BROADCAST engineering

AN INTERTEC PUBLICATION

August 1988/$3

Video technology update

Newsroom computers p. 44

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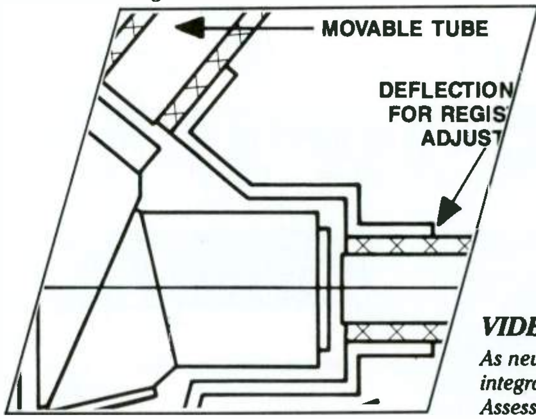
August 1988 • Volume 30 • Number 8



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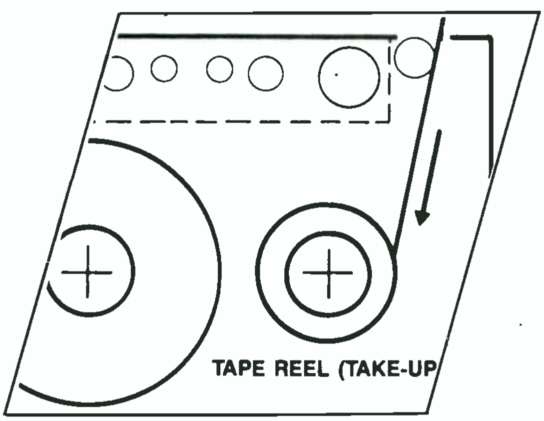

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ON THE COVER

Technology is moving at a rapid pace, especially in the area of video equipment. This issue examines key areas of product development, and assesses what these changes mean to broadcasters. Our cover this month illustrates the source of all live video, the camera pickup device. (Photo courtesy of Philips Elcoma Division, Eindhoven, the Netherlands.)

DEPARTMENTS

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FCC to establish AM interference standards

The National Association of Broadcasters (NAB) has urged the Federal Communications Commission (FCC) to establish AM radio interference standards and calculation methods that "more precisely characterize AM coverage and interference."

In its filing, the NAB said that FCC standards applied to a particular AM station significantly overestimate that station's actual coverage.

The association said that the commission's allocation policies should accurately predict coverage and interference to best serve the public interest and be rooted in the subjective expectations of AM service quality held by the listening public. The NAB contends that the result of the commission's proceedings must be applied not only to existing AM service, but also to the future AM allocations and technical assignments on the expanded AM band, 1,605kHz-1,705kHz.

Whatever AM technical standards are adopted, NAB said, the AM spectrum eventually will be exhausted. Although new AM stations can be added in the expanded band, the association said, it strongly objects to "endless 'shoehorning-in' of additional stations and causing new interference to existing stations where there is essentially no more room on the AM band."

The NAB supplemented its filing with two comprehensive studies: "AM Technical Assignment Criteria: An Examination of Issues Raised in MM Docket No. 87-267" by Harrison Klein, of Hammett & Edison; and "AM Radio Interference Study" by B. Angell and Associates. The Klein report is available from the NAB Station Services for $75 for NAB members and $100 for non-members. Telephone: 202-429-5380.

Rhodes named chief scientist of the ATTC

Charles W. Rhodes, principal research scientist with Philips Laboratories, Briarcliff Manor, NY, has been named chief scientist of the Advanced Television Test Center (ATTC). Rhodes, who has been with Philips Laboratories since 1986, has been involved in the development of the Philips high-definition TV (HDTV) system.

The ATTC was established this year by the broadcast industry to succeed and augment the projected National Association of Broadcasters' technology center. The purpose of the ATTC is to evaluate and test advanced TV technologies in cooperation with the Advanced Television Systems Committee and the Federal Communications Commission's special advisory panel on advanced television.

NAB applies for experimental AM station permit

The National Association of Broadcasters has filed an application with the Federal Communications Commission for

Continued on page 109

BROADCAST ENGINEERING

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INTERTEC PUBLISHING CORPORATION

Invest in your future

Technology is working overtime in the professional audio and video industries. Every trade show reflects advancements. Just keeping up with the pace of technology is a full-time job. Staying ahead of it is a real challenge. But regardless of how difficult it may be, staying ahead is the name of the game. It is the key to your future.

Broadcast Engineering magazine works to bring you the latest in developing technology every month and to explain what it will mean to you tomorrow. An invaluable element of this educational effort, however, is personal interaction with other members of the broadcast industry and allied industries.

The Society of Broadcast Engineers is offering its members and other engineers and technical managers in the broadcast, post-production and corporate/industrial communities an excellent opportunity to keep abreast of the state-of-the-art.

The SBE national convention, to be held for the third year, has grown to become a significant force in the educational efforts of the society. In conjunction with **BE**, the **Broadcast Engineering** conference has provided attendees with an impressive line-up of speakers from a wide variety of disciplines.

This year, the seminar sessions will be expanded to include additional topics on the cutting edge of technology, such as high-definition television and implementation of D-1 and D-2 recording equipment at broadcast and post-production facilities. The engineering conference luncheon, the cornerstone of the seminar portion of the show, will feature Lex Felker, chief of the FCC's mass media bureau. Four days of seminars will be presented on topics ranging from new approaches to AM antenna design, to the regulatory plans of the commission. Plus, exhibit hours have been lengthened to provide attendees with more exclusive exhibit time.

In the past, some attendees had to choose between two presentations that they wanted to hear. In response to requests from attendees at previous SBE conventions, the seminar sessions have been arranged so there are no concurrent papers.

The exhibit area this year will be even more impressive than the '87 show in St. Louis. The hall is more spacious, many exhibits will be larger, and more companies will be on the floor. A number of companies are planning new product introductions timed specifically for the SBE national convention.

In a significant move for the society, the SBE National Convention and **Broadcast Engineering** Conference is being held in conjunction with the Rocky Mountain Film & Video Expo and Region 8 International Television Association (ITVA) show. This joint effort brings together key elements of the broadcast and post-production industries, plus professional audio and video experts involved in corporate/industrial production and post-production.

This joining of forces will accomplish several important goals. First, it will provide a show that is greater than the sum of its parts. The SBE national convention has experienced steady growth since its launch in 1986. The Rocky Mountain Film & Video Expo and Region 8 ITVA conference has provided the professional audio-video community in the Rocky Mountain states with a first-class show for the past three years. Combining the two events in Denver this September will give each industry an opportunity to interact with the other. It also will give each group an opportunity to *learn* from the other.

The mix of elements at the 1988 SBE National Convention and **Broadcast Engineering** Conference will be synergistic. Experts from every area of the broadcast, post-production and corporate/industrial industries will be gathered in one place at one time. And a packed exhibit hall will provide a golden opportunity to view the latest in professional audio-video equipment.

The need to keep up with technology has never been greater than it is today. By attending this year's SBE National Convention and **Broadcast Engineering** Conference, you can more easily meet this challenge. The show will be Sept. 22-25 at the Currigan Convention Center in Denver.

Plan on attending. You owe it to your future.

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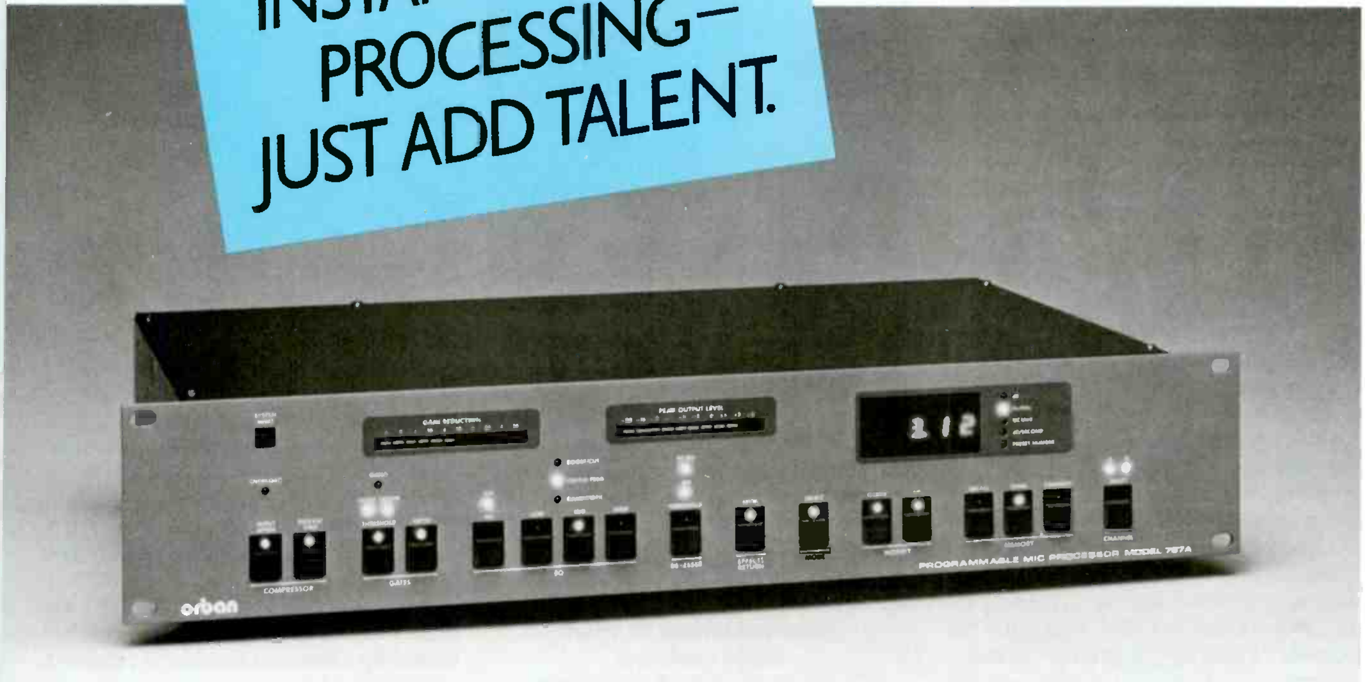

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Comparative renewal to be examined

By Harry C. Martin

The commission has proposed measures designed to curb abuses of the renewal process. It also proposed to clarify the standards for determining when an incumbent licensee is entitled to a renewal expectancy, and to refine or modify certain other comparative factors used in renewal hearings.

Incumbent broadcasters have been plagued at renewal time by competing applications. Many are filed solely for the purpose of forcing the licensee to pay a cash sum to avoid the expense and uncertainty of an FCC hearing. Since legislation removing the cap on renewal settlements was passed in 1982, this type of harassment has become more and more common.

The commission has made the following suggestions for reforming the renewal process:

- Reimposing limits on the amount of money, or other consideration, that an incumbent licensee would be allowed to pay to secure withdrawal of a competing application, or banning such payments altogether.
- Finding a method for ensuring the bona fide intentions of an applicant contesting the renewal. Suggestions include requirements for more complete financial disclosures and identification of all parties of interest.
- Requiring applicants to certify their good faith intentions at the time of application, rather than at the time of settlement, as is currently the case.

The commission also is considering ways to refine the definition of meritorious service in order to provide a more reliable benchmark for renewal expectancy. If those licensees who are meeting their public interest responsibilities can be identified, the potential for blackmail or sham applications will be reduced significantly.

Compulsory license reviewed

It is expected that the commission will suggest to Congress that the cable industry's compulsory copyright license be repealed. The staff is working on a legislative proposal to this effect.

Legislation on the matter already is pending in both the House and the Senate. Rejection by the District of Columbia Circuit Court last year of the revised must-carry rules inspired these legislative initiatives. The House and Senate bills both tie the continuation of the benefits conferred by a compulsory license to a cable operator's carriage of local TV signals.

Telco permitted to enter cable business

GTE has been allowed by the commission to construct a cable system in Cerritos, CA, as a result of a recently granted waiver of the rules banning telephone companies from owning or operating cable systems within their service areas. The FCC's Common Carrier Bureau issued the waiver because it found that without GTE's participation, the community of Cerritos would be left without cable service. The California and National Cable Television Associations have asked the commission to review this decision.

The telco/cable ownership restriction, which is incorporated in the 1984 Cable Act and the agency's rules, is designed to prevent cable TV from being monopolized by powerful telephone companies. However, legislation now pending would remove this ban. Such a relaxation would put the telcos into a position to become more deeply involved in the information services market.

Regardless of whether the restrictions are removed by Congress and the commission, the Bell Operating Companies (BOCs) will not be permitted such access without a specific waiver from the court. The BOCs still are being regulated by the U.S. District Court in Washington, DC, as a result of the AT&T divestiture proceeding. Because it is not a BOC, GTE is not subject to the court's jurisdiction.

Capitol Hill hearings

In May and June the cable TV and broadcasting industries squared off in hearings before the telecommunications subcommittee of the House of Representatives. Spokespersons from every facet of the video services industry appeared before the subcommittee. Local TV broadcasters, especially public and independent stations, lined up with Hollywood in an assault on the lightly regulated cable industry. They asked for must-carry legislation and greater congressional attention to alleged monopolistic practices by the cable MSOs.

A later hearing focused on HDTV. Broadcast and cable factions came out on opposite sides again, with the three major networks pushing for a uniform technical standard to ensure that viewers not served by cable will be able to receive a quality signal in as short a time as possible. Cable and satellite operators argued that imposition of a single standard would force the technical limitations of the broadcast spectrum on their broader-spectrum technologies. For this reason, cable and satellite interests view the rush to standardize HDTV as counterproductive.

TV station fined for indecent broadcast

A Kansas City, MO, TV station was fined $2,000 for its prime-time broadcast of the movie "Private Lessons," which the commission deemed indecent.

The Kansas City case was the first to result in a forfeiture under the indecency standards adopted in April 1987. Those standards do not permit the broadcast, before midnight, of material that ". . .depicts or describes, in terms patently offensive as measured by contemporary community standards for the broadcast medium, sexual or excretory activities or organs." A long court battle over the new standard is expected.

HDTV report issued

The commission's "blue ribbon" committee on HDTV submitted its first interim report. It recommended that the agency move ahead with signal-quality standards and allocate spectrum space to facilitate a 2-channel system for HDTV broadcasts.

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

Part 1

Strictly TV

The definition of high definition

By Dennis R. Ciapura

The most confusing and perilous era in the history of television is at hand. The Advanced Television Systems Committee (ATSC) recently voted to accept the 1125/60/16:9 production standard proposed by SMPTE. MUSE is still on target for DBS-delivered high-definition television (HDTV) by 1990. Cable delivery of HDTV was proved feasible in the 1987 MUSE CATV tests in the United States and Canada. The Japanese hardware barons are busy introducing a plethora of HDTV products from production equipment to consumer VCRs. How will terrestrial broadcasters compete?

As the work on production standards and the closed-circuit tests has plodded forward over the past few years, most terrestrial broadcasters have tended to view HDTV as a future technology—something to follow with interest, but nothing to worry about in the short term. But now it's getting a little scary.

A few years ago, there was quite a bit of speculation among broadcasters as to the future of cable; many thought that relatively few homes really would be served by cable, and that most of the cable networks would fail. It was more than a little surprising to witness the rate of consumer VCR proliferation and the development of the video rental aftermarket. With advertising revenues already fragmented, can the industry afford to have broadcast television recast as a low-tech service? Can it afford the development of a separate HDTV industry while an obsolete NTSC broadcast system fades into economic depression, the same way AM radio has faded in the shadow of FM stereo?

Timing is everything

With HDTV, as in the introduction of most new technologies, timing is everything. If it were reasonable to expect that CATV, DBS and other delivery competitors would not provide HDTV service for another 10 years, the best plan of action might be to push for the additional bandwidth necessary to support the best wideband single-channel system or one of the dual-channel alternatives. Unfortunately, the regulatory trend has been to allocate spectrum with a bias toward diversification, and the quest for additional spectrum undoubtedly would be an uphill battle. UHF channels 70 to 83 already have gone to land mobile, and with all the pressure on spectrum, it is difficult to be optimistic about bandwidth extension for the existing broadcast TV services, even in a 10-year time frame.

Because the timing is so uncertain, it is important to assess the possibilities within the existing broadcast bandwidth limits. This leads to another decision point: NTSC-compatible vs. a new optimized 6MHz system. In view of the monumental consequences of introducing a noncompatible format, it is critical that broadcasters determine what level of performance is expected by the consumer. After all, an early start with a competitive product is crucial to the capture of a dominant share of the HDTV market. History has shown that the success of a product is not necessarily a result of its technical superiority.

Performance vs. marketability

Consider, for example, the Beta-vs.-VHS contest in the consumer video market. Few technical reviewers would argue against the superior video performance of the Beta format, yet VHS has prevailed in the United States. It's a matter of consumer perception, and the average consumer rarely has the opportunity to engage in scientific A/B product testing. The basic, underlying fact is that both products produced a picture that was essentially the same to most viewers in a typical showroom environment. Factors other than technical superiority became key drivers.

The same conditions are likely to govern the transition to HDTV, so it is imperative that broadcasters do not confuse performance and marketability. The real challenge is determining whether performance level and features will be perceived by the average consumer as equivalent to the competing formats.

If the required performance can be achieved within the NTSC compatibility constraints, broadcasters may have the huge advantage of driving the HDTV transition, rather than struggling to stay alive in it. The key question, therefore, is whether competitive performance can be achieved with compatibility. The answer depends on three things: how clearly the NTSC limitations are understood, how close an NTSC-compatible format can come to the competing formats, and how noticeable the remaining differences will be to the consumer.

Evaluating consumer perceptions

Aspect ratio is by far the most recognizable and important HDTV feature. The "wide screen" look is likely to be the prime product differentiator in the showroom, so it is important that broadcast HDTV present the same kind of theaterlike display as the competing delivery systems. This leads to the dual challenge of achieving an aspect ratio that is essentially the same as the competing formats and is compatible with existing NTSC receivers.

The NHK production format and MUSE both feature a 16:9 aspect ratio, which is wide enough to eliminate pan-and-scan and has tested well with consumers. The VISTA 2-channel system developed by The New York Institute of Technology provides an NTSC-compatible main channel with a 5:3 aspect ratio, and the Compatible Video Consortium (CVC) proposal for HD-NTSC has been upgraded from a 14:9 to a 5:3 aspect ratio. With 56μs active line time to scan a 5:3, the porches are reduced but still are within a range that present receivers can handle without difficulty.

The main question, then, is whether the 5:3 aspect ratio will be perceived as essentially the same as 16:9.

Ciapura is vice president of technical operations for Noble Broadcast Group and president of TEKNIMAX Telecommunications, a San Diego-based technical management consulting firm.

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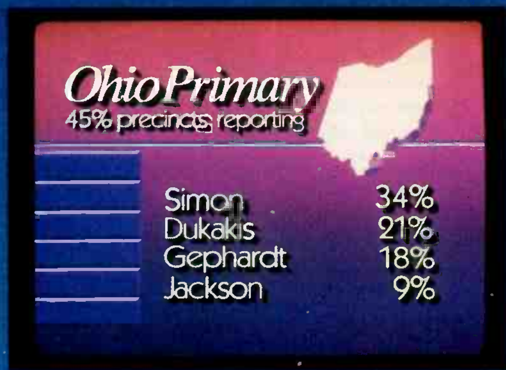

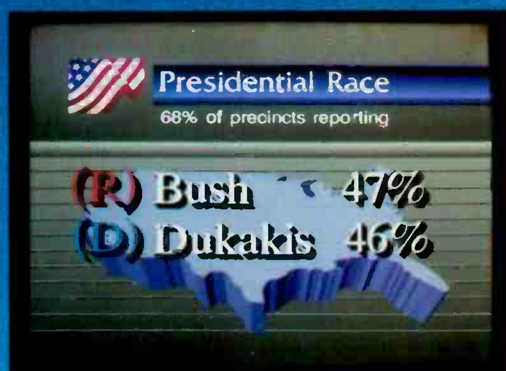

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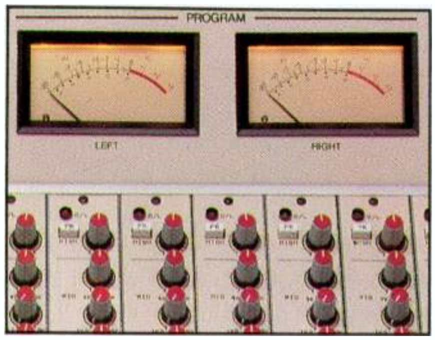


Know the FCC rules on DA calculations

By John Battison, P.E.

Last month's "re: Radio" concluded with a warning about using computer programs to calculate directional antenna patterns. A problem often arises when an eager engineer designs a custom program based on the well-known DA theory (forgetting that the *theoretical pattern* is no longer acceptable by the FCC), or purchases one of the many good computer programs available, but does not know how to use it properly. In either case, the engineer's time, and sometimes money, has been wasted.

Basically, the operation of a DA is based on vectors. Typically, at least two combinations of vectors will produce the desired pattern shape. However, one is usually better than the other. The appropriate vector combination is the one that produces the longest vectors in the major lobe. Some computer programs will select the best parameters based on efficiency and desired operation. These are the types of programs offered by consulting engineers.

Calculating rss

The rms (root-mean-square) is determined when a new DA pattern is calculated. During this procedure, the rss (root-sum-square) also is calculated. The rss is equal to the squared values of the radiation from each tower added (summed) together. The square root is then found, and this is the rss of the antenna array. It is another indication of efficiency and also is used as a measure of array stability.

The ratio of rss to rms should not be high. A high ratio often indicates an undesirably high gain. High gain may be the result of an error in calculations or of an unstable array that tends to change characteristics erratically because of weather conditions or other reasons. Often, a less high-gain or super-efficiency DA will be more stable and prevent such problems.

Here is an example of rss calculation for a 3-tower array with an expected radiation of 196mV/m from each tower. The result of squaring each radiation value is 38,416. The sum of the three is 115,248. The square root is then found to equal 339mV/m. Similarly, for a 2-tower array, the rss would be 277mV/m.

The observant reader will notice that this example uses the radiation at one mile value. This is an error that the FCC would not condone. The commission requires everything to be measured in metric units, in accordance with the WARC agreements and the switch to metrics in the United States. If an application is submitted in other than metric units, it may be rejected. At the least, the commission will require that a new series of figures using metric units be provided.

Verify the performance

After an antenna proof is performed, the rms is sometimes found to be far higher than the application showed. This generally indicates an error in the proof or an uncalibrated measuring instrument. For this reason, all ammeters to be used in a DA should be calibrated using the method described in previous columns. Or, if time permits, have the meters sent away to one of the calibration services.

An excessively high *paper* rms can sometimes be traced to errors in the curve-fitting analysis that resulted in high inverse fields. If you obtain a high rms after completing a proof, don't congratulate yourself on having a fantastic operation until you have checked for possible errors.

If the system uses a negative resistance tower, such as that shown in Figure 1, it is often the cause of the problem. But, remember: Contrary to what a lot of station engineers think, a negative tower is not simply a tower with a negative sign in front of the phase angle. For instance, $1.3\angle{-104°}$ is *not* a negative tower. The negative sign merely means that the phase angle is negative.

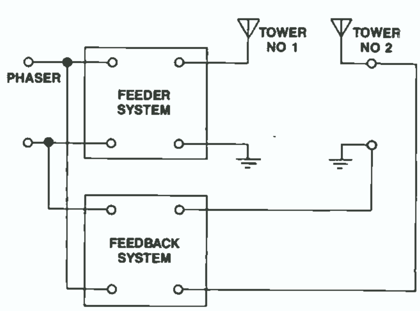


Figure 1. Simplified negative tower power flow diagram.

A negative tower reading might look like this: $-34\Omega + j30$. The negative sign in front of the base resistance shows that the tower is designed to take power *out* of the system and *return* it to the other towers via the phasing system. If this tower's coupling system is not adjusted properly, the power that was planned to be obtained from this tower will not be returned to the system, and the array efficiency will suffer.

For these reasons, it is essential the ATU and phaser are adjusted correctly. Remember that, in this case, the antenna becomes the power source, and the phaser system becomes the load. Unless the power source and the load are matched properly, proper power transfer will not occur.

Check the grounding

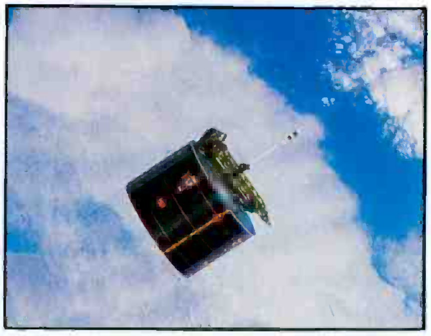
If the rms is much lower than anticipated, it is an indication of excessive losses in the system. If you are tuning a new installation, check to be sure that all ground straps have been properly brazed to the ATU circuits, the tower bases and the ground system itself.

I once worked on a new system that showed an extremely low efficiency. Naturally, my first thought was that the ATUs or phaser were misadjusted. However, close inspection showed that the low efficiency was caused by the absence of copper strapping between the ground system, the ATU and the tower bases. It was only after a physical inspection that the missing links were discovered.

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

Satellite technology

Up, up and away



By Elmer Smalling III

Following last month's discussion of rocket fuels and engines, let's examine a typical launch vehicle and launch procedure events during liftoff and ascent.

The launch vehicle

The Delta vehicle was used for the launch of early communications satellites. At a length of 115 feet and weighing 116 tons, Delta had a liftoff thrust of 305,000 pounds (or, to rocket engineers, 1.4 million Newtons). The Delta vehicle payload capacity was about 400 pounds for synchronous orbit or 5,500 pounds for near-Earth orbit.

The first stage of the Delta was a 90-foot-long Thor rocket that burned kerosene and liquid nitrogen. In a burn time of 3.5 minutes, the rocket developed a total thrust of 200,000 pounds.

A second stage consisted of an 11-foot section using liquid Aerozene-50 as a fuel. Nitrogen tetroxide, N_2O_4, was the oxidizer that began a 5-minute burn for a 9,400-pound thrust.

Stage three was five feet long. This solid-fuel section burned for 45s, for a thrust of 9,500 pounds.

A more recent rocket vehicle is the Titan IV. This 4-stage Titan's geostationary payload capacity is greater than 2,500 pounds, about 5 times the earlier Delta units.

In the first stage are two 115-foot, 10-foot-diameter solid-fuel rocket motors, each capable of 1.5 million pounds of thrust. The burn time of stage one is about three minutes.

Stage two burns for about one minute. During that time, the 85-foot liquid-fuel engine can develop a capacity for 550,000 pounds of thrust.

The third stage consists of a 33-foot liquid-fuel rocket with a thrust rating of 100,000 pounds. It has a burn time slightly longer than two minutes.

The fourth stage, a Centaur upper stage, is a cryogenic fuel rocket. In its 3-minute burn, the 30-foot-long rocket develops a 30,000-pound thrust.

In a large launch vehicle configuration such as the Titan IV, the main thrust producers are called the boosters (strap-on units) and the sustainer (the internal engine).

Shuttling to low orbits

The space shuttle is the most powerful launch vehicle to date, accommodating payloads up to 29,000 pounds in low-earth orbit and 2,300 pounds in geostationary orbit. Its launch system consists of three SSMEs (space shuttle main engines, fed by an external tank) and two strap-on solid-fuel rocket boosters. Only the large external tank is expended after launch. The two solid-fuel rocket boosters are jettisoned approximately two minutes after liftoff and parachuted into the ocean. The external tank is jettisoned immediately after the main engine shutoff. After this operation, the shuttle's orbital maneuvering system (OMS) provides the power needed to attain a near-Earth orbit.

Once the shuttle has completed its mission, the OMS is used to place the vehicle in a tail-first position and to decelerate enough to fall out of orbit (de-orbit). When this operation is completed, the shuttle is turned nose-first for re-entry.

The orientation of the shuttle is controlled by the reaction control system (RCS) until it is in the earth's atmosphere. There, friction and lift, caused by the molecules of air, allow the use of the aeronautic control surfaces to *fly* the shuttle. Rocket stages, expended motors and satellites eventually will drift out of orbit and fall back into the earth's atmosphere. Because of their tremendous speed and the resistance of the air, the re-entering bodies burn up.

To prevent burning of the shuttle when it re-enters, it is covered with tiles made of an ablative insulator material. These tiles cover the entire outer surface of the shuttle and burn as the heat of re-entry increases. The tiles are designed to be thick enough to protect the vehicle for only one re-entry. They must be replaced before each launch.

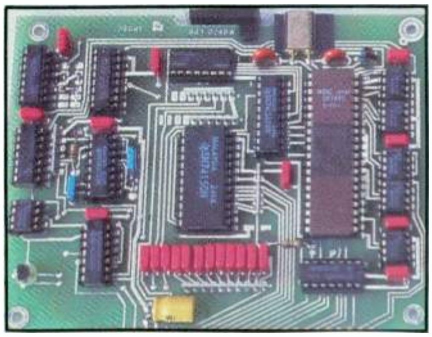
VEHICLE	PAYLOAD
H-1 (Japan)	550 pounds
Ariane III (ESA)	1,325 pounds
Long March 3 (China)	1,400 pounds
Titan IV (USA)	1,500 pounds
Zonda D1 (USSR)	1,600 pounds

Table 1. *A comparison of the launch vehicles currently used by various nations shows a wide range of payload capability.*

EVENT	TIME INTO FLIGHT
Liftoff	0:00
Booster engine cutoff	2:01
Booster jettison	2:04
Nose shroud jettison	2:30
Second stage jettison	5:30
Spacecraft separation	5:45
Start programmed pitch positioning	10:00
Stop pitch positioning	11:40
Apogee kick motor (AKM) ignition	13:45
AKM burnout	14:20
Adjust forward velocity	14:25
Start yaw positioning	14:45
Stop yaw positioning	15:30
Start roll adjustment	15:35
Stop roll adjustment	15:45
Blowdown hydrazine	19:30
Deploy solar array	19:45
Deploy search and receive (SAR) antenna	26:15
Deploy VHF antenna	28:00
Deploy UHF antenna	28:30
Deactivation of control system	33:45
Handover of vehicle to operator control	34:00

Table 2. *A typical launch by NASA could be represented by this schedule from T–0:00 to handover, when the vehicle control is given to the satellite operator.*

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



A dynamic waveform can make waves

By Gerry Kaufhold II

A circuit capable of generating ac signals is shown in Figure 1. Notice its similarity to the 8-bit R-2R ladder digital-to-analog (D/A) converter discussed in last month's "Circuits" column. Some filtering has been added, and you can assume that software has been provided to create a sequenced series of switch operations.

Frequency limits

When ac waveforms are produced from this circuit, the upper band of frequencies is limited by the speed with which the controlling element can manipulate the switch settings. For example, a 6305 microprocessor can produce tones up to 10kHz, but not much higher. The number of clock cycles required to process the instructions to produce the tones is set by the software instruction set, and the speed of each cycle is fixed by the speed of the master system clock.

The output of the R-2R ladder and buffer amplifier is shown in Figure 2. Notice the stair-step appearance of the signal. The discontinuities produce high-frequency noise and harmonics that must be filtered.

The lower band of frequencies requires special consideration. For example, if a circuit is expected to produce 10Hz tones, the rolloff of the low-pass filter should be set to begin near 12Hz, in order to block the second harmonic at 20Hz. Low-frequency filters for this range are complicated as well as expensive. Even for generating tones between 100Hz and 1kHz, the low-pass filter must be designed carefully if distortion and noise are to be minimized.

Producing dynamic signals

Analog filter design becomes the dominant issue when ac waveforms are generated with digital circuitry. Some function generators that use D/A converters have a tunable low-pass filter following the buffer amplifier. The software that controls the tone generator also controls the filter, automatically adjusting the filter cutoff as tone frequency changes.

Component tolerance also is important. Significant distortion can result from even minor variances.

Look closely at the size of the step between counts 4 and 5 in the stair-step waveform of Figure 2. This non-uniform stair-step will occur twice during each cycle—once as the signal increases and again as the signal decreases. The noise created by such non-uniformity in the stair-step is called *quantization noise*. This can occur at a frequency that is related to the number of cycles per second at which the stair-step is moving, or it can cause intermodulation products that are difficult to predict or eliminate.

The speed of microcomputers is inadequate to allow their use as control elements for high-frequency signal generators. To obtain frequencies in the video range, custom-integrated circuits are necessary. Studying the schematic diagrams and theory of operation of the station's digital framestore might be a good way to learn more about generating ac waveforms with digital circuits.

Kaufhold is an independent consultant located in Tempe, AZ.

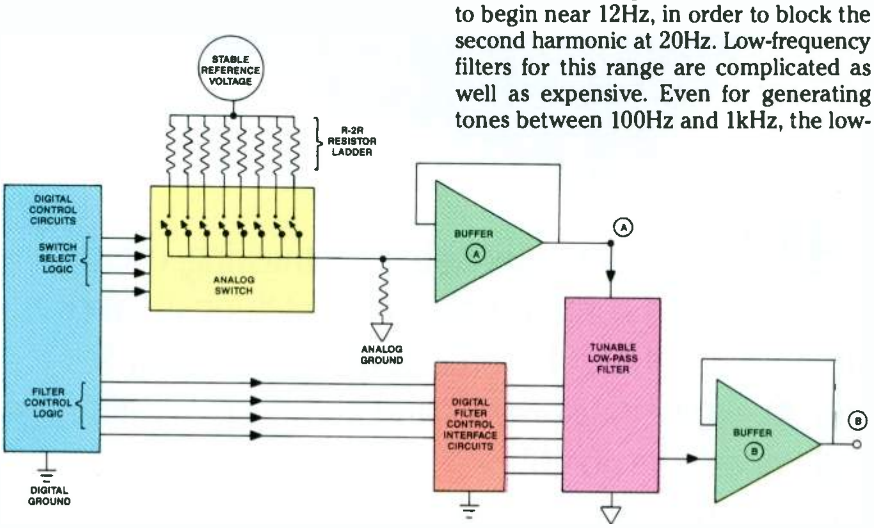


Figure 1. *This D/A converter circuit is capable of generating nearly sinusoidal waveforms. Note the separate analog and digital grounds.*

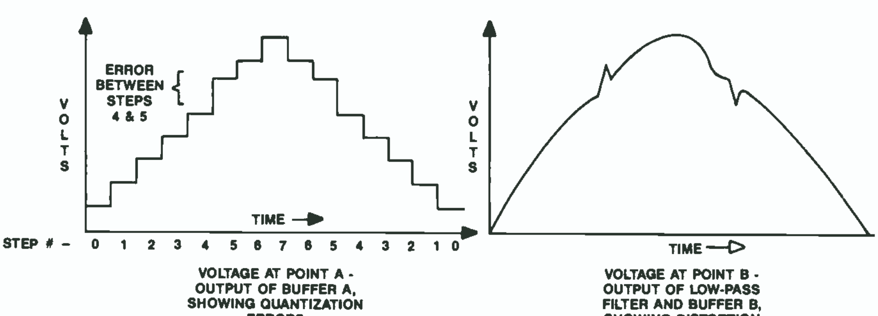
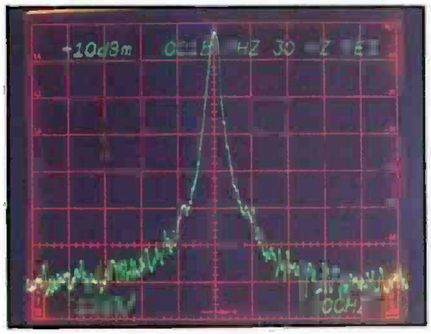


Figure 2. *Sample waveforms taken from the top end of the voltage range for the Figure 1 circuit. Note glitches due to quantization error.*

Part 5

Troubleshooting



CD player repair requires skill

By Brad Dick, radio technical editor

A common complaint of CD users centers on problems with tracking or skipping. The resulting audio signal sounds much like that produced by an analog disc when the tone arm skips. As with turntables, tracking and skipping problems often are caused by mechanical factors.

