 for automated testing justified in your operation? Automated functions can stretch the ability of one or a few engineers to handle a complexbroadcasting operation. Many test activities that require a skilled engineer to perform manually can be triggered by on-air talent and measured automatically if automated testing is available. Time-consuming proofs and performance verifications can be reduced from hours to minutes — or to a fraction of a second — and may not require any engineering participation until graphic data is ready to be analyzed. Audio quality can be maintained at higher and more consistent levels. On-air failures and expensive make-goods are reduced via predictive maintenance. For an amount comparable to a few months salary for an engineering assistant, more broadcasters are finding that these benefits justify the investment. ■

➡ For more information on automated audio test equipment, circle (303) on Reply Card. Also see "Analyzers, Audio System," p. 24 of the BE Buyers Guide.

Automated testing for video

Let a computer track down the problem.

By Mark J. Everett

The Bottom Line

Today's equipment is more complex and compact than ever. A few handfuls of chips have replaced millions of transistors. But despite fewer parts, repair and maintenance is more specialized and difficult. Through automation, manufacturers are streamlining the process, allowing technicians even more cost-effective maintenance methods.

Today's TV systems have some new yet common elements. First, customer needs are such that quality of the final product is extremely important. Next, modern equipment is complex. Last, the number of trained qualified technicians is declining. Given these conditions, manufacturers are challenged to meet quality demands in the face of the other two factors. The last few years have shown a beginning in a relatively uncharted area of video system testing. This article will explore some of the concepts and products developed to minimize engineering and technician time, while maximizing product quality and efficiency.

Creative thinking

Approximately one year ago, a major production company in Burbank was in the process of moving and rebuilding its entire facility. Engineers recognized the need to monitor equipment usage for scheduling machine maintenance. Some creative people, a few computers and the (now) basic computer port for machine control on the back of most tape transports allowed for some creative inventing. By monitoring the activity on the RS-422 control port, an automatic recording method was developed to track, in almost real time, the activities of each tape machine.

Because there is a big difference in machine wear between power on and play, simply tracking the hour meter time was insufficient for cost-effective maintenance. The system tracked play time, wind and shuttle time, and idle time on each machine by serial number. With the manufacturers' suggested hour run time on various mechanical parts, cost-effective preventive maintenance could be scheduled. In addition, the system recognized under- and over-used machines. It also provided a means for accurate time usage information on a machine basis. This meant that precise time billing information could be provided for editing jobs.

Everett is a product manager for Videotek, Inc. Pottstown, PA.

One more step

The next chapter in this direction was written when Digital Betacam recorders were introduced with advanced machine diagnostics. This feature takes an extra step or two beyond simple diagnostics. An external computer port is provided for status and condition monitoring by a remote computer. This feature takes the function possibilities instituted by the folks in the Burbank production facility and moves them into the future. Now, when queried by the correct software

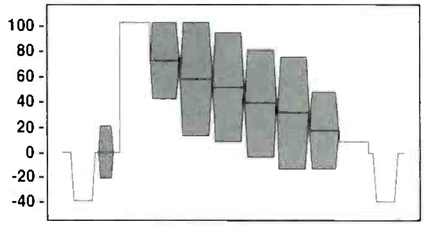

***Figure 1.** FCC color bars for general amplitude and timing measurements.*

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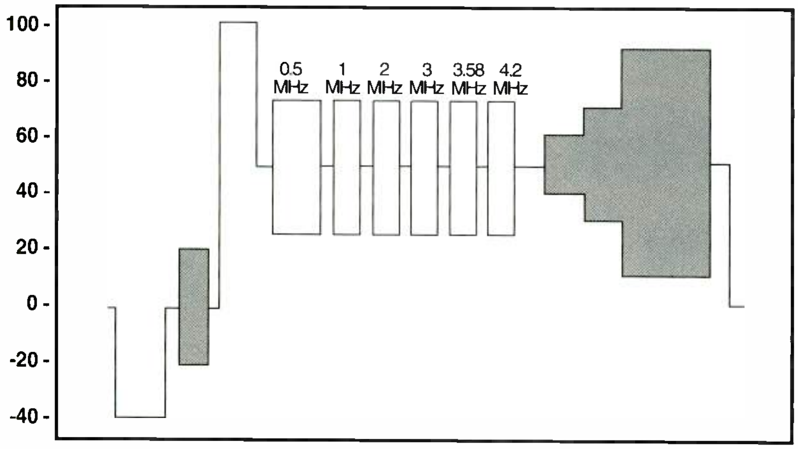

Figure 2. *The NTC-7 combination signal combines multiburst and modulated pedestal for frequency response and distortion tests.*

message, the machine has the ability to perform and report functional status and condition at any time. Power supplies can be monitored, servo motor speed variations can be collected and accumulated,

The key to this new concept is building self-diagnostics into complex machines.

signal systems and subsystems can be tested for performance characteristics, and more tests than we are able list are possible.

The key to this new concept is building self-diagnostics into complex machines. Miniaturization, large-scale integrated circuits (LSI), surface-mount technology and the proliferation of microprocessor-controlled circuits have all but eliminated the traditional technician's approach to system troubleshooting. Today, many repairs are whole circuit board replacement, some of which are quite expensive. Often, the defective board is serviced by the manufacturer in special test fixtures, using microprocessor testing devices to locate the defective area or component on the circuit board under test. The new concept is to build test ability into the circuit card and provide for a fairly simple means to access the test procedure on the circuit board without tearing the machine apart.

A few specialized subgroups are in this portion of a contemporary video monitoring system. The first, the internal diagnostics in the equipment, is now fairly apparent, but the external portions are still under definition. The basics of the external part are a computer, an interconnection network between the computer and all of the machines under test, and controlling software. A network interconnection scheme is already defined for at least one equipment supplier. Furthermore, some industry experts are currently working on a definition of a universal interconnection scheme, both hardware and software. The possibility that many different types of machines from many different suppliers might be interconnected on this future automatic testing network is quite high. This results in a need for some industry-wide software and hardware cooperation.

How it works

The system will have a master test computer loaded with the specific testing software for each machine model in the facility. Master controlling software will use the machine-specific software and address the machine for testing. Interconnections will probably be a single

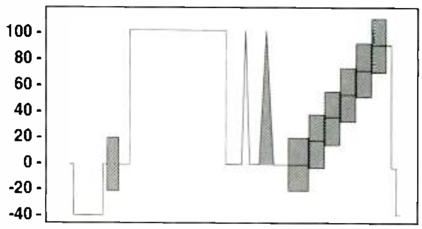

Figure 3. *The NTC-7 composite signal contains various signal elements for amplitude, phase and some distortion measurements.*

cable local area network. The software communication definitions will need to allow for identification to include manufacturer, machine model number, serial number, software version or versions, and common testing key words. Similarly, machine responses will include the same identification information and the results of the requested test in a common format.

This automated testing system will eventually lead to a single control station where an operator will be able to cycle testing through all of the machines in the plant, monitor usage, and locate to the circuit module or component any failure. Although this system will not be the answer to all of our problems, it certainly will reduce the problems of technicians performing repairs and maintenance. In addition, it could be expanded to include machine controls for all operations. However, some believe the performance of operation and maintenance should be separated physically, functionally and operationally.

Another full layer of operational testing has yet to be addressed — output signal quality. The same operator who is looking at a computer screen and getting messages, such as, "As of 08:33:18.5 on 24 December 1995, All testable functions of

The system tracks play time, wind and shuttle time and idle time on each machine by serial number.

all connected machines are OK, except ...," does not necessarily know the condition of the output signal. Another member of this automated testing system will probably be a signal measurement device. Here again, some products exist. Video signals would be directed through a routing matrix to an automatic measurement analyzer.

What to look for: Standards to the rescue

One big problem that manufacturers of automatic test equipment face is assisting the operator in the use of test signals and standards. Current technology simply will not allow a machine to examine a frame of active video and decide if the hue or phase is correct. The same problem exists with color intensity, overall intensity and many other aspects. Although there are devices to limit oversaturation and extremely high luminance, what about the slightly low side? Fortunately, there are standards and test signals — at least in the analog domain. (See Table 1.) These test signals are clearly and exactly defined by standards and regulatory agencies, such as the FCC, CCIR and the EIA.

Furthermore, numerous standards exist to define the acceptability of a signal in comparison to a specific standard. For

Continued on page 41

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Continued from page 36

instance, no one wants to view noisy video, but how do you determine how much noise is acceptable? A program originator, for example, knows satellite distribution followed by broadcast or cable distribution will add noise to the already less-than-perfect picture. The original pictures were generated by studio cameras with a signal-to-noise ratio of 73dB. They were recorded on a tape machine that took the effective signal to noise down to 56dB, and the distribution copy was a bit lower than that. Now, the 54dB video is taken to a high-quality satellite distribution service and they promise to comply with RS-250C satellite signal performance standards. How does he know what he is buying, and how is the performance checked? RS-250C requires the use of two NTC-7 test signals. These signals are inserted in the vertical interval by the uplink operator, and the receiver can test the performance of the link against an accepted and known standard. For most testing, once the vertical interval test signals are inserted, measurements of these signals at the input and output of each link can lead to quantitative performance analysis.

STANDARD	REQUIRED TEST SIGNALS
RS-170A	None, only a representative line of video
RS-250C	NTC-7 composite test signal NTC-7 combination test signal A line with no video for S/N testing (Line 12)
FCC (Broadcast)	FCC multiburst FCC color bars FCC composite VIR signal (very little current use) Zero carrier pulse (demodulator function) A representative line of video
FCC (Cable TV)	FCC multiburst or NTC-7 combination FCC composite or NTC-7 composite

***Table 1**. Common standards and test signals required for quantitative testing.*

TEST SIGNAL	NORMAL LOCATION
NTC-7 composite	Line 18 Field 1
NTC-7 combination	Line 17 Field 2
FCC color bars	Line 17 Field 2
FCC composite	Line 18 Field 1
FCC multiburst	Line 17 Field 1
Quiet line (S/N)	Line 12 Field 1
SC/H sample point	Line 10 Field 1

***Table 2**. VITS signals and their normal placement.*

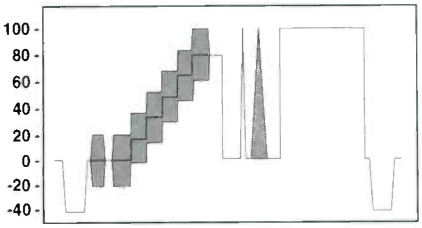

***Figure 4.** The FCC composite signal offers the same benefits as the NTC-7 composite signal and is normally placed on line 18, field 1.*

The production house or program originator must help the customer decide by which standard his output will be judged. There are RS-170A, RS-250C and its various subgroups for short haul, medium haul, long haul, satellite and end-to-end measurements. In addition, there are some old FCC performance requirements for broadcast television and some newly revised FCC requirements for cable TV operations. All of these standards are different, and all of them have their particular use in the world of television. Other standards also are available: the NTC-7 performance test set (which is basically replaced by RS-250C) and a whole series of CCIR tests for the rest of the world.

Once a performance standard has been decided, determine the scope and means of testing. At this point, all the tests required by these standards must be measured by inserting a certain video signal in the transmission path and measuring that signal at the receiver end. This signal insertion may be either a full field test signal or a VITS test signal. The difference is simple: Do you want to disconnect the program feed and use a test signal in its place, or do you add VITS into the program video and not disrupt the program feed? In either case, a test signal generator is needed.

Finally, the automatics can take over. At the point the test signals are added to a video signal, the automatic test set can be activated to evaluate the signals and lead to judgments about the picture quality. The automatic video analyzers available today work in a similar fashion. They have a library of test parameters as defined by all of those standards listed previously and are programmed to read test signals as defined by the various standards. For example, RS-170A requires that horizontal sync is measured at the 50% points, and the FCC testing requirement is measuring horizontal sync at the 10% point. Given normal rise and fall time for sync pulses, the same horizontal sync pulse will be measured to two slightly different values with these two different standards. The user must understand the implications connected with the measurements based on these various standards. In the United States, CCIR, for PAL, absolutely sets the location in the vertical interval of each of the required test signals. In the United States, almost any vertical interval test signal can be placed almost anywhere. (See Table 2.) A few restrictions exist, but there are normal locations for most test signals. Some of the normal locations, however, are in conflict with others.

Output signal quality testing has yet to be addressed.

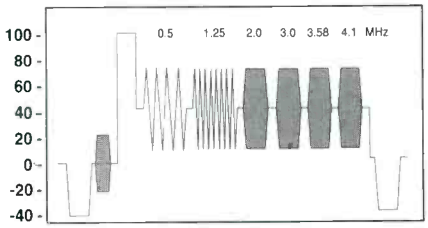

***Figure 5.** The FCC multiburst contains packets of six different frequencies and can be used for basic frequency response checks.*

Testing

Once the standards and signals have been selected and identified, you can perform the tests. Auto-measure instruments can be remotely accessed by a computer, fulfill a request to perform a given measurement on a selected input video signal and report the results in real numbers with a pass/fail message. These

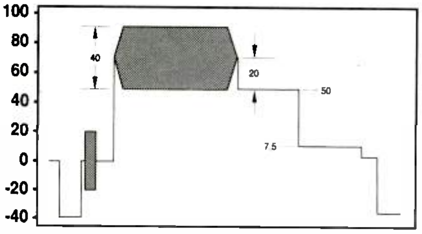

Figure 6. *The FCC VIR signal, normally found on line 19, field 1, is currently declining in use.*

units can perform hundreds of measurements based upon RS-170A, RS-250C, NTC-7, FCC (broadcast and cable television) and CCIR requirements. They are designed to make specific tests on specific signals, which may be either full field or on a single line in the vertical interval. Some can accept and automatically identify NTSC and PAL input video, and then automatically switch to operate in format of the input video. Finally, the operator can ensure signal quality without the traditional measurement instruments, subjective evaluations and interpretation differences.

So what does the future look like? Anything is possible, but some things are certain. First, customers will demand high-quality products. Second, hardware will become increasingly more complicated, with larger circuit modules in smaller spaces. Third, the availability of fully trained technical support staff will diminish. One solution to the problem is the automation of the testing and measurement of system components and signal evaluation. A single computer with a single operator will be capable of monitoring equipment condition and output signals throughout the facility. ■

For more information on automated testing, circle (304) on Reply Card. Also see "Analyzers, Video Systems on p. 24 of the BE Buyers Guide.

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Choosing a scope: Analog or digital

Differences between analog and digital scopes define how best to apply them.

By Vivek Chhabria

The Bottom Line

With the many variations of analog and digital scopes on the market, engineers often find it difficult to decide which type of scope is appropriate for their applications. Analog scopes are usually available at more attractive prices, while digital scopes include many intriguing triggering features that analog scopes lack. A good understanding of the attributes of and differences between analog and digital scopes will help the broadcast engineer make a more informed decision when purchasing one.

The growing number of choices for oscilloscopes makes purchasing decisions difficult for today's broadcasters. A primary distinction involves whether to choose an analog or digital design — the subject of this article. Prior to this discussion, however, a quick review of the general parameters to be assessed in either type of scope is required.

Common features include bandwidth, ease of use and video triggering capabilities. They must be considered in the context of current and future applications within the broadcast environment.

Scoping out scopes

The most basic issue is the published bandwidth of the scope. This figure refers to the maximum frequency the scope can acquire without distorting the signal. For measuring sine waves, the scope should have a bandwidth three to five times the frequency of the highest-frequency signal of interest. With square waves, the bandwidth needs to reach out to at least the sixth harmonic. For video signals, the scope's bandwidth must cover all significant pulse harmonics. For example, an NTSC signal's 33.3kHz line rate and 800 pixels per line creates a 26.64MHz pixel clock rate, requiring a scope with a bandwidth of several hundred megahertz.

Next, broadcast engineers should consider how easy a scope is to learn and use. The *user interface* of a scope should be straightforward and easy to understand and operate. One trend here is a simplification of the front panel and an increase in software menus displayed on the scope's screen.

The *number of channels* that the scope supports also impacts how efficiently the engineer can do a particular job. Multiple input channels make it easier to probe and compare waveforms as they propagate through stages in a video or audio system. Most analog and digital scopes come in 2- and 4-channel models, while a few higher-end scopes support more than four channels.

Other features that streamline the engineer's job include automatic measurements, cursors with readouts, and hard copy capabilities for documenting signal behavior. Scopes that can be programmed from an external controller also can be used in automated test setups. Portability also may be a concern.

The user interface of a scope should be straightforward and easy to understand and operate.

Adequate *video triggering* makes a scope particularly useful to TV broadcast engi-

Chhabria is a product marketing manager at Tektronix, Beaverton, OR.

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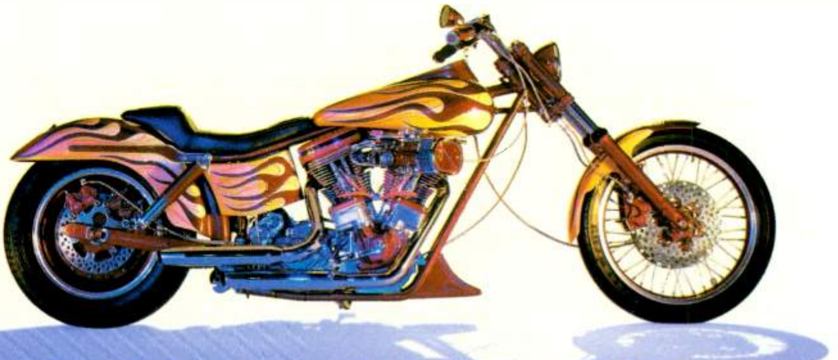

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neers. To support flexible video triggering, the scope should be capable of triggering on a variety of video activity, including lines, fields, pixels and individual color fields. It also must automatically recognize and trigger on the NTSC, PAL and SECAM standard formats to simplify viewing standardized signals. With the expanding custom video market, the scope should support HDTV formats by including tri-level sync triggering.

Analog scopes: Real time resolution

An analog scope draws a graph of an acquired electrical signal on the screen of a cathode ray tube. Via internal conditioning circuitry, the input signal guides the motion of the electron beam to show changes in the input waveform as they happen. (See Figure 1.) With little delay between acquiring the waveform and displaying it, the signal is displayed virtually in real time. For this reason, analog scopes

The primary advantage of the analog scope is its higher resolution at a lower cost.

are often referred to as *analog real time scopes* (ARTs).

Once the ART encounters a user-specified trigger condition, it sweeps the beam across the display screen, drawing the waveform. During the subsequent hold-off period, the beam returns to its starting point, and the scope does not display the input signal. The beam starts drawing again once the scope detects the next trigger event.

The primary advantage of the ART is its higher resolution at a lower cost, compared to *digital storage oscilloscopes*

The lack of storage capability is the analog scope's greatest liability.

(DSOs). Because an ART conditions the input signal instead of breaking it into discrete measurements, all analog scopes essentially provide continuous resolution. In fact, low-cost ARTs provide superior resolution than the standard 8-bit digitizers found in mid-range DSOs. High-performance digital scopes with faster digitizers offer better resolution, but at a substantially higher cost.

Furthermore, ARTs have extremely fast drawing rates, with hold-off times measured in microseconds. The combination of fast drawing rate and fast beam repositioning yields a display-update rate three to four orders of magnitude greater than a DSO.

The ART's high-speed drawing allows an analog scope to highlight important signal details with gray scaling. A faster-occurring event creates a faster-moving beam that has less time to excite the phosphor coating on the display. Therefore, faster events appear dimmer than slower sections of the waveform, giving an indication of the relative speed of an event.

With repetitive signals, gray scaling also indicates how often an event occurs with respect to the rest of the waveform. Aberrations that seldom occur appear much lighter because the electron beam draws them more infrequently than the rest of the waveform.

Along with superior resolution and signal fidelity, most engineers experience a sense of familiarity and trust in working with an ART. Because the scope works in real time and only conditions the signal, engineers are confident that the displayed waveform accurately reflects the input signal. In addition, analog scopes may be less intimidating because they perform a straightforward task: capturing and conditioning an input signal and then displaying it on the screen.

Nevertheless, the lack of storage capability is the analog scope's greatest liability. Because an ART cannot retain a waveform in some internal memory, it cannot perform a variety of functions easily ac-

Adequate video triggering makes a scope particularly useful to television broadcast engineers.

complished by a digital storage scope, such as the calculation of rms voltages and other complex mathematical computations.

Without storage capability, ARTs cannot provide any automated or internal documentation. Although a few analog scopes can download a screen image of the display to a printer, this is the exception rather than the rule. Scope cameras provide an external documentation for ARTs, but this cumbersome method of documentation relies on photographs that are easily damaged and that are hard to reproduce.

Finally, because an ART begins acquiring a signal once it recognizes a trigger, it can only display information after the trigger, not before. Although most analog scopes offer delay lines that allow the ART to display pre-trigger activity, this is usually limited to only 80ns of history.

Digital scopes: Processing data into information

In contrast, a digital scope converts the analog input signal into digital information, stores it and displays it. (See Figure 2.) First, the DSO samples and digitizes the input signal's voltage at regular intervals, then it stores the voltage value along with corresponding time information in internal memories. The size of this waveform record depends on the capacity of

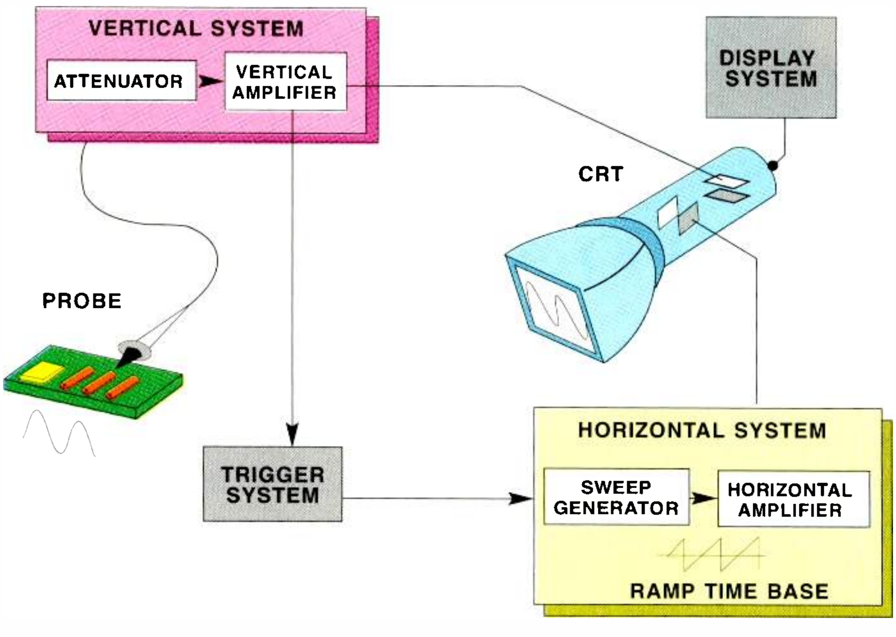


Figure 1. *Analog scopes condition and display an input signal virtually in real time.*

the DSO's memories. Once stored, the information can be manipulated and displayed to execute complex measurements.

The DSO continually streams the digitized information through its memories in a first-in/first-out (FIFO) process. This continuous process enables special triggering modes, such as glitch, pulse, runt and logic, that help the engineer precisely specify a trigger event.

Furthermore, instead of starting the acquisition process as it does in an ART, the trigger notifies the digital scope to finish filling the memories and end the acquisition. The operator can specify that up to 100% of the stored waveform is pre-trigger data.

As the incoming waveform is digitized, a DSO can perform advanced signal processing to translate raw data into finished information. For example, today's advanced DSOs provide multiple acquisition modes, including sample, peak detect, hi-res, envelope and averaging. The *sample* mode simply stores one sample in a specified interval. In *peak detect* mode, the DSO looks for the highest and lowest samples in an interval and saves them. *Hi-res* reduces noise by averaging samples on-the-fly. For repetitive waveforms, *envelope* reveals the maximum variations of a signal across time, whereas *average* calculates the average value for each point in a waveform over numerous acquisitions.

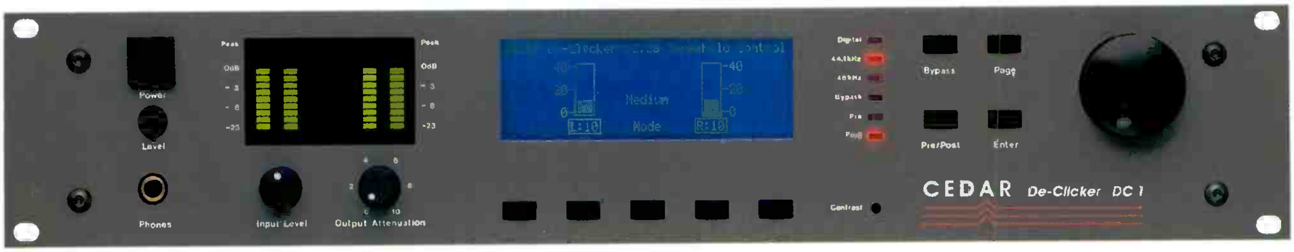
Many digital scopes can make automatic comparison measurements between waveforms, including live and stored signals. Multiple waveforms also can be stored indefinitely, allowing quick

Continued on page 52

USE AN ANALOG SCOPE WHEN:	USE A DIGITAL SCOPE WHEN:
Making a qualitative appraisal of a waveform.	Characterizing a signal.
Resolution is paramount.	Waveform storage and documentation are paramount.
Displaying fast sync pulses and edge jitters.	Capturing fast single-shot and low-repetition events.
Gray scaling and peristence help uncover the frequency of an event.	Advanced triggering helps isolate specific events.
Watching for undiscovered abnormalities.	Comparing two or more waveforms, especially stored ones.

Table 1. *The distinctions between analog and digital scopes suit them each for particular applications.*

REAL TIME AUDIO RESTORATION



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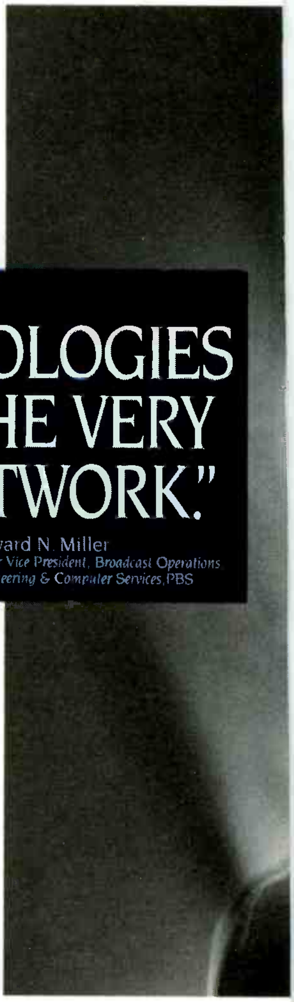
"*The video content will be accessed through on-line cart machines utilizing composite digital and an enhanced version of a* D-5 *component digital tape system. The component digital technology will eventually enable us to record and play back compressed forms of* HDTV *plus some non-video forms of data.*

"*When we looked at the alternatives available to us from video manufacturers, it was crucial to understand the direction they were taking—not just the hardware that might meet our current needs. Our decision to select digital composite* VTRs *was made with reasonable knowledge of where* Panasonic *was heading with component digital.*

"*The ability to play back composite digital recordings in the component domain is helpful, to be sure. But our primary interest in a component system is that it be a full bit-rate,* 10-*bit recording system.*

"NEW VIDEO TECHNOLOGIES WILL DETERMINE THE VERY NATURE OF OUR NETWORK."