The design of CD players occasionally makes it hard to differentiate between tracking and focus servo problems. For instance, a proper focus signal often is required before the tracking servo can output a tracking control voltage. To further complicate the problem, some CD players use the tracking error signal (TER) as a fine control for the traverse servo motor. Without the proper TER, the radial tracking coil and traverse servo have no control signals. Symptoms of mistracking may be caused by either condition.

Electrical failure

The first step in resolving this problem should be to determine whether the cause is mechanical or electrical in nature. In either case, a quick touch-up of the electrical tracking adjustments (described in last month's "Troubleshooting" column) is probably in order. If the problem persists, more detailed troubleshooting is required. A block diagram of a typical tracking circuit is shown in Figure 1.

One potential electrical cause centers on the error-detection and variable-gain circuits, through which the tracking error voltage often is routed. If the disc or improper tracking is causing the interruption of this signal, it may appear that the radial tracking or traverse servos are at fault when, in fact, they are not.

Start the CD player to see whether the pickup moves to the inner limit when power is applied. If it does, the reset and basic servo circuits are working. However, if the player still appears to be mistracking, trace the TER signal from the IC preamp to the tracking actuator coil. Note that several servo ICs may be involved, so be sure you monitor both the input and output signal points. Note that some IC servo circuits require several input signals before allowing the TER signal to pass. If any of the required status inputs are missing, the drive IC may not output the desired drive signal.

The traverse servo uses two commands to direct its motion. A forward (FWD) command moves the optical assembly forward, toward the outside of the disc. A reverse (REV) command moves the assembly back toward the inner tracks. The easiest way to check the traverse servo is through the search forward/reverse modes. If the forward and reverse signals (sometimes called kick F/R) are present, and the traverse servo motor moves the assembly, then the entire system is working properly.

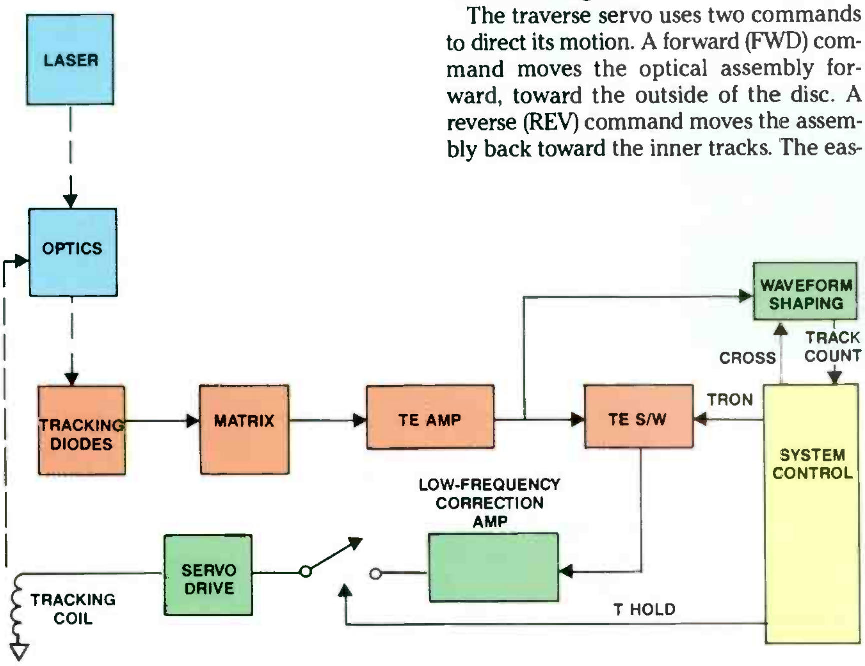


Figure 1. Simplified block diagram of a tracking servo circuit.

Mechanical failure

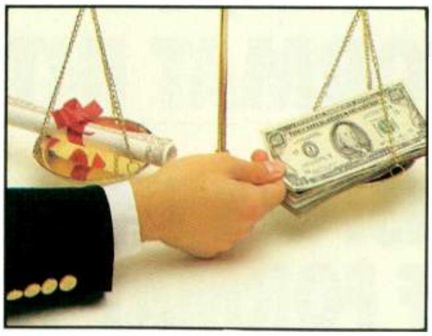
Often, the adjustments appear to be correct, and the EMF signal looks good on the scope, yet the CD player continues to mistrack. What then? Let's look at potential mechanical causes. Two areas need to be checked: the optical block and the sled drive mechanics.

Monitor the tracking error signal with the scope set to a 5ms time base. The display may show what appears to be random noise. However, if the sled is binding, you will see a gradual build-up of a fundamental frequency at about 250Hz. To demonstrate this problem, load a CD, and mechanically jam the sled during play. Monitor the TER signal, and note the change as you prevent the sled from moving.

If the CD player uses a pulse-width modulation (PWM) drive scheme, there is another way to check for mechanical binding. A common CD player using PWM drive has a normal sled drive pulse width of 2μs to 7 μs. When too much friction occurs in the drive system, the pulse width slowly increases, then drops to zero right after a skip. This happens as the drive circuitry tries to force the sled to move by applying more power (longer pulse width) to the motor. Then, the sled assembly breaks loose and jumps forward, or the objective lens reaches the end of its range and jumps backwards. In either case, for a moment, there is zero tracking error and, consequently, no correction. This is a sure sign of mechanical trouble.

Acknowledgment: Background information on this topic was obtained from "Audio Corner," by Kirk Vistain, *Electronic Servicing & Technology*, August 1987; and "Compact Disc Troubleshooting & Repair," by Neil Heller and Thomas Bentz, Howard W. Sams & Company.

Management for engineers



To achieve success, you have to define it

By Brad Dick, radio technical editor

What would it take to make you feel successful? Money? A new car or house? A particular job title? Although success is widely talked about, few seem to achieve it.

Ask 10 people what would make them feel successful, and you'll get 10 different answers. There is no one correct answer to the question. It's important, however, that you be able to define what would make you *feel* successful.

People often think that a higher salary or a better job title carries with it a feeling of success. This is not the case. Position and money seldom provide the automatic satisfaction that we assume they will. Therein lies one of the traps into which many of us fall. We mistakenly believe that if we can only get that next promotion, or earn $30,000 or perhaps $75,000, we will have achieved success.

When everything isn't enough

When asked what it would take to make him feel successful, a TV chief engineer earning more than $75,000 replied that he would consider himself successful if only he could make $100,000 a year. A network CEO said that success for her would be appointment to a presidential commission. In both cases, the person is viewed by others as tremendously successful. Yet, to themselves, these people have not reached that elusive goal of personal success. You'd be surprised at how many seemingly successful people actually see themselves as failures.

People often restrict their chances of finding success by operating in the *limiting mode*. Engineers are familiar with this term as it applies to equipment—a low power-supply voltage may restrict the maximum available output power. The equipment doesn't quit, but its performance is limited severely.

Much the same thing can happen in a person's life. Believing lofty goals and career challenges are beyond their capabilities, some people self-limit their performance by telling themselves "I can't." Such an approach to life often is used as a face-saving tactic. Never trying means that you won't fail, but it also guarantees that you won't succeed. The limiting mode also causes people to freeze up, to be unable to act or to make decisions. Excuses are abundant.

One CE, John, complains continually about his job. He gripes of working too many hours and receiving too little pay. John says he is going to return to school and finish his MBA degree, get out of broadcasting and make some "real money." John talks a good game, but he never takes any steps to complete the process. He never enrolls in classes or visits the school. He just continues to complain about his situation.

Never trying means that you won't fail, but it also guarantees that you won't succeed.

Consider the options

Getting out of the failure mode is not easy, especially if you've spent a good deal of your professional career telling yourself "I can't." First, you'll have to decide to make a change and to take charge of your future. The second step is to identify those things that would make you feel successful.

- What is really important to me?
- What rewards do I really want from life?
- What are my strengths, weaknesses, preferences and resources?
- What do I like about what I am doing now?
- What don't I like about what I am doing now?
- What do I really want to do?

Table 1. *Ask yourself these questions when developing a career plan. A close look at your answers will help you better understand what you want to do with your career, and you'll probably find out something about yourself.*

The third step, an important one, is to list your career options. This should be a free-wheeling exercise. Do not limit your possible options to "safe" choices. Consider all the things that you think might be fun and that you would like to do. Just because you've been the TV engineering manager doesn't mean you have to remain in the job. People change careers every day. The key is to list as many options as you can think of.

One engineer, when asked what he really wanted to do, said "go fishing." Well, not everything on your list may be feasible. After all, you still want to eat. However, go ahead and allow yourself to consider all the possibilities. You can boil them down into feasible choices later.

The fourth step is to evaluate your strengths and weaknesses. This is the time to be brutally honest with yourself. What tasks are you good at? What skills do you lack? For instance, if you get lost trying to find the bathroom, it probably wouldn't be wise for you to try to become a navigator.

Also, consider what resources are available to you. One engineer wanted to teach electronics. Unfortunately, the nearest university was several hundred miles away. When he determined that it wasn't economically feasible to move his family to that location, he looked to alternative resources. He found that the continuing education program at the local high school needed a part-time technical instructor. The job fulfilled his desire to teach, increasing his feeling of success.

The choice is yours

Not everyone will complete this planning process because it is often uncomfortable. Career planning can make you anxious because it involves change. Remember, though, career changes are seldom irrevocable. Adopt the attitude that change will be good for your career. Also, it's possible that a careful analysis will show that your current position is best for you. You'll never know, however, unless you evaluate yourself thoroughly and honestly.

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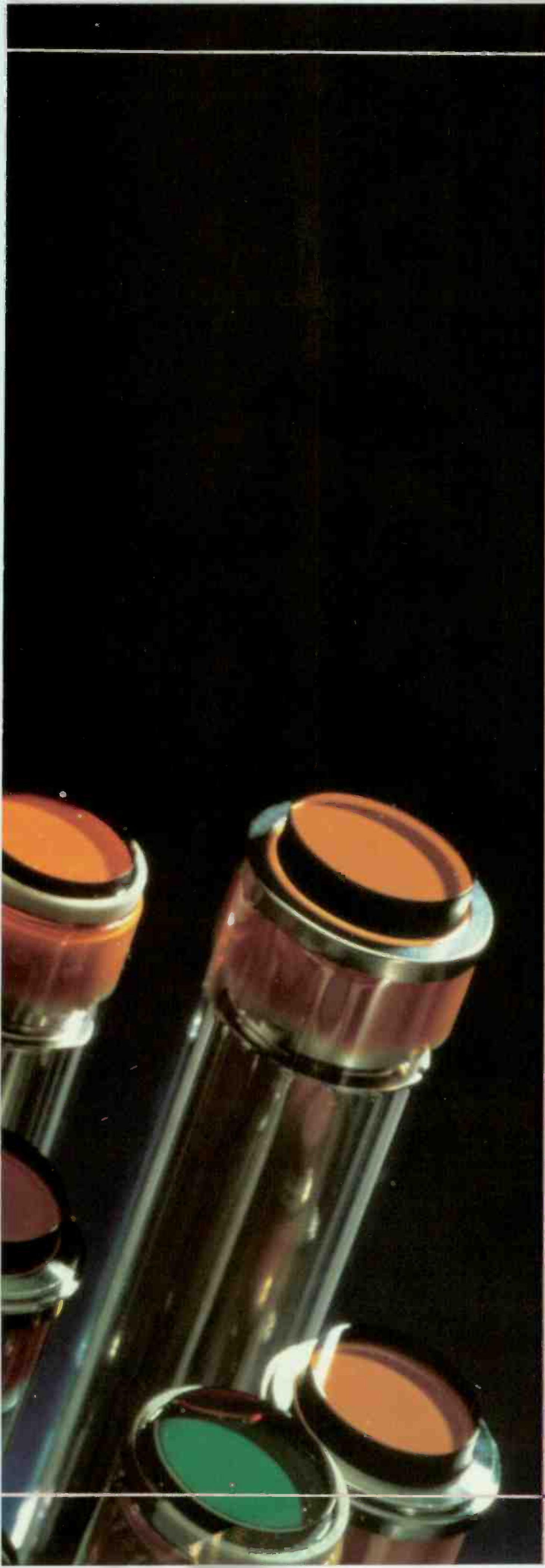

Video technology update

By Rick Lehtinen, TV technical editor

Video technology is on the move. That means you have to stay on your toes.

It's important to keep up with what's new in broadcasting, but it isn't always easy to do. It's hard enough just keeping up with things at the station. Time spent following the industry is time not spent maintaining equipment and planning facilities. But if you ignore the outside world to take care of immediate problems, you may find the future sidestepping you.

This month's special Video Technology Update is designed to help you in two ways. First, it highlights some trends that may interest you. Second, it gives you a chance to learn about new developments without having to leave your office, and that means you have more time to do your job.

Video technology is changing on several fronts. What used to take a chassis now takes a PC card, and what used to fill a card now sits in a chip. Developments of this kind are examined in "Directions in Camera Design," which discusses new uses of computers in lenses and introduces a new CCD that is said to be the first one that's HDTV-capable.

Although this type of progress is surprising, it is not overwhelming. After all, a new device may be smaller and better, but you generally understand its function from working with its predecessors. New technologies, however, sometimes quite removed from broadcasting's heritage, have a way of popping up in this business. Following these can be a little harder, because when you don't know the history of a technology, it's difficult to fathom its future.

One of these new trends is in the area of newsroom computers, which have now begun to reach out of the newsroom and hook up to other equipment. Two articles, "Weather Radar Systems" and "Newsroom Automation," discuss the potential for smooth integration of these technologies.

Here's the line-up of video technology articles in this issue:

As new technology continues to accelerate in all directions, it is integrated into almost every broadcast video product. What may seem to be little more than a trend today might be a key element in your planning and purchasing decisions tomorrow.

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Directions in camera design

By Rick Lehtinen, TV technical editor

Today's watchwords in lens and camera design are smaller, lighter, smarter.

Lenses are metamorphosing. Microprocessors, lighter metals, new glasses—each is displacing what went before. Additionally, increased use of charge-coupled devices (CCDs) has required lenses to be more accurate in every way, because the CCDs mount directly to the color separation prism, with no position adjustments to correct backfocus and no sweep circuits to fix lens-induced registration problems.

Tighter tolerances

The increased use of CCDs will require lens designers to tighten tolerances and improve manufacturing methods. Because CCD cameras have no registration or deflection controls, lens aberrations are picked up in the CCDs, and they enter the video signal before they can be corrected. (See Figure 1.) The cure is to prevent aberrations in the lens, and much research is under way in this area.

The errors introduced by lenses come from several sources. One serious problem is called *longitudinal chromatic aberration*. At its root is the physical law that lenses affect light in different ways, dependent on its frequency. The result is that the distance back from the lens at which the image will focus varies among red, green and blue.

In a tube camera, the movable yoke is adjusted until the focus point is found. This procedure is called "setting the backfocus." With CCD cameras, the physical bonding of the CCDs to the prism faces precludes mechanical correction for backfocus. These aberrations must be prevented in the lens assembly, hence the required improvements in lens technology.

Another lens-induced error, *lateral chromatic aberration*, is caused by the varying size of images among red, green and blue. Lateral chromatic aberrations manifest themselves as registration errors and usually can be corrected using the camera registration and sizing controls. Again, because CCD cameras have no such circuitry, lenses must minimize the tendency for error.

Both of these aberrations occur because the refractive index of glass varies with the wavelength of the light used, resulting in dispersion. These aberrations can be reduced by the use of different types of glass in positive and negative combinations, to form a lens that is achromatic. Dispersion effects cannot yet be entirely eliminated and, for this reason, lens research continues.

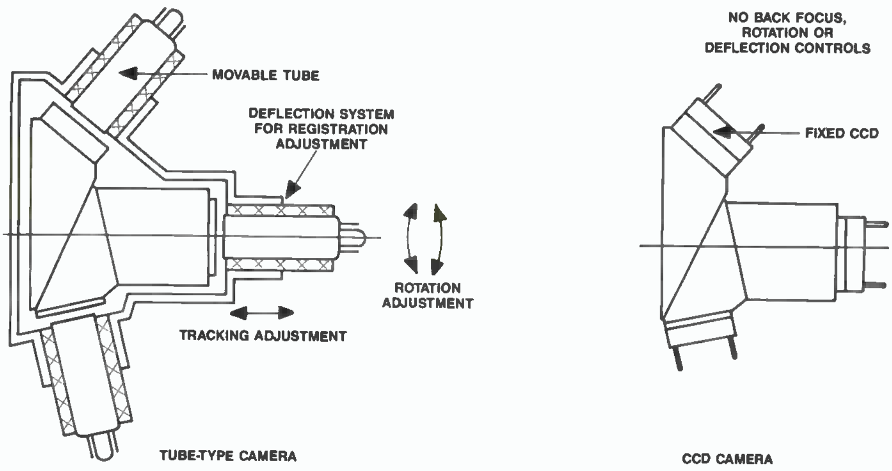

***Figure 1.** Tube-type cameras allow correction of longitudinal aberrations by physically moving the tube. Also, deflection circuitry modifies the tube sweep to compensate for lateral aberrations. CCD cameras, on the other hand, have no such adjustments. Lens manufacturers must minimize aberrations through careful design.*

Prism problems

The color separation prism is another source of lens error, although the prism is generally thought of as part of the camera body. Light that comes in through the lens must be coupled into the prism, and this process can introduce some errors. Moreover, the prism may have aberrations of its own, which further affect the image delivered by the lens.

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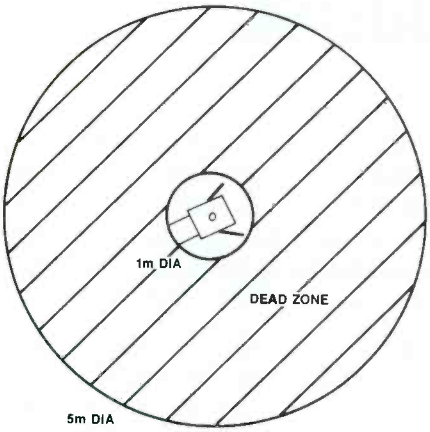


Figure 2. *Traditional zoom lens compensation elements leave a "dead zone" around the camera, an area that is too close to focus on. An improved lens mechanism featuring microprocessor control decreases the dead zone to zero.*

There also are some concerns as to the quality of the prisms used by camera manufacturers. Once free of the size and weight requirements imposed by the yokes and tubes, manufacturers were free to use larger (and, in some cases, less costly) prisms. The optical qualities of the newer prisms may not always match well with the glass used in the lenses.

The prism is the site of other potential troubles. Manufacturers use various means to align the CCDs on the prism faces and to affix them there. Any error in this step will show up as decreased camera performance. The process of matching the prism to the lens, then affixing the CCDs to the prism, is so critical that some lens manufacturers have wistfully considered doing it themselves and supplying the entire optical and pickup portions of a camera as one assembly.

Smart lenses

The computer has found its way into the lens. A paper presented by Bernard Angenieux and Gerard Corbasson (Angenieux Corporation of America) at this year's NAB convention described a new zoom lens that uses a microprocessor to precisely position internal lens elements. This added control does away with a longtime bugbear of zoom lenses—the dead zone in front of the camera that is too close to focus on. The paper stated that the zone can be as long as 10 feet. (See Figure 2.)

By manipulating internal elements that traditionally have remained fixed, the authors say, the new series of lenses can focus literally as close as the lens glass face. Microprocessors are required because the movements may be subtle, sometimes in the range of microns. A proposed application for such a computer-equipped lens would be sporting event remotes. A high camera in the press box could cover the action with a big zoom, then swing over for head shots of the talent.

Another use for lens computers is to control the shutters used in slow-motion options for certain lenses. A shutter, located in the lens, blocks the light flowing into the image sensors in the camera. For about 1/250th of a second during each frame, the shutter is opened, allowing light to fall on the pickup faces. The microprocessor maintains synchronization of the shutter with the camera's scan rate. This shutter effectively stops the motion in scenes with rapid action. As a result, still frames viewed on a recorder exhibit much less blur than normal pictures.

The drawback to shutter systems is that they allow less light into the lens. This means that the iris must be opened wider, resulting in a narrower depth of field. They also may work better out of doors in sunlight than indoors under artificial lights.

Hot new CCDs

New image sensors are being introduced that extend the use of CCD devices into the field of HDTV, an area previously served solely by camera tubes. The new devices provide high-definition and improved sensitivity.

The CCD has challenged the tube as the pickup medium of choice in ENG/EFP applications. At this year's NAB show, CCD cameras were introduced into the studio camera market as well. These new cameras capitalize on the CCD's small size, low weight, miserly power requirements and outstanding performance characteristics.

One domain in which CCDs have not yet made inroads is high-definition television (HDTV), where CCD performance still is overshadowed by tubes. Now a Japanese company (Toshiba) has announced the development of a CCD it says is capable of the performance levels required for HDTV.

A CCD image sensor converts light into electrical signals. Each device is composed of arrays of tiny cells called *pixels*. When light is focused through the lens onto the array, each pixel generates an electrical charge proportional to the intensity of the light. Today, CCD image sensors used in video cameras have approximately 400,000 pixels (maximum). A camera employing this type of CCD achieves extremely good resolution and can be used for many video applications.

HDTV cameras, however, will require CCD image sensors with as many as two million pixels. With HDTV broadcasting scheduled to start in 1990 in Japan, many manufacturers already have developed HDTV cameras. These cameras use pickup tubes, however, because two-million-pixel CCD image sensors do not yet exist.

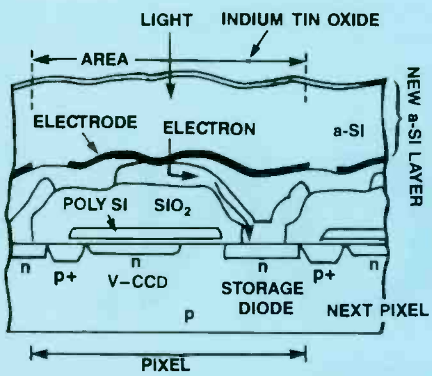
The problem in producing CCD image sensors with such a large number of picture elements is the maintenance of characteristics such as sensitivity and dynamic range. In proportion to the increase in the number of pixels, the size of each pixel is reduced, hence the area that accepts light to be converted into electrical signals. This decreases sensitivity. It is impossible to produce a two-million-pixel CCD image sensor with good characteristics using the conventional method for fabricating CCD image sensors.

Solving the problem

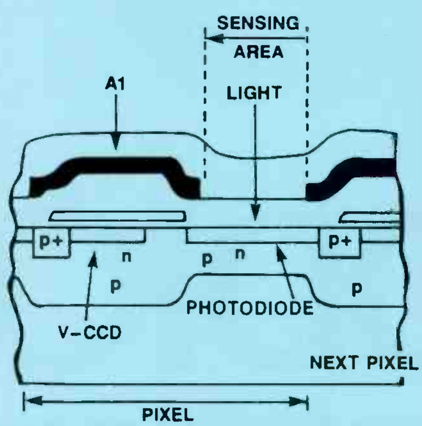
Toshiba's method of solving this problem was to overlay a new, additional layer on a conventional CCD structure. This new layer is made of amorphous silicon (a-Si), which acts as an extra sensing area. In this way, the aperture ratio (percentage of the sensing area that occupies the surface of each pixel) is 100%. Sensitivity is increased to 210nA (nanoamperes) per lux, which is four to five times higher than that of conventional CCDs.

The two million pixels are formed on a 16.2mm × 10.5mm chip by using a 1m microlithographic technology, a design rule even finer than that used for a 1Mb DRAM (dynamic random access memory).

Acknowledgment: This article was adapted from "The 2 Million-Pixel CCD Image Sensor," which appeared in the July 1988 issue of *Electronic Servicing & Technology*.



Conventional CCD image sensors contain approximately 400,000 pixels. Although that pixel count gives a high enough resolution for the 525-/625-line video formats, an HDTV CCD requires two million pixels.



A two-million-pixel CCD image sensor usually would have a decreased sensitivity or dynamic range because, if the pixel count were increased, the pixels would have to be smaller. An additional layer of amorphous silicon acts as a sensing area and converts optical information to electrical signals. The result is an aperture ratio of 100%.

Lens/camera communication

Lens computers also can be used for lens/camera communication. Sensors in the lens track the iris status, zoom length and other information and send it to the camera head. There, it can be used for operator feedback in the form of viewfinder displays that tell what the lens is doing.

Advanced tube cameras also can make use of this information to dial in corrections from a lens file. The lens tells the camera what zoom and focal lengths are set, and the camera then examines a file to determine if any known distortions exist at that combination of parameters. Correction data then can be entered automatically into the picture. HDTV systems in particular make use of this information to dynamically correct the camera for each lens focal length.

Smaller and lighter

Great reductions in lens weight have been achieved recently (notably by Nikon with their TV Nikkor series ENG/EFP lenses). The lighter weight is the result of three modifications. First, elements of the lens barrel and servo section were manufactured out of a magnesium alloy. The lenses themselves were reshaped to reduce their weight and were made out of a lighter glass that, according to the manufacturer, also has superior optical properties. The third modification was the integration of the extender and the servo section into one assembly.

Further reductions in size and weight are forthcoming. One area of research involves changing the shape of the metal pieces in a lens so that their structure actually contributes to their strength, similar to the way corrugation strengthens cardboard boxes. Milling and processing difficulties must be overcome before this approach can be adopted.

Another tack would be to replace the metal portions with other materials, such as graphite composites. A recent development by one manufacturer does away with the lens barrel as a separate piece of the assembly. Instead, the lens is supported, and the barrel is cast around it, captivating the lens and eliminating the need for internal spacers.

Research continues into the use of plastic lenses. However, today's manufacturing technologies do not yet allow production of a plastic lens of equal quality to glass.

A sense of balance

The technologies exist to further reduce the size and weight of lenses, but they must be paced to the speed with which cameras shrink. The lens and camera must maintain some sort of balance. Undoubtedly, advances in one technology will propel advances in the other.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Weather radar systems

By Raymond L. Durand

Radar compositing now makes the big picture even better.

Radar has been used to detect precipitation since the early 1950s, when radar equipment that had been developed during World War II became commercially available. Radars now supply valuable real-time weather information to a wide spectrum of government and private users. Moreover, they are no longer considered exotic and expensive meteorological tools—thanks to the National Weather Service (NWS), technological advances and competition among radar-display equipment manufacturers.

The NWS operates a U.S. network of 128 weather radars (see Figure 1). Since the late 1970s, they have allowed organizations with compatible display equipment to directly access radar data via conventional telephone lines. This availability has reduced costs drastically, making weather radar systems practical and affordable.

A recent development in this "dial-up" weather radar market is the composite weather radar display, which takes advantage of the overlapping coverage provided by the 128 NWS weather radars, combining their data to produce a composite image that is superior to current single-radar images. This article describes the practical limitations of weather radar systems and addresses the technical issues associated with using multiple radars to form a composite image.

Durand is manager of commercial operations for Technology Service Corporation, Santa Monica, CA.

Weather radar shortcomings

To assess the improvements offered by the composite image, it is first necessary to understand the shortcomings of conventional weather radars and how these shortcomings affect weather radar displays. Three major problems are:

- the attenuation and penetration limitations associated with storm activity.
- the range limitations caused by the earth's curvature.
- the effects of ground clutter.

To detect storm activity, the NWS weather radars broadcast a burst of electrical energy that is focused by the transmitting antenna into a 1° to 2° beam. This burst has been tuned to achieve the maximum detection possible while also providing the energy needed to penetrate and see through the intervening layers of precipitation commonly found in storm activity. However, the farther the energy travels, the more it is subject to absorption, scattering and other attenuation effects that limit a radar's ability to provide full detail of a large area.

The small, low-power marine and aviation radars operating at X-band (8,500MHz-10,680MHz) are particularly sensitive to attenuation. The powerful NWS 250kW to 500kW C-band (5,250MHz-5,925MHz) and S-band (2,300MHz-2,500MHz and 2,700MHz-3,700MHz) radars offer significantly better performance, but even these do not eliminate the need to consider attenuation for interpretation of displays.

The second shortcoming of conventional weather radars is that the earth's curvature limits the distance over which they can provide meaningful data. As the radar beam projects outward from the transmitting antenna, it travels essentially in a straight line. (Refraction effects cause it to curve slightly downward.) Consequently, the farther the beam travels, the greater its distance above the earth. This increasing altitude is a problem because precipitation tends to stay at elevations below 12,000 to 15,000 feet, and cloud tops rarely exceed 50,000 feet.

Table 1 shows radar beam altitude as a function of range and antenna elevation angle. As can be seen, the earth's curvature limits the radar's ability to detect normal precipitation activity to approximately 100nmi (nautical miles) to 125nmi, which is in contrast to the 200nmi to 240nmi display presentations commonly used.

The third shortcoming is the radar's inability to differentiate ground clutter from weather data. Weather radars are tuned

Figure 1. Since the late 1970s, the National Weather Service has allowed direct access by telephone lines to all 128 of its weather radars.

specifically to detect precipitation, but they also pick up echoes from the ground, mountains, buildings and other objects in the environment. These unwanted echoes show up as an annoying pattern on the radar display, often reducing the display's usefulness, particularly for areas near the radar site. The only way to solve this problem for dial-up weather radar displays is to blank out all data at the display's center, the area typically containing the most ground clutter. Unfortunately, this eliminates valid weather echoes as well.

Composite image

A weather radar image capability now available is based on the use of data from multiple radar sites that, together, provide overlapping coverage for a geographic area. The overlap is the key to this concept because it offers a way to minimize the shortcomings of conventional radar.

The storm-activity penetration problem is lessened when more than one radar is reporting on a given area, contributing to a process that leads to an augmented composite image. Moreover, multiple radars scanning the same area from different locations present reduced attenuation and range limitations. With the right geographic distribution of radar sites, ground clutter can be reduced or eliminated by having the radars fill in the blanked areas of adjacent radars.

The typical 200nmi radius display of a weather radar image covers a geographic area of about 400nmi × 400nmi. Computer analysis reveals that, on the average, nine radar sites surround the central site within each area, all of which can contribute information to the display. Table 2 lists the number of radars within each NWS radar's view (its 400nmi × 400nmi area).

Technical issues

Two principal technical issues must be addressed for the generation of an image that uses data from multiple radars: how to treat overlapping areas that contain conflicting levels of precipitation, and how to accurately position each radar on the composite image.

Conflicting precipitation levels in overlapping areas are resolved simply by using the highest of the conflicting levels. The resulting display then presents the peak precipitation levels seen by a combination of radars, doing so in the same 6-level format used for individual radar displays.

Accurate positioning of each radar return on the display is, however, a more difficult task, requiring more than just horizontal and vertical alignment. To ensure that the weather returns are positioned correctly and that they register with a common map background, complex geometric calculations must be made to account for the earth's curvature. A weather radar scans a 360° 2-dimensional area above the earth's sphere. From the radar's perspective at the center of the display, the earth's imaginary latitude and longitude lines are curved, not straight. That is why geographic boundaries aligned to latitude or longitude often appear curved on weather maps.

All NWS radars are aligned to true north—that is, each site is oriented so that resulting weather radar displays are presented with true north directly at the top. To correctly combine radar data from multiple locations on a common map, azimuth rotation corrections must be made to compensate for each radar's alignment to true north. Fortunately, data that comes through NWS's Remote Radar Weather Distribution System is transmitted in a radial format, which means it can be rotated easily to correct for the alignment

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problem. (This correction is significantly more difficult for older dial-up systems that use a raster-scan transmission format.)

Sample composite image

Figure 2 shows a composite weather radar image made with data from three NWS radars. This image, generated on Oct. 27, 1987, is centered at Patuxent River, MD. The three radars used to make the composite image are situated at Patuxent River, Atlantic City, NJ, and Cape Hatteras, NC. The individual images for these radars, which were processed in parallel with the composite image, are shown in Figures 3, 4 and 5, respectively.

As shown in the composite image, precipitation was detected along the entire coastal area. This large detection area is made up of the individual contributions from the three radars.

Comparison of this coastal area in the images shows how compositing alleviates the penetration, attenuation and range limitations of weather radars. Take, for example, the precipitation activity off the coast near the Virginia-North Carolina border. As can be seen in Figure 3, the Patuxent River radar detected only minimal activity past this border, so its image shows isolated level 1 and level 2 precipitation in this area. It was left to the closer, Cape Hatteras radar (see Figure 5) to detect that this area held larger precipitation areas

ALTITUDE (FEET) RANGE (nml)	AT 0° ELEVATION	AT 0.5° ELEVATION	AT 1.0° ELEVATION
20	265	1,325	2,385
50	1,654	4,305	6,955
100	6,615	11,916	17,215
125	10,336	16,960	23,583
150	14,882	22,830	30,776
200	26,452	37,044	47,632
240	38,082	50,788	63,486

Table 1. Radar beam altitude vs. range and elevation angle.

NWS RADAR LOCATION	RADARS IN VIEW	NWS RADAR LOCATION	RADARS IN VIEW	NWS RADAR LOCATION	RADARS IN VIEW
Abilene, TX	10	Fargo, ND	6	New York City, NY	9
Akron, OH	12	Fort Smith, AR	8	Norfolk, NE	11
Albany, NY	9	Fort Wayne, IN	15	North Platte, NE	11
Alliance, NE	6	Galveston, TX	9	Oklahoma City, OK	11
Alpena, MI	6	Garden City, KS	9	Omaha, NE	11
Amarillo, TX	7	Grand Island, NE	11	Paducah, KY	12
Apalachicola, FL	10	Goodland, KS	8	Patuxent River, MD	7
Athens, GA	14	Harrisburg, PA	11	Pensacola, FL	11
Atlanta, GA	15	Hartford, CT	8	Phoenix, AZ	2
Atlantic City, NJ	7	Hondo, TX	8	Pittsburg, PA	12
Augusta, GA	11	Houghton Lake, MI	9	Portland, ME	6
Austin, TX	10	Huntsville, AL	13	Portland, OR	0
Baton Rouge, LA	10	Huron, SD	6	Raleigh, NC	11
Beckley, WV	12	Indianapolis, IN	14	Rapid City, SD	4
Billings, MT	1	Jackson, KY	13	Rochester, MN	11
Binghamton, NY	10	Jackson, MS	13	Sacramento, CA	0
Bismark, ND	5	Kansas City, MO	13	San Angelo, TX	9
Bristol, TN	13	Key West, FL	3	San Juan, PR	0
Brownsville, TX	2	Lake Charles, LA	7	Savannah, GA	12
Buffalo, NY	7	Las Vegas, NV	2	Shreveport, LA	11
Burlington, VT	6	Limon, CO	5	Sioux Falls, SD	12
Cape Hatteras, NC	4	Little Rock, AR	10	Slidell, LA	8
Centreville, AL	15	Longview, TX	11	South Bend, IN	14
Charleston, SC	9	Los Angeles, CA	1	Springfield, IL	13
Charleston, WV	13	Louisville, KY	15	Stephenville, TX	13
Charlotte, NC	14	Lubbock, TX	6	St. Louis, MO	12
Chatham, MA	6	Macon, GA	14	Tampa, FL	5
Chattanooga, TN	17	Madison, WI	12	Topeka, KS	10
Cheyenne, WY	6	Marquette, MI	5	Tucson, AZ	1
Cincinnati, OH	17	Marseilles, IL	16	Tupelo, MS	10
Cleveland, OH	13	Memphis, TN	12	Tulsa, OK	10
Columbia, MO	11	Meridian, MS	13	Victoria, TX	8
Columbia, SC	13	Miami, FL	3	Volens, VA	11
Columbus, GA	16	Midland, TX	6	Waco, TX	10
Columbus, OH	16	Minneapolis, MN	8	Waterloo, IA	11
Concordia, KS	12	Missoula, MT	0	Waycross, GA	10
Corpus Christi, TX	5	Mobile, AL	10	West Palm Beach, FL	4
Daytona Beach, FL	4	Moline, IL	13	Wichita, KS	10
Des Moines, IA	15	Monett, MO	12	Wichita Falls, TX	10
Detroit, MI	12	Montgomery, AL	14	Williston, ND	1
Duluth, MN	6	Muskegon, MI	12	Wilmington, NC	7
Erie, PA	10	Nashville, TN	12	Worcester, MA	8
Evansville, IN	11	Neenah, WI	12		

Table 2. Number of radars in view of each NWS radar.