Howard N. Miller
Senior Vice President, Broadcast Operations Engineering & Computer Services, PBS



That means we can take maximum advantage of the high bit-rate capability of these machines, and consider them for future upgrades to HDTV*—as well as for some services that are not video-based at all.*

"*Currently, we are using some of our* D-3 *equipment to conduct subjective evaluations of video performance at various compression levels. Using a transparent digital tape system, we introduce no*

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Continued from page 48

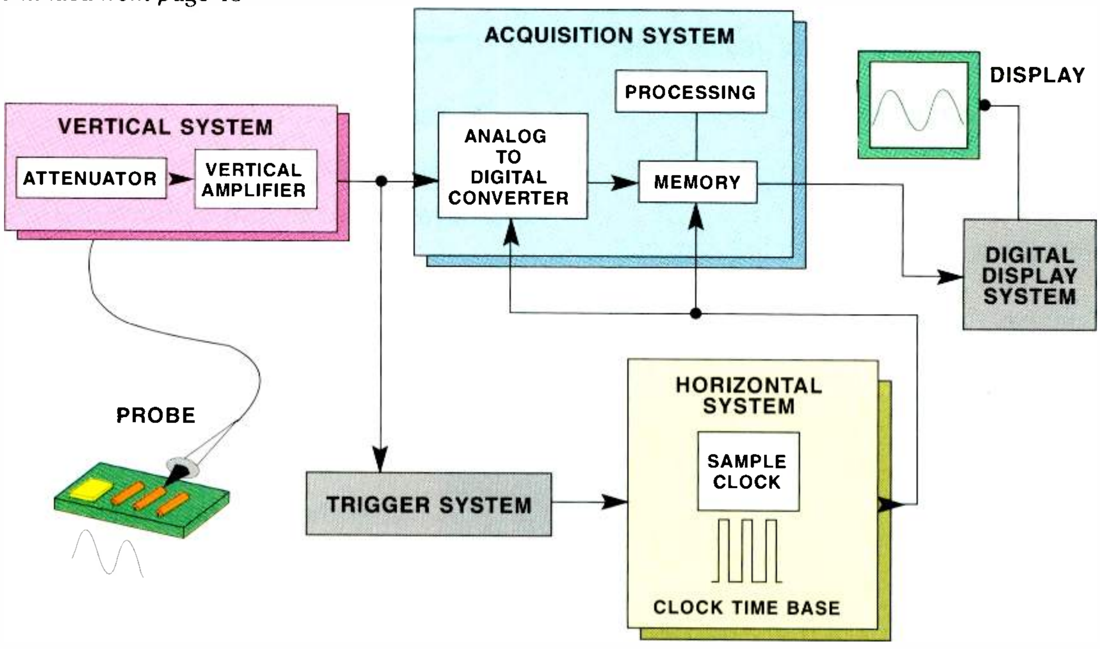

Figure 2. *Digital scopes convert input signals to digital information, store it along with time information, and then recreate the signal on the display.*

gathering of information on-site and for later analysis.

The same capabilities that create the DSO's strengths also produce its limitations. Digital scopes can miss large portions of signal activity because of the lengthy hold-off time (hundreds of milliseconds) spent acquiring, digitizing and storing signal information. As a result, engineers can experience the "rubber screwdriver" effect: When making level or timing adjustments on video or audio equipment, the response appears on the scope display a fraction of a second later.

The same capabilities that create the DSO's strengths also produce its limitations.

However, advanced triggering modes and longer memories can help to overcome deficiencies created by a DSO's large hold-off time. By waiting to trigger on a specific event, the scope has a greater chance of acquiring pertinent information. Longer memories allow the scope to acquire large portions of the waveform before having to pause for hold-off.

The digitizing of the input signal also affects the timing resolution of a DSO. Slower sample rates can cause serious distortions, especially *aliasing*. Theoretically, aliasing occurs when the digital scope cannot obtain more than two samples per cycle of the input signal's highest frequency component. When a waveform is grossly aliased, the scope displays a waveform with the input signal's overall shape but at a frequency lower than the actual frequency. Moreover, effects, such as edge-jitter, may appear as noise spikes instead of the familiar multi-edge display. However, faster samplers lessen the likelihood of these display aberrations.

In addition, digitizing the input signal limits the display's resolution in the time (horizontal) and amplitude (vertical) domains. With only eight bits (256 steps) of vertical resolution, a standard DSO can cause vertical distortion when displaying small signals. To counteract this effect, the *hi-res* mode in newer scopes actually increases vertical resolution up to 15 bits (32,768 steps) at slower sweep speeds for single-shot signals. Averaging also can increase resolution at all sweep speeds for repetitive signals.

Finally, many users find DSOs complex to understand and use. Their great range of acquisition modes and triggering selections can confuse and intimidate a new user. Newer digital scopes alleviate this problem through intuitive user interfaces, straightforward menu structures and universally understood icons.

Quality vs. quantity

Digital and analog scopes can satisfy many of the same applications, but some situations are more appropriate for one type of scope. (See Table 1.)

Users should choose analog scopes when assessing a signal's qualitative performance. In such cases, an ART offers vital clues about noise and metastabilities, showing instantaneous changes in signals as they occur. ARTs with intensity-enhanced displays can show fast signals at slow sweep speeds clearly and faithfully. This makes them preferable for monitoring live video waveforms or displaying fast sync-pulse edges (and edge jitters) in their entirety. It also is helpful when searching for undefined anomalies. In addition, gray scaling and persistence provide important information regarding the relative frequency and speed of distortions in the waveforms.

Digital scopes provide the types of measurements and storage needed for signal characterization. When quantifying precise measurements on detailed video signals, an engineer needs the DSO's mathematical and documentation capabilities. The scope's memory allows waveforms to be displayed when and where convenient. Comparing stored waveforms (including standard video and audio reference signals) to live ones can uncover important discrepancies. Waveforms also can be printed out or archived for documentation purposes. Their superiority in capturing low-repetition events makes DSOs better for observing elusive, infrequent problems in broadcast signals as well.

Analog and digital scopes continue to be indispensable tools.

ARTs and DSOs have distinct differences that determine which is best for specific broadcast applications. Analog scopes still have the highest single-shot bandwidth of any type of scope, with unsurpassed resolution, but they will probably never match the measurement and storage capabilities of the DSO. Digital scopes are coming closer to ART bandwidths and resolution, but the gap remains significant. As a result, analog and digital scopes continue to be indispensable tools across the entire spectrum of audio and video applications. ■

➡ For more information on analog and digital oscilloscopes, circle (305) on Reply Card. Also see "Oscilloscopes, Accessories," p. 26 of the BE Buyers Guide.

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Maintaining satellite systems

Satellites are still the choice for point-to-multipoint distribution.

By Greg Monti

The Bottom Line

With the proliferation of satellite-delivered programming available today in the markets of video, audio and data, many broadcasters are faced with maintaining multiple earth stations. Each of these downlink terminals is designed to receive a different type of signal, and therefore has its own operational quirks and its own failure modes. It is essential that broadcasters cultivate the preventive and corrective maintenance procedures required to keep these vital links operating properly.

$

Domestic satellite earth terminals may operate at C-band or at Ku-band. C-band downlinks are subject to interference from terrestrial (usually telco) microwave links. These point-to-point links can be problematic for an engineer attempting to install a C-band downlink, especially in an urban area. Terrestrial interference also can impair clean reception at an existing C-band downlink that is not frequency-coordinated. To prevent this, downlink terminals should remain registered with the FCC (licensing is no longer required) and a frequency coordination company (which requires a small annual frequency protection payment). This assures that terminals will be protected indefinitely from legal causes of terrestrial interference.

In some cases, engineers may have to deal with previously installed *uncoordinated* downlinks, which saved the owners a $500 to $1,500 initial coordinating fee. If a new terrestrial transmitter interferes with an uncoordinated downlink, first try pointing and polarizing the downlink antenna. A small accuracy improvement in these axes of motion can take care of many terrestrial interference (TI) problems.

Some situations require more time and expense, however. If the interference is coming from the back side of the satellite dish, the *knife edge* effect at the rim of the main reflector can bend the unwanted microwaves around the corner, often aiming them directly into the feedhorn. In this case, RF-absorbent material (sometimes sold as *TI filter disks*) attached to the edge of the parabola may suppress the interference.

In more extreme cases, a fence can be erected around the dish and metal window screening (hardware cloth) can be attached to reduce interference coming from the horizon. The most difficult environments may require that a concrete wall be built around the antenna or the antenna may have to be relocated.

Ku-band earth-to-space (downlink) frequencies are in the 12GHz range, and they are more attenuated by snow, rain or fog than are the lower C-band frequencies. On the other hand, parabolic dish antennas of given size have higher gains at Ku-band than at C-band frequencies. Furthermore, the Ku-band is not shared by terrestrial microwave users, so frequency coordination is rarely a problem.

Earth station antennas

An important goal of antenna designers is to assure that the antenna won't be mispointed or misshapen by wind or precipitation. The more the main reflector of an antenna flexes under the weight of snow or ice or under the force of wind, the less able it will be to accurately focus the received electromagnetic radiation toward the feed element. A small amount of ice on the main reflector can cause a large amount of signal degradation.

Serious ice storms may not occur every winter in your area, so you may want to

Monti is technical manager for the Future Interconnection System Project Office (FISPO) at National Public Radio, Washington, DC.

evaluate the cost-effectiveness of dish anti-icing systems. Hydrophobic coatings, such as Vellox, may be an inexpensive alternative to heating elements, but they must be reapplied periodically. The old standby maintenance procedures — a broom-wielding announcer sweeping snow and punching the dish with a gloved hand to break sheet ice — also works well in most cases.

Periodically check whether the back structure of the main reflector is in good shape. Loose or missing hardware, broken metal or fiber-glass tabs and missing splice strips between dish sections degrade gain. Sometimes, when hardware becomes loose, sections of the reflector may slip relative to one another such that the reflector is no longer a parabola. This may cause a small *squinting* error in the antenna, which can eat up a decibel or three of gain. Because most downlinks are designed for only 2dB to 4dB of margin, getting back even 1dB of gain is significant. To check for a squinted reflector, use a tape measure to check the overall diameter of the main reflector at two or three different cross sections. The reflector should not be out of round by more than 0.5%. Another method to check for squint is to sight across the plane of the front edge of the reflector. The entire circumference of the dish-edge should be in a single plane.

Some maintenance problems can be avoided by upgrading to a larger dish, even if it isn't necessary for gain reasons. Larger antenna diameter provides two improvements: more gain and more sidelobe rejection. With the advent of 2° satellite spacing, adjacent-satellite interference may have crept into your installation. In most cases, a 1.2m antenna cannot sufficiently reject a signal from a second spacecraft at 2° off boresight at C-band. Therefore, minimum antenna diameters of 2.8m to 4m are recommended for C-band, and 1.5m to 2m at Ku-band.

Power levels and footprints

Satellites have a definite life span, after which they need to be replaced. Networks negotiate for better deals on their satellite space leases and will often jump from one bird to another. No two satellite transponders have the same *footprint* (coverage). Signal levels also may be higher (or lower) than they were on the previous transponder at your location. Therefore, a change of satellite or transponder by the network can create unexpected problems for downlink station engineers.

This is why many consultants recommend building a downlink terminal with a large link margin (4dB to 6dB) calculated for the lowest-power video or audio service your site is likely to receive. If your downlink dish is eight or 10 years old and doesn't provide this level of margin, it may be cost-effective to replace it now rather than waiting for a spacecraft changeout when power levels may change unfavorably and service may be lost. A consultant or a computer program can help you determine what your downlink's margin is for a given power and bandwidth channel at a specific footprint location.

Pointing and polarizing

When noise and data errors arise, especially if they affect all receivers or demods connected to a single receive antenna, it's worth pointing and polarizing the antenna. A satellite dish cannot be checked for correct pointing or feed element polarization without actually moving the items to be checked to see if the signal is at maximum.

Many receivers have a signal level or a bit-error-rate voltage available to help you point your antenna. Attach a voltmeter and adjust in the following order:

1. Be sure the hardware that holds the non-movable parts of the dish or mount is tight.

2. Set the azimuth (east-west) and elevation (up-down) axes for maximum received signal, and temporarily tighten that hardware. Polar-mount antennas with a single drive motor that approximately follow the satellite arc have additional axes that require special treatment during setup. Consult the installation manual.

3. Set the polarization of the feed element for minimum interference from cross-polarized transponders or a maximum from the desired transponder. (The null of the undesired signal will be sharper and easier to spot.) Temporarily tighten