Local echoes

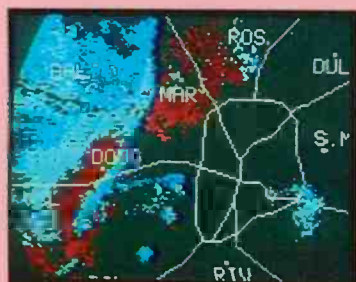
By Rick Lehtinen,
TV technical editor

In addition to the National Weather Service radars, local radars are available for purchase. These radars range from marine radars, which are sometimes fitted with video outputs, to extremely sophisticated, high-powered Doppler systems. The price rises in proportion to power and performance.

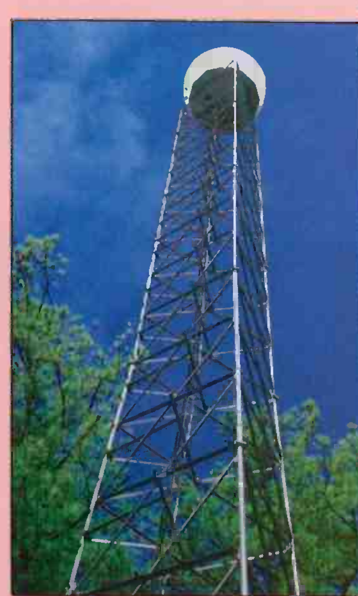
Local radars offer several advantages over the national, governmentally supplied signals, the biggest probably being the benefit of control. Stated simply, the NWS radar is not yours to play with. You monitor it, but you don't point it, and if the government meteorologist on duty feels like checking cloud tops when you want a picture of an approaching storm, that's too bad. The station desiring up-to-the-minute pictures for weather-related cut-ins may have to pay the price for its own equipment.

A local radar also can display weather phenomena overlaid on specially tailored local maps, whereas the NWS system may serve such a large area that specialization isn't feasible. Another advantage is that local radars, in some cases, may be more accurate than the NWS systems, especially in areas extremely close to or far away from the NWS transmitter.

A conventional intensity display of a rainstorm over Atlanta shows different strengths with different colors. Here, green plots light rain, yellow is moderate and orange is somewhat heavy. Colors are programmed locally. Typically, six colors represent all rainfall intensities.



A typical Doppler velocity display. Winds blowing away from radar are red, with darker shades indicating strongest winds. Winds coming toward radar are blue, with lighter shades denoting strongest winds.



Photos courtesy of WAGA-TV, Atlanta

A station radar on self-supporting tower provides radar coverage for WAGA-TV, Atlanta.

Conventional and Doppler

Weather radar systems come in two forms: conventional and Doppler. A conventional system emits a radar pulse, then times its echo. Echoes from distant targets take longer to return than those from nearby ones. A fuzzy target, such as drizzle, returns a weaker echo than drenching rain. The time and strength of the echo is plotted to create a weather image. Enhancements at the receiver may color-code the returns to aid in their identification. This kind of conventional display is sometimes called an intensity display, referring to the intensity of precipitation plotted.

Doppler radars can detect the speed and direction of the winds they encounter. They do this by thoroughly analyzing echo returns, looking particularly at phase shifts in the returned signal. Conventional radar ignores phase shifts, but Doppler systems compare the phase of the return pulses with the phase of the emitted pulses to extract the phase-shift information. This extra data is then interpreted to derive wind speeds and integrated into the displays.

Interference

What if everybody had a radar? Would the interference be so bad that nobody could see anything? Actually, yes. Radars interfere readily with each other, showing up as strange spirals and lines on the screen. Good engineering practice keeps such problems to a minimum, however. First, both the receiver and the transmitter are filtered. Additional filtering is installed in the transmitter waveguide, as required, to keep spurious radiations under control. Also, a small amount of frequency offset may be allowed at the site to permit a system to ease out of a competitor's way.

Of course, frequency coordination is an important issue in the operation of commercial radars. Most operate in the C-band, from about 5,400MHz to 5,600MHz. A few operate in the X-band, at about 10,000MHz, but these generally are low-power radars. With proper care, a large number of radars can be accommodated in an area.

Licensing

The procedure for licensing a radar installation is much simpler than some licensing procedures familiar to broadcasters. At this time, from the customer's point of view, it is essentially a matter of completing paperwork dealing with questions about the site, as well as technical specifications of the unit, which can be obtained from the manufacturer. Of course, frequency considerations are thoroughly researched as part of the license procedure.

containing level 3 and level 4 activity.

The Atlantic City radar (see Figure 4) detected the outer fringe of this same localized activity off the Maryland coast; it also penetrated through the fringe to reveal what it saw as a small area of level 1 precipitation. The Patuxent River and Cape Hatteras radars, however, being closer, detected that this small level 1 area was actually a large area containing level 2, 3 and 4 precipitation.

Two other examples of compositing clearly show how it can eliminate range limitations. The Patuxent River radar did not detect precipitation in Pennsylvania and northern New Jersey, or to the south in North Carolina. The Cape Hatteras radar missed the precipitation north of Richmond, VA. These individual range limitations were overcome by use of the composite image capability.

The ability to reduce clutter also is evident in the composite image. The blanking value used for this image was 20nmi for all three radars. Notice how the precipitation detected by the Patuxent River radar almost completely fills in the area surrounding the Atlantic City radar.

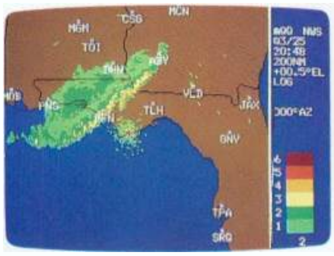
Significantly better displays

Composite weather radar displays are significantly better than conventional sin-

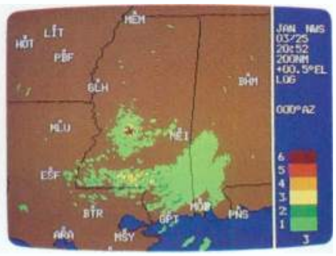
Continued on page 42

Four Radars

Pensacola, FL

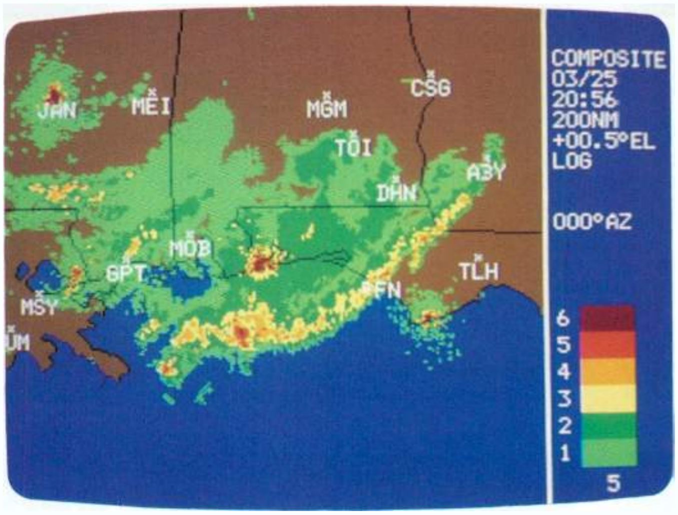


Apalachicola, FL



Jackson, MS

New Orleans, LA



Individual radar displays can only show you part of the picture. This composited image, centered in Pensacola, FL, combines echoes from four different radar sites and shows the true magnitude of the storm.

In One

When the real weather story is outside the range of conventional radar, you need Alden's new radar compositing feature.

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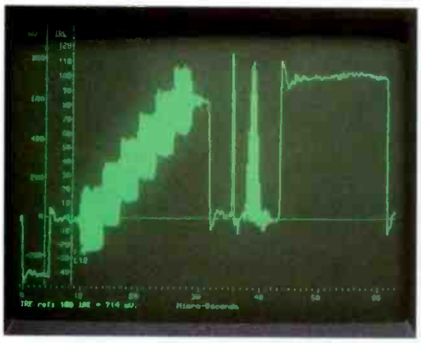
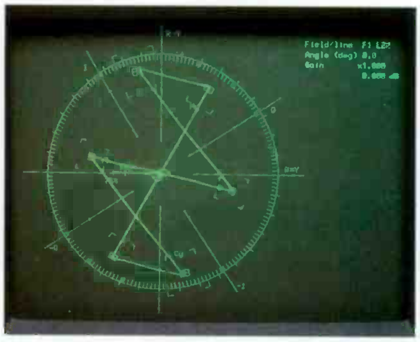
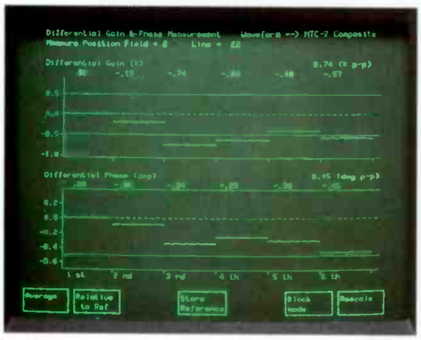
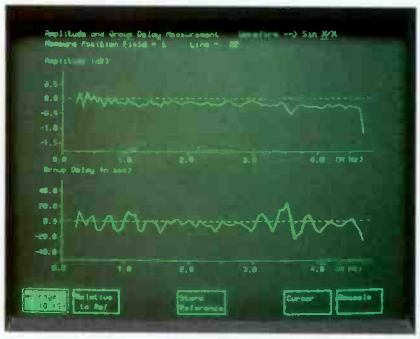
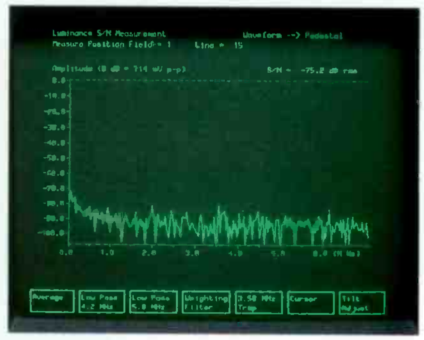


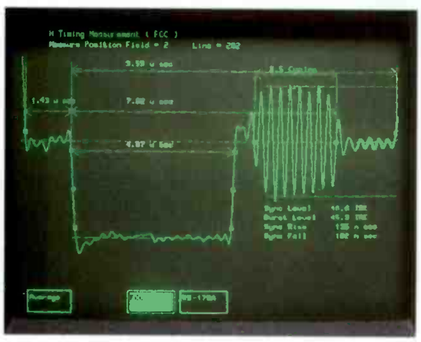


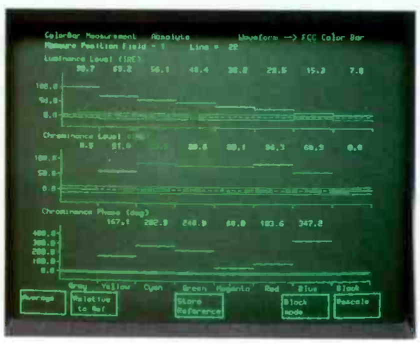
Video courtesy of KOIN-TV, Portland, OR.

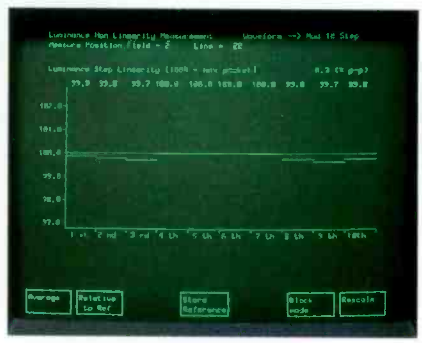


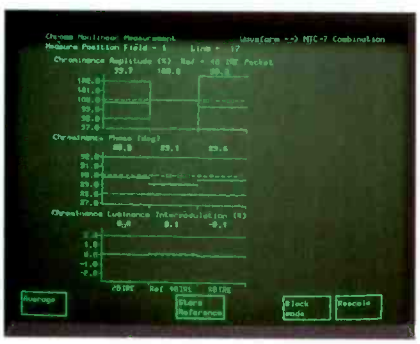


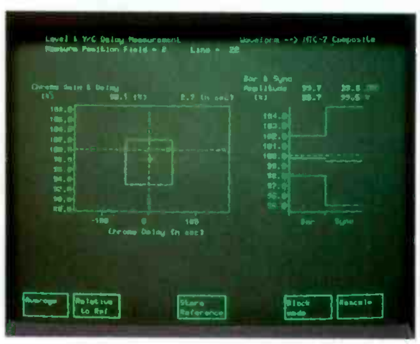


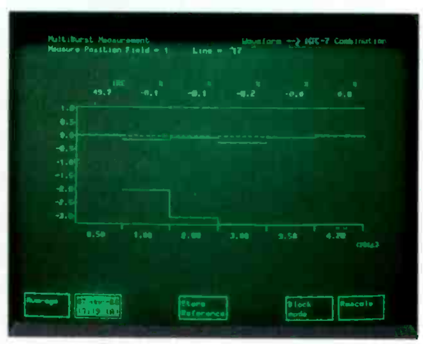












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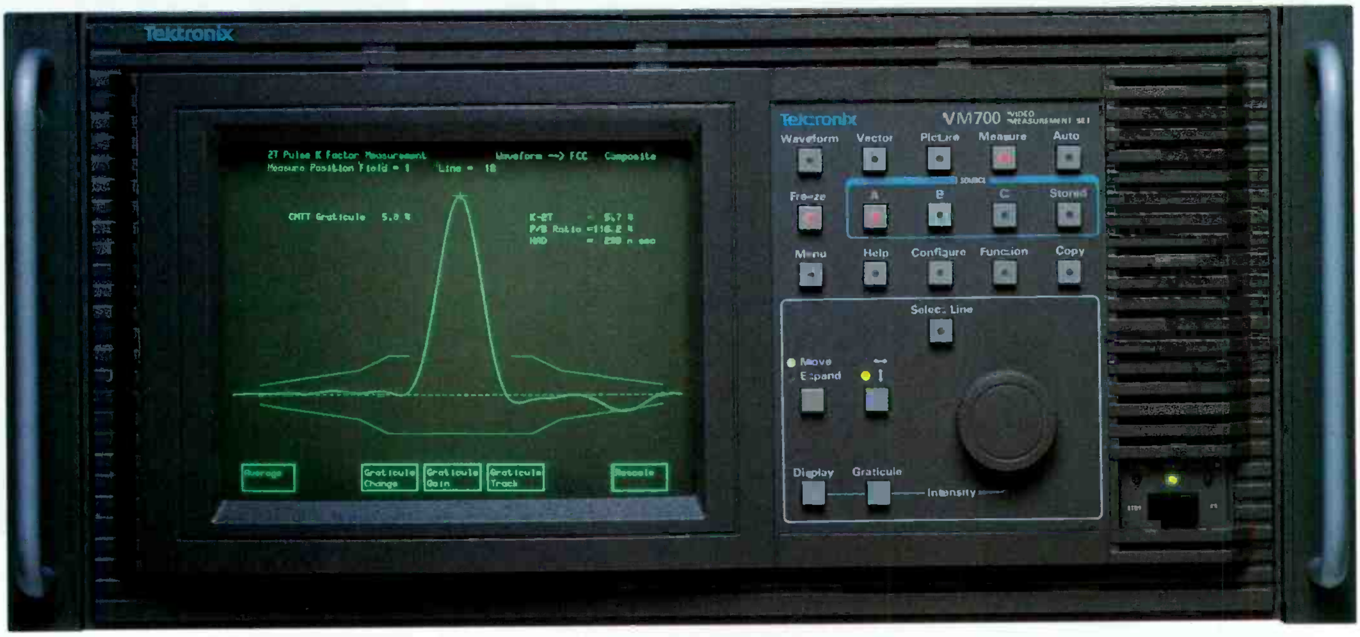

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LPATS: striking displays for thundershowers

By Rick Lehtinen, TV technical editor

As useful as radar can be, it does have some limitations. For instance, the "hook" radar signature associated with certain severe weather systems often indicates formation of a tornado. On the other hand, it might not. A 75-mile storm front may be displayed on radar, but truly violent activity may be taking place in only a small portion of it. Also, geography plays a role in radar effectiveness. Radar may be of more benefit in the flat plains of western Kansas than in the slopes and valleys of the Rocky Mountains.

A far more dangerous weather threat than either a tornado or hurricane is a thunderstorm. Although a well-placed tornado could cause incredible damage and loss of life, year in and year out, lightning kills far more. Several systems can detect the presence of lightning.

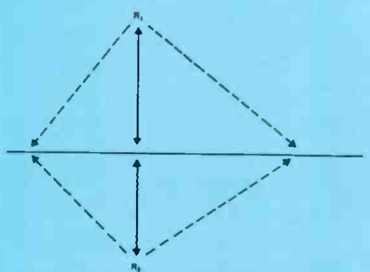
Lightning Position and Tracking System (LPATS) is a unique network that allows a real-time look at the position of cloud-to-ground (CG) lightning strikes for a designated area of the country. A commercial LPAT network in the United States, which provides a service available to broadcasters, is the National Lightning Detection Network (NLDN), operated by R-SCAN, Minneapolis. The system is fast, recording and displaying the strike and several of its characteristics, such as polarity and estimated amplitude, in less than 1s. It also is accurate, pinpointing strike locations in the center of each network to areas the size of a couple of football fields. Strikes on the network's periphery are detected to within a mile or two, up to a range of about 600 miles.

How it works

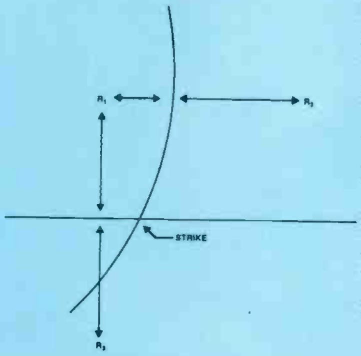
The NLDN LPAT system uses the *time of arrival* (TOA) method of calculating lightning position. The NLDN network consists of several regional networks located strategically across the United States. Each regional network contains six or more remote receivers. Each of the remote receive sites has an omnidirectional radio antenna connected to an AM receiver with a broadband front end, operating in the region of 200kHz to 500kHz, just below the AM band. (Cloud-to-ground strikes generate a lot of RF over a wide frequency band. RF in the 200kHz-500kHz range propagates nicely as a groundwave, hence its use for the network.)

All the remote receivers in a regional network connect to a central analyzer (CA) via a dedicated phone line. The system incorporates LORAN (a long-range radio navigation system used extensively for aviation and maritime purposes) as a time reference to pin down the location of each strike. At the remote sites, the LORAN signal is mixed with the output of the receiver. The combined signal is sent to the central analyzer from each of the remotes. After compensating for telephone delays, the CA compares when the radio waves from a given strike are received at each of the sites and uses this information to calculate the strike's location. The difference in the radio waves' time of arrival at each receive point is proportional to the distances between the strike and the receivers. Measurements taken between two receivers can place the strike anywhere on a hyperbola. Measurements taken between either receiver and a third create a second hyperbola. Where the hyperbolas intersect, the bolt occurred. Additional hyperbolas between other receivers further increase the accuracy.

Strike data from each central analyzer is made available to network subscribers. It also is sent via data-multiplexed phone lines to the NOWCAST Center, the network's hub in Minneapolis. From there, it is distributed to a number of end-users, such as broadcasters, researchers and weather-wire operators who make it available to their subscribers.



The possible location of a lightning strike is along a hyperbola, determined from the difference in the time of arrival of lightning-generated RF signals at receive stations R_1 and R_2.



A more accurate location of the strike is the intersection of the hyperbola between R_1 and R_2 and a second is determined from a third receive station, R_3, and either of the other two. More receive locations increase accuracy.

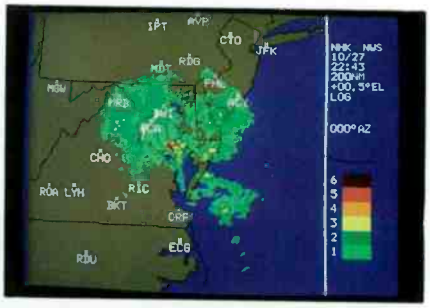


Figure 2. *Patuxent River, Atlantic City, Cape Hatteras composite, formed by electronically combining the images of all three radars.*

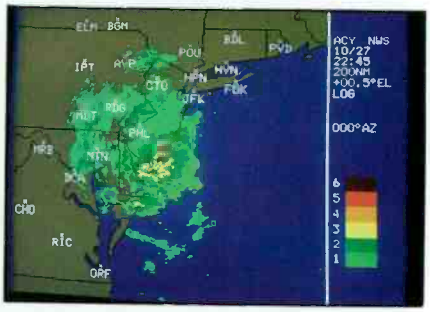


Figure 3. *Patuxent River radar image.*

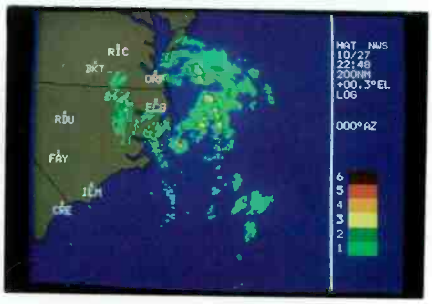


Figure 4. *Atlantic City radar image.*

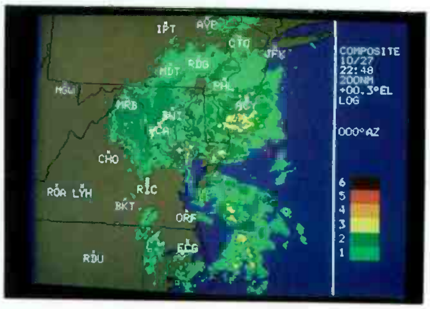


Figure 5. *Cape Hatteras radar image.*

Continued from page 38

gle-radar displays because their use of data from multiple, nearby radars solves many of the inherent physical limitations of weather radars. Moreover, the accessibility of the NWS network of radars and the availability of low-cost display equipment make composite displays feasible.

Newsroom automation

By Rick Lehtinen, TV technical editor

"Second-generation" newsroom computers are set to hook up and take charge.

Once they were just overgrown word processors. Today, however, newsroom computers are poised to become the hub of not only news generation, but also news production. The reason? Connectivity. Today's newsroom systems don't stop at scripts. They are developing hardware liaisons with other newsroom and production equipment. They soon will be able to take charge of a myriad of production tasks. (See Figure 1.)

Among the possible peripherals for newsroom computers are:

- teleprompters.
- captioning.
- character generators.
- cart machines.
- still-stores.
- switchers.
- camera automation systems.

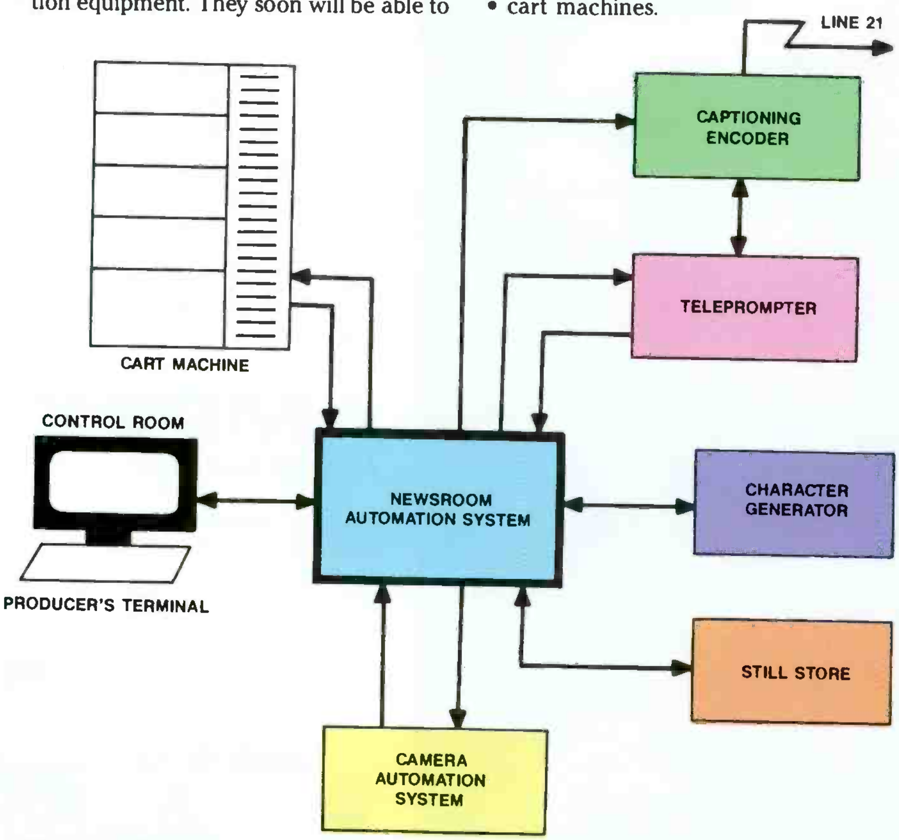


Figure 1. Advanced newsroom computer systems will control several pieces of production equipment, making it possible to upgrade production value while decreasing production cost.

Teleprompters

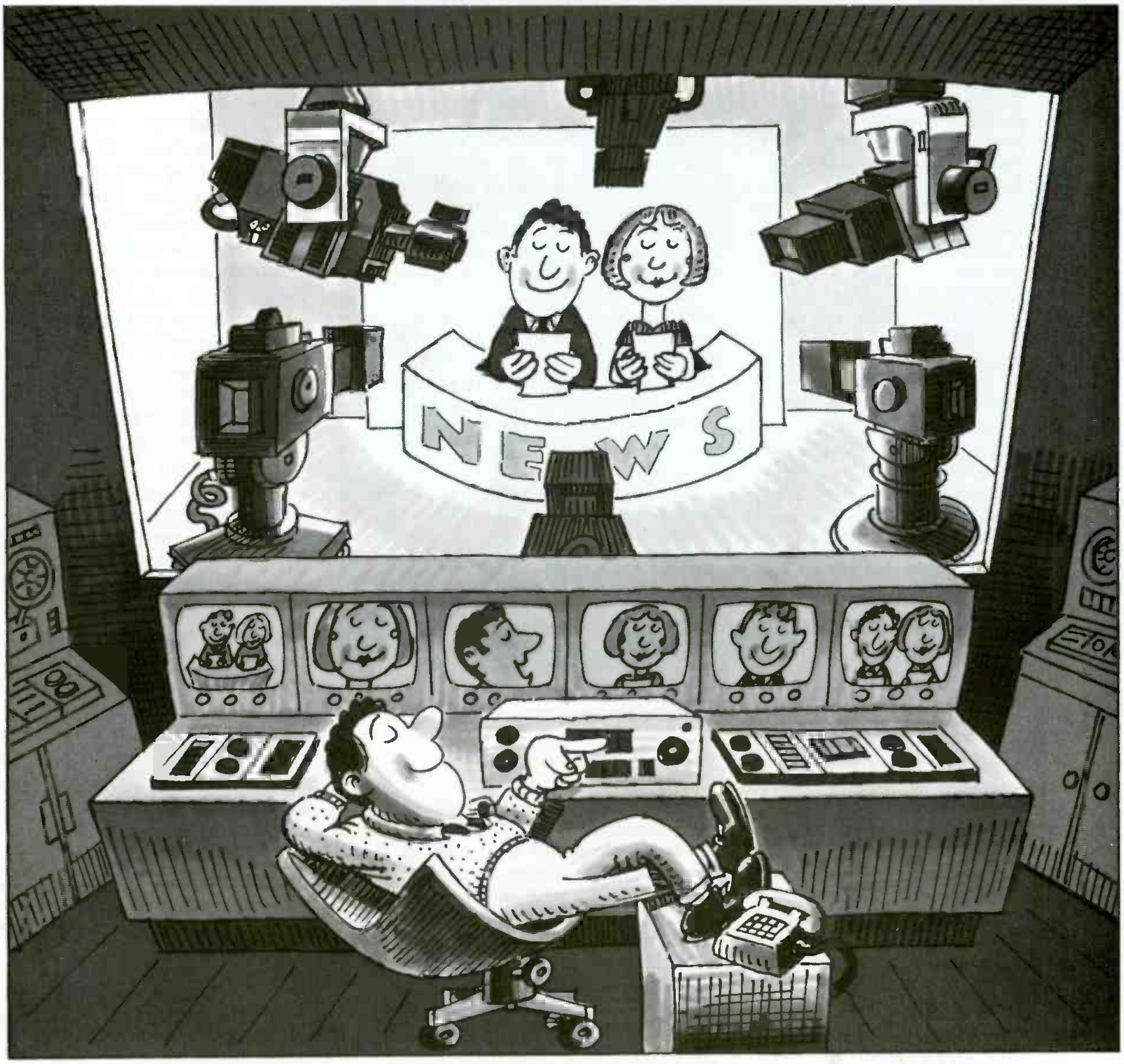
At one time, preparing the teleprompter feed-ready required last-minute retyping of the scripts, followed by furious "tape-and-tear" assembly sessions to feed items into the prompter camera in the right order. Early newsroom computers changed that to some extent. The last-minute manuscript mash-out was replaced by a few grunts from a high-speed line printer. But the tape-and-tear frustration remained.

Today's newsroom computers can feed teleprompters directly, electronically passing the script information to the prompter monitor without the intervening steps of paper and camera. The result is greatly increased flexibility. If the order of the rundown must change, the prompter file is updated electronically. No more frantic paper shuffle.

A good computer prompter system must overcome several challenges, not the least of which is achieving a good-quality monitor output. Talent must be able to see the script clearly in a variety of lighting conditions, some of which are not well-suited to reading. This requires bold, clear lettering that has good contrast. The prompter feed should move smoothly, without distorting the letters as they roll up. And the prompter operator requires a responsive control system that allows natural movement of the text to match the instantaneous speed of the reader.

Captioning

One bright side of newsroom automa-



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tion is closed captioning for the hearing impaired (see Figure 2). Stations that have tried captioning seem impressed with the audience reaction. Typically, 6% to 10% of the persons in a given ADI could benefit from a captioning service, each of whom could influence others in the same household to watch the channel.

To seize the market and community service advantages of captioning, some aggressive stations have hired court reporters to operate captioning equipment, or they have formed liaisons with volunteer groups who type in the newscast scripts. This typing is a lot of work, and it can be a tremendous expense. It also may risk increased station liability, because management can't be sure that the typists won't omit words, such as "alleged," important for the legal protection of the station.

In an automated newsroom, however, copy fed to the teleprompter is fed to the caption encoder as well. For little more than the cost of the encoder and driving software (about $10,000), plus some wiring, a station can have the captioning advantage, and management can know that what was captioned is what was written.

Of course, problems still exist with live, unscripted material and with spoken material recorded on videotape. Problems with videotaped material can be overcome by preparing a transcription of the taped material.

Character generators

If a reporter types a subject's difficult last name into the computer from notes, should it ever be necessary to physically type that name again? Shouldn't the computers just pass that name around (allowing the opportunity for an editor or producer to correct it), to prevent another person from misspelling it? This is one of the motivations for developing a newsroom computer/character-generator (CG) interface. Another may be that the large amount of data thrust upon the CG operator in the moments before the newscast, or the confusion caused by sudden changes in the rundown, increases the possibility of omissions and errors.

The strongest incentive, however, may be the potential to keep up with rapidly changing data such as up-to-the-minute sports scores and election returns, which, logically, should be updated directly from the wire services instead of being keyed in feverishly in the midst of production.

Two philosophies exist for handling the CG interface. One is to emulate a CG keyboard, and let the newsroom computer "type" in the commands necessary to create and store the super. The other is to electronically pass the information to the CG, where it is stored in a file location that fills in a predefined page format,

On the road again

As remote operations increase, so does the potential for electronic intrusion into a newsroom system. Imagine what would happen if one station could simply steal another station's rundown. There also is a growing danger of infestation in the computer world. An electronic "virus" or "germ" implanted in a newsroom system could cause no end of grief. It is vitally important that only authorized terminals connect into a newsroom system.

Remote operations require the distant terminal to log onto the newsroom system through an external connection, typically, a modem. The presence of a modem opens the door for anyone to make a similar attempt at logging on. Security measures guard against this. A terminal may log on only after proper identification, and access may be limited to only certain files. However, security systems can be defeated, and intrusion is something with which a system manager should rightfully be concerned.

Perhaps a bigger risk than intrusion is the importation of "viruses" or "germs." Computers acquire these contagions when they "visit" other systems, such as public bulletin boards or databases. These insidious programs may be designed to louse up data, say by transposing characters, and may do so on an infrequent basis so as to defy detection. In an accounting environment, this could be dangerous. In a word-processing environment such as a newsroom, however, these germs may pose no more threat than a bad typist.

More insidious bugs, however, modify the control codes that computers use to identify files. This can result in the total obliteration of data. For reporters, this is bad news.

Beefed-up security precautions are likely to become a sales point in the newsroom computer field. Already some manufacturers are claiming that systems proprietary hardware may be less vulnerable to electronic intrusion than those using readily available standard computer equipment.

The PC connection: election night automation

The amount of election night data that arrives at a station from news or election wire services is too great to sort, collate and enter into the character generator for display in anything close to real time. To address this problem, many stations have acquired election return computer systems, either purchasing them from vendors or building their own.

These systems ingest wire information and data entered at local terminals, translate it into a form the CG can use, and feed it out to the character generator. Additionally, a human election interface, called the "producer's screen," is provided to show totals, new leaders in a race and winners. When the equipment is not calling elections, it does a handy job of keeping up with sports scores, such as area high school football and basketball, in which a large number of contest scores change continually.

Wire service data is fed to the computer from a number of sources, including news feeds from governmental vote tabulation centers, news wire feeds such as UPI and AP, and data that is telephoned into the station and typed in manually.

The computer, which is often a PC or clone, sifts out the data it needs and discards the rest. The newly received data is compared with the data already stored. If the new returns are higher, they are written to memory. If an error has somehow crept in, and a total has gotten too high, the system administrator usually can correct it.

The freshly updated data is displayed on the producer's screen. This information is used to decide what races to discuss during the election coverage. In some stations, the producer's screen is networked to other interested parties as well. Some producer's screens mark updated races with a color, and if there is a change in leadership in the race, the corresponding part of the display flashes.

The fresh data also is sent to the character generator, where it writes updated scores into predesigned pages. When the producer calls for various pages to be shown on the air, those pages contain the most recent data available.

Election systems can be used during other parts of the year as well. With different software, a system can serve as an automatic sports score system for the CG. The CG operator can simply call up the correct page, and the numbers presented will be the most recent. Election systems also can be used to display any other rapidly changing data.

Typical producer's screen displays multiple race results. Red color indicates new totals, and flashing red indicates change in leader.

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Robert Lankton, Chief Engineer
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"Their performance and reliability keep us sold."

"We wanted a console flexible enough to use in master control, production and news. We shopped for features and specs, but we also looked for ease-of-use and reliability. We got just what we wanted in our four Auditronics 200s."

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"I insisted on outboard power supplies and no monitor amps in the console for noise reasons. I was impressed with Auditronics' VCA technology, which at the time was not available elsewhere. We wanted the self-contained clock and timer. We needed the switching logic to interface between the A and B inputs, (a neat concept most other consoles don't offer). And we needed a lot of extra line inputs to support our satellite feeds. We needed a first-rate telephone interface. Auditronics beat its competitor hands-down on this. And, of course, modular design was a must for serviceability. We got it all in the Auditronics 200."

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"I found the 200 logically laid out and very easy to train our people to use. The jocks like them and can easily understand them, which is very important to management."

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Figure 2. *With a second-generation newsroom computer system, low-cost, real-time closed captioning can be achieved by routing the computer-generated teleprompter feed to the captioning encoder as well.*

or template. Each approach has its advantages. The newsroom system can either prompt the operator with which page number to call next, or can actually call up the super on a preset channel, and wait for the human to "take" it to air.

News footage a la cart

Another new correspondent with the newsroom computer is the cart machine. Generally speaking, the newsroom/cart machine interface creates, then continually updates, the cart machine's play list. The computer keeps track of which tapes need to be cued and instructs the cart machine to get them ready. If the rundown changes, the required new tapes are written into the play list. If a tape is called for in the script, but is not present in the machine, the producer is warned. When it is time to roll a tape, a human hits the "go" button.

On a different level, if the computer can control a cart machine, can't it control tape machines and a routing switcher output to record news feeds? Systems of this type have been installed in various locations. Controlled by a touch screen or a mouse, the systems take in scheduled feeds, make tapes, generate bar-code labels and output all the information into a database that follows the cart.

In much the same way the computer can play tapes and call up CG pages, it also can call up slides off the still-store. First, the reporter must select a still and write it into the script. This requires a directory for previewing. Some systems interface directly to the still-store. Some will supply a resolution-reduced image on the reporter's terminal. Others will use a PC network in which one computer acts as a file server, holding the master directory. It is thought important to house all the current stills in only one system to avoid scripting the wrong slide because of an outdated directory.

As long as the computer is controlling so many aspects of a news production, couldn't it run the switcher too? Some manufacturers envision a switcher interface that could preset the switcher based on commands embedded in the script. Another approach would be to recall effects previously stored in the switcher's memory.

A camera automation system also could be controlled by the newsroom computer. The camera moves could be preset similar to stills or character-generator pages. There is not yet a standard interface for the camera systems, but in most cases, manufacturers are building their equipment to prepare for the day of integration.

Human involvement

Timing is a major concern in newsroom automation. Because news is a spontaneous business and is conducted live, contingencies occur. Even a cough or stammer eats up its share of time, and that could throw off a computer that is locked to a clock to time a program. The course

Continued on page 108

The winner on points: LDK 90 with Frame Transfer CCDs

Our picture of two hockey players illustrates the benefits of higher resolution: the more pixels (picture elements), the sharper the picture.

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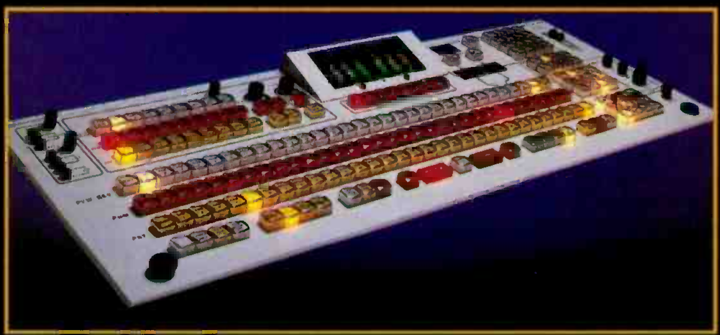

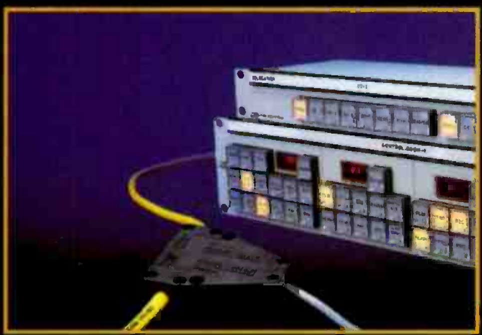

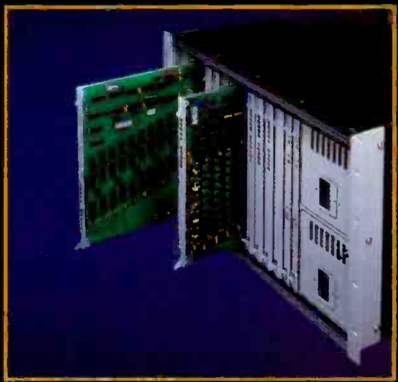

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Stereo TV grows up

By Dennis Ciapura

MTS is alive and well.

Last year, 4,349,000 stereo-equipped (MTS) direct-view televisions were sold in the United States. This year, the Electronic Industries Association (EIA) is forecasting the sale of 5,300,000 stereo TV sets. Stereo-equipped projection televisions probably will account for the sale of at least another 25 million sets per year. The dramatic growth of stereo TV receivers over the past five years is illustrated in Figure 1.

A representative of one receiver manufacturer (Hitachi) estimates that 50% of all 20-inch sets and 75% of 25-inch or larger receivers are MTS-equipped. In addition, the EIA estimates that 20% of all current TV receivers are stereo or stereo-adaptable. Overall, this data suggests that there may be 17,750,000 stereo televisions in the field by the end of the year.

Because MTS is penetrating so rapidly, there is little doubt that mono TV audio soon will become as rare as mono FM radio. Many retailers report a high level of viewer awareness of stereo availability. An informal dealer survey conducted in southern California revealed that more than 75% of prospective TV set buyers were aware of stereo television. After a demo, nearly 50% of those who had not been aware of the feature concluded that stereo is desirable. Viewers know about stereo television, they like it, and they're buying it.

Ciapura, BE's consultant on radio technology, is vice president of technical operations for Noble Broadcast Group and president of TEKNIMAX Telecommunications, a San Diego-based technical management consulting firm.

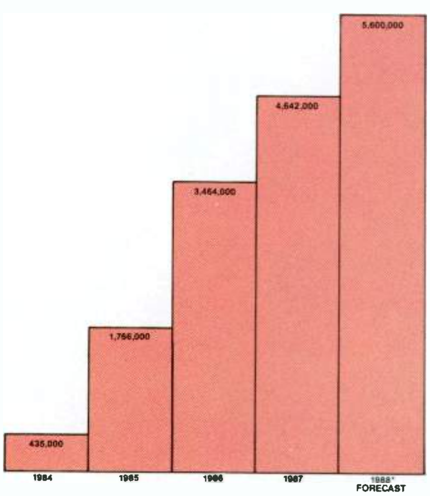


Figure 1. *Annual MTS receiver sales have increased dramatically over the past five years.*

The stereo bandwagon

From a broadcaster's perspective, this news may be a little surprising. After all, only one of the networks has broadcast in stereo audio long enough to generate audience interest. Furthermore, it is difficult to imagine an audio feature selling video products.

The key to the early success of MTS receivers in the marketplace has been the relatively small price differential. In fact, the better-quality TV sets are now almost always stereo-equipped. The additional cost for stereo is insignificant in a high-end product in which the features are what's critically important. A secondary factor is that most video improvement and remote-control features have become so universal, even in inexpensive sets, that product differentiation has become more difficult. In essence, the stereo option helps move the buyer up the scale.

If the consumer side of the equation is compelling, what about broadcast trends? Although broadcasting relies on technology, programming is the product. This tends to make the broadcast industry slow to introduce new technology unless it will have an impact on the marketability of the programming.

There always will be pioneers who launch into new technologies before there is economic justification, as was the case with color. It has been true of MTS.

After airing some experimental stereocasts in 1984, NBC commenced regular stereo programming in July 1985. The network reports that more than 140 of its 207 affiliates have converted to stereo operation. However, Randy Hoffner, NBC senior staff engineer, points out that these stations cover more than 88% of the total TV audience.

CBS introduced stereo last year and reports that about 60 of its 200 affiliates have converted. In March of this year, CBS announced that all its fall programming would be distributed in stereo. ABC, with more than 50 affiliates converted, has revamped its New York facilities to handle stereo and is now well-positioned to increase MTS content.

Increased competition

Independent TV stations in the more competitive markets have responded to the network challenge by converting to MTS and running their own stereo programming. Some of this programming has been quite innovative. The Fox network also is airing stereo programs. Based on MTS generator sales figures, industry sources estimate that a total of nearly 500 MTS stations are in operation.

TV stations in heavily cabled areas face additional competition from the major movie services and MTV, which also offer stereo audio. The widespread use of stereo VCRs and a whole new generation of audio receivers with TV interface features can affect the audience the TV broadcaster is trying to attract.

In "The Real World of Stereo TV," an article in the September 1986 issue of **Broadcast Engineering**, we explored the decision path leading to stereo conversion from a business perspective. We concluded that stereo would ". . . soon become a way of life at TV stations." That has certainly happened in the major mar-

kets, and the conversion cycle will be almost complete in the next two years.

Most stations that have converted to stereo find the ICPM problem easier to live with than originally anticipated. Also, staging the conversion process, as suggested in the article, has provided many stations with a less expensive alternative. In 1986, the issue was *when* to convert. In 1988, it's more a question of *how* to engineer the best stereo sound. MTS has indeed grown up!

Competitive performance

The basic audio reproduction available from the new stereo sets is far better than what was available from the older mono systems, with their minimum-quality 4-inch speakers. For years, the lack of high-quality audio-receiver performance acted as a de facto license for sloppy TV audio. Today, excessive compression and inadequate audio headroom create an irritating sound on wideband receivers. Using an AGC amplifier every 10 feet along the audio path is an inelegant substitute for proper level control.

Many of the cable services are providing excellent audio. The typical squashed-and-clipped broadcast TV audio sound is pale by comparison. Ironically, excessive compression is unnecessary because the audio signal always extends well beyond the video coverage area. It isn't necessary to use high-audio density in TV audio to extend coverage.

Surround sound

Providing optimum MTS quality is a 3-faceted challenge. Obviously, the integrity of the mono signal and the stereo effects must be maintained. In addition, the TV broadcaster must ensure that the transmitted signal is fully compatible with the new feature of *surround sound.*

Except for the brief and abortive quad experiments, radio never had to contend with surround compatibility. The widespread adoption of Dolby stereo with surround for movies has created a new audio vehicle to carry surround sound into the consumer market. Because the surround signal is basically an L−R component matrixed onto the left and right stereo audio, it is automatically present in any tape, disc, cable or broadcast presentation of a movie containing a surround mix.

Surround decoders in video-compatible audio receivers have become popular. In fact, the most sonically exciting application of broadcast stereo television is the presentation of stereo programs with surround. A recent "Amazing Stories" episode on NBC was mixed for surround and was probably the first made-for-TV dramatic production in intentional surround.

Potential problems

Proper surround compatibility can be compromised by poor stereo phasing, differential distortion and the use of stereo synthesizers. Of these, poor stereo phasing is the easiest to remedy. Interchannel audio phase shift is a maintenance problem that also affects the monaural signal through high-frequency cancellation. But out-of-phase speech sibilance, which jumps back to the surround, is particularly irritating. Fortunately, phase-shift problems can be alleviated through the use of automatic phase-correction equipment.

Differential distortion occurs when a center-channel (L=R) signal is not reproduced cleanly and equally in both channels. For example, if a left-channel line amp is clipping slightly, but the right-channel line amp is not, the total distortion on a mono set may go unnoticed. However, the L−R signal generated in this way will be amplified in the surround channel, creating an annoying spitting sound that is especially noticeable in speech.

Use synthesizers with caution

Most stereo synthesizers produce their stereolike effects by generating an L−R signal, which, unfortunately, goes right to the surround output in the most distressing way. The result is a giant echo sound reminiscent of early '60s vintage AM radio. Worse yet, if the synthesizer is operated in an automatic mode, it will switch constantly between mono and stereo in typical TV applications where center-channel (mono), left-only and right-only signals all can occur in the same program.

Many of the synthesizers employ audio delays that actually generate more L−R than is found in real stereo programming. This produces an effect that is immediately apparent in stereo, but still provides compatible mono.

Although it may be attractive from a promotional standpoint to air synthesized stereo in the absence of stereo programming, those viewers with the best equipment will receive a degraded signal. During the transition period, when stations must deal with both monaural and stereo programming, the following compromise criteria should be adopted:

- Remotely control the synthesizer through the switcher so that predominantly stereo sources, such as network feeds and stereo audio carts, are unaffected. This approach prevents the erratic switching phenomena that can occur if a combination of stereo and monaural sources are used.
- When enough stereo programming is available from the network, a simpler practice would be to manually defeat the synthesizer, starting with the evening news to avoid the sonic disruption of local spots airing with synthesized stereo.
- If the degree of L−R generation in the synthesizer is adjustable, select a lower level of difference-signal output. A compromise setting that produces just enough stereo effect to be noticeable on a stereo set without surround certainly will be less objectionable on systems with surround.

Exploiting the MTS advantage

There are many opportunities to produce local stereo audio to supplement what is available from network and syndication sources. Stereo ENG, for example, is easy and fun. Most of the popular field recorders have at least two audio tracks, which make it easy to substitute the usual mono mic with either an X-Y or M-S stereo microphone as a simple stereo source. The differential spatial characteristics of a stereo mic will provide an ambiance that is pleasing in stereo and surround, and the mono will be compatible as long as the user holds the mic properly.

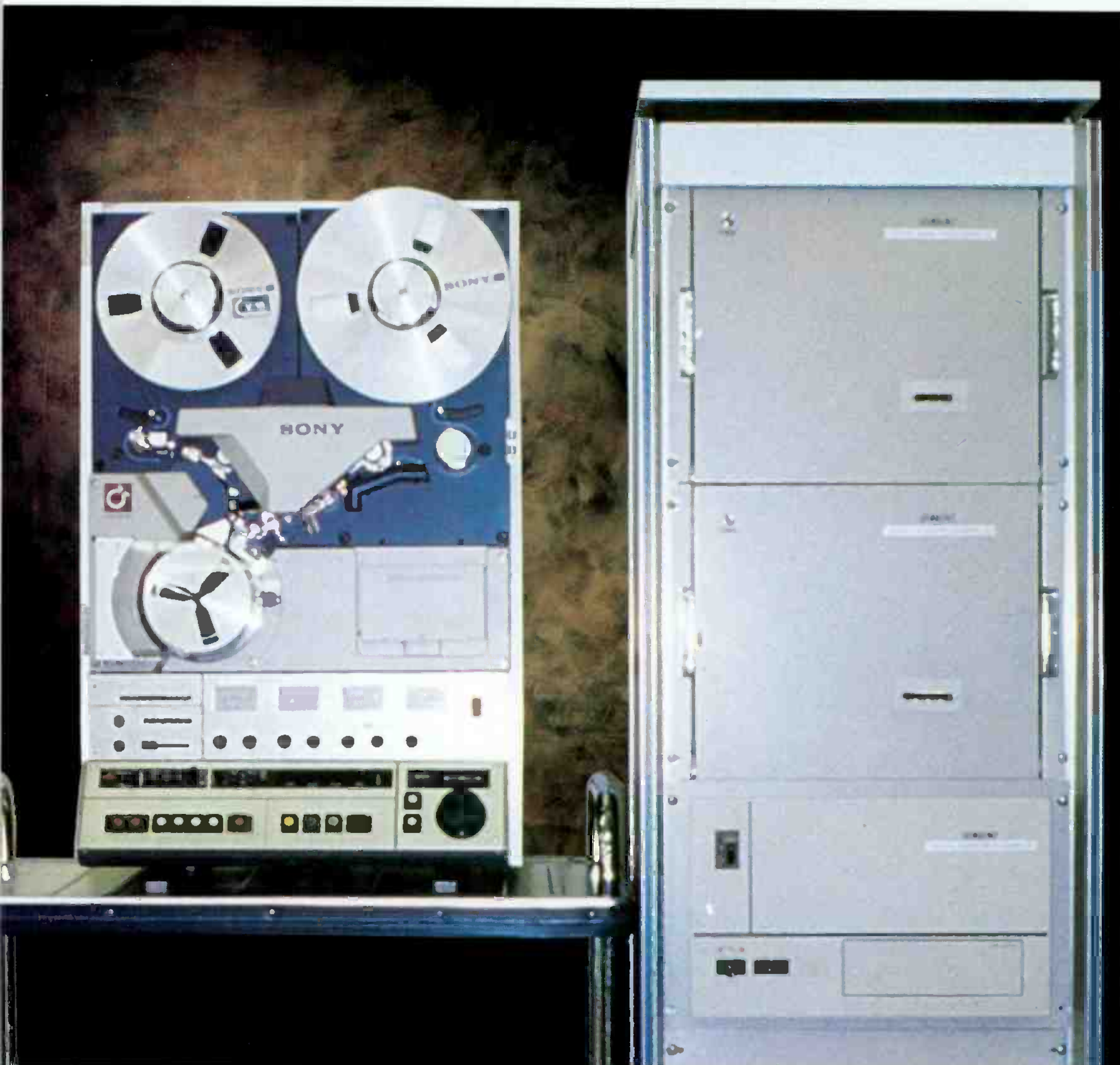
More sophisticated producers may prefer to use a field mixer with a mono voice mic and a separate stereo mic for ambiance. M-S configurations even allow recording in the encoded mode so that the stereo effects can be optimized in post-production. Inexpensive stereo field mixers are available from a variety of manufacturers, so the location task doesn't have to be any more complicated than a mono shoot.

Newscasts also can contain appealing stereo events through the use of a little imagination and some simple pan presets. Tight shots of a single subject would be panned center as usual. Long shots of the whole team would have each individual positioned from left to right as they appear at the news desk. This technique is used frequently in stereo movies and makes for a realistic scene transition.

If the audio console has microphone channel pan pots, multiple mics with the required pan settings can be used to achieve the desired effect while also providing mic redundancy. Stereo theme music also enhances the presentation. With stereo open and closing themes, ENG segments, sports music beds and news desk audio as described previously, there is certainly no need to synthesize your local audio to stereo.

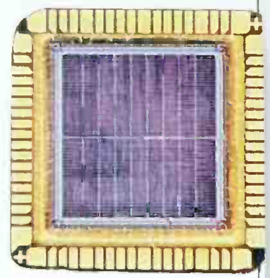
It is obvious that the industry is well into a new phase of MTS implementation. Most of the stations that have converted have found that their existing transmitter plants and antennas work just fine with stereo. Studio accommodations can be as simple or as complex as your station's budget allows. Fortunately, the audio design work is comparatively easy and straightforward.

Regardless of the extent of conversion, stereo audio offers a new competitive tool for those stations with the energy and creativity to use it to their best advantage. The receivers are out there.



■ A landmark achievement...In 1978 a Sony experimental DTTR clearly demonstrated the tremendous advantages of digital video recording.

■ A single Sony VLSI circuit chip can replace several conventional boards of complex digital processing circuitry.



The digital video revolution is taking shape. Gradually and inevitably, the world of video is changing.

Because it is happening step by step, many of you may not be aware of precisely where it stands. So, we've prepared this progress report on the Digital Video Revolution. And, as you'd expect, Sony is leading the way, just as it has with so many other profound shifts in video and audio technology.

The Digital Video Era isn't new to Sony. In fact, it was back in 1978 that Sony first created an experimental digital VTR, which demonstrated the viability of digital recording. The Digital Video Era became official in 1986, when Sony introduced the DVR-1000 videotape recorder—freeing the broadcast industry from the limitations of the composite analog realm.

■ In professional audio, the Sony PCM-1610/1630 has become the recording industry's de facto standard digital mastering system.

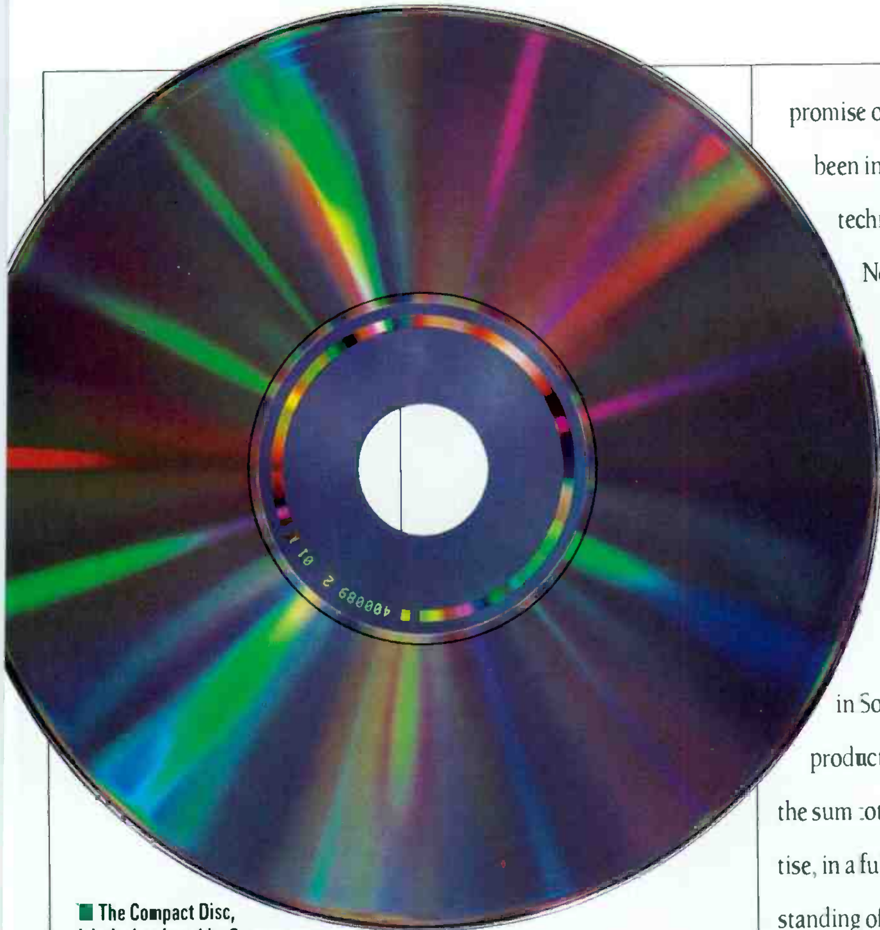
Two years later, a new world exists.

Today, Sony is broadening its leadership in digital video recording. Only Sony is offering and delivering (no small distinction) an extended line of digital video products, including DTTRs (the latest terminology for "Digital Television Tape Recorders"), bit rate converters, peripheral components and accessories. What was recently embryonic technology is now a growing product line, covering a wide range of studio applications from production to broadcast.

Sony's leadership includes all aspects of digital video recording, from signal processing, transport design, tape formulations, to cassette design and high density recording. Sony is also light years ahead because of our VLSI technology, creating chips that carry an enormous amount of information—which is critical to digital processing.

The industry looks to Sony.

Sony's groundbreaking work in digital video recording made it



■ The Compact Disc, jointly developed by Sony and Philips, has brought digital audio to the masses and changed the way the world listens to music.

inevitable that Sony would play a pivotal role in developing the technical foundation for the industry format standards. Sony's leadership in digital audio provided further resources, as digital audio is an integral component of the new digital video formats.

The cooperation was at the same high level as the technology.

The process that led to the formulation of VTR standards for digital equipment was a rare display of industry cooperation. (And that same cooperation is still going on.)

Sony is proud to have been part of that process. An effort that was supported by major manufacturers and user groups around the globe, beginning in 1979. Two separate groups, representing the EBU and the SMPTE worked closely and intensively during the years, to reach a format agreement.

As a result, format wars can be avoided and manufacturers can focus on enhancing their product technology for the benefit of all.

The promise of new technology. The reality of new technology.

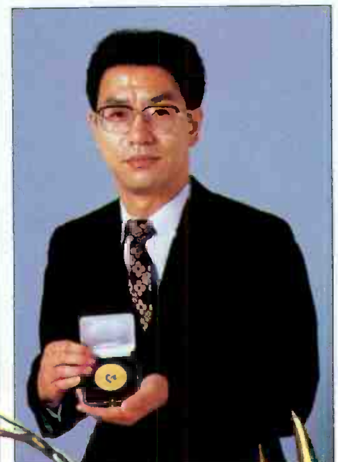
Sony's efforts in realizing the promise of digital video have been international. Sony technical leaders in Japan, North America and Europe have all contributed to the complete, expansive digital video product line that we bring you in 1988.

When you invest in Sony digital video products, you are investing in the sum total of all this expertise, in a full and rich understanding of where digital video technology is today, and where it is going tomorrow.

The Sony mastery of the craft is unmatched in the industry.

We invite you to read on. The Sony Progress Report on the state of digital video will demonstrate how far the technology has come, what it can do for you and how Sony's product line can help you enter the new world of digital video.

■ A key contributor...Takeo Eguchi of Sony has been an active member of various working groups on DTTR standards within the SMPTE and EBU/MAGNUM.



"Outstanding Achievement In Engineering Development."

At the 40th Annual Prime-time Emmy Awards, The Academy of Television Arts & Sciences awarded an Emmy to Sony in recognition of its outstanding engineering work on the D-1 Component Digital Television Tape Recorder.

DVR-1000 4:2:2 Component DTTR

The dream comes true.

With the establishment of well-defined standards, manufacturers faced the formidable challenge of putting them into practice. The world's first production component DTTR was delivered in 1986, and, to no one's surprise, it came from Sony. The Sony DVR-1000, has since been heralded as a revolutionary and outstanding technical achievement. It fully delivers the benefits of component digital video recording and unquestionably provides the highest possible video and audio quality available today in a studio recorder, while conforming to SMPTE D-1 and EBU recommendations.

Component video has a number of demonstrable advantages over composite video. Certain artifacts are unavoidable in the composite encoding process. These are easily observed in graphics devices, telecines, cameras, and effects units—their pictures invariably look better in component form. In composite systems, editing at points other than those defined by the color framing sequence can result in picture shifts; in component systems, editing can be performed at any frame. And with composite signals, small phase and timing errors can cause picture and color shifts.

The DVR-1000 handles the three video signal components—Y (luminance), R-Y and B-Y (color difference information)—separately from input to output. The input/output interfaces include analog Y/R-Y/B-Y, R/G/B, and Betacam® components in addition to parallel component digital video interface conforming to SMPTE and CCIR recommendations. Line level analog audio, as well as an AES/EBU digital audio interface is also provided. The DVR-1000 can thus be connected to a wide variety of input and output devices, providing the transparent performance characteristics of digital recording without compromising the advantages of a component video system.

Ideally suited for high-quality production and post-production applications, the DVR-1000 is most effective in an environment where all devices, such as VTRs, switchers, graphics and effects units, are interfaced via the digital I/O. By maintaining signals in the digital form wherever possible throughout a facility, repeated A/D and D/A conversions can be avoided, thus maximizing long-term signal quality.

DVR-1000

UNPRECEDENTED VIDEO QUALITY. More than 20 generations of dubbing are possible without loss of picture or sound quality. Reproduces broadcast-able pictures at ±¼x normal speed and recognizable pictures at up to ±40x normal speed.

FOUR DIGITAL AUDIO CHANNELS. PCM audio channels provide in excess of 90dB dynamic range with uniform, wideband frequency response. Internal digital routing enables channel-to-channel dubbing without external patching. AES/EBU digital I/O can be configured as 4 independent channels or 2 stereo pairs. Multi-pin connector provides single cable interface for all 4 channels.

ERROR CORRECTION. Data errors, such as those caused by tape dropouts and momentary head clogs, are completely recovered by an advanced Reed-Solomon error detection and correction scheme. Large errors beyond the capacity of the correction system are handled by Sony's powerful error concealment techniques, aided by data shuffling.

SOPHISTICATED MAINTENANCE FEATURES. Built-in diagnostics, video and audio test signals, test switches, and full monitoring capabilities aid the user in maintaining optimum performance levels.

ADVANCED CONTROL PANEL WITH MENU-DRIVEN DISPLAY FOR EASY OPERATION. A large variety of tape handling, editing, setup, and maintenance functions are available via the easily mastered, logically positioned controls. A sophisticated electroluminescent panel with 12 main menu keys and 12 function keys provide rapid access to the built-in facilities.

BUILT-IN EDITING FACILITY. Two DVR-1000's can be simply interconnected via their RS-422 control ports for full editing capability. Control panel displays all necessary data, and edit data entries can be easily made through the function keys and numeric keypad.

CASSETTE OPERATION FOR HANDLING EASE AND MAXIMUM TAPE PROTECTION. The DVR-1000 accepts M cassettes (34 minutes max.) or L cassettes (96 minutes max.)

D V R · 1 0

DIGITAL VIDEO RECORDING FOR THE NTSC ENVIRONMENT. A true "plug-in" upgrade for NTSC facilities, the DVR-10 is capable of transparent dubbing through more than 20 generations and provides up to 94 minutes of record/play time. The Dynamic Tracking™ system provides broadcastable pictures anywhere from −1x through 3x normal speed. Recognizable color pictures are produced at up to ±40x normal speed for high speed search.

FOUR DIGITAL AUDIO CHANNELS. PCM audio channels provide in excess of 90dB dynamic range with uniform, wideband frequency response.

ADVANCED CONTROL PANEL WITH MENU-DRIVEN DISPLAY FOR EASY OPERATION. A large variety of tape handling, editing, setup, and maintenance functions are available via the easily mastered, logically positioned controls. A sophisticated electroluminescent panel with 12 main menu keys and 12 function keys provide rapid access to the built-in facilities.

ERROR CORRECTION. Data errors, such as those caused by tape dropouts and momentary head clogs, are completely recovered by the D2 format's Reed-Solomon code error detection and correction scheme. Large errors beyond the capacity of the correction system are handled by Sony's powerful error concealment techniques, aided by data shuffling.
Even the total loss of one head during playback is virtually undetectable by the viewer.

BUILT-IN EDITING FACILITY. Two DVR-10's can be simply interconnected via their RS-422 control ports for full editing capability. Control panel displays all necessary data, and edit data entries can be easily made through the function keys and numeric keypad.

WRITE-AFTER-READ CAPABILITY. Permits video and audio signals to be played, modified, and re-recorded at the same tape location. Operations normally requiring two VTRs, such as audio sweetening, color correction, or title superimposition, can be performed with one DVR-10 connected to external processors. A-B roll editing can be performed with 2 DVR-10's instead of the usual 3 recorders.

CASSETTE OPERATION FOR HANDLING EASE AND MAXIMUM TAPE PROTECTION. The DVR-10 accepts S cassettes (32 minutes max.) or M cassettes (94 minutes max.)

DVR-10 D-2 Composite DTTR

A second format gives the composite world a digital alternative.

While the DVR-1000 component DTTR is ideal for state-of-the-art production facilities, it became increasingly apparent that today's television industry could benefit greatly from the application of digital recording techniques to the existing analog composite video signal format. So Sony went to work on the development and standardization of a composite DTTR.

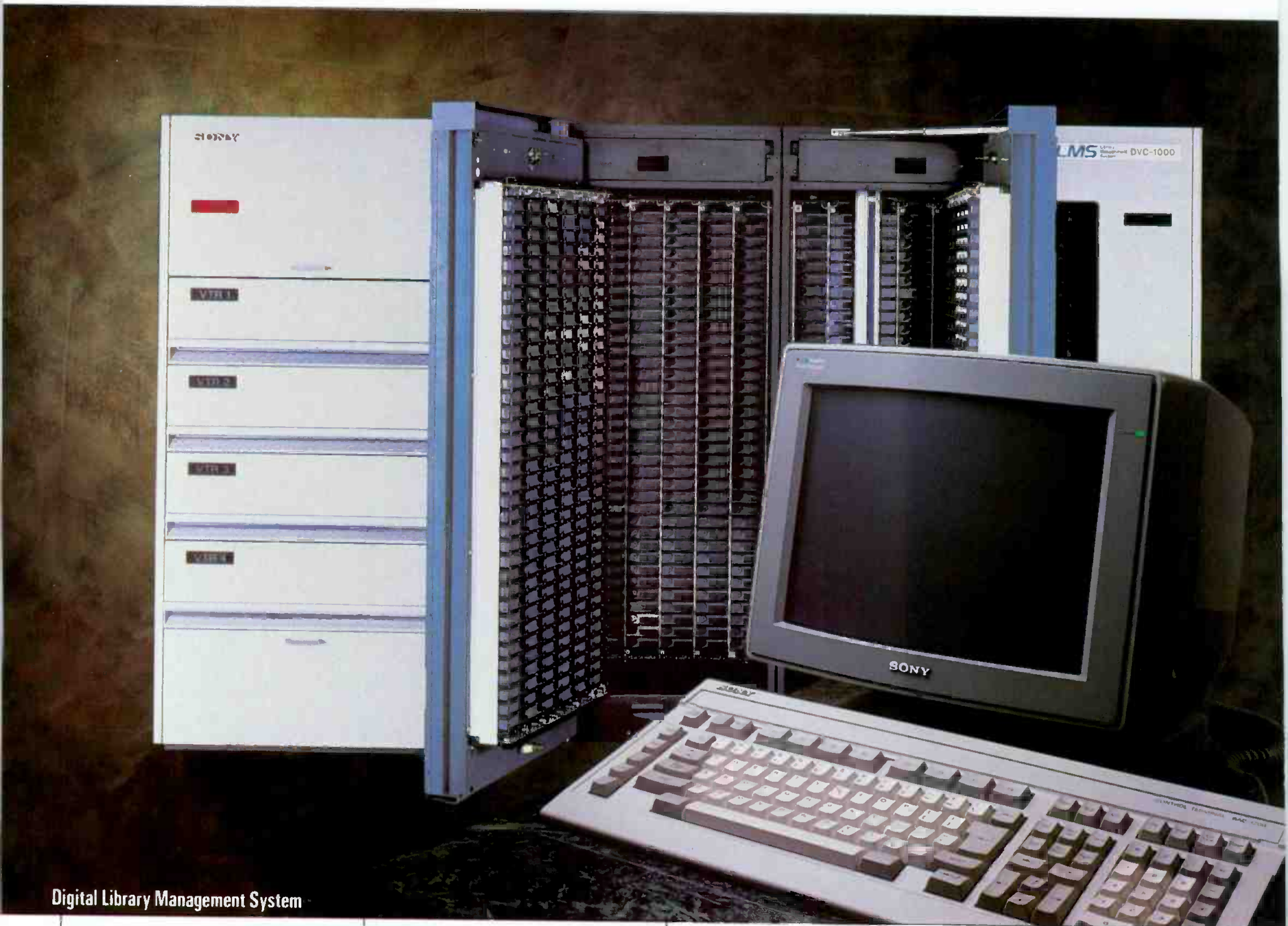
In December, 1986, Sony and Ampex submitted the D-2 format to the SMPTE as a recommended composite DTTR standard. Today, the D-2 format for NTSC composite digital video recording is supported by a broad base of users and manufacturers.

The Sony DVR-10 fully conforms to the proposed D-2 format standard and provides the highest level of performance currently available in a composite studio recorder. It delivers all the advantages of digital video recording, including exceptionally wide bandwidth, high S/N, and total absence of moiré. And it does so while maintaining the convenience and compatibility of the single-cable analog NTSC interface.

The DVR-10 is a full-featured VTR with numerous operational capabilities and flexible system interface. In addition to analog composite video I/O, the DVR-10 also has a parallel input and output digital video interface. This permits direct digital-to-digital dubbing between two DVR-10's for the highest quality signal transfer. Analog and digital audio interfaces, the latter utilizing the AES/EBU standard in stereo pairs, are also provided for maximum versatility.

The DVR-10 is remarkably compact and lightweight, considering the tremendous amount of circuitry needed for high-quality digital video and audio recording. It is only 6 rack units high—about the same size as a Betacam® studio VTR. And its power consumption is only 470 watts. A DTTR of this size and efficiency would not have been possible were it not for Sony's advanced VLSI circuit technology.

The size, features, and performance of the DVR-10 make it ideal for integration into virtually any existing NTSC environment, including production, post-production and broadcast facilities. It can be used as a replacement for existing 1-inch and ¾-inch VTRs. And it is the logical choice for new system installations designed to maintain maximum composite signal integrity.



Digital Library Management System

The age of broadcast automation benefits from Sony digital recording technology.

There are, clearly, numerous applications for the D-2 DTTR in the vast television industry. One of these, in which the DTTR's extremely high signal quality and advanced monitoring capabilities are particularly advantageous, is broadcasting. The modern trend toward increasing broadcast automation and, hence, decreasing supervision has made it more difficult to keep tight reins on signal quality. Digital recording assures a high degree of confidence while reducing the need for extra care and skill in maintaining the quality of program material throughout multiple generations.

The automation trend has also resulted in the creation of ever more sophisticated multi-cassette playback systems. When the Sony Betacart® system was first introduced in 1984, it made reliable, flexible multi-cassette video playback an operational reality. Today, Sony has combined its considerable expertise in multi-cassette presentation and digital recording to create an expanded Digital Library Management System (LMS). The Sony Digital LMS is, quite simply, the most advanced high-capacity multi-cassette playback system available, taking broadcast operations to new heights of efficiency and on-air quality.