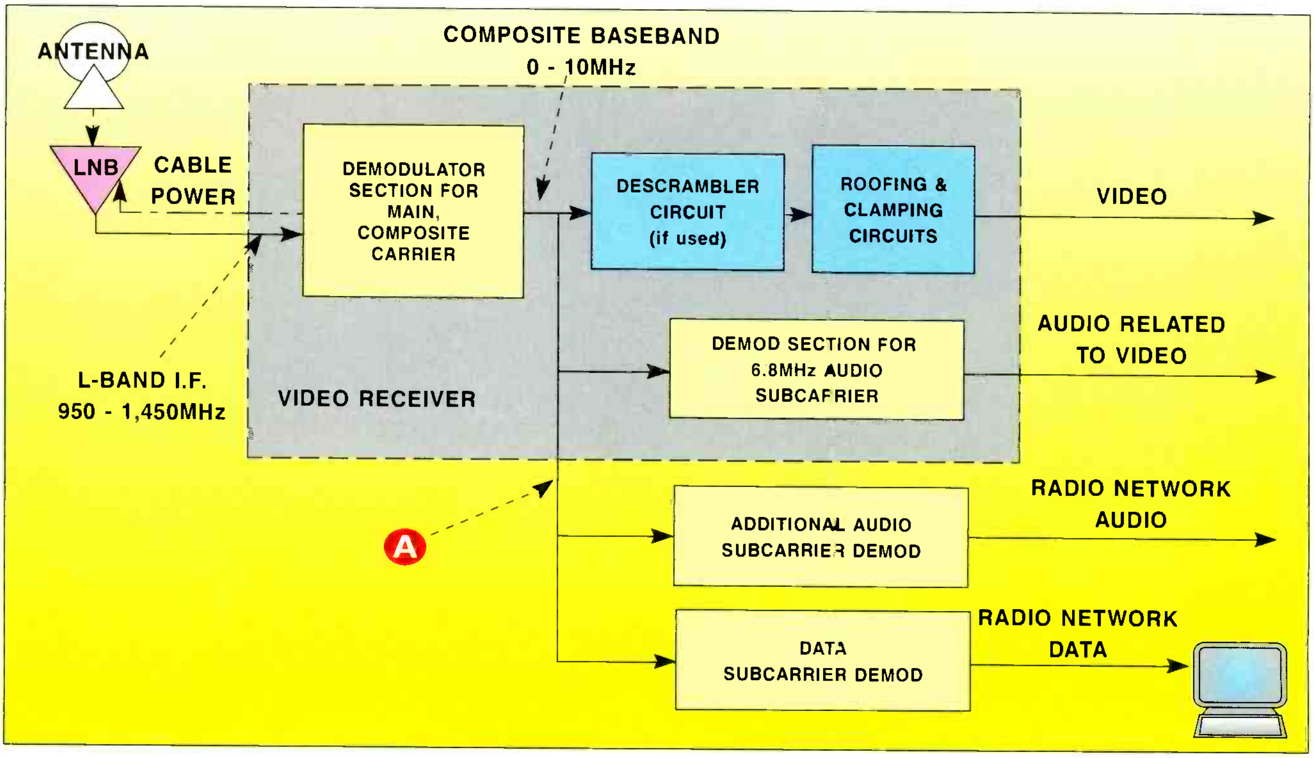
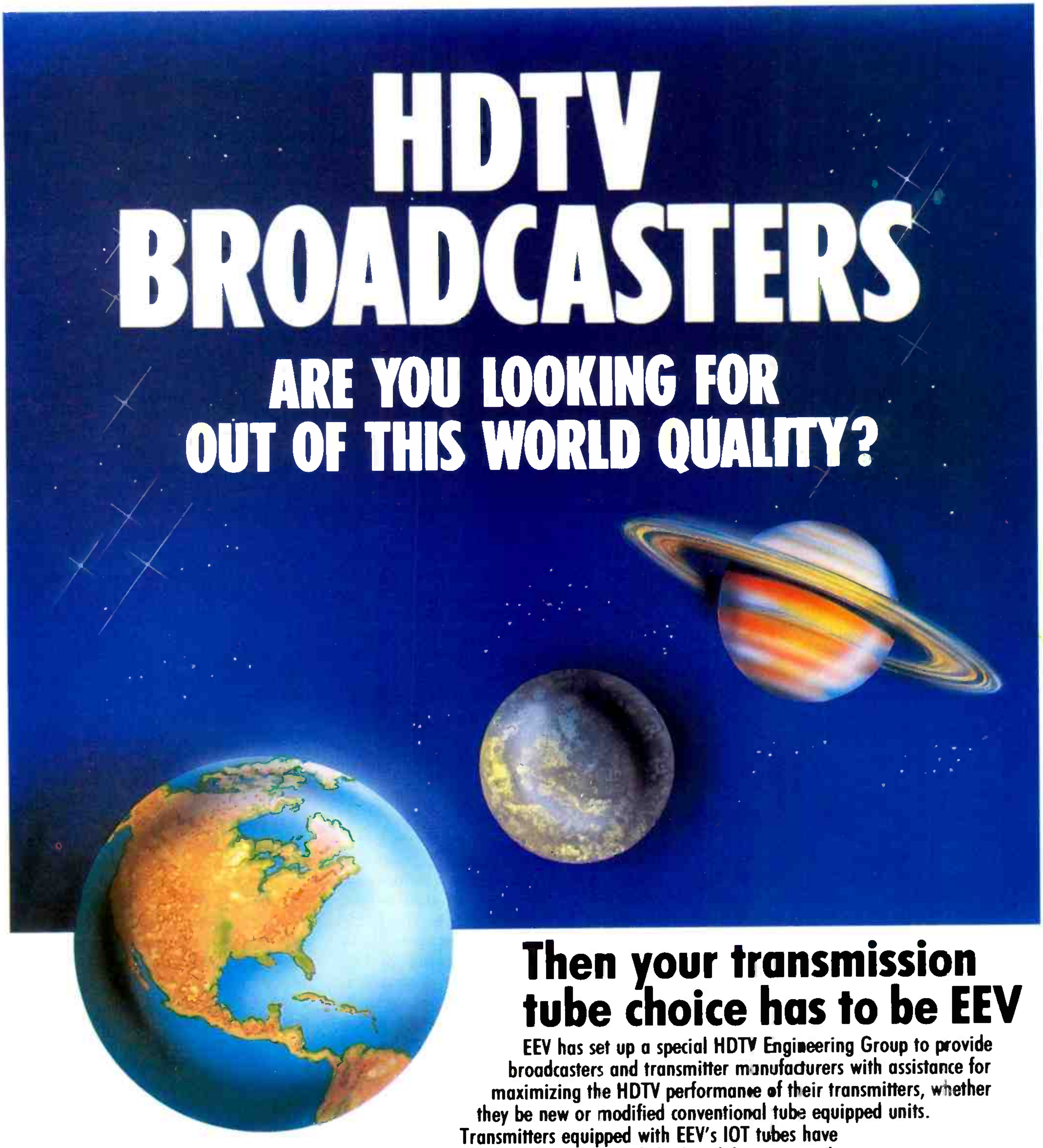


Figure 1. *Block diagram of a typical video or subcarrier downlink. The presence and content of analog subcarriers at point A can be checked with a general coverage receiver that can demodulate FM.*



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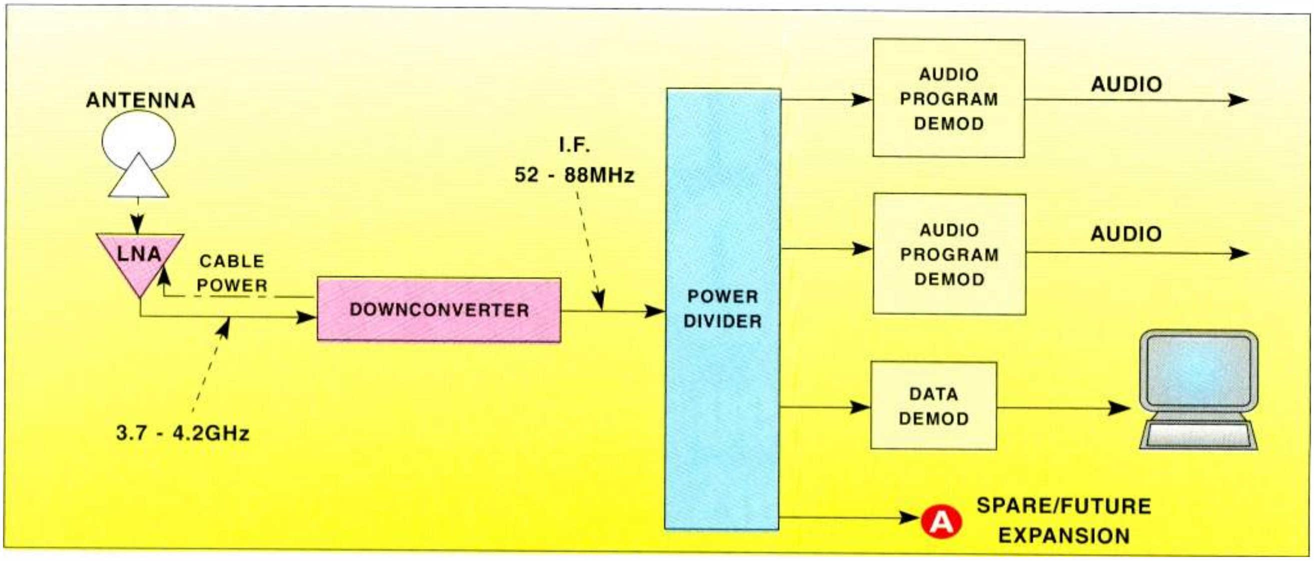

Figure 2. *Block diagram of a typical SCPC downlink. A consumer TV-sound radio can check for analog carriers at point A in a 70MHz IF system.*

the polarization hardware.

4. Repeat steps 1, 2 and 3. Polarization and pointing interact with each other. To get a maximum, you should run through these steps twice, doing the pointing first. A mispointed antenna can never reach a good cross-polarization null.

5. Tighten all hardware.

Recent floods, earthquakes and hurricanes have reminded broadcasters that there's no such thing as an immovable structure. If you are recovering from such a natural disaster, consider re-pointing your satellite antenna. Even if your satellite system hasn't experienced such a calamity, remember that foundations settle over time.

LNAs and LNBs

At downlinks, a *low-noise amplifier* (LNA) or an *LNA plus block frequency downconverter* (LNB) is the first active stage. An LNB shifts the 4GHz or 12GHz spacecraft microwave frequency to L-band (950-1,450MHz). LNAs are identifiable by their type N output connectors. LNBs use type F connectors.

Spare LNAs and LNBs are cheap insurance against failures. Get the lowest noise temperature you can for a reasonable price. C-band LNAs are available from supply houses at temperatures of approximately 35°K for about $150. LNB prices are only slightly higher. Ku-band noise temperatures are higher, usually near 100°K.

Generally, LNAs and LNBs are powered through their output cable. A long coaxial line can cause enough voltage drop in some situations to create problems. LNAs and LNBs have onboard voltage regulators, but those rarely work well when delivered less than approximately 10V. You can't check the voltage at the LNA by disconnecting it and clipping a voltmeter onto the coax connector because it must be measured under load (with the LNA or LNB connected). For this purpose, keep an F- or N-type Tee connector handy. Tee connectors are a bad engineering practice almost everywhere — except for this.

Replace any gaskets at waveguide flanges when replacing an LNA or LNB. Check pressurization of the feed element if it is so equipped.

LNB stability

A $200 LNB contains a local oscillator of several thousand megahertz, which is exposed to 100° temperature swings from summer to winter. It is not unusual for a standard (non-crystal-controlled) LNB output band to be 3MHz or more off frequency. It also is not unusual for LNB outputs to contain substantial amounts of *phase jitter* or frequency instability. In video and subcarrier receivers seeing a main carrier with an FM deviation near 10MHz, these errors are not significant. AFC circuits usually resolve the large frequency errors.

Care should be exercised when narrowband, single-channel per carrier (SCPC) audio or data receivers are used with an LNB. These receivers, unless they contain tracking and jitter control circuits, will show frequent data errors or extremely noisy analog audio when used with standard LNBs. Stabilized LNBs are available from most equipment sources, but they usually cost three to five times as much as non-stabilized LNBs. If your network is shifting from video subcarrier or FM-squared transmission to digital SCPC, you may need to upgrade your LNB.

Cable

If your site uses an LNA, the outdoor cable will usually be foam-dielectric coax. When replacing or installing connectors on this cable, follow the directions closely. Dimensions are critical inside the connector so that the rubber gaskets and silicone grease used in many connectors can seal water out of the cable.

If your site uses an LNB, the LNB output, which is probably an F connector on the end of a piece of RG-59, is a source of water ingress. If your site is more than eight or 10 years old, there's some good news. The F-59 connectors used in the early 1980s were an inexpensive compromise. F connectors have come a long way in waterproofing and physical security since then. Check with a CATV or other distributor for recommendations. It's worth $20 in parts and labor to replace a 39¢ F connector through which 80% of your station's programming passes.

If you're experiencing partial signal degradation, don't underestimate the weight of street traffic. If your antenna cable crosses a road or parking lot, even if it is in conduit, it may have been partially crushed by a passing vehicle that the pavement — and the conduit — weren't designed to handle.

TVROs and subcarrier downlinks

Video receive-only terminals (TVROs) are used by radio and TV stations and by cable head-ends. A main demod section demodulates the big FM carrier, usually containing analog video, either scrambled or unscrambled, plus subcarriers that are further demodulated to audio or data. Periodically check power supply and signal quality voltages, clean edge connectors and make sure the F connectors are intact.

When troubleshooting, consider that many video receivers have more than one input for the LNA or LNB signal. Usually, one is labeled for vertical transmissions, the other for horizontal. Not all

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satellites use the same polarization plan. If you've recently pointed to an unfamiliar satellite and you are receiving sparklies on all video transponders, you may be receiving only the crosstalk between inputs. Swap the V and H cables or flip a V/H odd/even setup switch on the video receiver.

If your station also owns a video receiver separate from the composite receiver normally used to demodulate the baseband of subcarriers, it can be used as a troubleshooting aid or as a spare demod. To substitute for a failed subcarrier receiver — or to listen to the output of the composite baseband demod — use a general coverage (0.5MHz to 30MHz) receiver equipped with an FM detector section. (See Figure 1.) This feature is occasionally found in higher-end short-wave receivers. Assuming the IF bandwidth is adequate, you'll be able to recover audio from a subcarrier in either FM mode or in AM mode using slope detection.

SCPC downlinks

SCPC is another common method of sending radio network audio. Traditionally, SCPC systems are thought of as analog FM with companding for noise reduction, but digital SCPC systems are now becoming available. Either L-band or 70MHz IF is used in SCPC downlinks.

Analog SCPC channels use radio frequency bandwidths between 50kHz and 200kHz. Inadvertent substitution of a receiver with the wrong bandwidth usually results in problems. A wideband channel will sound grossly distorted on a narrowband SCPC receiver as the FM carrier deviates in and out of the passband of the demodulator. Using too wide of an SCPC receiver won't work either. Doubling the bandwidth of the demod doubles the amount of noise it sees, so the effective carrier-to-noise ratio will fall by 3dB. In many cases, 3dB is the entire margin for the downlink site, and such a drop will produce continuous clicks and pops. In most cases, however, the solution involves simply training operators to use the correct settings, perhaps with a sheet of crib notes strategically posted.

Most SCPC demods have squelch or mute controls on the front panel. Signals below an absolute level mute the output. If something has happened to the absolute downlink level in your system, a temporary fix may be to loosen the squelch setting so that lower-level signals break through and are received. The resulting audio may be too noisy to broadcast, but at least you'll have an idea of where to look for the trouble.

If one demod is not working but is frequency-agile, try tuning it to another channel on the same network or to another network on a nearby frequency.

Some engineers have found success in using an FM or TV field-strength meter to measure output levels of downconverters that use a nominal 70MHz output frequency. However, the presence of the high noise floor from the LNA along with many narrowband signals usually makes picking out individual signals difficult. Per-carrier levels at 70MHz demod input are usually -60dBm to -30dBm (-12dBmV to +18dBmV in 75Ω).