The Digital LMS provides unparalleled flexibility, both in configuration and operation. Different models provide a range of choices in cassette sizes and capacities, so that the system can be custom tailored to individual broadcast facility requirements. Basic systems can be expanded in capacity by adding cassette consoles. They permit broadcasters to keep an extensive library of cassettes on-line and readily accessible, thus reducing the labor involved in loading and unloading. The cassette-based operation also ensures the ultimate ease of operation, with no special skills required for library maintenance.

The Digital LMS uses 4 (expandable to 6) DVR-C10 D-2 composite DTTRs, which operate totally in the digital domain. They provide the same outstanding performance as the DVR-10 standalone DTTR. In fact, a DVR-10 can be installed in place of a DVR-C10 in an emergency. In the Digital LMS, D/A conversion is performed after the switchers to provide standard composite analog video and line level audio outputs. It can, therefore, be easily integrated into existing broadcast environments, providing the highest level of video and audio quality possible.

Options to interface the Digital LMS with traffic and automation systems improve the flow of vital station information and reduces paperwork and time-consuming manual data entry. The LMS also provides powerful operational and management features giving broadcasters comprehensive, long-term control over their operations.

Programming flexibility is assured by the system's Multi-Segment applications software, which allows the integration of single-segment commercials and multi-segment programs. It also permits total control over program replay from the system's operator consoles. The system simultaneously supports three operator consoles, providing sophisticated multi-user, multi-tasking capabilities.

With its many sophisticated features and capabilities, the Digital LMS remains unsurpassed for reliability and ease of operation. All mechanical components are designed to deliver continuous trouble-free operation. The DVR-C10 DTTRs provide the full complement of Reed-Solomon error correction and Sony's superb error concealment circuitry to ensure the best possible on-air picture quality at all times. And the signal monitoring capability of the DVR-C10 provides operators with ample warning of tape and recorder conditions that could become on-air problems. System dependability is further enhanced by numerous built-in safeguards and bypass capabilities that help eliminate costly on-air "down" time.

The combination of large-capacity media storage and management with state-of-the-art digital video/audio performance makes the Sony Digital LMS an ideal choice for today's highly automated, quality-conscious broadcast environments. Its flexible design permits it to be integrated into virtually any modern traffic or automation system. And because it operates reliably with a minimum of manual intervention, maintenance, and supervision, it enables broadcasters to realize considerable labor savings.

DVC-1000S DVC-300M

VERSATILE CONTROL SYSTEM INTERFACE. Host computer interface permits the LMS to be operated as a peripheral to master control automation systems. Alternately, daily playlists and library maintenance information can be downloaded directly from a station's traffic system.

DETAILED REPORTS FOR SIMPLIFIED, THOROUGH STATION AND LIBRARY MANAGEMENT. System generates as-run logs that provide detailed accounts of all on-air events. Library managagement software provides "required cassette" and numerous other reports to aid system operators.

TIME-PROVEN BAR CODE CASSETTE IDENTIFICATION. Originally developed for the Betacart system, the Sony bar code ID contains all relevant cassette information and eliminates the need for a separately maintained database. Multi-segment cassettes contain an on-tape directory which permits identification and location of program segments. Cassettes can be easily prepared and labeled off-line, completely independent of the on-air process.

CONTROL OF UP TO 4 EXTERNAL VTRS. Permits RS-422 control of Sony VTRs in almost any broadcast format. External VTR outputs are switched through LMS for total control. One of the external VTRs can be used to assemble and play backup spot reels.

EASY-ACCESS CASSETTE STORAGE BINS. 14 input bins and a 14-cassette output port simplify loading and unloading. 28 direct access bins are provided for short-term storage. All cassettes can be accessed for emergency manual loading without opening the console.

HIGH-RELIABILITY DESIGN WITH BUILT-IN DIAGNOSTICS. Self-aligning elevator mechanism eliminates tedious adjustments. Re-alignment after the replacement of a VTR is automatic. Maintenance is aided by an extensive array of hardware and software diagnostics. Modular system design makes replacement of mechanical assemblies fast and easy.

BVM-1910 Master Control Monitor with BKM-2080 Digital Interface

■ It takes a special color monitor to display the subtleties of the digital video signal.

The Sony BVM-1910 19" Broadcast Color Monitor has already set new industry standards for resolution, color uniformity and stability. With the addition of the BKM-2080 Digital Interface option, the BVM-1910 becomes the ideal monitor for D-1 format environments. It is also the industry's first color monitor that permits direct connection of either parallel or serial 4:2:2 component digital video signals. Analog inputs for composite, R/G/B, SMPTE, and Betacam component signals are also provided.

Digital Matrix Switcher

■ The transition to digital is easier than you'd think.

While signal recording, processing, interfacing, and transmission will one day be entirely digital, today's production environment demands integration of analog and digital signals. Sony's digital matrix switchers and analog/digital converters meet this need.

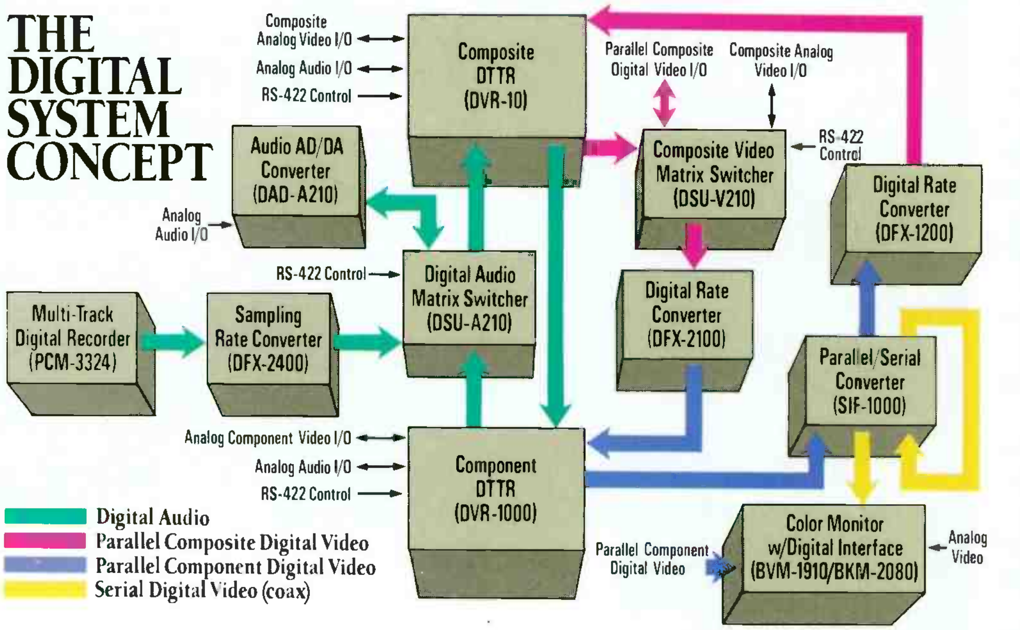
Sony matrix switchers are highly flexible, and are configured with plug-in modules. They expand to 16 inputs and 6 outputs or, 6-in/16-out. The matrix may be configured to virtually any size within those limits, and a selection of either analog or digital input and output modules provides unmatched versatility. The video and audio switchers can be controlled via their RS-422 ports.

The DSU-V210 Video Matrix Switcher handles parallel composite digital video signals. It has a built-in black burst and color bar generator.

The DSU-A210 Digital Audio Matrix Switcher handles serial digital audio signals conforming to the AES/EBU standard. It has a built-in 1 kHz tone generator.

The DAD-A210 Audio D/A and A/D converter provides a convenient analog input/output interface to the DSU-A210.

THE DIGITAL SYSTEM CONCEPT



DTTR interfacing requirements? Sony has the answers.

While Sony DTTRs have been designed to provide considerable interface flexibility, the real world of studio applications poses numerous challenges and obstacles. Through the further application of advanced digital processing and VLSI circuit technologies, Sony engineers have developed a line of peripheral components that address the specialized problems of bit rate conversion and signal distribution, help avoid unnecessary A/D and D/A conversions, and enable the smooth integration of audio and video devices. These products enhance the already outstanding utility of Sony DTTRs and help maintain the high-quality digital signals throughout a studio environment.

DFX-1200 Digital Bit Rate Converter

Converts 4:2:2 component digital video signals to 4 fsc composite digital video signals. In addition to sampling frequency conversion, the DFX-1200 encodes the separate Y, R-Y, and B-Y signals into a composite digital NTSC signal with correct I and Q bandwidths.

DFX-2100 Digital Bit Rate Converter

Converts 4 fsc composite digital video signals to 4:2:2 component digital video signals. Adaptive filtering is used for the Y/C separation of the NTSC signal. This assures a wideband luminance signal and a chrominance signal free from cross-luminance and cross-color distortion. Conversion from I and Q to R-Y and B-Y signal formats is also performed.

DFX-2400 Digital Audio Sampling Rate Converter And VSU-3310 Vari Sync Unit

The digital audio tracks on D-1 and D-2 recorders utilize a 48kHz sampling frequency. In many cases, digital audio signals come from sources with varying sampling rates—for example, the CD's 44.1kHz. Rate conversion is required in such cases.

The DFX-2400 accepts any sampling frequency between 30kHz and 50kHz, and converts it to 32kHz, 44.1kHz, 44.056kHz, or 48kHz, which represent all audio sampling frequencies in use today. It also enables format conversion between the AES/EBU standard and Sony's SDIF-2 standard. It operates totally in the digital domain, providing performance far superior to units that rely on D/A and A/D conversion.

The DFX-2400, with the VSU-3310 Vari Sync Unit, also facilitates synchronization of the digital audio signal clock to the video signal. The DFX-2400 will synchronize its internal clock to an external signal. The VSU-3310 accepts a variety of sync inputs and produces a word sync output that can be used to vary the speed of digital audio recorders. These units permit external digital audio sources to be used in video editing.

SIF-1000 Parallel/Serial Converter

Integrating digital equipment into an existing studio need not be complex. Serial signal distribution permits the use of existing coaxial cable to carry the digital video signals. Distributing the signal in serial form is important because parallel digital signals were intended to travel only over limited distances.

The Sony SIF-1000 is both a parallel-to-serial and serial-to-parallel converter, permitting serial signal distribution over coaxial cable up to 500 meters in length. Its signal coding is switch selectable for operation with 4:2:2 component or D-2 composite digital video signal.

Sony. We're more than pivotal to digital.

We believe this Progress Report has demonstrated that digital video could not have evolved to its current level without the ongoing contributions of Sony.

Sony is the only manufacturer providing a choice of composite and component digital formats. We are the only manufacturer providing a comprehensive line of digital video products and interfaces. Our commitment to the industry is to provide the technology necessary to lead the Broadcast and Post Production markets into the new digital era.

And as this blossoming technology yields even more, you can be sure we will be the driving force behind that, too.

Because even though digital video is new, the story behind it is an old one: Sony shows the way.

SONY®

Broadcast Products

Moving into R-DAT

By Brad Dick, radio technical editor

There may be an R-DAT in your future. Then again, maybe not.

The basic analog recording process has not changed much since its inception more than 40 years ago. We've managed to improve the quality available from audio recorders, but the process is pretty much the same as that used shortly after World War II, when Bing Crosby sang into the decks developed by Ampex.

That process is about to undergo radical change with the advent of digital technology. Although digital recording schemes, primarily pulse-code modulation (PCM) systems, have been available for years, they never saw widespread use.

Borrowing technology from the video industry, Japanese tape-recorder manufacturers have developed a new type of audio recorder that uses the best of both worlds—digital signals for maximum quality and rotating-head recording techniques for compactness.

Digital recording opens the door to a whole new range of production possibilities. One major benefit of digital recording lies in the ability to layer audio without the signal-to-noise loss that typically occurs in the analog domain. A second benefit is the sonic improvement that digital techniques can bring to a tape recorder. Another is enhanced operational control features, such as indexing for automation and searching. And these recorders provide all these advantages in an extremely compact system that gives new meaning to the term "portable."

Digital audiotape (DAT) recording currently centers on the *rotary digital audiotape* (R-DAT) format. Although a second method of digital recording exists, called *stationary digital audiotape* (S-DAT), it has yet to receive as much interest. Because R-DAT machines are just now becoming available, broadcasters need to better understand R-DAT.

Major R-DAT specifications

The six major operating modes of R-DAT are summarized here. Although the technology used in each of the formats is the same, different applications require special features. One special consideration, for example, is the current prohibition of direct digital-to-digital compact disc-to-R-DAT copying.

The standard configuration, Mode I, uses a 48kHz sampling frequency and 16-bit linear quantization. Mode II is designed to be compatible with A-mode (TV sound) satellite broadcasting. This mode allows direct digital recording of 32kHz, 16-bit satellite-delivered audio. Mode III is devised to meet the special requirements for recording audio from the West German broadcast satellites. (Note that in this mode, the tape and drum revolution speed are reduced by one-half, which increases recording time to four hours.) Mode IV permits 4-channel recording. Modes V and VI are for playing prerecorded tapes. The 44.1kHz sampling rate, which is identical to that used by CDs, makes production of CDs and prerecorded R-DAT tapes efficient for record companies.

Professional machines may be equipped to operate with the standard 48kHz, 16-bit sampling system or, alternatively, 44.1kHz with 16-bit or 32kHz, 12- to 16-bit sampling. At this time, the 44.1kHz sampling mode is available only on a few professional R-DAT machines.

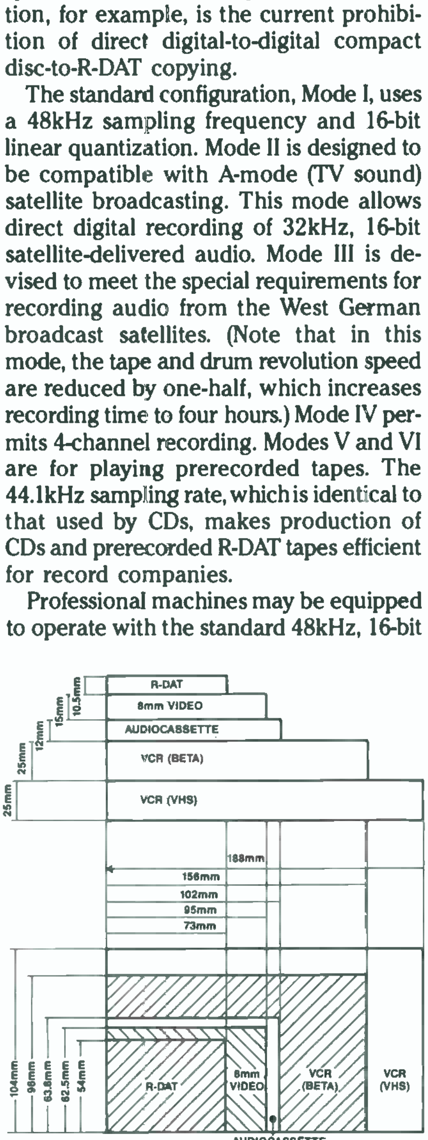


Figure 1. This chart depicts the differences in size among various audiocassettes and videocassettes.

The 44.1kHz sampling mode is not available in consumer machines because it matches the rate used in CDs. The recording industry fears that R-DAT machines would result in widespread pirating of CDs. An R-DAT machine operating at the same sampling rate as a CD could, theoretically, make identical copies of the CD.

Because consumer R-DAT machines are incapable of recording at the 44.1kHz frequency, direct CD-to-R-DAT digital-to-digital copying isn't possible. Copies of CDs can be made on R-DAT recorders only by passing the CD audio through a set of digital-to-analog and analog-to-digital converters and onto the R-DAT machine.

The potential for making high-quality tape copies from CDs has made the record industry nervous. One result was its demand for implementation of the CBS Copycode system, which was supposed to prevent such action. In an effort to resolve the issue, Congress directed the National Bureau of Standards (NBS) to conduct thorough tests. The related article, "Copycode," page 74, reviews the results.

Digital cassette tapes

The high-packing density (144Mb/s/in^2) required by R-DAT recording demands superior tape and cassette performance. The R-DAT cassette, shown compared with other cassette tapes in Figure 1, measures 73mm × 54mm × 10.5mm. Despite the cassette's small size, the R-DAT tape is the same width (3.81mm) as the tape used in an analog cassette.

The DAT cassette housing is more like a videocassette than an analog cassette. A front lid covers the tape's surface. In addition, a sliding bottom plate protects the metal tape from dust or other contamination and damage. Current tapes provide up to two hours of recording time at the standard tape speed. A half-speed mode doubles this time by reducing tape and head rotation speeds by one-half.

Although the half-speed mode causes no problem in recording, playback requires additional consideration. While in playback, the head must trace the same recording track twice and maintain normal cylinder rotation speed. Typical implementations of this feature (Mode III) rely on 12-bit non-linear quantization and a sampling frequency of 32kHz.

Transport features

The recorder features a helical-scan rotary head (scanner), similar to that used in a VCR. Rotating at 2,000rpm, the scanner contains two or four heads. The design places the record/play heads in contact with the tape for 50% of the time (90° wrap), as shown in Figure 2.

The high rotational speed has a secondary advantage in certain applications. The drum, which is tilted 6° and spins at 2,000rpm, creates a gyroscopelike effect. This improves machine stability, which is especially important in remote recording applications.

The 90° wrap means that only a short length of tape is in contact with the drum. This reduces tape damage and allows high-speed search with the tape in contact with the drum. Because it reduces tape tension, this technique also permits longer head life. Typical search speeds are from 200 to 300 times normal play speed. It may take as long as 40s to move a 2-hour tape from end to end.

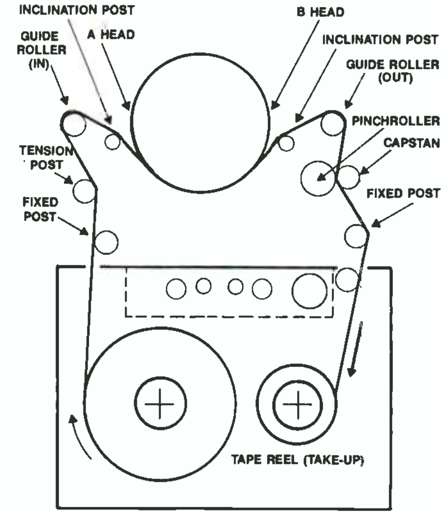


***Figure 2.** The R-DAT tape loading path is similar to that used in a VCR. Note that the tape contacts the head at 90°. This offers several advantages, including read-after-write, reduced tape tension and high-speed searching.*

The addition of a second pair of heads, separated from the other heads by 90°, makes it possible to provide simultaneous playback. Although this feature is not critical for consumer use, professional applications demand this option.

Track design

In conventional analog decks, the old signal must first be erased before a new signal can be recorded. R-DAT uses a process called *overwriting* that eliminates the need for erase heads. The new data simply overwrites (replaces) the old data.

The basic R-DAT track format is shown in Figure 3. The standard track width is 13.591μm. The track length is 23.501mm. The linear tape speed of 8.15mm/s (approximately 0.32in/s) results in an effective writing speed of 123in/s, which is 65 times faster than the analog cassette speed of 47.6mm/s (1 7/8in/s).

To save additional space, the 13.59μm-wide (approximately one-fifth the diameter of a human hair) diagonal tracks are laid down with no gap between them. The two record heads are tilted 20° from each other, which further differentiates the adjacent data tracks. The result is a set of parallel data tracks with different azimuths and no gaps between them.

On playback, each head "sees" only the correct data track. The adjacent tracks are effectively invisible because their magnetic patterns are at the wrong angle. The process requires that the playback heads be approximately 50% wider than the tracks that remain on the tape. This permits the *automatic track finding* (ATF) to function.

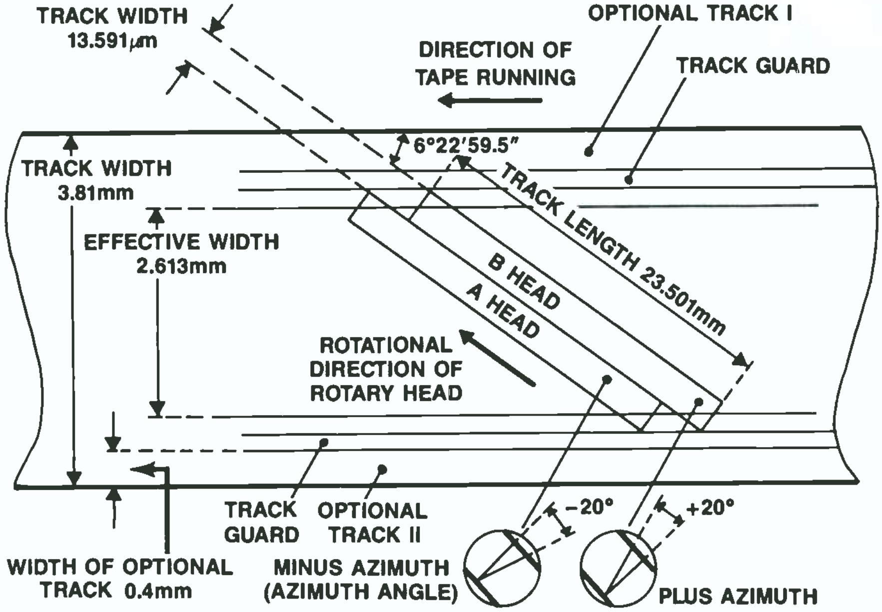


Figure 3. *A helical-scan track format. Note the lack of guard bands between the tracks and the ±20° azimuth head positioning.*

Signal processing

The data signal to be recorded contains much more than just audio. The provision for error correction requires that approximately 37.5% of the original signal be added back to the composite signal. By the time subcodes are included, a transmission rate of 2.46Mb/s is required. This signal is compressed by a factor of three and processed at 7.5Mb/s, which enables the signal to be recorded discontinuously. The resulting R-DAT output waveform is shown in Figure 4.

The audio data is subjected to 8-bit to 10-bit conversion and double Reed-Solomon encoding, which are effective in error correction. In addition, the signal is rearranged as interleaved blocks that make playback possible even if one playback head becomes clogged. The data is recorded as 288-bit blocks, as shown in Figure 5. A close look at the diagram reveals that, with the exception of the sync byte, all block address interleaved contents can be checked by means of 8×3=24 bits.

The PCM areas allocate eight bits for ID purposes. These ID codes contain information about sampling frequency, channel number, quantization number, tape speed, copy protection and the status of emphasis.

Subcodes also are recorded along with the audio. These signals are located above and below the PCM tracks. They are used mainly for recording program numbers and various control signals, and they permit high-speed searches. The R-DAT subcode capacity is 273kb/s, which is 4.5 times that available from CDs. Because so little of the subcode space is currently needed, it could be used to record digitized video still-frame sequences, with the picture changing every few seconds.

Automatic track finding

The rotating head scheme requires that the play head be able to accurately trace

Continued on page 70

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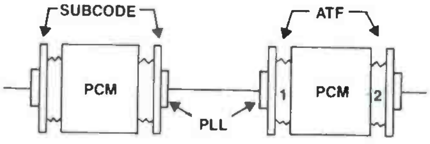

Figure 4. The R-DAT output signal showing the subcode and automatic track-finding waveforms.

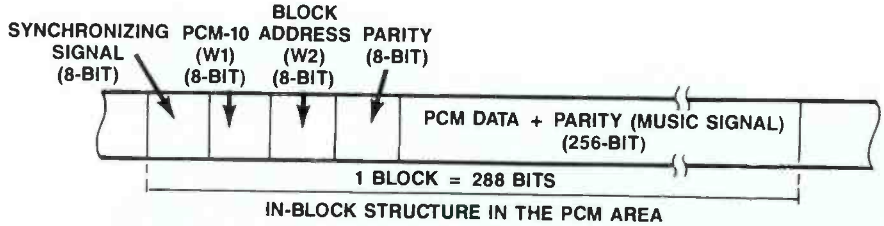

Figure 5. Each PCM data block consists of 288 bits. The PCM ID, address and parity can be decoded from only 24 bits of data.

Continued from page 66

the recorded tracks. To accomplish this, an ATF system is employed. The ATF signal consists of two sets of five blocks and is recorded along with the digital data. (See Figure 6.) The ATF consists of a pilot signal (F1); sync signal 1 (F2); sync signal 2 (F3); and erase signal (F4). As the head rotates, the presence of an ATF signal is detected through either the F2 or F3 signal. The adjacent pilot signals (F1) on both sides are compared immediately, and a decision is made as to whether the tracking is correct.

The F1 signal is comprised of a low-frequency signal that is not affected by the azimuth setting. Consequently, crosstalk can be picked up and detected from both sides. Because the ATF signal compares the crosstalk using an analog method, the processing is different from other circuits. Also, because the ATF area is recorded onto two parts in the track format, a small amount of track curvature does not result in tracking errors. This, together with the use of wide heads, results in a system in which compatibility between machines is easier to achieve and tracking controls, such as those on VCRs, are not needed.

Crystal ball

Although R-DAT has had a shaky start, due in great part to the Recording Industry Association of America (RIAA) and its stance on copy protection, it seems the technology finally is becoming a reality. Although R-DAT recorders were shown at this year's NAB convention, their availability is subject to question.

The issue of copy protection has not been laid to rest. Although the CBS Copycode system probably was buried as a result of the NBS tests, R-DAT manufacturers have yet to flood the shelves with hardware. Some industry experts believe that as long as the price of R-DAT machines remains high (several thousands of dollars), little will be done to prevent their import. However, if a manufacturer attempts to release R-DAT recorders at a more reasonable price (such as $750), the RIAA may again try to limit their importation.

In an effort to remove R-DAT from such legal entanglements, some Japanese manufacturers met recently to discuss a second copy-protection scheme. The process reportedly would allow one CD-to-R-DAT copy to be made without audio degradation. However, if the user attempted to use the R-DAT copy to record additional clones, the recording process would be inhibited. In other words, one CD-to-R-DAT recording would be permitted, but subsequent R-DAT-to-R-DAT recordings would not. It still would be possible to digitally copy from one R-DAT machine to another, provided the original source was not a CD.

High profits

There may be another reason Japanese manufacturers are hesitant to bring low-cost R-DAT technology to the United States. Current sales of compact disc players and software are at an all-time high. Recent figures show that the dollar volume of U.S. manufacturers' prerecorded discs and tapes increased 20% last year.

Continued on page 74

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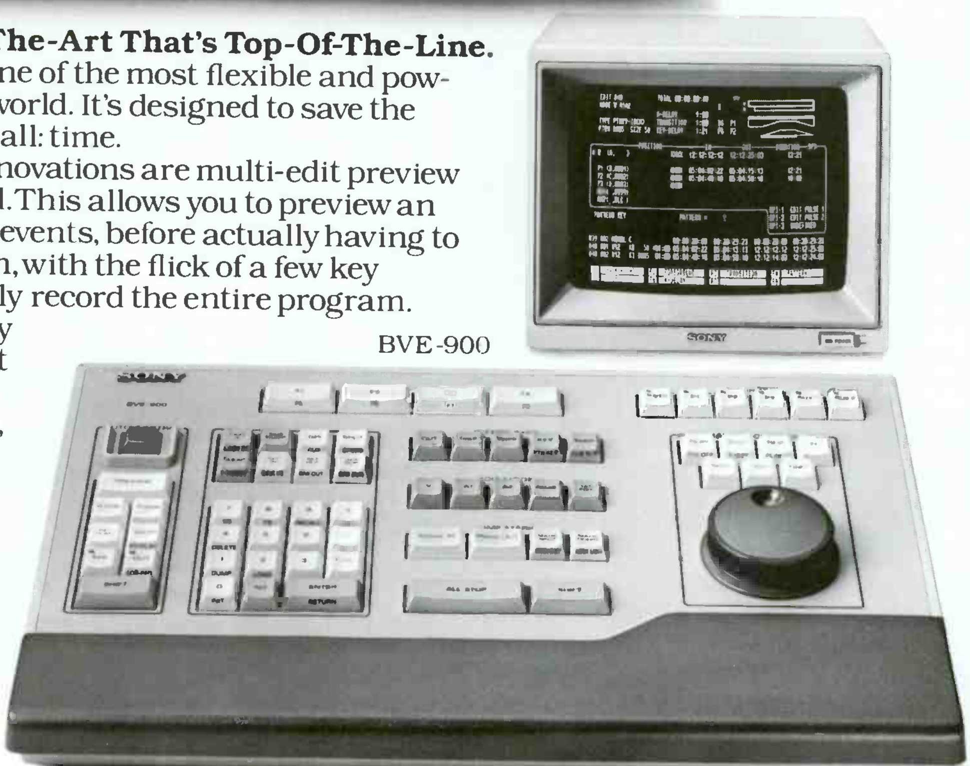

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switcher Learn-With-Create features allow you to record a move without having to re-rehearse it. In addition, the temporary record assignment greatly speeds up multi-layering. And the most complete set of test diagnostics in the industry helps reduce system downtime. No wonder this top-of-the-line editing system can meet all your present and future needs.

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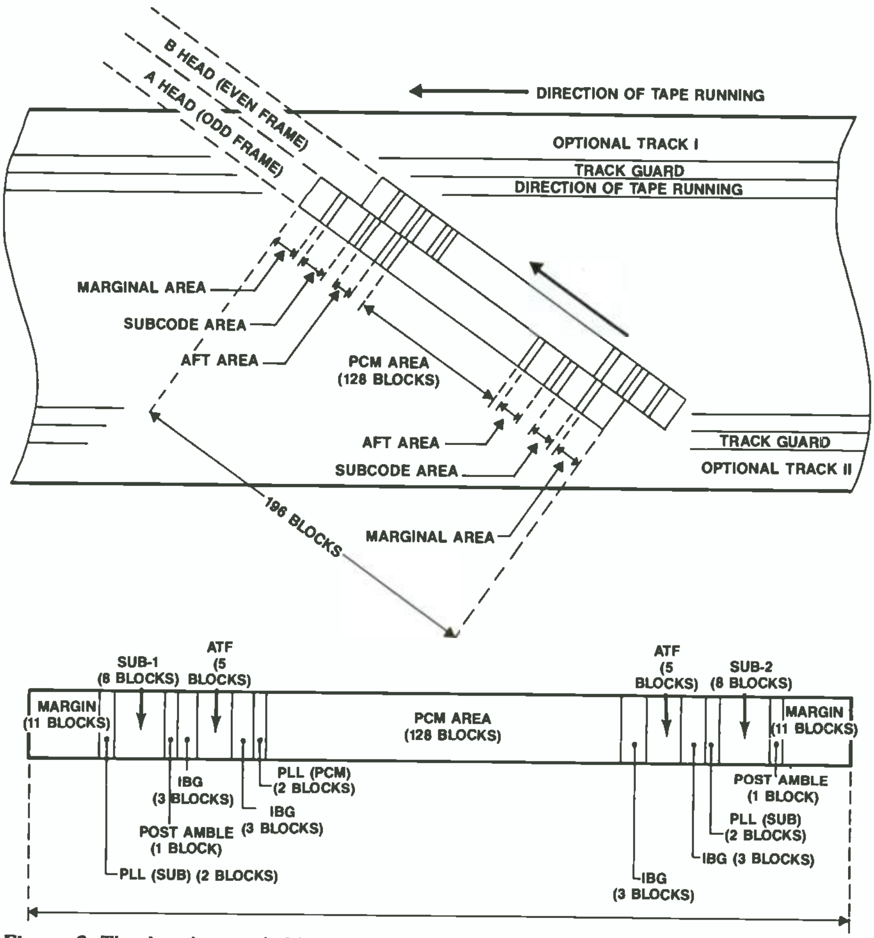

Figure 6. *The data is recorded in track lengths of 196 blocks. Note that the ATF and subcode areas surround the PCM data, which contains the audio.*

Copycode

Although it's not exactly vaporware, R-DAT is certainly not the widespread success it was hoped to be. Hailed as the ultimate audiotape recorder in 1983, R-DAT has yet to achieve professional (or consumer) marketplace success. The reason is not technical glitches, as is often the case for new technology, but the controversy surrounding the machine's capability to duplicate a CD without compromising its audio quality.

The RIAA entered the fray early, claiming that DAT would allow digital cloning of CDs and other high-quality audio programming. In an effort to prohibit copying, the recording industry proposed that record-inhibit circuits be installed into every R-DAT machine. The circuit, called Copycode, was developed by the now-defunct CBS Laboratories.

Copycode was designed to prevent unauthorized duplication of digitally encoded music. A notch, centered at 3,840Hz, would be cut into the audio before it was recorded onto the CD. The DAT recorder would contain a circuit that looked for this notch. If no material appeared in the notch, then the R-DAT record circuit would be disabled for 25s.

NBS tests

Tests on the Copycode system ultimately were mandated by Congress. The NBS investigated Copycode to find out whether the notch was audible and whether the decoding scheme could be fooled into not recording non-encoded material or into recording encoded material.

The results showed not only that Copycode was audible, but also that the decoders could be fooled in many cases. To discover whether the system could be circumvented, the NBS developed several working circuits that would "fool" the copy-prevention circuitry.

In its summary of test results, NBS stated that the primary reason the system did not achieve its stated purpose was because of the decoder.

Another consideration was the subjective listening tests. In one test, 69 out of 84 listeners correctly identified encoded material more than 50% of the time. NBS said the odds of this happening by chance was three in one trillion.

Unit shipments rose by 14.3%, to the highest level since 1978. The total number of discs and tapes shipped last year (706.8 million) was just short of the all-time high of 726 million recorded in 1976. The real star, the compact disc, continues to show dramatic growth, with unit shipments rising 93% from last year. Even cassette ship-

Continued from page 70

ments were up by 19% compared with last year.

Record companies and audio equipment/software dealers do not want to kill the CD technology golden goose that continues to lay high-profit eggs. There seems to be a fear that low-cost R-DAT machines and tapes might drastically reduce profit margins as consumers turn to a format that allows them to record their own tapes.

High costs

It's possible today to purchase a CD player for less than $150. Two factors make it unlikely that R-DAT machines can be marketed in the United States at a price close to that level.

First, the dollar/yen ratio has changed drastically over the past two years. A check of manufacturers' suggested prices indicates little potential for R-DAT machines at even 10 times the price range of the CD player.

Second, the R-DAT technology is already relatively mature, relying on VLSI circuits developed for video applications. Consequently, it may not be possible to obtain sizable price reductions through technological developments.

Competing technology

Another technological advancement may further confuse the issue. In May, Tandy announced the development of an erasable optical disk it calls THOR (Tandy high-density optical recording). The company indicated that a recorder/player would be available within 18 to 24 months. The device would rely on 5¼-inch CDs similar to those used today and would cost approximately $500. The recorded disks could be used in standard CD players for either audio or data storage.

Other companies announced similar products for the computer industry in late June. Although these products may not directly affect broadcast stations, their announcement may further inhibit R-DAT deployment.

All this means that professional R-DAT machines will be quite expensive in the near future. Until millions of consumer R-DAT machines can be sold, manufacturers have no choice but to keep product costs high in an effort to recoup their investment. The significant drop in price that accompanied the growing popularity of CD players will not occur on the R-DAT front until consumers embrace the technology.

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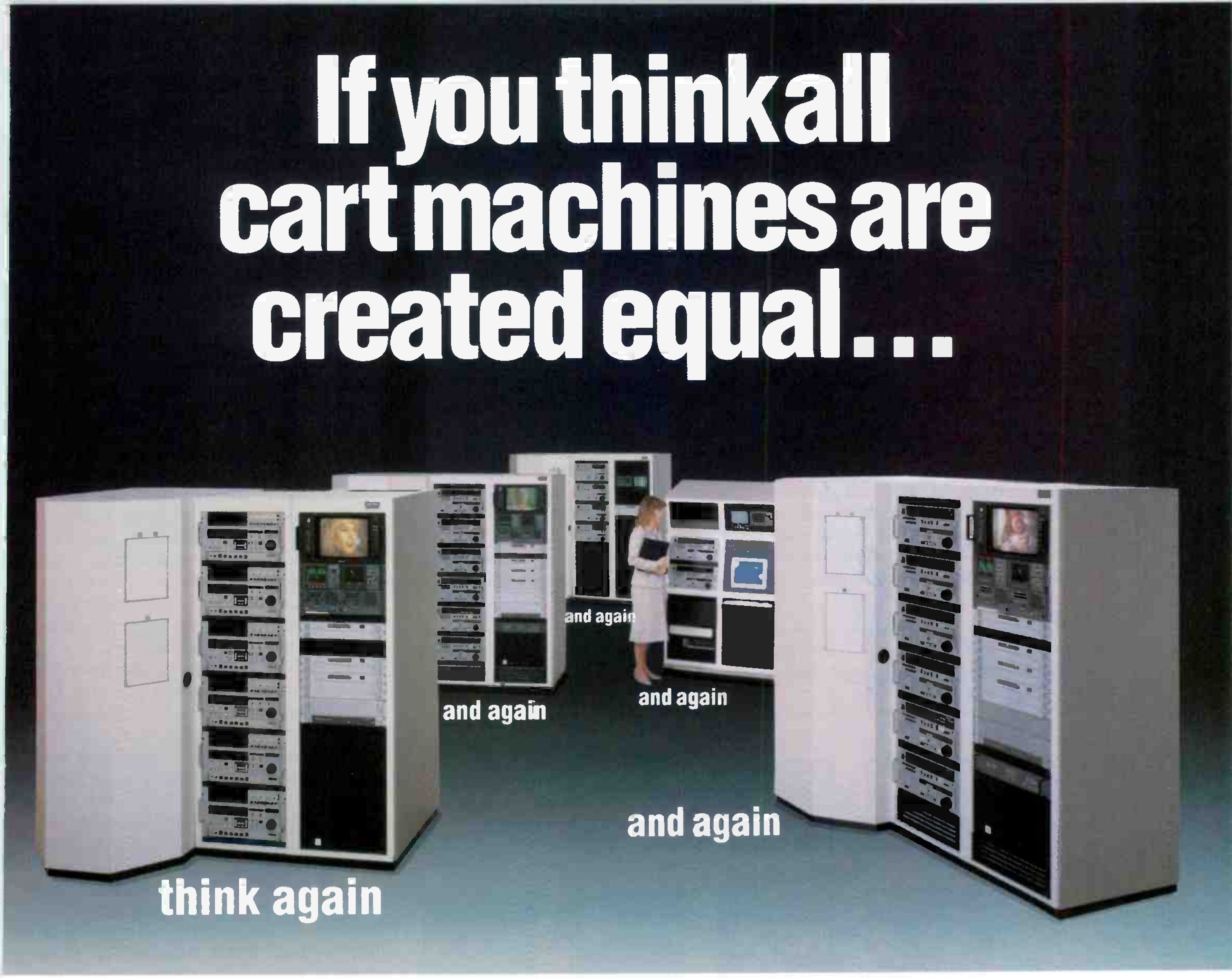

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The D-1 and D-2 formats

By Rick Lehtinen, TV technical editor, and Carl Bentz, technical and special projects editor

Video recording became a reality more than 30 years ago, and it has evolved through a number of recording formats over the years. Applications in broadcast use 2-inch quadruplex and helical-scan systems with 1-, ¾- and ½-inch-wide tapes. But a new era has emerged as practical digital video recording sheds the cloak of laboratory development. Is there a compelling need for two digital formats? Specific applications for the D-1 and D-2 formats suggest that there is.

Video recording gave broadcasters a valuable tool. As each analog format appeared, signal-processor and editor packages emerged to stabilize its electromechanical irregularities. Yet, in the background of every format, a weakness remained. An undesirable *multiple-generation syndrome* surfaced at a different number of generations for each format. Various factors were blamed for the image degradations, which became more apparent with each generation. Among them, *chroma noise* was considered a major contributor. It was not until the D-1 digital component format became a reality that better explanations of the analog phenomena were discovered. What was called noise was found to be more phase modulation, transport jitter and compounding of improper machine setup. The closest thing to chroma noise in a digital system is the bit-error rate (BER), a value used to evaluate recording quality.

Multiple generations are among the advantages attributed to digital recording. In post-production, it is not unrealistic to involve 17 generations. Analog formats exhibit problems after one-third that number.

Recording, in general (digital not excepted), has weaknesses that raise concerns about the quality of reproduced signals. However, digital systems integrate safeguards to overcome some of the weaknesses. The following discussion investigates the methods. Note that no compatibility exists between the D-1 and D-2 formats in terms of interchangeability. They are discussed together in this article because of similarities in concept.

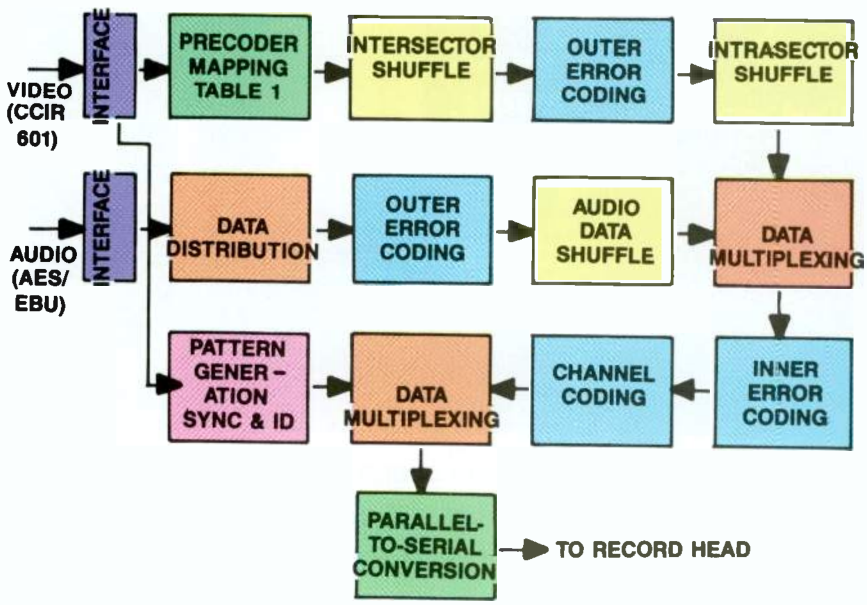

Figure 1. D-1 record block diagram.

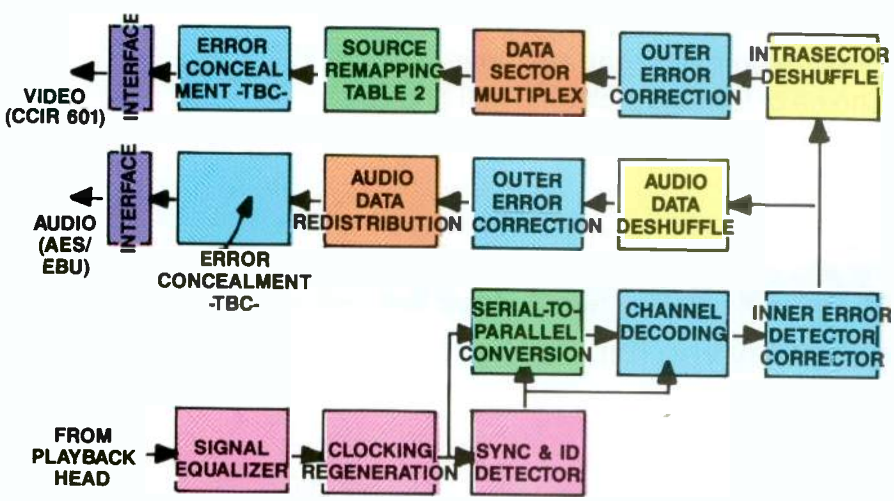

Figure 2. D-1 playback block diagram.

Advantages of digital recording

With any form of recording, playback quality can be no better than the original recording. Any inaccuracy of signal-path adjustments before data is written on the tape cannot be corrected easily, if at all, during playback. Media failure, such as physical flaws in the tape and damage caused by operator carelessness or recording-equipment malfunctions, may result in an unusable recording. In digital recording, however, the factors that often render analog recordings unusable are diminished significantly.

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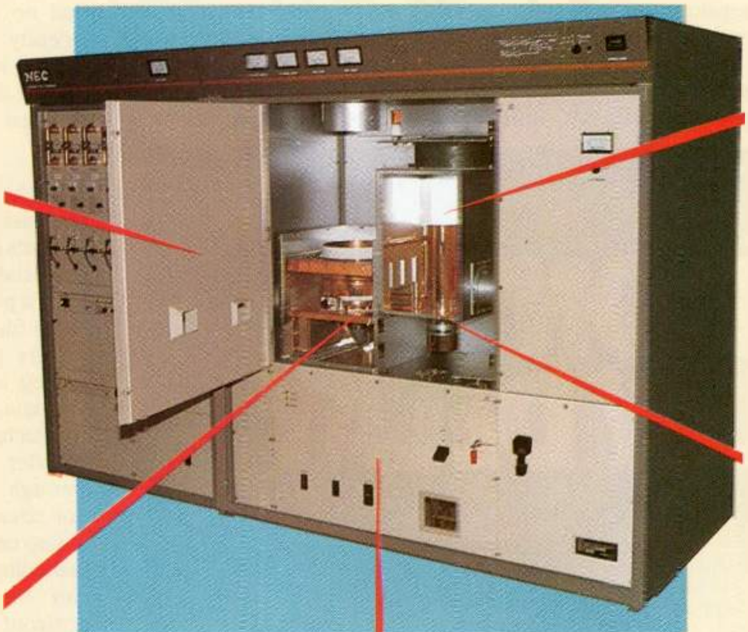

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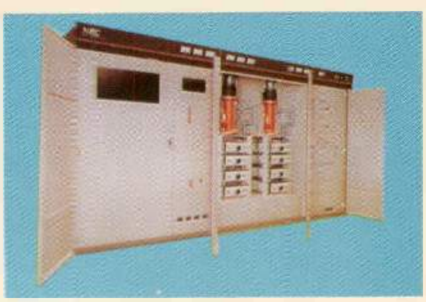

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material according to the polarization of magnetic domains. In making a saturated recording, all domains point either *north* or *south*, the *1* and *0* of digital. Analog recording adapts frequency modulation of a carrier by video signals to this binary storage nature of tape. However, randomly variable properties of tape exist for which an analog system cannot compensate. Varying physical dimensions of the medium are among those properties.

Processing for the digital VTR

To some, processing might suggest automatic control over excess levels, enhancement and other alterable signal faults. Functions, such as video AGC, are possible and practical. However, in digital recording, signal processing addresses the probability that errors of some kind will occur during recording and playback. Therefore, the concern of processing is manipulation of the datastream to prepare for possible *error correction* and the response of a recording system to dc levels.

Error correction and *concealment* alleviate the effects of many media irregularities and events that leave momentary gaps in the datastream, and they overcome most visible dropouts or mechanical media failures (wrinkles, creases and loss of magnetic material). Where analog recording places adjacent pixels of images adjacently on the tape, the concept in digital recorders is to spread points of the image over a large area on the tape, so that no adjacent pixels are written adjacently on the tape. The more important process is error correction, which handles most of the problems. Concealment is really a last-resort effort to hide problems.

General concepts

In the D-1 system, video enters the recorder as three separate digital components (see Figures 1 and 2). Depending upon the facility, these components could be in a parallel format or in a multiplexed serial form. Analog-to-digital (A/D) converters are required in a component analog facility. The D-2 system accepts one analog composite input on a single conductor. Processing begins immediately after the signal has been sampled through A/D converters (if the input was not already in digital form).

Step one is called *precoding*. To simplify precoding, certain parts of the video signal can be deleted. For example, the horizontal-blanking interval (including subcarrier burst) is constant and repetitive, and it can be reconstructed at the output of the machine from system reference signals. The same is true of the vertical-blanking interval with the exception of data on VBI lines. If you cannot ignore that data, you can pass it through the recording electronics without special processing beyond eventual channel coding. Tables 1 and 2 illustrate how precoding remaps the digital information.

Because of the large amount of information required to describe the TV image, the information is broken into smaller portions. After precoding, each field is divided into segments (five 50-line segments for D-1, three 85-line segments for D-2). Each segment is subdivided into sectors, which are the blocks of information that will be written to the tape after processing.

Digital information forming the *video* lines of a segment are distributed evenly through the sectors of that segment by an *intersector shuffle* or scrambling process. For additional assurance that no two adjacent image pixels are recorded adjacently, an *intrasector shuffle* is performed. This is a 2-part process consisting of an *intraline shuffle* to rearrange data words within each line, followed by a *sector-array shuffle* to rearrange all data and previously calculated error-correction words from the previous steps throughout the sector.

As video data passes through its processing steps (shown in Figures 1 and 2), similar procedures prepare the audio signal.

							LS WORD (4 BITS)									
MS WORD (4 BITS) INPUT	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	08	07	24	06	23	22	5C	05	21	20	5B	1F	5A	59	A2
1	04	1E	1D	58	1C	57	56	A1	1B	55	54	A0	53	9F	9E	DA
2	03	1A	19	52	18	51	50	9D	17	4F	4E	9C	4D	9B	9A	D9
3	16	4C	4B	99	4A	98	97	D8	49	96	95	D7	94	D6	D5	F6
4	02	15	14	48	13	47	46	93	12	45	44	92	43	91	90	D4
5	11	42	41	8F	40	8E	8D	D3	3F	8C	8B	D2	8A	D1	D0	F5
6	10	3E	3D	89	3C	88	87	CF	3B	86	85	CE	84	CD	CC	F4
7	3A	83	82	CB	81	CA	C9	F3	80	C8	C7	F2	C6	F1	F0	FE
8	01	0F	0E	39	0D	38	37	7F	0C	36	35	7E	34	7D	7C	C5
9	0B	33	32	7B	31	7A	79	C4	30	78	77	C3	76	C2	C1	EF
A	0A	2F	2E	75	2D	74	73	C0	2C	72	71	BF	70	BE	BD	EE
B	2B	6F	6E	BC	6D	BB	BA	ED	6C	B9	B8	EC	B7	EB	EA	FD
C	09	2A	29	6B	28	6A	69	B6	27	68	67	B5	66	B4	B3	E9
D	26	65	64	B2	63	B1	B0	E8	62	AF	AE	E7	AD	E6	E5	FC
E	25	61	60	AC	5F	AB	AA	E4	5E	A9	A8	E3	A7	E2	E1	FB
F	5D	A6	A5	E0	A4	DF	DE	FA	A3	DD	DC	F9	DB	F8	F7	FF

Table 1. *Following the A/D conversion of input video, a mapping of data bits initiates the error-correction scheme.*

System specifications of each format call for four digital audio channels. Each channel is processed identically and is inserted into the datastream at an appropriate time for recording. The audio information is delegated to an area between video sectors on each recorded track across the tape of D-1. For D-2, audio sectors lead and trail the video sector on each recorded track. See Figures 3 and 5. In both systems, audio is 100% redundant. That is, all information is recorded twice. Error correction is applied to audio, but concealment is not.

Before the data is written to tape, *channel coding* is performed. Reasons for channel coding are that dc levels and low-frequency components do not pass through the rotary transformer connection between the heads on the scanner and the outside world, and that dc and low-frequency signals are not reproduced correctly with ferrite heads. Relative dc levels will affect proper reproduction of the recorded information. To facilitate reproduction, channel coding breaks up dc and near-dc content of the digital stream before recording.

To overcome dc problems in D-1, an *NRZ* (non-return-to-zero) coding is used. This method inverts the serial bit signal as a function of the logical high level of a pseudorandom sequence based on the system clock. It is equivalent to multiplying, modulating or logically "ANDing" the data signal with a pseudorandom sequence. Because a random sequence has zero dc content (by mathematical and physical theory), multiplication creates a data signal with no dc content.

D-2 uses *Miller-squared* code for the same function. Miller-squared code is dc-free. It also is insensitive to amplitude variations and confines signal energy into a relatively narrow bandwidth, compared with NRZ codes. (See Figure 7.) The restricted bandwidth reduces crosstalk between D-2 video tracks, but that

	INPUT	LS WORD (4 BITS) 0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
MS WORD (4 BITS)	0	00	80	40	20	10	08	04	02	01	C0	A0	90	88	84	82	81
	1	60	50	48	44	42	41	30	28	24	22	21	18	14	12	11	OC
	2	0A	09	06	05	03	E0	D0	C8	C4	C2	C1	BO	A8	A4	A2	A1
	3	98	94	92	91	8C	8A	89	86	85	83	70	68	64	62	61	58
	4	54	52	51	4C	4A	49	46	45	43	38	34	32	31	2C	2A	29
	5	26	25	23	1C	1A	19	16	15	13	0E	OD	OB	O7	FO	E8	E4
	6	E2	E1	D8	D4	D2	D1	CC	CA	C9	C6	C5	C3	B8	B4	B2	B1
	7	AC	AA	A9	A6	A5	A3	9C	9A	99	96	95	93	8E	8D	8B	87
	8	78	74	72	71	6C	6A	69	66	65	63	5C	5A	59	56	55	53
	9	4E	4D	4B	47	3C	3A	39	36	35	33	2E	2D	2B	27	1E	1D
	A	1B	17	OF	F8	F4	F2	F1	EC	EA	E9	E6	E5	E3	DC	DA	D9
	B	D6	D5	D3	CE	CD	CB	C7	BC	BA	B9	B6	B5	B3	AE	AD	AB
	C	A7	9E	9D	9B	97	8F	7C	7A	79	76	75	73	6E	6D	6B	67
	D	5E	5D	5B	57	4F	3E	3D	3B	37	2F	1F	FC	FA	F9	F6	F5
	E	F3	EE	ED	EB	E7	DE	DD	DB	D7	CF	BE	BD	BB	B7	AF	9F
	F	7E	7D	7B	77	6F	5F	3F	FE	FD	FB	F7	EF	DF	BF	7F	FF

Table 2. *Before D/A conversion in the reproduction mode, video data is reorganized to its original positions according to a plan such as this mapping transform.*

characteristic has another valuable function in D-2. Miller-squared code can overwrite previous recordings without causing a significant increase in the error rate upon playback. Consequently, no rotary erase heads are required on the D-2 composite digital system, making the scanner less complicated. On D-1, a separate erase function is required, although that function may be handled with the record head.

D-1 specifically

In the D-1 system, the last 250 lines of each field (14-263 and 276-525) are recorded. Of these, lines 21-263 and 283-525 contain video data. No VBI lines (14-20 and 276-282) are included in the *source-precoding* step.

A digital active line contains 720 luminance samples (bytes) with another 360 bytes each for R−Y and B−Y, a total byte count per line of 1,440 (defined as bytes 0 to 1,439), which follows a 4-byte SAV (start of active video) timing reference. Sampling in this system (based on 13.5MHz) is specified by CCIR-601 as the 4:2:2 ratios of luminance to color-component samples.

The input video data is precoded by a one-to-one mapping algorithm. Tables 1 and 2 illustrate the video precoding and inverse video output mapping transforms. To rearrange items in a group of objects, one-to-one mapping is used to move each item, according to a predefined plan, from a specific location within group A to a specific location within group B.

To accomplish this, each pixel is identified as an element in an array of 250 recorded lines per field, with each line containing 720 pixels. Pixel IDs are pairs of integers. For example, $P_{i,j}$ is the pixel in the i^{th} row and j^{th} column. Columns with even j associate with a luminance value $Y_{i,j}$ and co-sited color difference values $CB_{i,j}$ for B−Y and $CR_{i,j}$ for R−Y. This leads to the 4:2:2 video data sequence for line i as:

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$CB_{i\,0}\ Y_{i\,0}\ CR_{i\,0}\ Y_{i\,1}$ ...
$CB_{i\,k}\ Y_{i\,k}\ CR_{i\,k}\ Y_{i\,k+1}$ ...
$CB_{i\,718}\ Y_{i\,718}\ CR_{i\,718}\ Y_{i\,719}$
where $0 \leq i \leq 249$, $0 \leq j \leq 719$
and $k = 2(\mathrm{int}(j/2))$.

The intersector distribution divides data from one video field into five segments of 50 lines each. A segment is then broken into four sectors. If *m* designates the number of a line within a segment of the picture, that is, $m = i \bmod 50$, and sectors *r* are designated $0 \leq r \leq 3$, pixels within a segment are distributed evenly among the four sectors according to the relationships for luminance Y,

$r_Y = 2((f+g+j) \bmod 2)$
$+\mathrm{int}(((j+2)(m \bmod 2)) \bmod 4)/2)$

and chroma difference,

$r_C = 2((f+g+\mathrm{int}(j/2)) \bmod 2)$
$+\mathrm{int}((((j/2)+2(m \bmod 2)) \bmod 4)/2)$,

where *g* designates the segment in which line *i* occurs, according to

$g = \mathrm{int}(i/50)$ and
f = the least significant part of the field ID (for the 525-line system only). The result is 180 luminance pixels and 50 pairs of color-difference pixels per line in each sector of a segment.

The 2-step intrasector shuffle uses similar methods to scramble data in a predetermined scheme that enables error correction upon playback. During playback, exact *inverses* of the original processing transforms are used. As a result, errors or failures as drastic as the complete loss of one head (from actual head failure to mere clogging) can be compensated with little or no observable artifacts in the reproduced image. The problems that remain, under normal circumstances, submit to error concealment, an interpolation process that creates a missing pixel by calculating what should logically exist at that point based on the value of pixels around the empty spot.

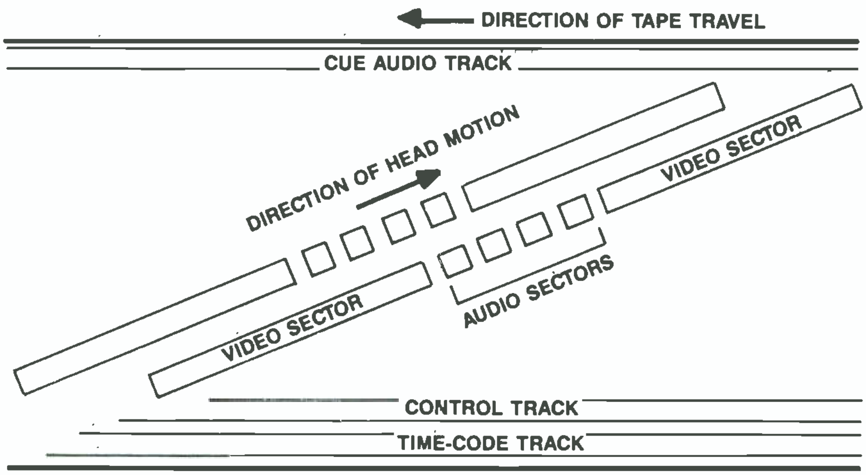

Figure 3. *D-1 component digital format.*

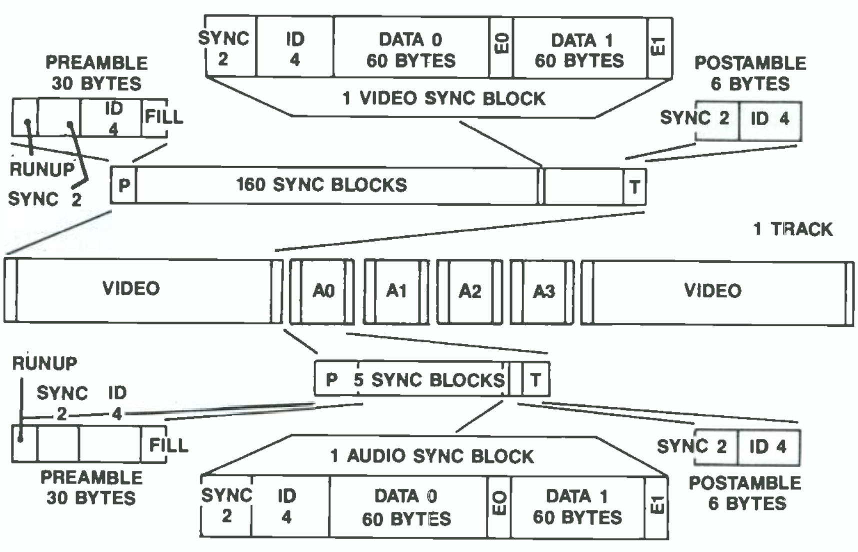

Figure 4. *The D-1 video track (not to scale).*

D-2 NTSC specifically

Processing for D-2 follows the concepts of D-1, but with some variations. First, a video field is divided into three segments of 85 lines each. Each segment will be recorded within a pair of adjacent helical tracks, with one field taking six tracks on tape, compared with 10 tracks for the D-1 format. Because 255 lines of a 262.5-line field are sampled (7.5 lines per field are not), some VBI data lines are in D-2.

Each line contains 768 samples in the active-line period (horizontal blanking and burst are excluded), based on a $4 \times F_{sc}$ sampling frequency, where F_{sc} = 3.579545MHz for NTSC. Sampling is performed orthogonally with the phase reference maintained relative to B–Y.

Footprints—format definitions

The recording footprints for D-1 and D-2 are different, and neither supports the other. (See Figures 3 and 5.) These variations support the intended purposes of the formats. The design of D-1 is to capitalize on performance characteristics available with digital signals, particularly in facilities using digital (and analog) component technologies, and on the capabilities of easier interstandard transfers. Chromakeying with components is a technique of prime interest. D-2 answers the need for a more economical digital format for NTSC, PAL and PAL-M facilities, where digital performance can be appreciated, but where transparency of component technologies are not required.

The real document of a recording system is its *on-tape* footprint. If a recording device places data on a medium in a manner that allows another system to recover the data (transparently), then interchange exists. Some actual system design factors can vary as long as interchange is maintained. Different applications may be better served by alternate transport geometries, including different scanner diameters, an appropriate scanner rotational velocity and so on. For example, the D-1 standard document indicates the system supports various scanner configurations. The important point is that the system, with a particular scanner, must be able to read the information written to tape by any other scanner for the format.

The plans for writing data to tape differ significantly for D-1 and D-2. In Figures 3 and 5, several points are apparent. D-1 includes guard bands between helical tracks, and D-2 does not. The head azimuth angle of 0° is consistent for D-1 from track to track; alternate tracks with D-2 are written with the azimuth angle alternating between +15° and −15°. The 30° difference between adjacent tracks holds crosstalk to a negligible level. The azimuth of cue, control and time-code tracks in both plans are the same.

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The guard band in D-1 protects against intertrack interference. However, the increased linear space needed to record 10 tracks and guard bands of one video field presents a problem in reproducing information at non-standard playback speeds. With the more compressed plan of D-2 (six tracks without guard bands), designing the head-to-track signals dynamically, in a manner similar to type C systems, is accomplished more easily. More flexible and complex variable-tracking capabilities for D-1 remain in question.

In D-1, two video sectors on a helical track are separated with four audio sectors, a design to protect audio integrity, moving it away from the more accident-prone edges of the tape. Audio is written twice. (Video data is placed on tape only once.) In overlay audio edits, one copy of the original audio data is retained unchanged, in case a different approach to the edit is preferred at another time.

In contrast, a D-2 track includes two audio sectors at each end of an uninterrupted video sector. As in D-1, audio sectors are duplicated for added protection. The attention given to audio follows research that concludes the ear is more discerning than the eye of inexact error concealment. D-2 designers think the shuffling system is sufficiently robust that a second copy of video data is not required.

The main reason for the D-2 audio and video data placement with the alternating recording azimuth angle is to accommodate the variable-tracking function. Another factor of transport design improves writing and reading stability of the more densely recorded data by positioning the control-track head closer to the scanner by 19mm in the D-2 plan. The change improves control pulse-to-video tolerance and allows more compact transport-mechanism design.

The structure of the track for the two formats illustrates how the signal of each system is formed. (See Figures 4 and 6.)

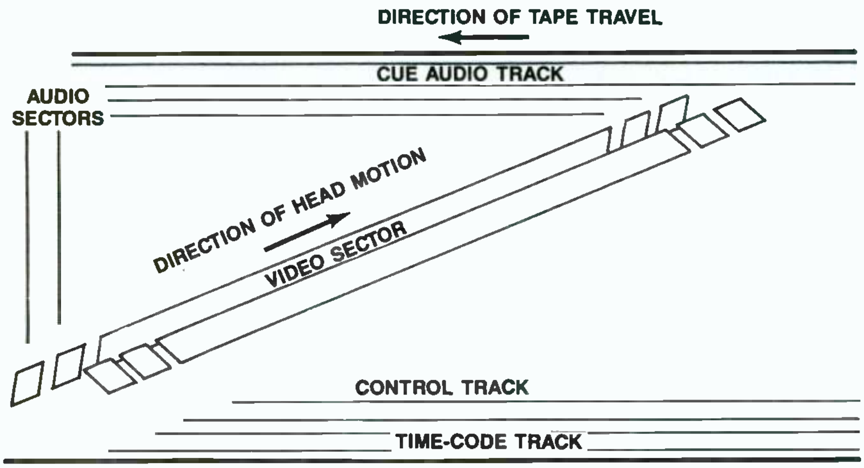


Figure 5. D-2 composite digital format.

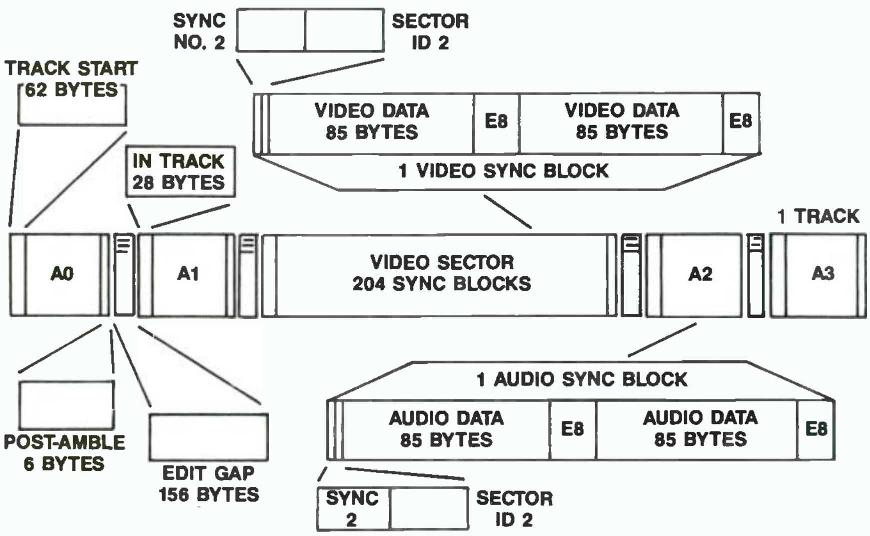


Figure 6. A D-2 track broken down (not to scale).

Error correction and concealment

Recording data is justified because of a desire for immediate or eventual recovery of the information. An obvious worst-case situation occurs if a recording is inadvertently erased. Although sophisticated techniques exist to recover significant amounts of information from erased analog audio, erasure of a video recording normally renders it unusable. It is highly probable, on the other hand, that damaged recordings can be recovered, depending on the type and extent of the damage.

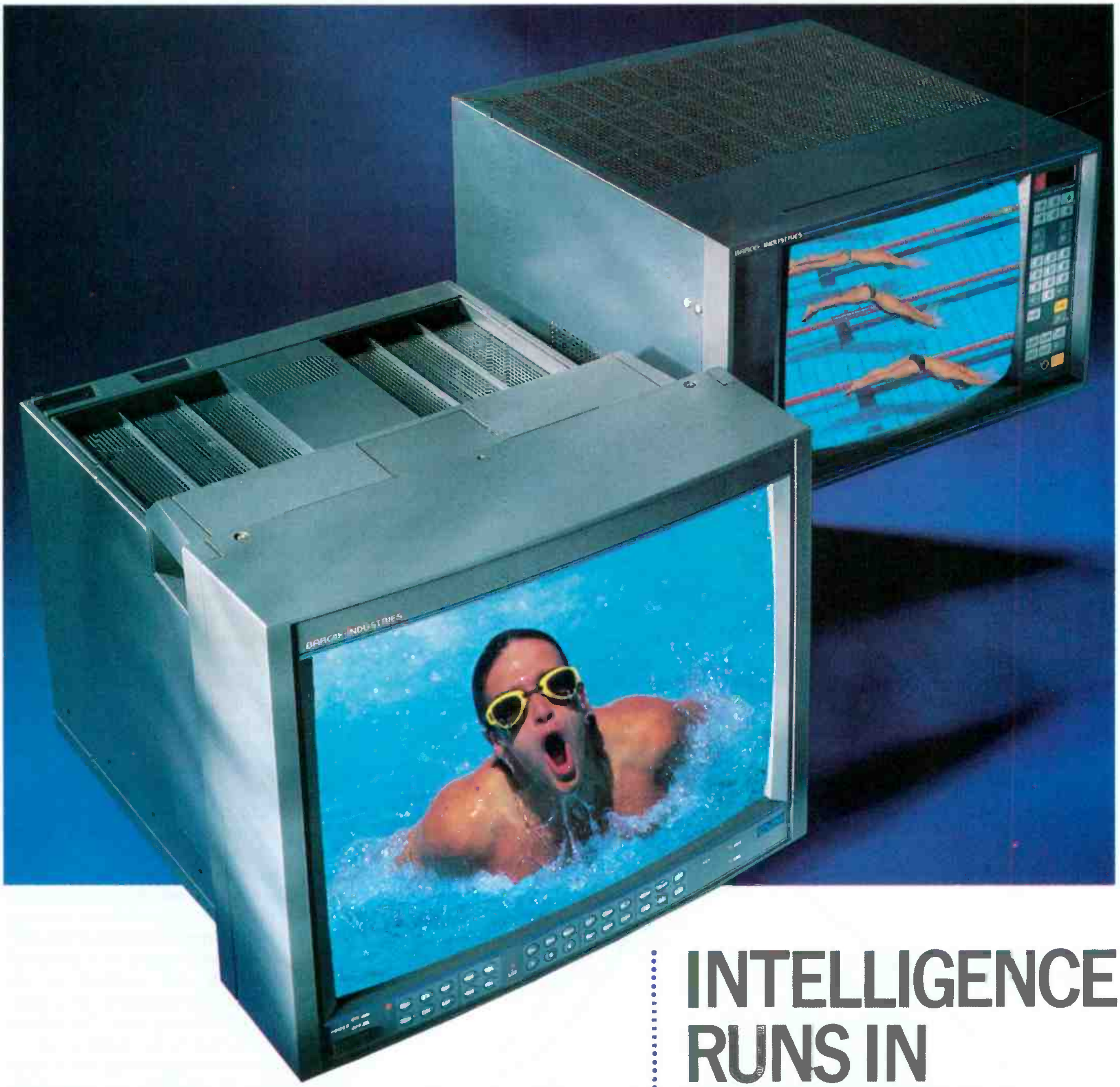
Damage or errors are categorized by three types. The *head failure* condition (true head failure or head clog) is effective along the line of a video track. An *area defect* typically affects a relatively short distance along a track, but may involve several adjacent tracks. A *scratch* may involve many tracks, perhaps as a recurring position along the tracks or as a progressively moving position along several tracks, according to the angle of the scratch relative to a track.

In a typical analog video recording, small area defects, such as dropout, are concealed with a dropout compensator. Physical damage, such as a transverse or longitudinal scratch on the tape, produces a more obvious flaw in the analog picture, but the repetitive nature of TV helps to conceal the damage fairly well. Through a consistently updated, delayed video line, data from the previous line fills the dropout. As the degree of damage increases, the ability to conceal the flaw with equipment typically associated with analog recorders decreases.

Digital formats correct or conceal a large number of errors. Errors may range from a single bit, caused by noise, to large area problems, such as scratches or media-coating flaws. A large group error usually involves thousands of bits.

Multiple steps of shuffling have been mentioned as a means to reduce errors in image reproduction. Inner and outer coders (perhaps named for their proximity to the recording medium, but in reality, more like nested parentheses in algebraic equations) combine several vigorous data-shuffling processes in both D-1 and D-2. The coder generates test words or checksums from a block of data through the use of a Reed-Solomon algorithm. The checksums are recorded along with the data. During reproduction, a decoder re-evaluates data blocks and compares the new calculation with the recorded test sums (see Figure 2). The checksum process occurs after each of several levels of shuffling.