A substitute for monitoring SCPC channels out of a 70MHz downconverter is a "TV sound" radio. The downconverter output band (52MHz to 88MHz) occurs mainly in TV channels 2-6. (See Figure 2.)

Multichannel digital audio downlinks

Digital transmission using multiple channels per carrier has been used by the ABC, CBS and Westwood One (Mutual and NBC) networks for more than 10 years. Downlink hardware for this system demodulates the main carrier and the resulting signal is then time-division demultiplexed into the individual channels. Digital decoder cards then produce the audio. The original system decoded a

384kbit/s stream into a single 15kHz audio channel. Most of these have been replaced by a data-reduced system using 128kbit/s for 20kHz audio. You must have the proper type of card to receive each service. Unlike analog subcarrier and SCPC systems, consumer equipment cannot substitute for a digital decoder card.

As with any digital equipment, noisy power lines and noisy DC power buses in the equipment can cause data errors. If the power supply for a digital system's receive frame hasn't been checked recently for ripple and noise under full load, the manufacturers strongly suggest such a check. A maintenance round of replacing regulators and filter caps may be in order.

Sun transit outages

Twice each year, in the spring and in the fall, all satellite downlink terminals undergo solar outages. Sun transit outages occur when the sun, the satellite being received, and the earth station are all in a straight line, and the solar interference degrades or wipes out satellite reception. Engineers have long been familiar with solar transit outages, but programmers and air staff may not be and may require semi-annual reminders.

If you receive a complaint from the staff about noisy or non-existent network audio around the equinoxes, check whether a transit outage is occurring at that time before taking other action. If the weather is relatively sunny and the shadow of the feed element is in the center of the dish, a solar outage is occurring. Tell the programming people there is nothing you can do about it. Solar outages can't be rescheduled.

Digital transmission using multiple channels per carrier has been used for more than 10 years.

Summary

When problems occur with your satellite downlink installation, check general items, such as pointing, polarization, LNA/LNBs and cables for problems common to more than one receiver. Downconverters and video or composite baseband receivers handling analog signals can be checked with consumer- or enthusiast-grade receivers, if they're available. The troubleshooting of digital satellite signals usually requires extra copies of the proper receiver or decoder. You may want to buy spares if you can't rely on a centralized management and maintenance program. Check connectors, signal quality and power supply test points every six months. These steps go a long way toward keeping the network or syndicated life blood flowing to your station. ■

For more information on maintaining satellite earth stations, circle (306) on Reply Card. Also see "Antennas, Satellite R/T, TVRO," "Satellite T/R Components, Electronics" and "Test & Measurement Products," pp. 20-26 of the BE Buyers Guide.


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Troubleshooting PC-based equipment

It's not as difficult as it appears.

By Curtis Chan

The Bottom Line

The ability to troubleshoot PCs is becoming a valuable skill as PC-based equipment infiltrates almost every area of broadcasting. Down PCs can be costly, both in lost revenue and lost productivity. Employees who are capable of bringing a dead PC back to life can save the company time and money — and make themselves invaluable.

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It's late afternoon on Friday when the chief engineer gets a frantic call to come down to the newsroom. When he arrives, he finds most of the staff hiding behind anything resembling a shield. Looking into the news director's office, he sees a usually sane, quiet man jumping up and down in a hostile frenzy, with his fists clenched, groaning and wailing. From a distance, the poor man looks like he's doing a bad Elvis impression. Upon closer observation, the chief engineer realizes the news director is just having computer problems.

When PCs go down, temperaments can range from mild aggravation to outright hysteria. We've become so dependent upon computers that it's hard to remember that only two decades ago a fraction of businesses were computerized. Analysts estimate that business losses from down computers translate into the billions of dollars. Sales, service, customers and productivity all suffer while the computer is being revived.

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

Don't get mad, get smart

Have you ever stared at your screen and seen the message "Abort, Retry, Fail" staring back at you? Or, maybe upon boot-up, the computer's speaker sounds a general alert followed by wisps of smoke coming from every opening in the cabinet. Even worse, have you ever heard the hard drive sound like a plane landing without

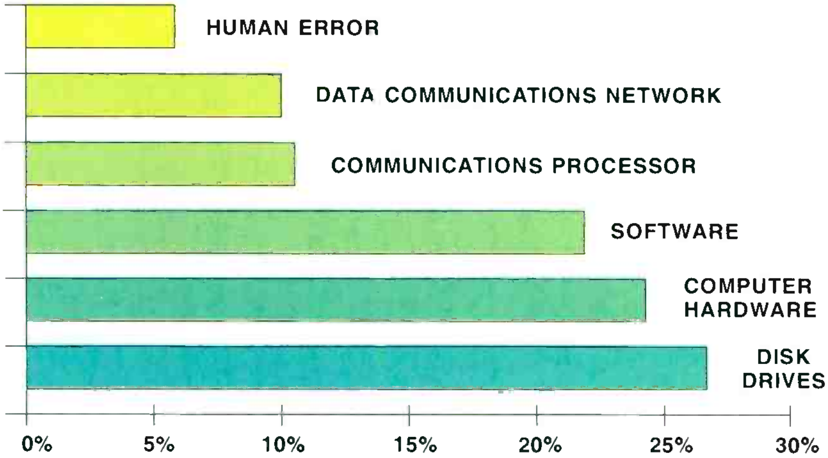


Figure 1. Relative percentages of problems causing computer system failures.

its wheels? At one time or another, most people have suffered through one of these experiences.

Now is the time to put your troubleshooting skills to work. For the adventurous, read on. It doesn't take a computer genius to solve most of the problems associated with computer failures. It is assumed the reader has a fundamental grasp of how a computer works and knows what is meant by the following: microprocessor, CMOS BIOS, hard drive and such terms as IDE, SCSI, interrupts and DMA attributes.

In order to troubleshoot PC-based equipment, you must first have a basic knowledge of the PC. Verifying the status of the PC is the first step. The basics of troubleshooting PCs will be examined to familiarize you with the process of solving problems with PC-based equipment. Once the PC is operational, standard troubleshooting skills combined with diagnostic software are the next steps to solving the problem.

The closest thing to a magic bullet is a complete and current backup.

Examine Figure 1. If you have followed the basics and are willing to roll up your sleeves, then it is time to start troubleshooting and learning a systematic approach to getting a PC back on-line.

Don't overlook the obvious

First, check the obvious. If nothing works, check for power at the outlet. Make sure that cables are tightly connected, and verify that the UPS or surge suppressor is working. Verify the circuit breaker is armed, the keyboard key lock is disabled, there is paper in the printer and all other applicable devices are turned on.

If needed, open the case and verify that all of the boards are properly seated in the motherboard. If you've passed this test and the computer powers up, consider yourself lucky. Then, do yourself a favor and back up your data.

Once powered up, if the computer only boots up with the floppy boot disk, there is probably a corrupted file on the hard drive. A large share of PC problems, regardless of appearance, come down to corrupt, misconfigured or missing files. These problems can be caused by something as simple as turning off the computer while the processor is still performing background writes to disk.

Electrical surges or power outages also can corrupt data (fairly common in unstable power environments). In this case, if you have a PC utilities disk or diagnostic repair software, you might try to use it. Make sure you've remarked out all applicable TSR (Terminate and Stay Resident) programs and cache drivers (Smartdrive, Norton Speed Cache, Lightning for Windows, etc.), because some repair utilities can conflict with these. They also can conflict with defragment utilities.

The magic bullet

The closest thing to a magic bullet is a complete and current backup. Although not as fun and sophisticated as diagnostic tools, good backups can save you hours and dollars. Simply reinstall the backup on the hard drive. If you're concerned that the problem may occur again (computer virus), consider repartitioning and reformatting the hard disk.

Repartition using the FDISK command and then reformat the drive using the DOS format C: /s command. To accomplish this, FDISK.EXE and FORMAT.COM must be on a bootable floppy. Don't forget to let your BIOS know what you've done as well.

Backup is the most important preventive maintenance you can perform on your computer. Regular backups can take an enormous bite out of the sting of a lost hard drive.

Divide and conquer

After checking for obvious mistakes, if you are staring at a blank screen even though the monitor is on, check the power supply rails and make sure that the circuit breaker is reactivated. If the power supply checks out, it is time to look elsewhere.

First, check the boot sequence. For instance, if the green light on a drive suddenly hangs, a defective drive or system controller board could be the problem. If you get past this point and the screen is displaying a message, such as CMOS ERROR or INVALID DRIVE TYPE/HDD FAILURE, check the CMOS battery and its connection to the motherboard. Critical

The twisted cable

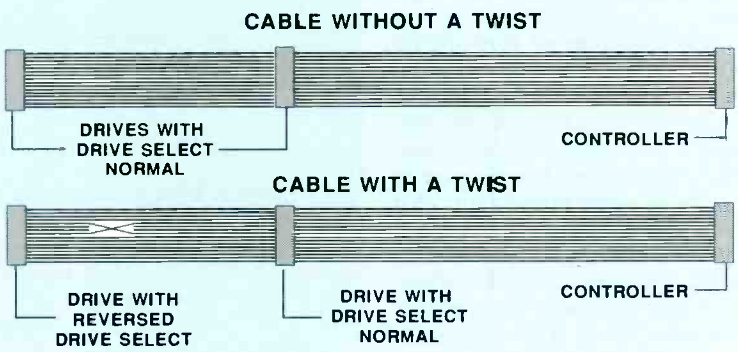
By Steve Epstein, technical editor

When working on PCs, you may have noticed some drive cables have a section twisted. Why? First, some drive basics. Disk drives have drive select jumpers that allow for more than one drive to be daisy-chained together on the same cable. The drive select jumper is used to distinguish one drive from another. If two hard drives are connected to the controller board with a straight cable (no twist), the drive select jumpers must be set to DS0 on the first drive (C:) and DS1 on the second drive (D:).

One the other hand, if a cable with a twist is used, both drive select jumpers must be set the same. The reason for this is simple, the twist in the cable reverses the drive select configuration. If the drive select is set to DS1, the twist makes it appear as DS0, and vice versa. When using a cable with a twist, if both drives are set to DS1, the drive with the twist becomes the C: drive. If both drives are set to DS0, the drive with the twist becomes the D: drive. The same thing also happens with floppy drives.

The twisted cable simplifies troubleshooting, in that drives A: and B: can be reversed simply by recabling them. Without the twist in the cable, the drive select jumpers would have to be reconfigured as well. This also can be used when drive A: is a 5.25" drive and you get in a 3.5" floppy that has to be installed through the A: drive. Assuming the B: drive is a 3.5" and there is a twist in the cable, simply reverse the A: and B: drive connections. Now the 3.5" drive is the A: drive and B: is the 5.25".

One thing to note, XTs have the jumper set to DS0, so the non-twisted connector goes to the C: drive, however, on ATs the jumpers are set to DS1, so the connector with the twist goes to C: drive. As usual there are probably exceptions to this, check the system you are working on to be sure.



information is stored in CMOS for reference during start-up. A battery maintains the memory while the computer is off. One common cause of down PCs is lost CMOS information due to a dead battery. Also, listen and count the beeps. They're telling you something is wrong (consult your manual). For example, eight beeps usually means there is a problem with the video card.

Take inventory of the system, recording what's installed and their respective settings.

Sometimes, the computer gets past the BIOS boot-up sequence only to show INVALID or MISSING COMMAND INTERPRETER. This probably means that the COMMAND.COM file on the C: drive is missing or damaged. To remedy this, copy the COMMAND.COM file over from a bootable diskette with the same DOS version. An INVALID DRIVE SPECIFICATION could indicate a missing or corrupted driver or bad CMOS. Norton's NDD or DiskFix might help here.

Next, verify there are no interrupt or DMA conflicts. This can happen when additional cards or new memory managers are added. If the computer worked fine before, try remarking out the potential conflicting statement in your startup files or push F8 while booting up. This allows you to activate each statement during boot-up. If you get past this section and DOS runs fine but Windows does not, try running Windows in the standard mode by typing WIN /S. If the problem is solved, it probably lies in the upper memory area or in virtual memory. Look for conflicts in the hardware or drivers. If all else fails, reinstall the program. This may require modifying the WIN.INI and/or SYSTEM.INI files for proper operation in the Windows enhanced mode.

If HDD FAILURE is displayed or if you can't get the DOS prompt for the drive you want to access, consider the drive controller card or a defective drive. If you still cannot access the drive after resetting the controller card and making sure the cables are connected, verify that it spins. If not, suspect a faulty drive. In older hard drives, a sharp jolt to the side (be careful) may bring it back to life. (The problem may be caused by motor cogging or drive binding.) If this is the case, the drive is warning you of imminent failure. Immediately copy or back up everything on your disk while there is still time. If the hard drive is truly dead, consider a data recovery service.

Data recovery tips and services

No matter how hard you try to protect your data, someday you will encounter the "File not found" message. If the drive works and you inadvertently deleted a file, your options from which to choose include the DOS undelete function, Norton's SmartErase and other off-the-shelf software packages. Undelete your erased file immediately because once a file is deleted, the computer won't hesitate to record new data in its place.

Do not use a file recovery program if you suspect an electrical or mechanical drive failure. This is especially true for head crashes or drive electrical problems. For general data corruption as a result of viruses, use a good anti-virus program, such as Norton Anti-Virus or Dr. Solomon's Anti-Virus Toolkit. Last, do not entrust your valuable data to someone who lacks the training and expertise to solve your problem. Don't be surprised if you're told that your data is unrecoverable after the fact.

Recent facts are quite revealing. One study found that out of 60% of the people who initially attempt alternative methods of recovery, 43% also had tried commercial utilities with no success. For those attempting to recover their data, NCSA estimated the cost of rebuilding a 20MB file was $17,000 (19 days) for sales and marketing data, $19,000 (21 days) for accounting data, and $98,000 (42 days) for engineering data. Therefore, it may be worthwhile to trust the data to recovery services.

Diagnostic software

At best, diagnostic programs tell you whether certain hardware components are probably OK, including specific operating conditions. Good programs also test the majority of your system, including software/hardware configurations, RAM,

Do's and don'ts

Before jumping in, know some basic rules of survival in the PC jungle.