To understand error correction, think of a cash register printout. You find individual items (data blocks) and a total (checksum). If the total of the individual prices does not agree with the total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printed on the slip, then an error has occurred in describing the articles or in entering the prices. In principle, if the block test total is not correct, the entire list is unreliable. In this case, an error is detectable, but it cannot be corrected from the information available.

If a test sum is linked to each data block and a weighting factor is incorporated for each entry, chances for error correction improve. (See Figure 8.) For example, a weighted total evaluates the first price with a factor of one, the second with a factor of two, and so on. Each weighting factor depends upon the position of the item on the slip. At the end of the list, the total of the weighted values is appended to the data block as a second test sum.

Suppose an error occurs when the second item is read as nine rather than seven. A sum is calculated and compared with the test sum taken from the recording. Differences between the new test total and the (recorded) value from the register slip reflects the position of the error. In the example (see Figure 8), the error of the second test total ($\delta\Sigma_2$) is twice as large as the difference in the first test total ($\delta\Sigma_1$). This suggests an error of two has occurred in the second item on the list. Subtracting two from the second item results in a correct value of seven.

The correction of group errors is more complicated than correction of a single bit error. Suppose that a group error is created by a breakup in the source signal being recorded. If a large error is distributed among many blocks in the recording, then each block is reliably correctable upon reproduction. For example, a group of 1,000 consecutive errors must be distributed over 1,000 blocks with one error per block. Data shuffling distributes group errors (head or signal failures) during recording. Reshuffling (descrambling) distributes errors produced by the medium or heads during playback.

By nesting two correction circuits (the outer and inner coders), you can deal with most individual and group errors. (See Figure 9.) The outer code breaks the input datastream (digits 0 through 8) into 3-number packets. Two test totals are appended to each packet. Now alter the block through a mapping transform that changes each packet (row) to a column. The inner coder calculates two additional checksums for each row and appends these onto the rows. This version of the data is written to tape.

During playback, the inner decoder finds and corrects individual errors. An inverse transform moves all matrix elements back to their original placement. If a group error has occurred, the outer decoder tackles remaining errors that now appear as individual faults in each packet.

In a digital record/play system, mapping transforms are used on a grand scale. Not only is a field broken into segments and sectors, the segments, sectors and individual lines undergo shuffling. As a result, tape damage, instead of destroying portions of the picture, may appear as little faults spread over the picture. With luck, any faults are within the correction range of the coding circuits.

Suppose that you lose 20 pieces out of a picture puzzle before it is assembled. The result is not total destruction. When the puzzle is assembled, according to the keyed shapes, error is spread out. If you view the assembled picture, you still see the picture, although you might need to interpolate some spots. That is the concept behind processing in D-1 and D-2.

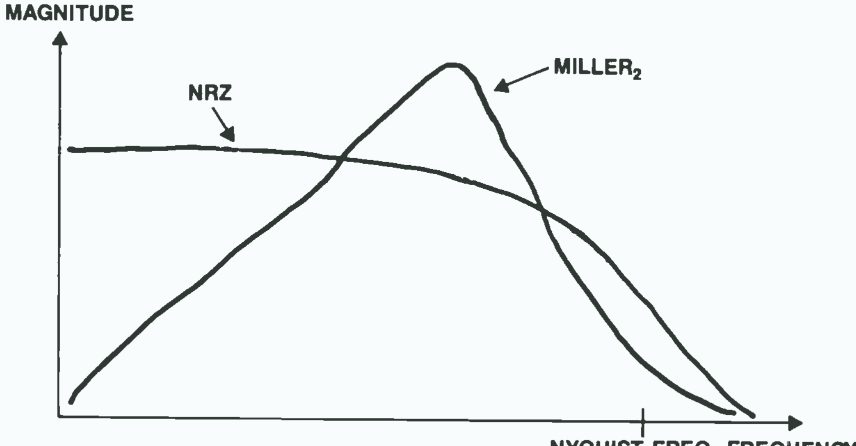
Figure 9 numerically illustrates outer- and inner-code shuffling. Suppose that errors corrupt a group three consecutive data words and one separate data word during playback. The inner decoder corrects the individual error. In the inverse reshuffling process, the group is converted into three individual errors, which are correctable in the outer decoder.

The final step to suppress problems is error concealment, which is an interpolation. In dropout compensation, missing data is replaced from the previous line. For error concealment, values of a group of adjacent pixels are applied to an algorithmic filter to determine the probable value of the missing pixel. The output of the filter is the replacement pixel.

Although concealment does not involve the masses of shuffling of correction schemes, processing algorithms for interpolation are quite complex to achieve reasonably correct results. If minute details involved numerous single, separated pixels of vastly different luminance, and if dropout errors occurred in those pixels during playback, concealment might be unable to regenerate the correct data. However, detail is seldom limited to individual pixels, especially over a period of several TV fields.

Within the standards for D-1 and D-2, variations can be provided by different manufacturers. Error concealment is one such variation. The efficiency and accuracy of any one product in performing concealment will be dependent upon the interpolative algorithm developed by its manufacturer.

New technologies present new challenges. Digital video-recording systems are



NOTES:
1. USE PSEUDO-RANDOM DATA SOURCE
2. SPECTRUM OF EQUALIZED P.B. CHANNEL, PRECEDING LIMITER

Figure 7. *The relative bandwidths of NRZ and Miller-squared data encoding indicates why the D-2 system is less sensitive to adjacent tracks and previous recordings.*

Original	1st Test	Off-Tape	2nd Test	Corrected
3	x1= 3	3	x1= 3	3
7	x2=14	9	x2=18	7
10	x3=30	10	x3=20	10
Σ_1 20		Σ_1 22		20
	Σ_2 47		Σ_2 51	

based on the values—$\delta\Sigma_1$ = 22−20 = 2
based on positions—$\delta\Sigma_2$ = (51−47)/(22−20) = 4/2 = 2

Figure 8. *An example of error detection by using checksums.*

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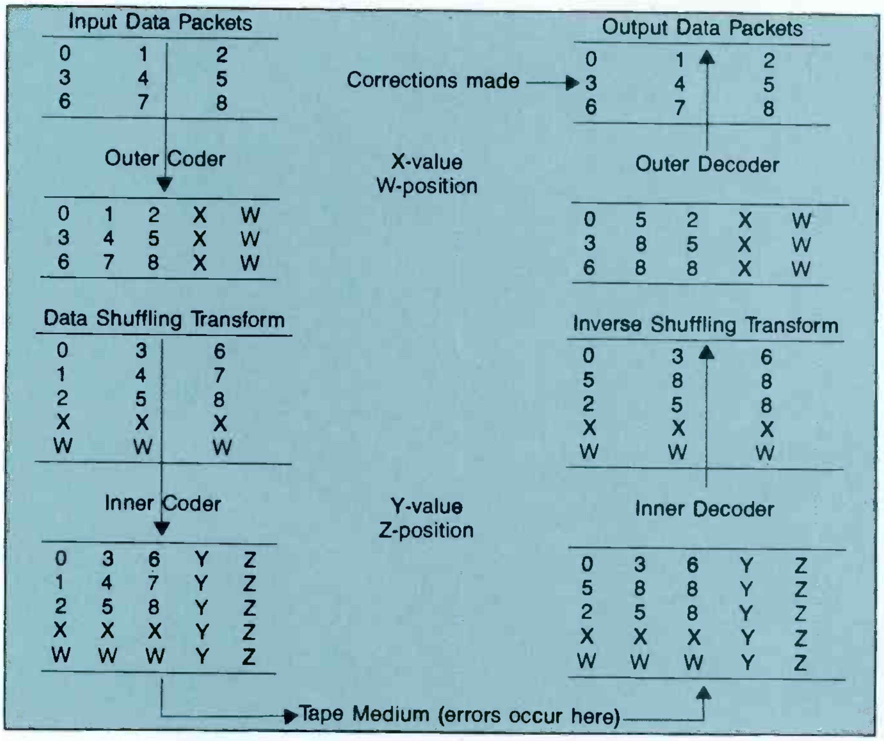

***Figure 9.** Multilevel error correction with outer and inner coders.*

no exception. The preceding comments are provided as an introduction to how digital video recording systems operate. Because simplifications have been made, a list of articles about digital video recording is given for additional reading.

Editor's note: This article was developed from published and unpublished material listed in the bibliography. Additional assistance was provided through conversations with authors of some of those papers. Fred Remley, chairman of the SMPTE working group on the digital video recorder standard, reviewed the material for accuracy. Also a member of the SMPTE television recording and reproducing technology committee, Remley is director of Michigan Media, University of Michigan, Ann Arbor, MI.

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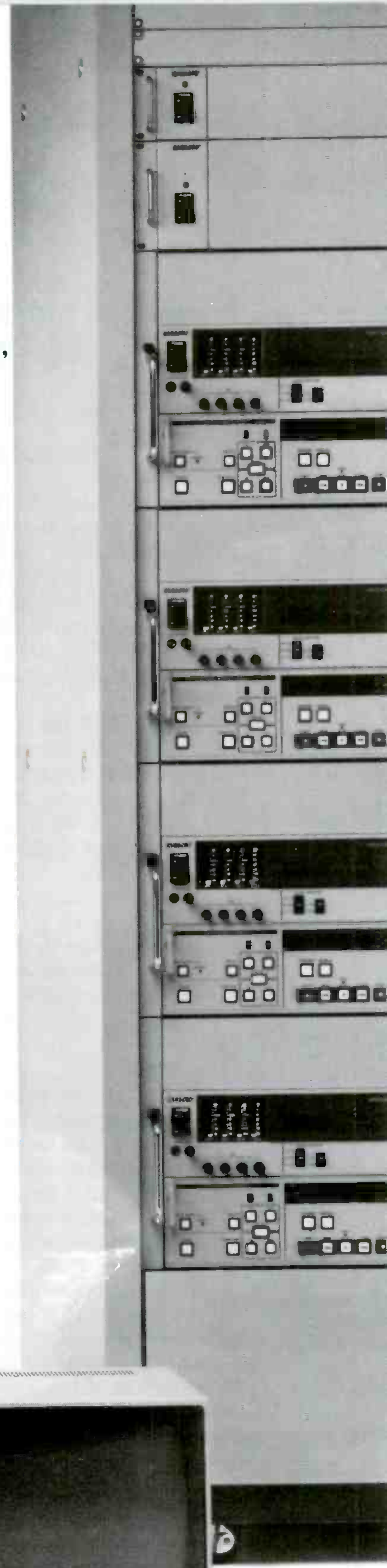

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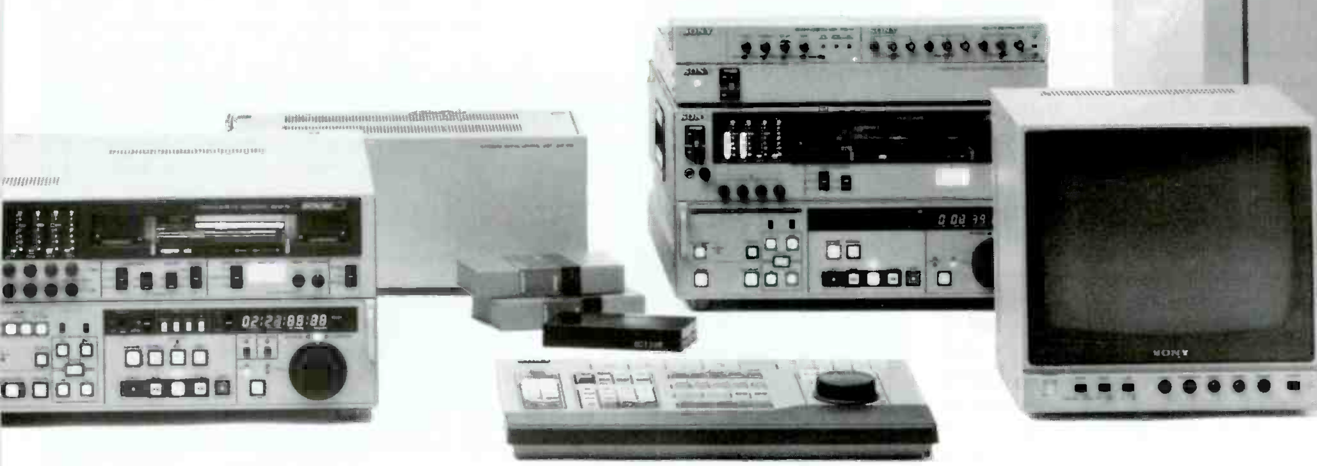


Circle (57) on Reply Card

Formulas aid in plotting coordinates

By Dane E. Ericksen, P.E.

A common task for the broadcast engineer is the plotting and retrieving of geographic coordinates. This article describes a pair of fast and effective algorithms that automate this sometimes tedious, and often error-prone, responsibility. These two programs, *PLOTLAT* and *FINDLAT*, can save you a lot of time and reduce your errors.

In Docket 80-90, the FCC updated its distance-calculation rules and specified the use of a pair of trigonometric series (formulas) for calculating the length of a degree of latitude and longitude. (Previously, the rules had specified a tabular approach.) These same formulas can be used to accurately calculate the latitude and longitude of a point, given the map scale and distances, from the nearest reference coordinates. Alternatively, the formulas can determine where to plot a specified latitude and longitude for a given map scale.

Basic rules

You can calculate the length of a degree of latitude (Dlat) or longitude (Dlong) by assuming the earth is an ellipsoid and by using the formulas shown in Table 1.

These formulas are derived from a binomial theorem expansion of an ellipsoid model of the earth. For the Clarke ellipsoid of 1866, upon which topographic maps in the United States are based, the ellipticity is equal to 1/294.98. The ellipticity, *f*, is defined as (a – b)/(a), where *a* is the equatorial radius and *b* is the polar radius. For our purposes, a is equal to 6378.2064km, and b is equal to 6356.5838km. Because the actual derivation of the trigonometric series is quite lengthy, it will not be given here. It is sufficient that these formulas exist and can be put to good use.

To get an idea of how much a length of a degree of latitude or longitude can change, examine Figures 1 and 2. Figure 1 shows the change in the length of a degree of latitude over the range of 0° to 90°. A similar comparison for longitude is shown in Figure 2.

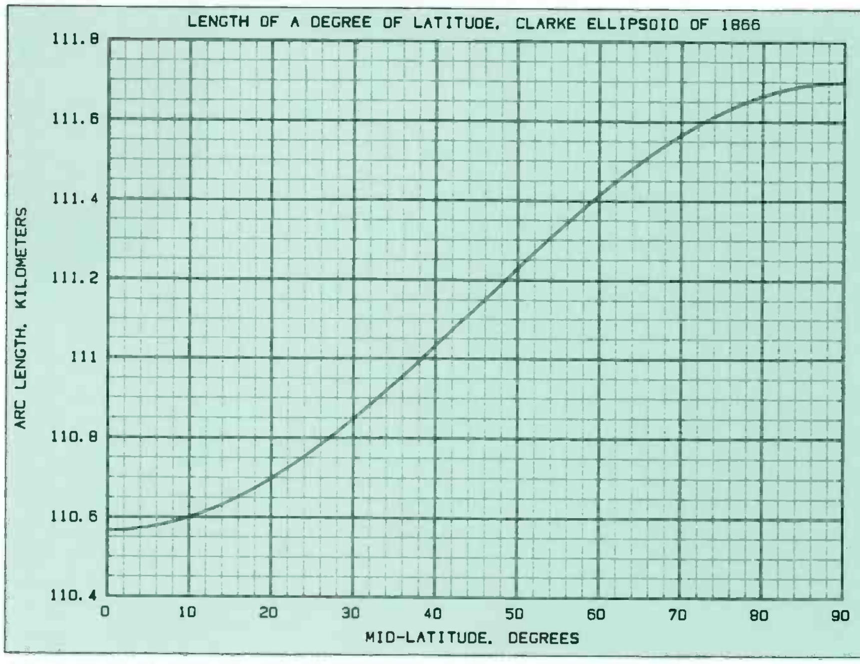


Figure 1. *The length of a degree of latitude changes as the latitude changes.*

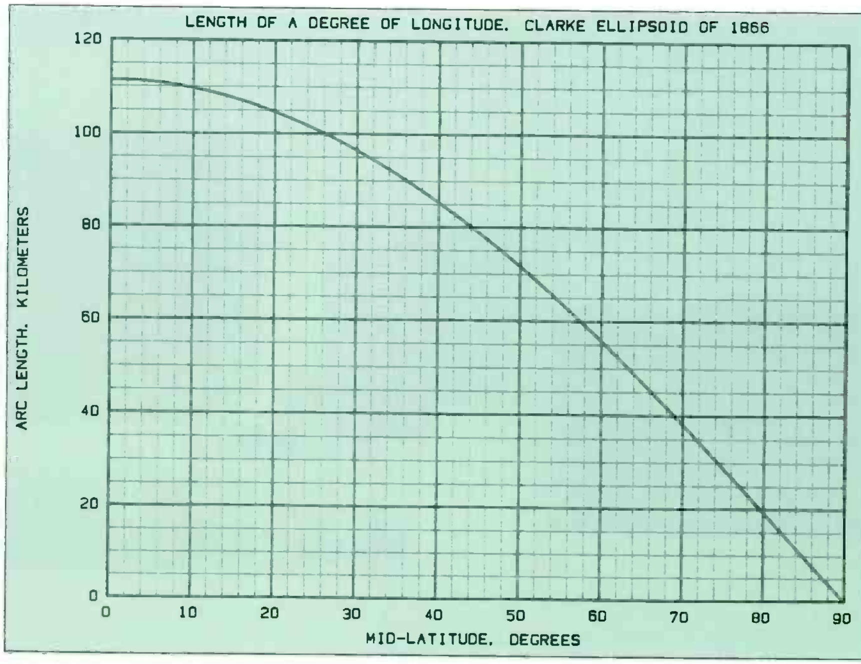
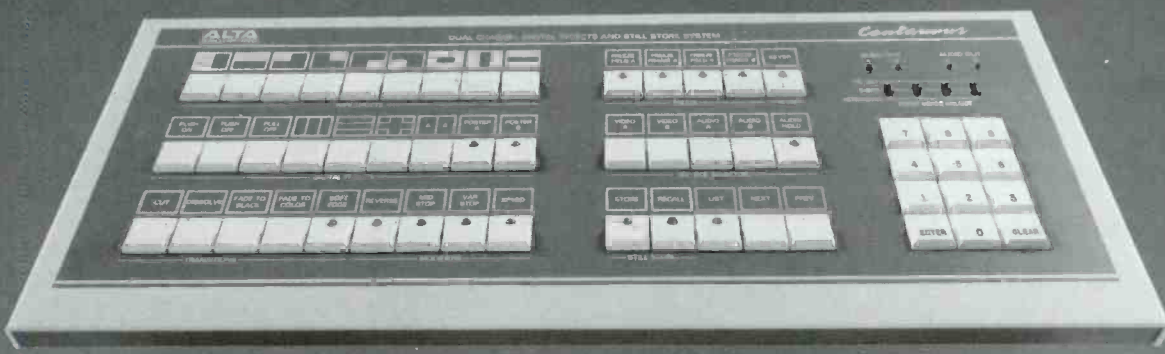


Figure 2. *The length of a degree of longitude is dependent upon the latitude. The formulas described in the text illustrate this relationship.*

Ericksen is an engineer with Hammett & Edison Consulting Engineers, San Francisco.



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Storage Capacity*	200 fields 100 frames	**250 fields 125 frames**	207 fields 207 frames	200 fields 200 frames
Synchronizer	—	**Dual**	—	Dual
TBC	—	**Dual**	—	—
Production Effects	1 wipe dissolve —	**9 wipes dissolve 7 digital**	1 wipe dissolve —	3 wipes dissolve 3 digital
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Formula 1

$$\text{Dlat} = 111.13209 - 0.56605\cos(2L) + 0.00120\cos(4L) - 0.000002\cos(6L)\ldots$$

Formula 2

$$\text{Dlong} = 111.41513\cos(L) - 0.09455\cos(3L) + 0.00012\cos(5L)\ldots$$

where Dlat = length in kilometers of one degree of latitude, at latitude L

Dlong = length in kilometers of one degree of longitude, at latitude L

L = midlatitude of the arc

Formula 3

$$x = \frac{(\text{delta long., deg.})(\text{Dlong, km/deg.})(39{,}370\text{in/km})}{(\text{map scale})}$$

Formula 4

$$y = \frac{(\text{delta lat., deg.})(\text{Dlat, km/deg.})(39{,}370\text{in/km})}{(\text{map scale})}$$

Table 1. *These formulas are used to define the relationships between map distances, incremental latitude and longitude distances and the desired point and map scales. Refer to the text for a detailed explanation of their use.*

SERIES	SCALE	TICK MARK INCREMENT
7.5 × 7.5 minutes	1 to 24,000	every 2.5 minutes
15 × 15 minutes	1 to 62,500	every 5 minutes
60 × 30 minutes	1 to 100,000	every 7.5 minutes
2 × 1°	1 to 250,000	every 15 minutes

Table 2. *This program permits the use of any of these map scales. Note, however, that not all scales may be available for every area of the country.*

Map coordinates

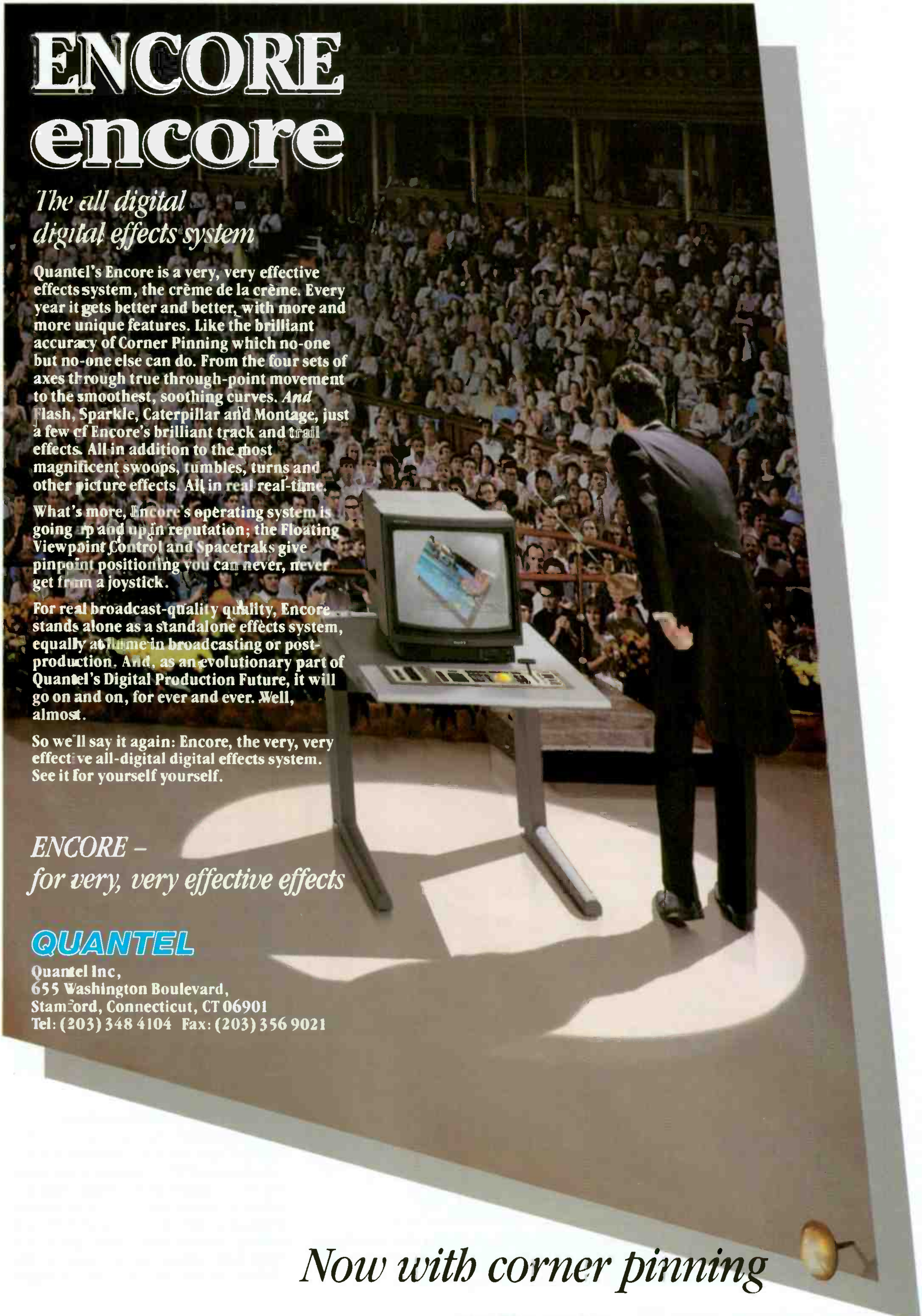
Now that the length of a degree of latitude and longitude can be calculated as a function of latitude, it also is possible to calculate the map distance up or down and right or left from a standard latitude and longitude reference mark. Such a procedure allows you to locate precisely the desired point on a map.

Formulas 3 and 4 define the relationship between:

- the map (X, Y) distances in inches.
- the incremental latitude and longitude between a reference latitude and longitude and the desired point (delta latitude and delta longitude).
- the map scale.
- the previously defined Dlong and Dlat terms.

The delta latitude and longitude values represent the difference in degrees between a known reference point (for instance, the corner of the map) and the desired point, perhaps a new transmitter site. Because map scale is known, use formulas 1 and 2, and calculate Dlat and Dlong. Formulas 3 and 4, in turn, produce a set of distances that can be used to locate the desired point on the map.

It should be noted that the 39,370 inches/km figure is used only in the United States, which has never adopted the inter-



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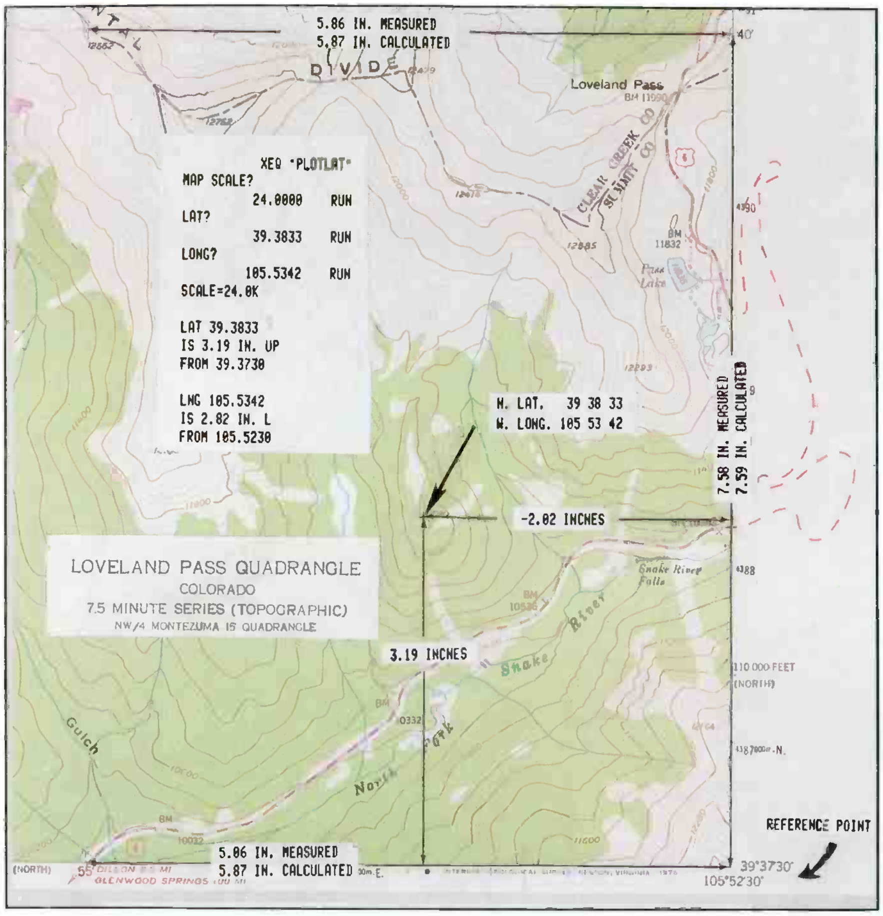


Figure 3. The PLOTLAT program is used to plot a given latitude and longitude on a 24,000 to 1 scale 7.5-minute series quadrangle map.

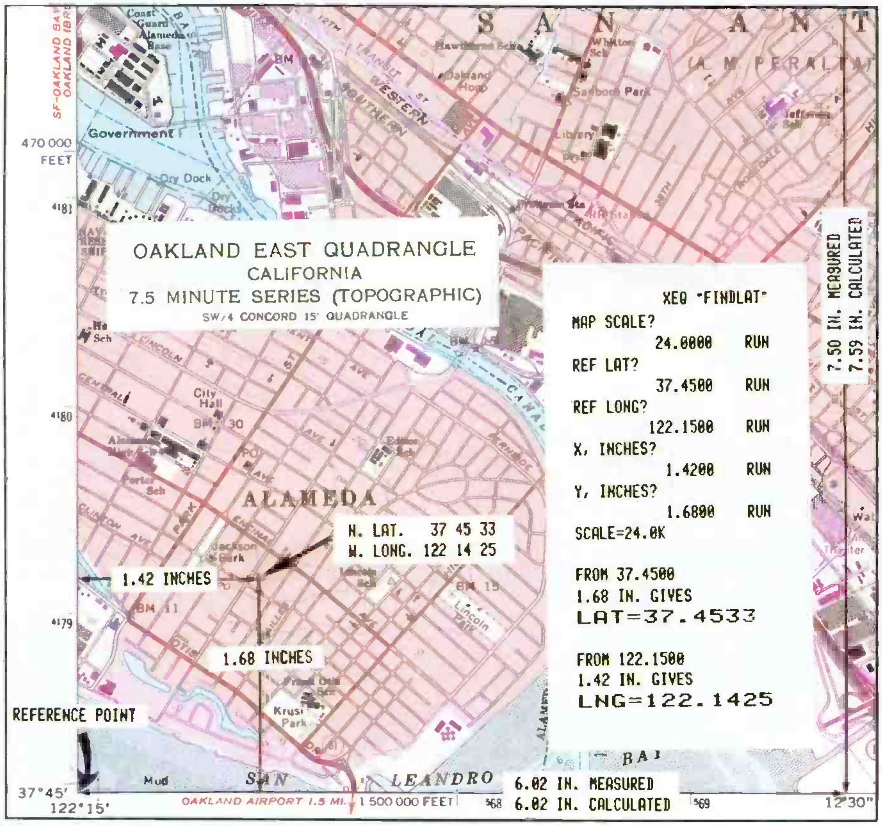


Figure 4. The FINDLAT program can determine the geographic coordinates of a desired point. Note that both the "X" and "Y" distances are entered as positive values because the desired point is to the right and above the reference point.

national standard of one foot = 0.3048m, exactly (or, 39,370.07874 inches/km, approximately). Instead, the United States continues to use the relationship one foot = 1,200/3,937m, in accordance with the U.S. Metric Law of 1866.

The United States Geological Service (USGS) topographic maps are published in the series shown in Table 2.

Therefore, once you specify the scale, the tick mark increment is known. An algorithm can, therefore, automatically reference its X–Y distance in inches to the closest standard tick mark.

PLOTLAT program

Program PLOTLAT will calculate the (X, Y) distance in inches from the nearest standard tick mark. The inputs to PLOTLAT are the latitude, the longitude and the map scale. North latitudes and West longitudes are considered positive. South latitudes and East longitudes are considered negative. If the map scale is 24,000, 62,500, 100,000 or 250,000, PLOTLAT automatically will select the nearest tick mark increment. For any other scale, the program will prompt for the appropriate increment. The (X, Y) distances are specified according to the Cartesian coordinate system, where a positive X indicates movement to the right, and a positive Y indicates upward movement.

Figure 3 shows a sample PLOTLAT run. The insert shows the data requested by the program. Note that latitude and longitude are entered in a *(degree).(minute)(second)* format. For example, 37°, 13 minutes, 7s would be entered as 37.1307.

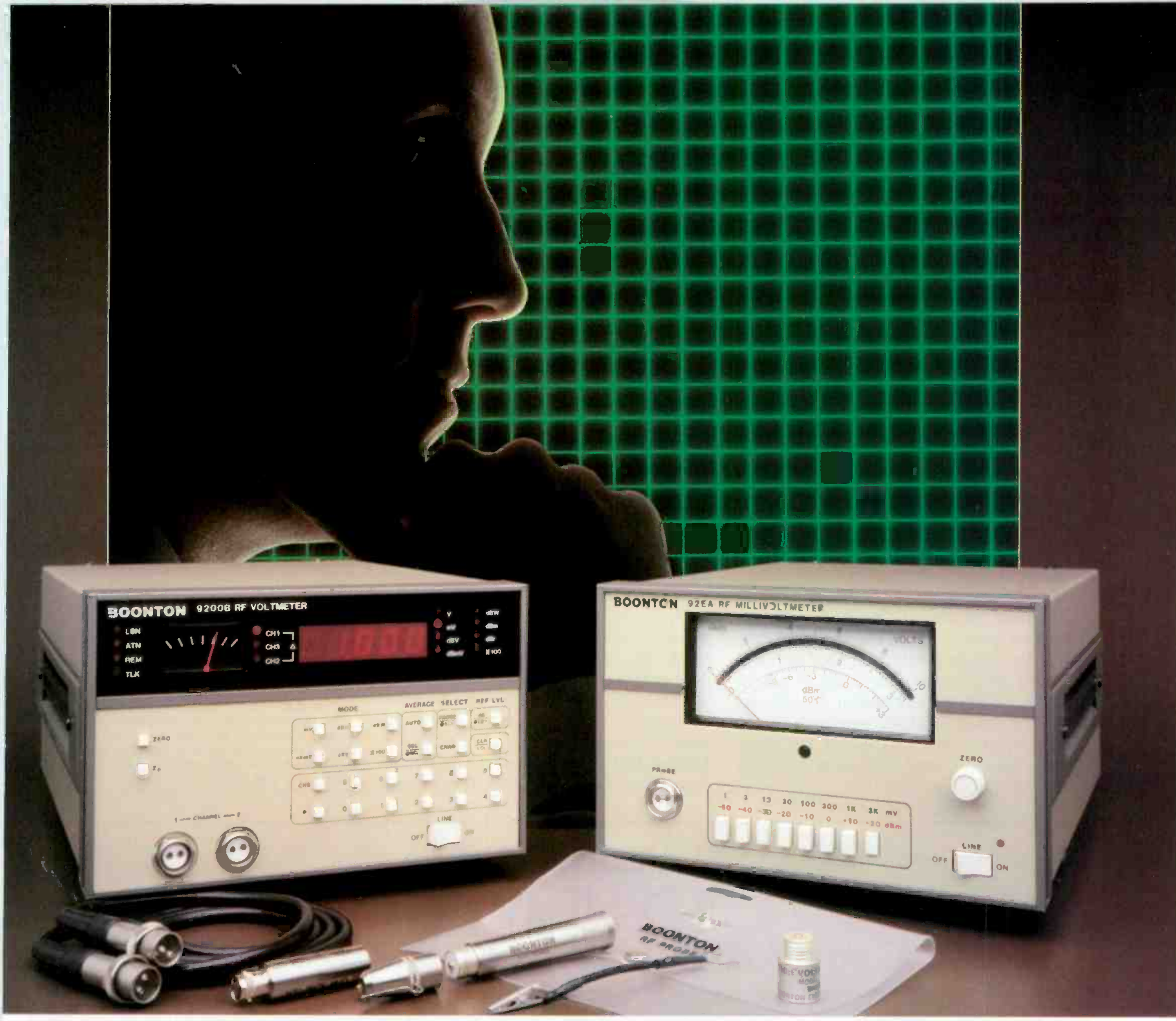
FINDLAT program

Program FINDLAT will calculate the latitude and longitude of a point if given the map scale, the (X, Y) distances in inches and the reference latitude and longitude from which the (X, Y) distances are measured. Because the length of a degree of latitude is a function of latitude, FINDLAT uses an iterative technique to calculate the latitude. However, the program quickly converges, and only a single iteration is needed.