• Do have a rudimentary working knowledge of the computer's operating system.
• Do invest in a quality UPS, line conditioner or power surge suppressor.
• Do make backups often, especially before starting repairs.
• Do make one or two bootable system floppy disks compatible with the operating system. For reference, make sure all of the hidden system files, COMMAND.COM CONFIG.SYS and AUTOEXEC.BAT are copied over to the bootable disk.
• Don't use a bootable floppy disk to start your computer if the floppy is a different version of DOS (or Windows) than on the hard disk.
• Do keep notes of recent remedies tried. This saves time and money.
• Do use screen dumps liberally for notes on progress and to develop an audit trail.
• Do keep track of all changes, and don't change more than one thing at a time.
• Do try to get telephone help if it's available. Describe your situation clearly.
• Don't remove or insert boards, plugs, cables, wires or chips while the power is on.
• Don't touch the motherboard or plug-ins with sharp metal objects (screwdrivers) while the power is on.
• Don't let anyone touch your computer unless you've first made complete backups of important data and programs, or at least have the last iteration.
• Do take a break and access the risks by making a value judgment about three factors:

1. How much critical data is on the PC? If it is partly functional, can you afford to have it go down during a repair attempt?

2. How difficult would it be to work around the problem until a backup can be done, or can it wait until after hours? If you don't have any backups, continuing operations could turn a difficult recovery task into a hopeless one.

3. Will the problem become worse if ignored? Intermittent failures or random interrupt and DMA anomalies are hard to track without some prior knowledge. ❑

CPU, drives, video controller and drive controller. Among diagnostic programs are analytic tools, data recovery tools and data/disk maintenance tools. Although most claim to perform miracles, no present program helps untangle incompatibilities and conflicts among programs or between programs and hardware.

Up to 80% of hardware diagnostics is done by swapping out parts. There are exceptions to the rule, such as SpinRite, Norton DiskDoctor, PCTools DiskFix, Micro 2000's low-level disk formatter and RenaSonce's SB-Pro. These sophisticated programs can often tell what is wrong with a disk and sometimes fix the problem. Enhanced diagnostic systems require connection to the system under test via RS-232 or IEEE-488.

Some systems have built-in tests controllable by diagnostic software or by another host. Good test software packages serve as a decision support system for the technician. They should allow the incorporation of case-specific circumstances, personal experiences or gut-level decisions, even to the extent of ignoring the test program's recommendations.

Taming interrupts, DMAs, UMBs and addresses

A PC is like a house of cards. The more cards and programs you add, the higher the chances of device conflicts. Four resources that hardware adapters fight over are interrupt request (IRQ) lines, input/output (I/O) addresses, direct memory access (DMA) channels and upper memory blocks (UMBs). UMBs are blocks of RAM addresses that range from the top of conventional memory (640k) and the bottom of extended memory (1,024k), where the adapters have RAM and ROM. The only exception is when two devices share the same attribute but only one is on at any given time (for example, a fax/modem).

One quick note on the difference between extended and expanded memory. LIM (Lotus-Intel-Microsoft) Expanded Memory Specification (EMS) version 4.0 defines a 64K area of memory in or near conventional memory. This area can be addressed as four 16kB pages. Up to 32MB of memory can be accessed by refering to page numbers, each page number refers to a 16kB area of memory. Extended memory on the other hand refers to addresses above 1,024K. These two types of memory are not normally interchangeable. Older versions of DOS-based programs such as Lotus 123 are designed to work with expanded memory, but cannot access the extended memory. Newer DOS programs, especially graphics intensive games can access extended memory but not expanded memory.

Up to 80% of hardware diagnostics is done by swapping out parts.

Older systems based on the 8088 and 80286 are limited to expanded memory only, although the 80286 can access extended memory in the standard mode. DOS extenders are usually required to access extended memory on the 80286 chips and above. Memory managers such as QEMM386 are able to adjust memory pointers in order to make extended memory look like expanded and vice versa. Windows has its own memory manager and can access both types and use them as required.

Eight steps to success

Assuming the trouble started after installing another adapter, system conflicts can be minimized by doing the following:

1. Remove the offending board and its associated connections.
2. Verify default settings, including jumpers and switches. Instruction manuals are often outdated or wrong.
3. Take inventory of the system, recording what is installed and their respective settings. Without an accurate summary, choosing IRQ or DMA settings can be difficult.
4. Pinpoint the conflict's source by comparing notes to the new adapter's manual or by using a diagnostic software program.
5. After locating an open address, reset jumpers and switches to the appropriate settings. These may require software changes as well. On some cards (sound cards), two sets of IRQs and DMA settings (one for DOS and one for Windows) may need to be altered.
6. After resetting the switches, reinstall and test the new adapter.
7. If that doesn't work, change tactics by pulling another board and changing its settings.
8. If that fails, call the new board's technical support line. Check if there are any software updates that might solve the problem. If the company moved or went out of business, several resources are available, such as the FCC's Public Access Link at 301-725-1072, CompuServe Information Services at 800-848-8990 or Micro House International at 800-926-8299.

Conclusion

Try to overcome two common fears. First, don't let common mistakes fool you into thinking you've broken your computer. Second, when all else fails, seek assistance. Plenty of people who are wiser and more knowledgeable about computers can assist you. ■

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Circle (48) on Reply Card

Intercom system design and selection

It's often the easiest system to forget, but one of the hardest to do without.

By David Lawrance

The Bottom Line

Intercom systems are an integral part of the production process. However, when budgets get tight, the intercom system often ends up taking the cuts. Don't underestimate the importance of this system. Careful planning is a part of any project, including the design and selection of the intercom system.

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Today's TV business is moving forward at a pace that could take your breath (and budget) away if you are not careful. Many areas of studio and TV technology require so much attention that consideration for the intercom system is either left to the last minute or forgotten altogether, followed by desperate cries of "What about the intercom system?"

Well, what about the intercom system? Do you think of it as a tool for talking or as vital equipment for serious communications needs? Whatever your attitude, voice communications plays a crucial role in program production, whether it's live remote broadcasts, daytime drama production or up-to-the-minute news broadcasts. Every application needs careful consideration before you choose the appropriate intercom system.

Early days

Early intercom systems were based on the use of relay technology, hard wired to give predetermined switching connections. This approach had the problem of being hardware and wiring intensive, even for a small system of, say, 16 users. Significant and proportional degradation in audio performance became evident as systems increased in switching size. Audio signal routing using relays suffered from crosspoint noise, reliability problems and limited flexibility when expanding the system. All of these factors contributed to the decision of taking a different approach.

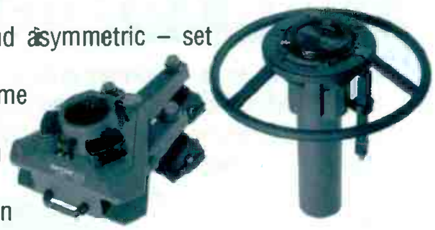
Opportunities arose with advancements in semiconductor technology. The next phase of intercomswas built using solid-state analog switching, which allowed a higher level of switching capability and high reliability with improved audio performance. At the time, system sizes of 48 to 64 users were becoming a common requirement. However, control of these switching devices remained hard wired. Flexibility was limited if the overall system configuration needed to be changed for long-term reconfiguration or for the instant, on-demand change.

Software control

By replacing hard wiring with software-controlled hardware, it became possible to introduce configuration flexibility into the overall system design of intercom and studio communications. Integrating software and hardware enabled on-demand control to be extended to the operator, providing quick changes of system configurations. Over time, broadcast facilities have become less labor-intensive and have required higher productivity from personnel, leading to the rapid acceptance of this type of intercom system.

In the analog domain, however, limitations remain. Quality can be adversely affected by hardware throughout the chain. The lack of dynamic control of crosspoint levels, coupled with complex setup procedures for interfacing numerous external analog signals, often requires careful and expensive system design.

Lawrance is general manager, sales and marketing, for Philip Drake Electronics Limited, Welwyn Garden City, England.



Digital intercom?

Intercom manufacturers also have considered the benefits of digital technology. (See Table 1.) Because of the ever-increasing matrix sizes, the issue of equipment size has become a significant factor. Developments were undertaken to introduce hardware that maximized the opportunities presented by software control. (See Figure 1.) This has resulted in the development of fully digital intercom and voice communications equipment for use throughout the broadcast world. Users of large studio systems and small radio studios, where cost and simplicity are key factors, have benefited. Digital systems have finally made their mark in the intercom arena.

PROBLEM	SOLUTION
Limited rack space for a large matrix.	Through digital, large matrix sizes can be accommodated into a smaller frame, typically 123 user groups into a 9-RU frame.
Redundancy of key components.	Extra power supply, matrix card and microprocessor can often be supplied within the same frame for backup.
High cost of multipair wiring.	Digital systems require fewer pairs or use a single coaxial cable.
Complex interfacing with 2- and 4-wire systems.	Built-in isolated interfaces available.
Integration of all needs without relying on a single large system.	Several matrices can be networked and controlled via ethernet, forming one large system or several smaller ones.
Easy to reconfigure and monitor hardware.	Advanced software allows on-line reconfiguration and monitoring as well as diagnostics.

Table 1. *Some design problems/limitations and how they have been solved by digital systems.*

Don't kid yourself

Consider how important your intercom system really is. What range of problems do you want to resolve? Remember that they are not always the obvious ones. What are the key factors relating to selection that will ensure these needs are met? Additional consideration must be given to users' needs from a technical and operational point-of-view. Take all of this into account before establishing a budget and evaluating options.

Consider who is affected, directly and indirectly, if a problem occurs with the intercom system. It is not only the user who gets angry because the system has failed or spare parts have not been delivered on time. If the system fails, productions can be jeopardized and, because of lost revenue, management might ask questions about who selected the intercom system.

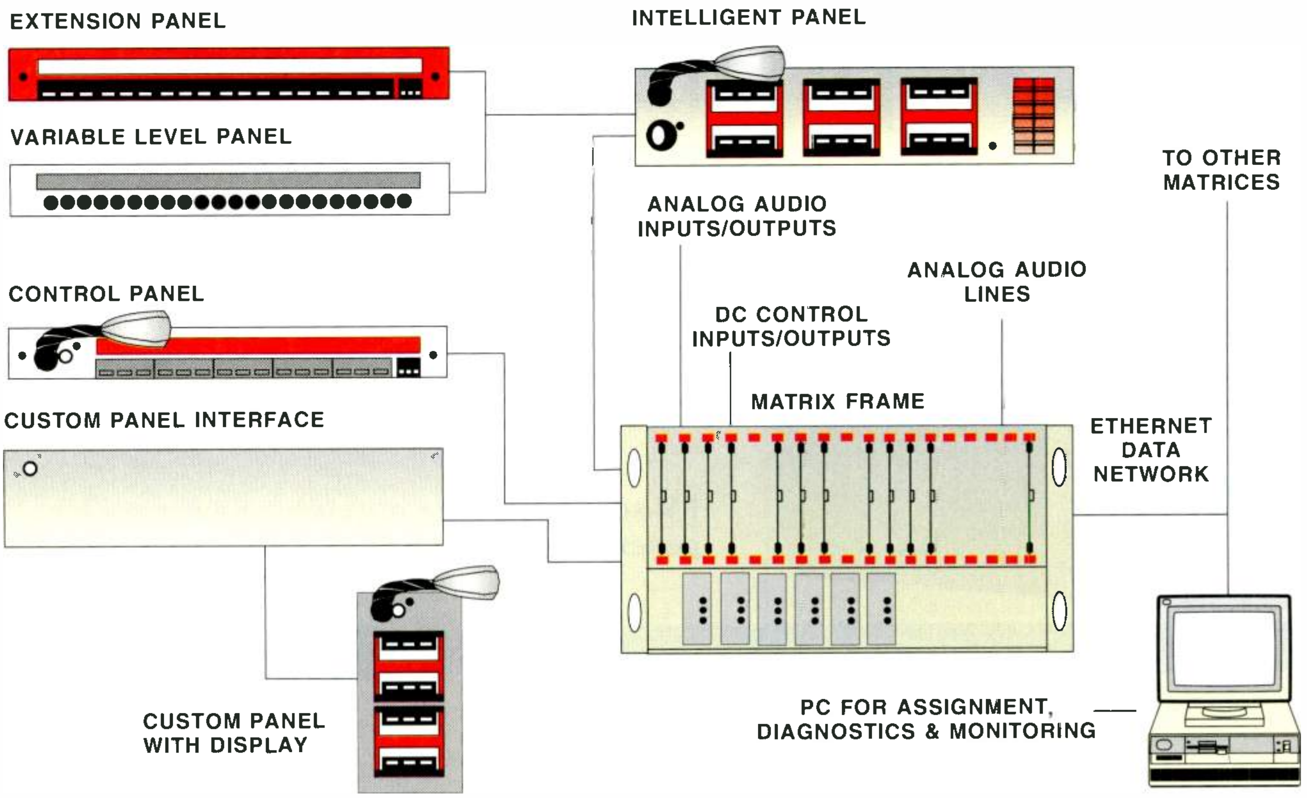


Figure 1. *Possible configuration of a digital intercom system.*

Smart planning

In reality, planning often goes out the window when emergencies arise. Regardless, devise a plan to ensure that a quality intercom system fits within the budget.

Before you begin looking at available systems, establish exactly what is required from the equipment and who is going to use it. Different applications may require different equipment. Start with a blank sheet of paper and consider what is needed, including:

- *Application.* Will the system be used for a TV studio, inter-area, remote van, video post, radio, studio, complete broadcast facility or a newsroom?
- *Budget.* Set a budget and work within it.
- *System use.* Will the system be used occasionally or 24 hours a day? Will different configurations be needed? Who will use the system, and what is their technical competence? How easy is it to operate the system?
- *Reliability.* How important are reliability, spares and redundancy? What is the cost?
- *Installation.* Will the suppliers be able to meet your deadline? What difficulties might be encountered during installation? Are you replacing an old system or installing a new facility?
- *Interfaces.* What types of interfaces are needed for other communications equipment, such as radio intercom, beltpacks, telephone lines, 4-wire circuits and existing intercom equipment?
- *Future needs.* What are your future plans? How will they affect the intercom system?

Careful consideration of these factors will give you a greater understanding of overall system requirements. Evaluate options and discuss the finer points of the system with your supplier(s). Don't underestimate the importance of good research in understanding your needs.

Design partner

Next, find out who the main suppliers of intercom systems are and consider what level of consultancy you require. What elements of the design, manufacture and installation can you handle yourself? What level of maintenance support will be required? Choose your supplier carefully and make sure it can meet your support needs before going any further.

Good system design relies on meticulous planning and a dedicated team focused on achieving planned objectives. Think of your supplier as a member of the team who will support you throughout all aspects of the project.

Design considerations

When evaluating the facilities available from different manufacturers, it can be difficult to understand how they will meet your needs. Digital systems are available, offering more facilities and flexibility at a cost point more favorable than an analog system of similar size. Investigate digital and analog solutions, and consider the merits of each.

Choose a system that offers good overall value for current and future needs. Consider the lifetime required and whether an expandable system is needed. What is the manufacturer's track record? Talk to sites where installations have been working for some time, and ask them about their experiences with your potential supplier.

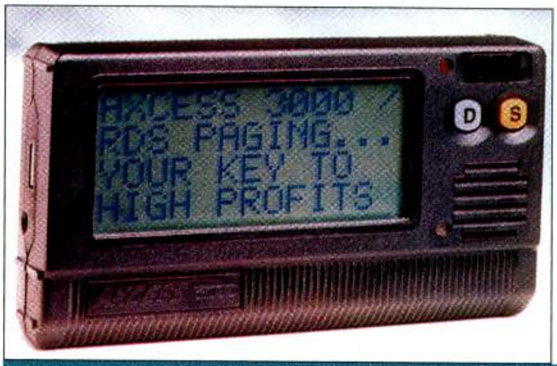
The intercom system is not just a tool for talking, but an integral part of the production process that can make your life easier or more difficult. Think about what would happen if the intercom system broke down. When money gets tight, don't let the intercom budget be the first to get squeezed. Recognize the importance of the intercom and evaluate the options, but don't forget to elevate its importance in terms of budget and priorities. Give yourself enough time to choose a system design that matches your needs.

Once installed, an intercom system is like breathing: It's an ongoing process happening without thought. But if it stops, the result can be terminal. ■

➡ *For more information on intercom systems, circle (310) on Reply Card. Also see "Intercoms" on p. 7 of the BE Buyers Guide.*

Radio in transition

New profit centers



FM subcarriers are providing new ways for generating revenue.

By Eric Small

The Bottom Line

A broadcaster's biggest asset is still his or her spectral real estate. For FM stations, some of this spectrum is fungible as excess capacity that can be leased. Although this is nothing new, improved technology and demand for new services has changed the subcarrier environment for the better, with a growing universe of potential clients emerging. Many of tomorrow's new profit centers at the radio station may come from this revised auxiliary broadcast marketplace.

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What could be new about the oldest non-advertising source of revenue for FM radio? In the 1950s and '60s, subcarriers that delivered background music saved many commercial FM stations from bankruptcy, but these services gradually fell into disrepute in later years. Recently, subcarrier applications have undergone such an evolution that they must be regarded in a whole new light.

Background music no longer dominates subcarrier applications. Instead, low-cost, small-aperture Ku-band satellite downlinks now carry much of the country's background music programming. The grouping of retail shops into shopping malls hastened the switch to satellites — one dish can provide several different music formats to scores of stores.

In many larger markets, ethnic broadcasting has replaced background music as the biggest audio user of subcarriers. In New York, for example, as many as 15 different languages are broadcast on the subcarriers of metropolitan FM stations — including Korean, Italian, French, Russian, Serbo-Croatian and several dialects of Chinese. The companies producing these services provide subcarrier radios to listeners in the ethnic community on a subscription basis. These operators are often inexperienced in broadcasting, however. If an FM broadcaster offers basic assistance in obtaining subcarrier receivers and assembling a simple studio, a long-term client for one of the station's subcarriers can be created.

Small is president of Modulation Sciences, Somerset, NJ.

Photo courtesy of AXCESS USA, Metairie, LA.

Data broadcasting is another important use for subcarriers. A variety of services employ data subcarriers to deliver their message. Stock market and currency quotes, paging, transit information, wire news services and weather data are just a few of the typical users of data subcarriers. In the past, most of the users of data subcarriers have been technically sophisticated organizations that come to FM stations knowing exactly what they want and having all of the required equipment in hand.

More recently, the increased demand for data broadcasting has spawned a group of data-service operators desiring subcarriers, and these users are less well-informed or equipped. They could, therefore, benefit from the technical support of experienced broadcasters.

RDS changes the environment

The introduction of the Radio Data System (RDS) has amended the simple "cash and carry" relationship with data transmission services. The standard for RDS transmission includes the provision for managing *multiple independent users*. Not only can the radio station use RDS in the manner for which it is justly promoted — to deliver the station call letters, logo, music format, and possibly artist/title or related programming identification — but, concurrently and without interference, RDS can deliver several revenue-producing services.

Paging, global positioning system (GPS) corrections, remote control of billboard

lighting and displays, accurate time of day, traffic information, and mass transit information are examples of the types of services that can be carried on the so-called *transparent data groups* of RDS.

Each of these services represents a potential independent revenue stream for the radio station. A station should consider whether to lease its entire RDS subcarrier or to maintain control of the channel. Leasing the whole channel provides revenue from one user of the RDS datastream, but eliminates its use as a promotional tool for the station. Maintaining control of the RDS channel and leasing specific services may offer several income streams as well as retaining the promotional value.

Another consideration favoring the use of RDS to produce additional revenue is its total lack of effect on main channel operation. The low injection level of 2.5% needed for most RDS operation means insignificant loss of main channel modulation. The FCC "giveback" of 50% percent of the modulation allocated to subcarriers [FCC rule 73.1570(b)(2)] further reduces the actual impact to 1.25%.

Additionally, making the carrier frequency of RDS the third harmonic of the stereo pilot and choosing a data rate that is an integer factor of the pilot removes the chance for RDS to crosstalk into the stereo main channel. More than 10 years of RDS experience in Europe confirms its non-interfering characteristics.

Future IVHS applications

Various projects of the Intelligent Vehicle/Highway System (IVHS) plan to employ the subcarrier capability of broadcast stations. Although these systems remain experimental and are unproven in wide broadcast usage, they offer the potential for significant revenue for radio stations within a few years.

Also, because IVHS subcarrier systems target the general public, they offer the broadcaster an opportunity to create a more traditional profit center from their subcarriers. Many IVHS projects are envisioned as public/private partnerships. Therefore, the subcarrier delivered to the public should be available for carrying commercial material. If IVHS evolves as anticipated, the subcarriers of a radio station may become an extension of the same profit center as the main channel. Rather than leasing the subcarrier, a station could sell time on the IVHS service, reaching a targeted in-car audience.

Some may have noticed the failure to use the traditional *SCA* terminology here. SCA stands for *Subsidiary Communications Authorization*, a concept that was made obsolete in the FCC rules in 1983 and has not been used since then by the commission in any documents. Subsequently, the FCC has more accurately

Continued on page 85

An active LED sign on a Dallas Area Rapid Transit bus, fed by an FM data subcarrier. The 27" x 6" display can produce text and graphics. News, weather, sports, trivia, transit system information and advertisements are carried on the service, which employs a 4.8kbit/s datastream on a 67kHz subcarrier of KJMZ-FM, Dallas, 100.3MHz. (Courtesy of Modulation Sciences.)

Industry Briefs

BUSINESS SCENE

Sony Broadcast International, Basingstroke, England, has supplied RTBF, Belgium; RTL 4, Netherlands; TGRT, Turkey; and TVS, United Kingdom, with DVS-6000C digital switchers.

Furthermore, Polish Radio has placed an order for two DMX-B4000 fully digital radio on-air consoles. RTE, an Irish broadcast station, has adopted Sony's Digital Betacam format as well. MTV Europe also has ordered 12 Digital Betacam DVW-A500P recorder/players and a BVC-1000 library management system.

Two European companies, Nimbus Data & Technology and Optical Disc Manufacturing Equipment, have purchased Sony CD mastering hardware.

In an upgrade of its studio production, news bureau and field acquisition capabilities, NBC, New York, has made an agreement to purchase Sony studio CCD cameras and various Betacam SP products over the next three years. The agreement also provides for an upgrade path for NBC to newer digital technologies as they become available during the term of the agreement.

Panasonic, Secaucus, NJ, has delivered six AQ-11D digital signal processing cameras to Benedek Broadcasting Corporation, Rockford, IL, for use at three of its TV stations: WIFT-TV, Rockford, IL; KHQA-TV, Quincy, IL; and WHSV-TV, Harrisonburg, VA.

Chyron, Melville, NY, has supplied three iNFiNiT! graphics systems to the Sunbeam Television Group for use at its WHDH-TV station, Boston.

In addition, CBS TV, New York, is using the CODI Sketchpad to graphically highlight football plays for TV viewers during CBS Sports coverage of the 1993/1994 NFL season.

Pro-Bel, Dunwoody, GA, has sold a routing system to Big Shot Productions, Baltimore.

Also, Air Studios has chosen Pro-Bel digital audio reference and distribution equipment for its new headquarters at Lyndhurst Hall, Hampstead, England.

In addition, Pro-Bel has supplied five analog video routers to the Advanced Communications division of British Columbia Telephone (B.C. Tel), the second largest telephone company in Canada.

Leitch, Chesapeake, VA, has sold several Logo generator/inserters to ABC, New York.

Avid Technology, Tewksbury, MA, has supplied the "Letterman" show, CBS, with a Media Composer digital non-linear editing system.

Xenotech, North Hollywood, CA, has sold 45 lighting units to Luxor, Las Vegas.

Dynatech Video Group Asia Pacific, Hong Kong, has been chosen to supply the Australian Broadcasting Corporation with the Quanta Delta range of free form text and image generators.

AKG, San Leandro, CA, has supplied a C5900 TriPower microphone for use during Rod Stewart's "Unplugged" world tour. In addition, the C401, C414, C409, C408 and Blue Line microphones are being used during the tour.

Alamar USA, Campbell, CA, has installed an MC-900 TV automation system at KMSS-TV, Shreveport, LA.

Strassner Editing Systems, North Hollywood, CA, has chosen Marketec/Thomas & Thomas to represent the entire product line of Strassner editing systems.

Sony, Montvale, NJ, has received its 17th Technical Achievement and Scientific Development Emmy Award from the National Academy of Television Arts and Sciences (NATAS).

Sabine Musical Manufacturing Company, Gainesville, FL, has been awarded a patent for its unique method of controlling acoustical feedback. The patent protects the technology that is used in the company's professional sound products — the FBX-900 Feedback Exterminator and the ADF-1200/2400 workstations.

A.F. Associates, Northvale, NJ, has been awarded a contract to build the Bronx Community Cable Programming (BronxNet), New York.

The Broadcast Store, New York, has added a 1,500-foot service department and 1,500 additional feet of showroom space to its New York facility.

BTS/Philips Electronics, Simi Valley, CA, has been awarded a Technical Emmy by the National Academy of Television Arts and Sciences for the development of prism camera technology.

Bird Electronic Corporation, Cleveland, has established a sales subsidiary, Bird Electronic Limited, Singapore, for sales and technical support to the Asian/Pacific electronics market. The address is 3A Unit 6, Tyrwhitt Road, Singapore 0820; phone 65-299-2537; fax 65-299-8509.

IDB Broadcast, Culver City, CA, has entered into a long-term transmission service agreement with ICN Enterprises' basic cable service, the International Channel.

Under the agreement, IDB Broadcast will provide full-time transmission service to the International Channel's transponder on Satcom C-1.

PEOPLE

Navroze S. Mehta has been chosen as senior vice president for Comark Communications, Colmar, PA.

Andrew Griffith and **Bill Johnson** have been appointed to positions with Hollywood Digital, Hollywood. Griffith is audio editor and Johnson is vice president of operations.

Melville J. Berry has been named sales and technical support manager of the COMPOSIUM real time digital compositor product line for Microtime, Bloomfield, CT.

Steve Claybourn, Frank DeFina, Tony Barton, Tim Roberti, Jim Jagodinski, Paul Depperschmidt, Mark Mifflin, Holly Robinson and **Gary Bridges** have been appointed to positions with Panasonic Broadcast & Television System Company's Professional Audio Division. Claybourn is head of the Satellite Division. DeFina is national sales manager. Barton is Southern zone manager. Roberti is Central zone manager. Jagodinski is Eastern zone manager. Depperschmidt is dealer sales manager, Southern zone. Mifflin is marketing manager, display products. Robinson is sales development manager, Eastern zone. Bridges is sales development manager, Western zone.

Tom Haga has been named president of Pioneer New Media Technologies, Upper Saddle River, NJ.

Bryan Arbon has been chosen as product support manager of the North American market for Pro-Bel, Dunwoody, GA.

■

New Products

Betacam recorders/players
By Sony

• **UVW Series Betacam SP**: cost-effective; complete component video system for acquisition, post-production and distribution; consists of the UVW-1800 editing recorder, UVW-1600 feeder/player, UVW-1400 recorder and UVW-1200 player and is complemented by the UVW-327PAC camera/recorder package; recorders and players come standard with built-in time base corrector/stabilizers and longitudinal time-code generator/readers; offers component, composite, Y/C composite and RGB inputs and outputs, plus serial RS-422A or RS-232C interfaces; fast frame-accurate picture search speed is 5x for color and 16x for black-and-white images.

Circle (350) on Reply Card

Betacam videocassettes
By Sony

• **UVWT Betacam SP series cassettes:** designed for use with Betacam SP 1000 PRO UVW series VTRs; offers increased RF output, even after repeated use; available in 10-minute (UVWT-10MA), 20-minute (UVWT-20MA) and 30-minute (UVWT-30MA) lengths; large UVWT cassette lineup includes lengths of 60 minutes (UVWT-60MLA) and 90 minutes (UVWT-90MLA).

Circle (351) on Reply Card

Editing system
By Sony

• **DES-500 Destiny:** integrated editing workstation for the desktop user; designed to work with UVW Series Betacam SP component video recorders and players; PC-based system provides advanced editing, switching and special effects capabilities using a Microsoft Windows-based 486 computer workstation; includes a 4-VTR edit controller, a 4-channel audio processor and optional paint and character generation programs; EDL can store up to 999 events; provides flexible RS-422 9-pin control of four VTRs with the optional ability of expanding to six; Traveling Workspace option provides an ultrawide monitor viewing function that allows more workspace than conventional desktop video systems; supports Sony S-VHS, Hi8, U-matic, PVW Betacam SP and UVW Series Betacam SP VTRs and is SMPTE time-code-based for accurate synchronization.

Circle (352) on Reply Card

Wireless cable antennas
By Shively Labs

• **6950 and 6960:** feature excellent bandwidth characteristics for MMDS/ITFS; horizontally or vertically polarized; standard directional and cardioid patterns; custom pattern studies available; include pressure relief valve; unique fiber-glass radome standard equipment; DC grounded for lightning protection; beam tilt upon request; include rugged mounted brackets.

Circle (354) on Reply Card

Software
By SoftWright

• **RF design software:** uses Logley-Rice method of prediction of received field strength; software module is integrated into the Terrain Analysis Package (TAP) system for extensive modeling of RF coverage studies for land mobile, cellular, paging, broadcasting and microwave radio systems; TAP system is PC-based and can be used to design or evaluate existing or proposed transmitter sites and hardware configurations prior to actual construction.

Circle (355) on Reply Card

Router
By NVision

• **NV3128-D:** fully dynamic port-oriented router designed specifically for the audio/video production facility; each 9-pin D-type connector port can be configured as either controlling, controlled or off; high impedance, which allows machine that previously only controlled to be controlling as well; requires only one connector per machine; contains 128 universal ports; can define each port separately.

Circle (356) on Reply Card

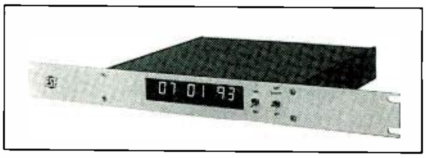
Video patch jack
By Trompeter Electronics

• **J24WHF:** serial digital 75Ω video patch jacks; high-frequency version of the J14 series of normal-through patch jacks (BNC rear interface); offer an extended bandwidth of DC to 720MHz; typical return loss is greater than 40dB through 720MHz.

Circle (357) on Reply Card

Interface
By ESE

• **ES-195:** Master Calendar and Grass Valley Group "Master 21" switcher interface; can drive digital time and date displays as well as provide a GVG "Master 21" with the same time and date information; receives ESE time code from a master clock or time- code translator and converts this data into two formats: ESE serial time code (which drives digital time and date displays) and ASCII form (which the GVG "Master 21" switcher decodes and uses for its time and date reference); features include 1¾-inch rack-mount enclosure, optional battery back-up, six .56-inch yellow LED displays and automatic leap year compensation.



Circle (360) on Reply Card

Portable RF load systems
By Bird Electronic Corporation

• **MODULOAD:** self-contain, high-efficiency RF load systems; designed to operate in the broadcast environment with CW, AM, FM SSB and pulse-modulated power; 8660 series can dissipate 15kW rms and the 8670 series is rated at 30kW rms; both series feature an externally mounted load resistor, which can be remote mounted to accommodate custom installations; protected by a series of electrical interlocks; coolant temperature and interlock status visible on a large front-panel display.

Circle (353) on Reply Card

Routers
By Dynair

• **Series 36:** series of compact 120MHz routers; available for high-resolution computer graphics and HDTV video, and composite broadcast television, including NTSC, PAL and SECAM; packs a full 36x36 outputs of video into three rack units; provides 432 video crosspoints per RU; control features include Actual Switch Closure and Switch Status Verification from the crosspoint, external control through ethernet, Source Preview-Before-Take, MS DOS-based system control software programs and Critical-Function Alarm System.

• **Digital X:** 16x8 serial digital video routing switcher; first digital router available with a fiber-optic input and output option; compact 2-RU switch handles digital signals, such as D-1, D-2 and AES audio; automatic signal equalization and reconstruction at each input ensure proper data recovery when using up to 300 meters of low-loss Belden 8281 or equivalent cable; optical fiber can be used for

greater distances; uses no reclocking circuitry.

Circle (358) on Reply Card

Digital audio editing system

By Avid

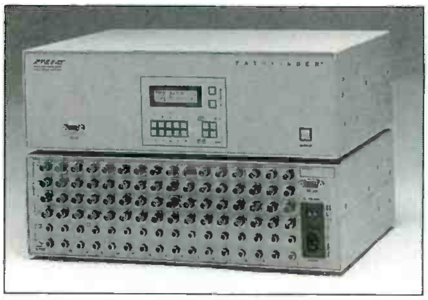
• **AudioStation:** designed as a transfer station for dialog editing and audio editings; cost-effective; features include master/slave machine control; EDL import and auto conform; time compression/expansion, pitch shift, ADR/loop record mode, track bounce/mixdown, project management tools, and storage solutions; supports the exchange of digitized audio media and edited sequences with other Open Media Framework (OMF)-compliant digital audio workstations and post-production systems.

Circle (359) on Reply Card

Matrix switcher

By INLINE

• **PATHFINDER:** 16-port reconfigurable RGBS and stereo audio matrix switcher; combines advances in digital and analog design for switching of low- and high-resolution video signals from any input to



any output; can reconfigure any port to an input or an output; defines different matrix configurations for each group of video or audio; ease of use through RS-232 or front-panel controls.

Circle (363) on Reply Card

Free guide

By Andrew Corporation

• **HELIAX coaxial cable selection guide:** free 16-page guide to HELIAX coax cable for cellular, land mobile, paging, microwave, broadcast and military applications; illustrated with color photos; easy-to-read; describes the construction and benefits of Andrew's LDF load, superflexible foam and air dielectric cables; lists complete electrical and mechanical characteristics of each cable in tabular form.

Circle (365) on Reply Card

Instructional videocassette

By Graham-Patten

• **D/ESAM instructional videocassette:** 25-minutes long;describes each of the key D/ESAM user benefits and technical functions, as well an overview of audio-follows-video editing; additional copies of the VHS cassette are available free from Graham-Patten's Grass Valley headquarters.

Circle (361) on Reply Card

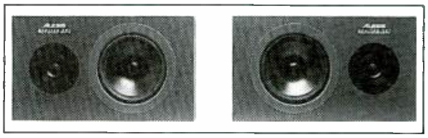
Circle (54) on Reply Card

Circle (55) on Reply Card

New Products

Studio reference monitor
By Alesis
• **Monitor One:** high-efficiency, 2-way near field studio reference monitor; designed for professional and project recording; uses a 6.5-inch low-frequency driver with a mineral-filled polypropylene cone, a strong linear rubber surround and a 1.5-inch voice coil wound on a high-temperature Kapton former; features SuperPort speaker venting technology; 100W program power capacity; 45Hz-18kHz frequency range (+/-3dB); 4Ω load impedance.

Circle (368) on Reply CardConsole



By Auditronics
• **Destiny 2000:** on-air radio console; combines the features of hard disk system control with the familiarity of an on-air radio console; works in automated, live and live-assist formats; in assist mode, a touchscreen gives instant access to the immediate playlist and shows countdown times; FastTracks feature gives instant access to sound effects, jingles, legal IDs and weather warnings.

Circle (362) on Reply Card

Extended warranty
By Andrew Corporation
• **HELIAX warranty:** extended 3-year warranty of HELIAX coaxial cable, elliptical waveguide and connectors at no additional charge; includes any defect arising from improper connector attachment; if the connectors are attached by someone other than Andrew or an Andrew-certified distributor; the cable and connectors are still covered for three years, but the attachment workmanship is not covered.

Circle (366) on Reply Card

Remote trigger unit
By Akai
• **DL600:** for Akai's DD1000i and DD1000s magneto optical disk recorders; designed for live, real time applications; allows the DD1000 to operate as two independent stereo cart machines, each with its own stop, start and pause controls; four different cues can be armed to trigger for each output, and while one cue plays, another may be selected from a pool of 256 cues.

Circle (367) on Reply Card

Cable signals
By Tektronix
• **Cable Multiburst and Cable Sweep signals:** additions to VITS 200 NTSC inserter signal set; complement VITS 200's signal set, supplying all the test signal necessary for FCC in-channel response and color signal measurement; Cable Multiburst pack frequencies are 0.5, 1.25, 3, 3.75 and 4MHz; Cable Sweep signal extends from 100kHz to 4.2MHz and characterizes response across the entire signal; can be added to version BO2XXXX VITS 200 generator/inserters with a field upgradeable kit.

Circle (369) on Reply Card

Transport system
By Vyvx
• **DV6010:** medium-capacity digital fiber transmission system for high-quality video transport applications; can transmit eight video channels in either one or two directions simultaneously; uses 10-bit uncompressed video technology; available optionally in a fully redundant ver-

New Products

sion, including hot standby switching capability; requires only 19-inches of vertical rack space.

Circle (370) on Reply Card

LED VU meters

By Logitek

• **Super-VU series:** features an expanded range with 40 tri-color LEDs; provides simultaneous loudness and peak modes, plus information on your stereo image and mono sum; other features include a user-adjustable zero point, brightness adjustment and Max Hold; up to six displays fit in a 1-RU box; available in either an analog or digital input version.

Circle (371) on Reply Card

Coverage/analysis programs

By EDX

• **MSITE and TPATH:** multisite coverage and multilink analysis programs for use on PCs; use full 32-bit compiler; MSITE version 2.0/2.5 features composite signal coverage studies for up to 100 transmitter sites; TPATH version 2.0/2.5 features single or multilink path analysis; allow user to select from several different propagation models, plot 3-D terrain displays and create Windows bitmap files.

Circle (372) on Reply Card

Connectors

By Andrew Corporation

• **C41-series:** quick-attach connectors for line of 1/4-inch Superflexible HELIAX coaxial cable; use unique "collet compression" design that makes attachment quick and easy while providing high retention against pull off; can be field installed in less than three minutes and does not require tab-flaring or soldering to the cable's outer conductor; type N and SMA connectors have been optimized for low VSWR performance up to 6.5GHz; available in type N plug straight and right angle, type N jack bulkhead, BNC plug, SMA jack bulkhead, SMA plug straight and right angle; three type N designs feature silver-plated bodies, gold-plated contact pins and hex-shaped coupling nuts to reduce the interference effects of intermodulation distortion.

Circle (364) on Reply Card

Converter

By NVision

• **NV1050:** 4-channel AES/EBU digital audio sample rate converter; features film-to-tape transfer, video standards conversion, 3/2 pull-down applications and field DAT recordings; accepts any AES/EBU input rate from 32kHz to 50kHz; supports varispeed sample rates; provides any AES/EBU output rate from 28kHz to 54kHz; accepts video, AES/EBU or Word Clock Back Timing.

Circle (375) on Reply Card

TBC synchronizer

By James Grunder & Assoc.

• **Feral Effect TBC synchronizer:** features line and pixel interpolation for smooth, clean vertical and horizontal video compression; allows users to produce "over-the-shoulder" and other special effects for a multitude of applications, such as ENG/EFP broadcasting, production and post-production editing;; available as a board-level product that plugs into any auxiliary slot in either the Amiga or IBM PC or as a 1-RU high stand-alone unit.

Circle (376) on Reply Card

Continued from page 78

referred to these services as *broadcast subcarriers*, which is the term used here.

Broadcast subcarriers offer an array of opportunities for radio stations to create new profit centers. These include new services carried under the RDS mantle at 57kHz, as well as other, wider-bandwidth and dedicated-user services at the more traditional 67kHz and 92kHz frequencies. By providing an auxiliary service, such as data and ethnic broadcasting, broadcast subcarriers will generate revenue by leasing. Conversely, by extending service to the public through IVHS, a whole new outlet for advertising may open.

A number of manufacturers have begun to offer new hardware for the transmission and reception of such services. Broadcasters who are interested in pursuing potential new revenue streams would be wise to explore these options in their current marketplace. ■

For more information on FM subcarriers and RDS, circle (309) on Reply Card. Also see "Exciters, Generators," p. 20 of the BE Buyers Guide.

News continued...

from page 4

FX cable service to launch in spring

FX is the new Fox Inc. basic cable network scheduled to launch on March 1, 1994. It will be the first entertainment network to interact with its audience, and will launch a live "breakfast show," which will be produced by Fox Circle Productions.

FX will be its own entity, with its own identity. It will feature a mix of live and original programming as well as film and TV libraries.

VOA and JPL show direct DAB

The Voice of America (VOA) and the Jet Propulsion Laboratory (JPL) demonstrated direct digital radio broadcasting of CD-quality audio via satellite Sept. 28-30 to telecommunications experts from throughout the Americas at the Organization of American States' CITEL Conference in Buenos Aires. With the cooperation of the Argentinian government, the demonstration was held inside the central telecommunications building, the site of the conference.

A tracking and data relay satellite (TDRS) operated by NASA was used to beam a CD radio channel into the Buenos Aires area. The beam was 2° wide, and covered hundreds of thousands of square kilometers. The satellite delivered 7W of power to the radio channel. This was received inside the building by a low-gain flat circular antenna with an 8cm radius and fed into a digital receiver. The receiver system is an early design of a receiver designed by JPL as a prototype.

The demonstration used an ISO/MPEG digital compression method to produce a 256kbit/s stereo signal. Reception was made in the S-band at 2,055MHz.This frequency is close to the U.S. allocation of 2,310-2,360MHz for satellite sound broadcasting and 600MHz above the L-band allocation. The demo showed the feasibility of both frequncy bands for satellite sound broadcasting. ■

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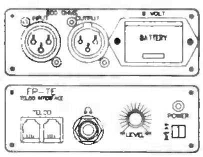

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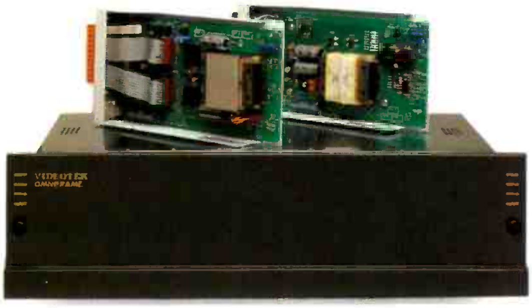

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