As with PLOTLAT, the reference latitude and longitude are entered in a (degree).(minute)(second) format, and the Cartesian coordinate system directions are used. Figure 4 demonstrates the FINDLAT program.

Accuracy considerations

To determine the accuracy of the PLOTLAT and FINDLAT programs, the author measured 50 7.5-minute series maps and 30 15-minute series maps. Only unfolded, uncreased maps, stored in a room-temperature flat file, were used. A 24-inch Bruning Duraluminum scale, graduated every 0.02 inches and accurate within 0.005 inches per foot, was used to measure



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the map edges.

For the 7.5-minute series maps, the rms error for the X (longitude) dimension was 0.0289 inches, with a standard deviation of 0.0263 inches. This is the error between the measured map top and bottom and the calculated map top and bottom, and it represents the entire 7.5-minute width of the map. Because the nearest tick mark will be a maximum of 2.5 minutes away, the error should be divided by three, giving an effective rms error of 0.0096 inches.

For the Y (latitude) dimension, the rms error was found to be 0.0341 inches, with a standard deviation of 0.0209 inches. Again, this is for the entire 7.5-minute map height, so the effective error to the nearest 2.5-minute tick mark is one-third that amount, or 0.0114 inches.

For the 15-minute series maps, the rms error in the X direction was 0.0229 inches, with a standard deviation of 0.0198 inches. This error is again for the entire width of the map. Because the nearest tick mark will be a maximum of five minutes away, the error again should be divided by three, giving an effective rms error of 0.0076 inches. For the Y dimension, the rms error for the entire 15-minute map height was found to be 0.0182 inches. The effective rms error, over a 5-minute segment, is only 0.0061 inches.

The commission expects geographical coordinates to be reported to the nearest second. For 24,000 to 1 scale, 7.5-minute series quadrangle maps near the U.S.-Canadian border, 1s of latitude equals 0.051 inches, and 1s of longitude equals 0.035 inches. Consequently, the errors resulting from the PLOTLAT and FINDLAT programs correspond to approximately one-fifth of a second of latitude and one-third of a second of longitude.

Of course, at lower latitudes, the error becomes less pronounced because of the increasing length of a degree of longitude. For example, at San Diego, 0.01 inch on a 24,000 to 1 map corresponds to 0.20s of latitude and 0.23s of longitude.

Even in Anchorage, AK, where 1s of longitude equals 0.024 inches on a 24,000 to 1 scale map, and only 0.0092 inches on a 62,500 to 1 map, the nominal 0.01-inch rms error of the PLOTLAT and FINDLAT programs still should be tolerable.

The commission requires that the largest-scale topographic map available be used when determining geographical coordinates. This is normally the 24,000 to 1 scale map. However, there are some portions of the United States for which this scale is not available. For these areas, the less detailed 62,500 to 1 series maps must be used. At this smaller scale, 1s of latitude corresponds to 0.020 inches, and 1s of longitude corresponds to 0.013 inches near the U.S.-Canadian border. Although this does not provide the comfortable 3:1 margin of error that the 24,000 to 1 series maps provide, the PLOTLAT and FINDLAT rms errors still are less than 1s in both latitude and longitude.

The PLOTLAT and FINDLAT programs can be used to automate the task of plotting and retrieving geographic coordinates. Although the programs will not eliminate blunders, their use should make such occurrences less likely.

Although it is the author's belief that use of these programs will meet the FCC's expectations of accuracy, no warranty to that effect is given. For applications subject to the commission's "hard-look" policy, verification of the geographic coordinates by a second method still is recommended.

Editor's note: Space does not permit printing the program code for the PLOTLAT and FINDLAT programs. If you would like to obtain a copy of the program documentation, mail your request to Dane Ericksen at Hammett & Edison, Box 68, International Airport, San Francisco, CA 94108-0068. Include a self-addressed business-size envelope with 25 cents U.S. postage.

Program documentation for the Hewlett-Packard HP-41 series programmable calculator will be returned to all requesting parties. If you are using another computer system, refer to the formulas presented in this article to write similar programs for your specific computer.

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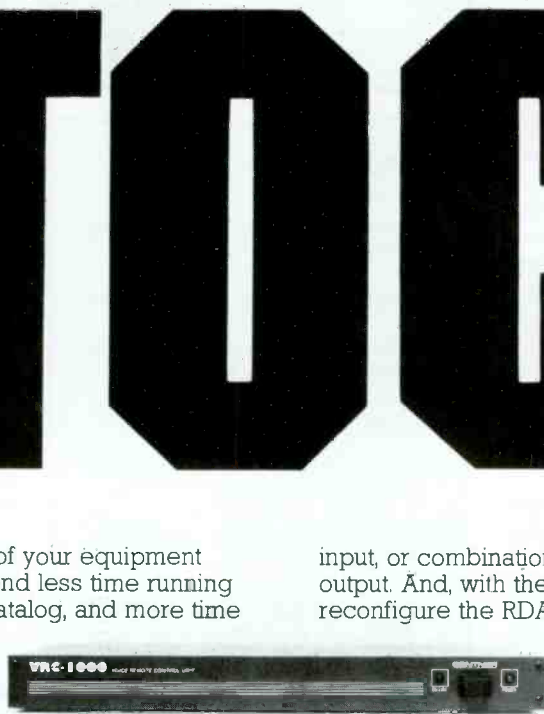

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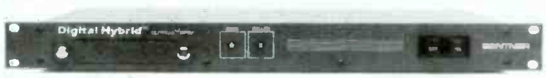

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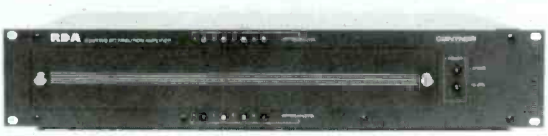

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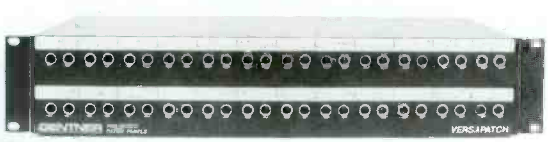

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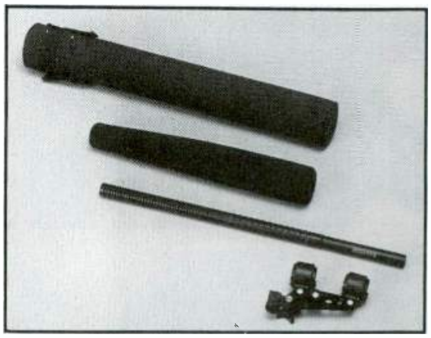

Shure SM89 shotgun microphone

By Todd Boettcher

Unlike many new products designed for the professional broadcast market, a new microphone generally does not create much excitement among engineers. After all, it's just another variation of a product that's already available. Even shotgun microphones, which have a more limited list of applications than other microphone types, are available from many professional microphone manufacturers. Even so, the Shure SM89 shotgun microphone is a worthy rival, and it looks like a winner.

Performance characteristics

Almost 21 inches long, the microphone definitely is in the long shotgun category. As is common with all directional microphones, the polar pattern is broader at low frequencies than at high frequencies. At 1kHz and below, the pattern is hypercardioid; above 1kHz, the pattern is lobar (see Figure 1).

Significantly, the microphone's multifrequency polar patterns show exceptional consistency and smoothness. As a result, the sound quality is open and natural, even at 30° off-axis, as shown in Figure 2. Beyond that, the high frequencies disappear quickly, but the remaining lower-frequency signal is still clean and defined, not muddy.

Because the hypercardioid pattern has deep nulls at 120° off-axis, the SM89 can be panned up to 30° off-axis to reduce unwanted rear sound without affecting the quality of the primary sound. This is not possible with other shotgun microphones that have lobar patterns at all frequencies, because they have no well-defined multifrequency nulls.

The frequency response is rated at 60Hz to 20kHz, with a switchable high-pass filter at 160Hz. In either case, the lows roll off at 15dB/octave, much steeper than other shotgun microphones. This steep slope effectively eliminates rumble (flat response) and wind noise (rolloff) without affecting the respective passbands. With the addition of the furnished foam windscreen, there is virtually no wind noise, even in a strong breeze.

A heavier windscreen is not available. However, if you need additional wind protection, the microphone will fit into windscreens made for other microphones.

The high-frequency response contains a 4dB peak at 9.5kHz to compensate for high-frequency loss through air with distant pickup. Consequently, intelligibility does not suffer, even with less-than-ideal microphone placement. In a test at a major league baseball game, the microphone provided a natural, full-bodied sound of the playing field (such as bat cracks) while subduing the loud cheering of the crowd. The result was a well-balanced natural sound to accompany the video.

The maximum rated SPL of 126dB is

Performance at a glance

- *Pressure gradient/line combination microphone*
- *Frequency response: 60Hz-20,000Hz*
- *Output impedance: rated at 150Ω, recommended load 800Ω*
- *Output level: at 1kHz −52dB(2.5mV)*
- *Output clipping level: at 1kHz, 800Ω load −1dBV(0.89V)*
- *Maximum SPL: 126dB SPL at 1kHz, 800Ω load*
- *S/N ratio: 79dB reference 94dB SPL*
- *Power: phantom voltage range 11Vdc-52Vdc 2mA*

Boettcher is a staff engineer at WTMJ radio and TV, Milwaukee.

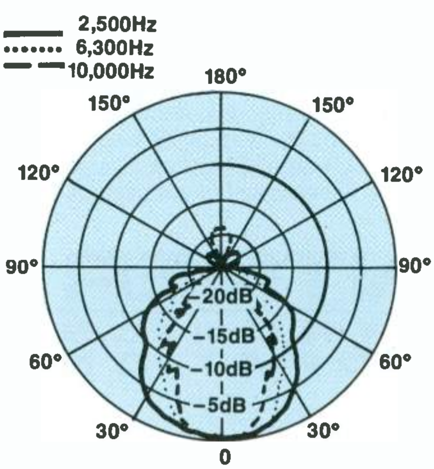

Figure 1. *The microphone exhibits hypercardioid characteristics at low frequencies. It exhibits lobar characteristics (shown here) at frequencies above 1kHz.*

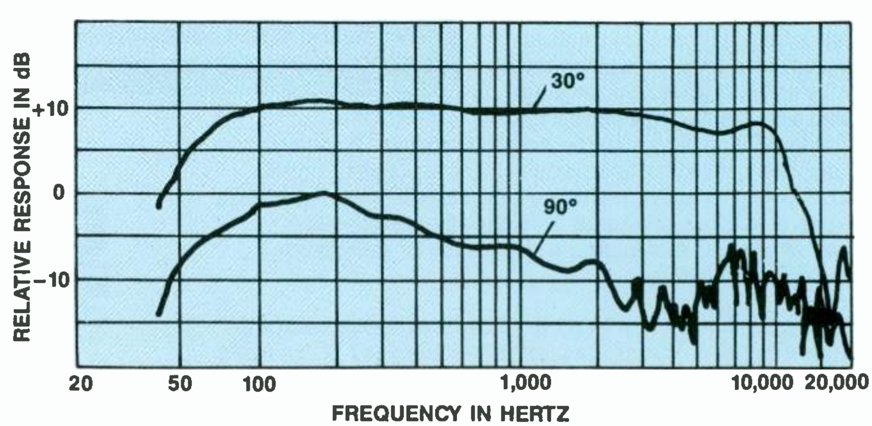

Figure 2. *Its directional characteristics and smooth frequency response allow the microphone to be positioned to minimize undesired sound pickup. This graph shows the response of the desired source positioned at 30° off-axis and the undesired source at 90° off-axis.*

adequate for almost every application (except perhaps a rocket launch pad or a near-proximity gunshot). Even a trumpet played *forte fortissimo* (fff) is only 125dB SPL, six inches in front of the bell. Also, the self-noise of 15dB SPL is excellent and indicates a quiet pre-amplifier. The transformer-balanced output feeds a male XLR output connector.

Another advantage of the SM89 is its extremely light weight. At 195g (6.9 ounces) it is at least 20% lighter than its competition. This is especially helpful when it must be mounted on a hand-held camera or on a fish pole. In addition, the "high-tech" satin black finish is unobtrusive, in case it appears on camera or flying in a theater.

The microphone is designed to operate from an 11Vdc-52Vdc phantom supply. For many applications, this is easily accommodated. When phantom power is not available, an optional PS1A power supply is available. This microphone cannot accept an internal battery.

An RFI filter is included in the preamplifier. Tests were made in close proximity to a handi-talkie, a microwave transmitter, and in a high-RF multiple-antenna broadcast environment with no RFI susceptibility. See Figure 3.

Additional considerations

Mechanical handling noise is a problem with the SM89. It simply cannot be handheld because any handling movements are quite audible. The problem can be overcome, however, by using the optional A89SM shock mount. This 2-point suspension shock mount mechanically isolates the microphone from all handling noise and provides secure, balanced support for this or any other ¾-inch-diameter microphone.

The mount's design includes a clever strain relief for the microphone cable (up to 0.237-inch diameter). In addition, it can mount on three standard threads: 5/8-27; 3/8-16; and 5/16-18. The shock mount is comprised of two sets of concentric C-shaped clips, with the inner clips elastically suspended within the outer clips. The inner clips are capped with plastic tips to avoid scratching the microphone case. The first time I removed the microphone from

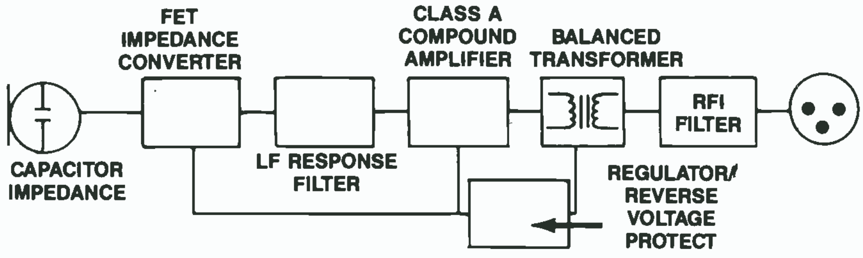

Figure 3. The microphone includes an RFI filter, as shown in the block diagram.

the shock mount, one of the plastic tips came off. Apparently it was not seated properly and needed regluing. Its absence did not affect microphone support.

Although the microphone is quite durable, the carrying case is recommended. The case is made of a 22-inch length of 2½-inch-diameter plastic pipe with a foam cushion at each end. The pipe is encased in a thin layer of foam, which is covered by a heavy-fabric outer case. The fabric-hinged cap is closed with a Velcro clasp for easy, all-weather use. The microphone can be stored in its foam windscreen inside the case, making it virtually immune to physical damage.

As perfect as the case is for protecting the microphone, there is no provision for attaching, supporting or protecting the shock mount. Nor is a separate case available for the shock mount. Because the microphone may be subject to extensive field use, it would be desirable for the shock mount to also have a field case that could be attached to the microphone case with Velcro straps to keep them together.

Field trials

Field testing on a hand-held camera brought about several other considerations that are not the fault of the microphone. Many hand-held cameras have integral single-point mic holders designed for "short" shotguns. Therefore, they do not incorporate a separate mic mount stud. When mounted in the integral single-point holder, the SM89 was front-heavy enough and long enough to enter the camera lens's field of view.

As an alternative, it was decided to tape the microphone to the top of the camera just behind the wide-angle field of view. Although this secured the mic, it then became susceptible to handling noise. Also, because of the close proximity to the camera head, it picked up the whirring sound of the electric lens zoom motor. Clearly, a better solution would permit the use of a shock mount on the camera.

For voice applications, the microphone works best on a stand, boom or fish pole. At a distance of two to five feet, voices were natural and intelligible. Because of the microphone's reach, the user must be careful about background sounds and acoustics.

The Shure SM89 is a high-quality condenser shotgun microphone with a pleasing, natural sound. It is durable, lightweight and competitively priced. It should serve the broadcast community well in news gathering and production.

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

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

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

Ready to Score Another Scoop!

Toshiba's Mt-3 Satellite Scoop System makes live coverage of fast-breaking news events routine.

This complete Ku-band system fits in 10 compact, lightweight flight cases that meet IATA carry-on baggage regulations.

Once on site, an array of proven Toshiba design advances facilitate set-up. A 1.8M parabolic antenna with a simplified 360° azimuth rotary mechanism in addition to an easy polarization, 6-segment FRP antenna reflector make set-up short and sweet.

The synthesized exciter minimizes MCPC/SCPC carrier phase noise and provides all-purpose control flexibility. And advanced microprocessor controls assure complete access with all existing international communication satellites.

Toshiba's Mt-3 Satellite Scoop System effectively takes the work and worry out of live news coverage.

The Mt-3 was developed jointly by Toshiba and CBS Engineering and Development.

Satellite Scoop System
Mt-3

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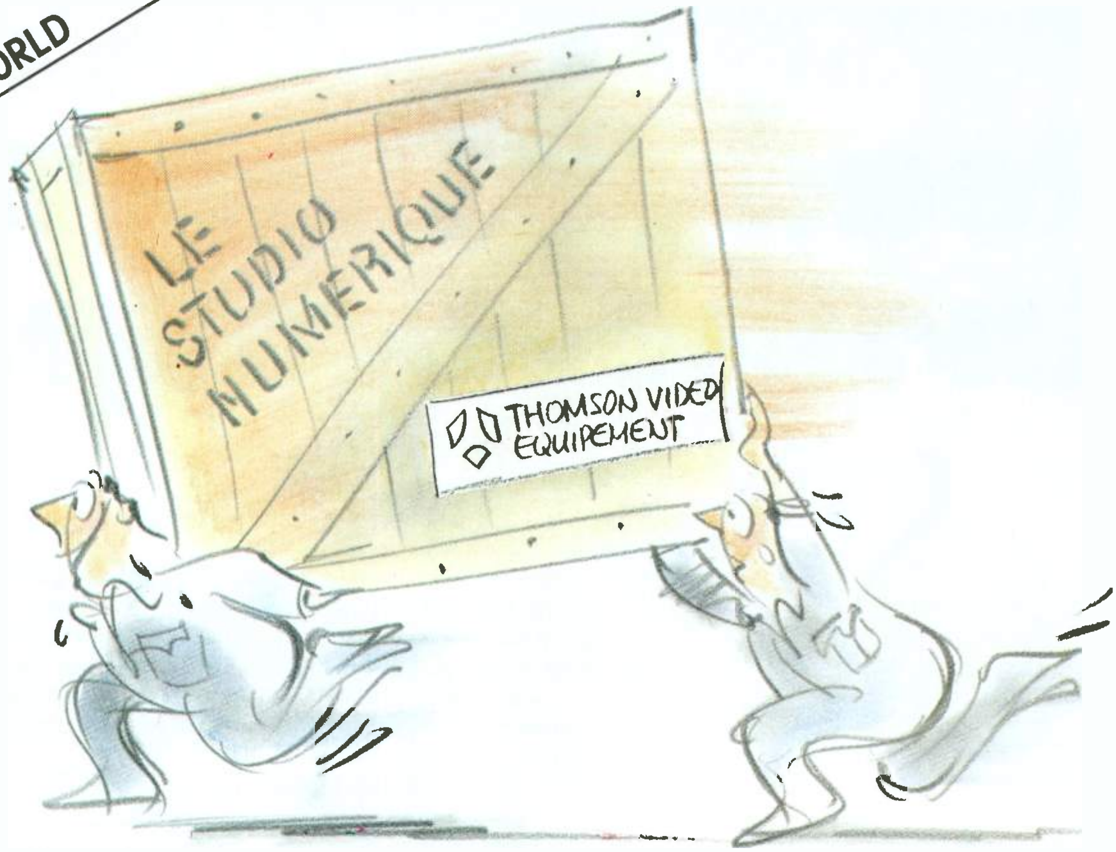

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SBE Update

Candidates prepare for election

By Bob Van Buhler

Candidates for the annual SBE election have been selected. All current officers plan to run for re-election, and at least eight candidates will compete for positions on the board of directors. Officers are elected to 1-year terms; directors, under the revised bylaws, serve 3-year terms.

Candidate Jack McKain, of the Kansas State Network in Wichita, KS, has served on the board since Ron Arendal's administration. Vice president Robert Van Buhler, WBAL-AM and WIYY-FM, Baltimore, also is seeking re-election. Secretary Richard Farquhar, SOS Productions, Columbus, OH, seeks re-election after a 1-year term in that office. Farquhar has worked for several years on the certification committee. Bill Harris, KRZN-AM and KMJI-FM, Englewood, CO, is running for a second term as treasurer. He previously served as a member of the board of directors.

Board of directors

Of the eight candidates in contention for the six 3-year terms as directors, six are incumbents. These eight represent the official submissions from the nominating committee. In accordance with the bylaws, other candidates may be added to the ballot as a result of last-minute submissions by the general membership.

Jeff Baker of Heritage Communications, Rochester, NY, seeks re-election, as does Dr. Mary Beth Leidman, Indiana University of Pennsylvania. Both have worked on projects for the Ennes Foundation.

Another incumbent, Joe Manning of Arizona State University's KAET-TV, also is seeking an additional term. Manning has been the guiding hand of the sustaining membership committee for several years and deserves credit for its success.

Steve Brown, WLTE-FM, Minneapolis, has served the board for two years, since his appointment to a vacancy created by a director resignation. Brown serves on the chapter liaison committee and is editor of the newsletter, "Short Circuits." This newsletter, sent to chapter chairmen, provides informative material for use at local chapter meetings.

Robert Goza, KMOV-TV, St. Louis, also appointed to the board because of a vacancy, has been active in the planning of each of the national conventions. Goza's appointment was to the vacancy created by the retirement of Jim Wulliman.

Ed Roos, WPTV-TV, Palm Beach, FL, has served on the board since his appointment during the administration of Richard Rudman. He is seeking a 3-year term.

Paul Montoya of Shamrock Broadcasting's KXKL-AM/FM, Denver, is one of two candidates seeking a first term at the national level. Montoya has served the Denver chapter in a variety of offices, including chapter chairman and frequency coordinator.

Paul Lintz, who also seeks a first term at the national level, is retiring as director of engineering for WTOL-TV, Toledo, OH. He indicates that he will have time and resources to travel on society business.

The directors who will continue to serve the remainder of their terms include: Phil Aaland of KGUN-TV, Tucson, AZ; Terrence Baun of Multimedia Radio, Milwaukee; Dane Ericksen of Hammett & Edison, Oakland, CA; David Harry of Potomac Instruments, Silver Spring, MD; Larry White of KNOO-TV, Tulsa, OK; and Tom Weems of Tektronix, Beaverton, OR.

Biographies, photos and a description of each candidate's goals and objectives will be published in the "SBE Signal" before the election, which will be timed to coincide with the national convention, in the fall.

Frequency coordination manual

Past president Richard Rudman, a member of the All-Industry Frequency Coordination Council, recently completed an important chapter for the "Broadcast-Cable Frequency Coordination Manual." The chapter focuses on the coordination process and how it is to be accomplished.

The manual's first chapter, about policies and procedures, was written by the SBE. It discusses the issues of frequency coordination administration and committee organization.

Another contribution by the society was Gerry Dalton's chapter on database administration. This chapter details the software requirements to use IBM-compatible or DOS computers to administer the coordinated area database.

Initial review copies for selected frequency coordinators should be ready by convention time.

National involvement

Many other broadcast organizations are involved in the NFCC meetings. These include National Cable Television Association; Radio and Television News Directors Association; National Association of Broadcasters; National Public Radio; and the major networks, ABC, CBS, NBC, CNN and Mutual.

Four SBE members are involved at the national level: past president Richard Rudman, counsel Chris Imlay, national frequency coordination committee member Gerry Dalton and vice president Robert Van Buhler, who is also vice chairman of the national committee.

Perhaps the longest term and most constructive involvement by a network representative could be attributed to Martin Meany, director of allocations engineering for NBC Television. His unflagging support and visibility at national frequency coordination committee meetings, and his sage and tactful advice at the all-industry meetings, have been crucial in the success of both organizations.

The all-industry NFCC is chaired by SBE and NAB engineering advisory committee member Jerry Plemons, Outlet Communications, Providence, RI.

It is particularly important that frequency coordinators attend the frequency coordination meeting at the convention. It is scheduled for 8 a.m. on Sunday, Sept. 25, in Currigan Hall of the Denver convention center. If you are a local coordinator, plan to be there.

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

Continued from page 48
generally envisioned for the control of production equipment is to have the newsroom computer get things ready, but allow the human to actually "take" them. The computer can compare the scripted time of each segment with the "take-up time", and keep track of a show's progress. Such a course integrates the newsroom computer into news production to about the same extent as it is in news writing. The humans get to do the creative end of production; the frantic "busy work" goes to the computers.

There are probably advantages in not relinquishing *too much* control to the computer. In a news program, the technical director not only presets all the necessary effects, but also has the responsibility *not to take them* if something goes wrong. Many a director has been spared an embarrassing mistake by the TD's ability to size up a situation and change plans instantly and creatively. Such expertise is developed only after years of experience.

Some manufacturers envision a new tool for the technical director. It would be a universal control box that operates each of the interfaced devices. It may well consist of a touch screen with bright softkeys. The status of each device probably would be displayed, as would some indication of what is preset on each. Appropriate "go" or "next" buttons would be used to activate each device at the appropriate instant. Perhaps such a system could even be programmed to perform, unaided, certain program segments that vary little from night to night, such as show opens, closes and standard breaks. "Panic routines," preset courses of action that buy time when things go wrong, also might be programmable.

Fulfillment of second generation

Second-generation newsroom systems must overcome communication barriers among different pieces of equipment. Although it seems an easy matter to have the computer issue the instructions instead of humans, in reality it is extremely difficult. Many character generators, for instance, have the ability to receive external instructions, but few send any type of acknowledgment signal back up the line. A human must oversee the process because if the CG were to fail, the newsroom computer probably would never know it.

It is similar with the control systems for most broadcast equipment today. A human must determine whether an instruction was actually executed. Protocols may exist to overcome these communication problems, but they require wider implementation.

Continued from page 4

an experimental AM radio station in Beltsville, MD. The move is part of the NAB's ongoing efforts to improve AM radio.

The facility, which will operate on the 1,660kHz frequency and use power up to 5kW, will be designed to confirm whether new theoretical antenna designs will be able to achieve separate control over skywave and groundwave signals.

The NAB is planning to operate the facility for approximately two years. If the designs prove effective, the NAB plans to urge that these techniques be adopted by broadcasters, and incorporated in appropriate sections of the FCC rules.

NAB opposes changes in TV DA technical criteria

The National Association of Broadcasters has told the Federal Communications Commission that it "strongly opposes" any change in the agency's TV directional antenna technical criteria. However, the NAB said it supports the commission's proposal to eliminate other technical standards that the association agrees have outlived their usefulness.

In its filing, the NAB said that the use of highly directional antennas at UHF and VHF can cause additional TV interference to occur, usually in the form of ghosting. The association contends that the elimination of all directional criteria from the rules, as the commission proposes, runs counter to the development of efficient spectrum usage.

The NAB said that aside from the difficulty of predicting and measuring directional TV signal strengths, a highly directional TV antenna may be unstable and/or change performance over time. "We believe the commission's current limitations are reasonable and serve to 1) assure maximum service to the public and, 2) minimize the likelihood of TV interference."

Group formed to support ATSC/SMPTE HDTV standard

A number of manufacturers of production equipment for high-definition TV (HDTV) program production have formed an organization to support the application of the ATSC/SMPTE 1125/60 HDTV production standard in the United States. William G. Connolly heads the technical efforts of the HDTV 1125/60 Group.

The primary purpose of the HDTV 1125/60 group is to enhance U.S. program production opportunities by actively supporting the 1125/60 production standard for HDTV studio origination and program exchange. It aims to provide an industry forum for close dialogue between U.S. TV producers, HDTV systems users and manufacturers who can guide the development of production equipment using the ATSC/SMPTE HDTV production standard.

One of the activities of the HDTV 1125/60 group will be to provide accurate information on the ATSC/SMPTE HDTV production standard to all interested manufacturers, as well as to the technical and non-technical groups currently studying advanced TV systems.

Among the charter members of the group, the manufacturers who currently offer or intend to offer production equipment using the ATSC/SMPTE 1125/60 HDTV production standard are: Chyron, Cinema Products, Compression Labs, Dynair Electronics, Dynatech Broadcast Group, Grass Valley Group, Hitachi America, Ikegami Electronics, Magni Systems, NEC America, Panasonic, Panavision, Quantel, Rank Cintel, Sony Corporation of America, Symbolics Graphics, Toshiba America, Ultimatte and U.S. JVC.

By John Blau,
European correspondent

Murdoch-Sugar plan for more channels may start standards war

Plans have been made to bring four more TV channels to Europeans beginning in February. But the price of those plans may be a standards war in the making.

Sky Channel, the satellite arm of Robert Murdoch's multimedia corporation, secured space for the channels on the Astra medium-power satellite, which is to be launched in November. Satellite dishes capable of receiving the Sky TV channels will be produced by the U.K.-based Amstrad consumer electronics company. The dishes will be 60cm in diameter.

To keep costs down, Sky TV has chosen to transmit in PAL, the present European broadcasting standard. Although three of the four channels will be available throughout Europe, Sky TV and Amstrad plan to concentrate on the U.K. market.

The venture between Murdoch and Alan Sugar, president of Amstrad, may launch a war over technical broadcasting standards. The Murdoch-Sugar alliance is being viewed as a pre-emptive strike on the British satellite TV market to block Murdoch's main competitors, British Satellite Broadcasting (BSB) and British Telecom. Sky TV will not only transmit its programs in PAL instead of D-MAC, which was chosen by its competitors, but also will start broadcasting before the others.

According to industry experts, there are two non-technical problems with D-MAC. First, the microchips needed to decode signals sent in D-MAC and convert them to the present PAL standard will not be available in large quantities until next year. Second, the cost of adding such a decoder to satellite receiving equipment is expected to double the price to the consumer.

In a related story, the German-based Internetall semiconductor company has won an order from BSB to design and produce four million chips for DBS receivers. Great Britain plans to launch a direct broadcast satellite next year.

Unlike the Germans and the French, who opted for the D2-MAC transmission standard, the British have chosen D-MAC for their three TV channels. The chip components will consist of two ICs. The first will decode D-MAC signals; the second will decode signals for future DBS programs.

Sony, Panasonic cling to hopes for HDTV in Europe

Sony Europe is making a strong push for HDTV on the continent. In cooperation with the Japanese TV network NHK, the company has helped developed a 1,125-line, 60Hz system, which both parties would like to see become the international industry standard.

Dr. Takashi Fujio, director of TV research at National/Panasonic in Japan, recently commented that he has little "elbow room" to negotiate any sort of compromise on HDTV. Most European broadcasters and equipment suppliers have shown little interest in converting to Japan's proposed 1,125-line, 60Hz industry standard.

Intelsat V in orbit

Intelsat V is Europe's latest telecommunications satellite to go into operation. It was launched aboard the Ariane 2 rocket and put into its geostationary orbit on May 17. Intelsat V is intended primarily for European telecommunications, but several public TV stations plan to use it for internal studio-to-studio programming.

Business is good despite lost mission

The German Association of Satellite Receiving Equipment expects a brisk business for parabolic dishes despite the failed launch of TV-SAT 1. The association cites smaller-dish antennas and lower costs as the reasons. Suppliers are offering 90cm-wide-dish antennas for Eutelsat TV transmissions.

International Broadcast Equipment Exhibition

November 16–18, 1988
Convention Center Tokyo, Sunshine City, Tokyo, Japan

Over the last 20 years, Inter BEE has grown into the largest, most advanced exhibition of broadcasting-related equipment in Asia. Inter BEE '88 will carry on the tradition, showing leading-edge technology. Last year's show attracted more than 22,000 visitors from around the world to see the latest developments in high definition television and video technologies, CCD cameras of studio quality, and the fast-growing direct broadcast satellite field. This year, Inter BEE '88 will once again present the newest in video, audio, and new media technology. Make it your business to attend Inter BEE '88.

Inter BEE

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Multiline frequency extenders

Comrex has introduced the following frequency extenders:

- A generation of multiline frequency extenders provides 10kHz audio on three standard telephone lines. Encoders are available rack-mounted or in portable housing. All line-management functions are fully automatic.
- The PLXmicro pack is a compact frequency extender for use with a cellular telephones. It is a full-duplex unit with a monitor decoder and hybrid. The unit is battery-operated and contains both microphone and tape inputs along with AGC and optional ac power supply.

PLX micro packs

Circle (351) on Reply Card

Software update

Environmental Satellite Data has introduced True View Dimensional Weather, a software update to existing ESD front-end weather work stations and weather graphics systems. It adds the capability to create true, 3-D images of high-resolution weather satellite and radar imagery. With the update, a TV weathercaster can create an airplane projection base map centered on any city in the United States. The software then will remap the clouds or radar into a user-defined, 3-D display to accurately match the custom base map. Images can be created for a static display or for time-lapse looping to show the vertical development of weather over a period of time.

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Computer systems, software

IBM has introduced the Application System/400 computer system, which controls six AS/400 models. The computer features double the performance of the System/38 and five times that of the System/36. With its advanced function and programming flexibility, more than 20 programming, database or user-query languages are available. The computer arrives with its own classroom and repair capability, in the form of on-line education and 24-hour on-line electronic service and support features. Additional benefits of the System/400 include an integrated state-of-the-art system, large application library, improved ease of use, reliability, connectivity with other IBM systems, fast processing, and investment protection for System/36 and System/38 owners.

The model B10 AS/400 system

Following is a list of specialized software suppliers:

- Columbine Systems, Golden, CO, markets several different software packages, including those that automate traffic, film and music inventory management, scheduling and sales, and billing and accounting functions.
- Enterprise Systems Group, Colorado Springs, CO, offers the Broadcast Manage-

ment System, which automates audience research, sales proposal preparation, traffic/operations and film inventory. It also has billing and accounting applications.

- Jefferson Pilot Data Systems, Charlotte, NC, markets systems for broadcast management that feature sales management reports. They also handle billing, sales and traffic functions, accounts receivable and general accounting applications.
- Management Solutions, Springvale, MN, has a software package called Radio Station Management that offers traffic and billing functions, performs sales and spot load projections to inform management of daily sales status, and provides exact time affidavits for billing.

Two companies have developed software packages for Cable TV systems operators:

- Creative Management Systems, Toms River, NJ, features a software package called the System 1.
- Information Systems Development, Coral Springs, FL, markets a software solution called CableMaster.

Circle (352) on Reply Card

Equalizer and pre-amp

API Audio Products has introduced the following products:

- The API 5502 equalizer is a 19-inch rackmount device, and is an all-discrete unit (no ICs) that has the same circuit design as the original API 550A modular equalizer. The equalizer has four frequency bands and 14 frequency points, including 20Hz and 20kHz. The unit has all gold switches, four API 2520 op-amps and 36 discrete transistors. It is self-powered, using a toroidal power transformer. Many functions are selectable with special jumper plugs, including the polarity of the in/out XLR jacks, the overall gain of the EQ in 3dB steps, and a high-/low-bandpass filter selector that can be bypassed completely.
- The 3124/3124M microphone pre-amplifier/mixer mounts in one 19-inch rack space. It comes in a 4- or 2-channel version and features XLR mic inputs that are internally selectable for 150Ω or 600Ω, and a front-panel ¼-inch Hi-Z input at mic level. It has a 20dB pad for the microphone input; a mic/line switch; an LED bar-graph display with −12, −6, 0, +8 and 16; and a microphone pre-amp gain control. The output sections consist of an XLR balanced output that clips at +28dB and a ¼-inch-balanced output that clips at +22dB. The 3124M has all the features of the 3124 plus a stereo bus, an auxiliary bus, a mix level control, panning and an auxiliary send with a stereo return.

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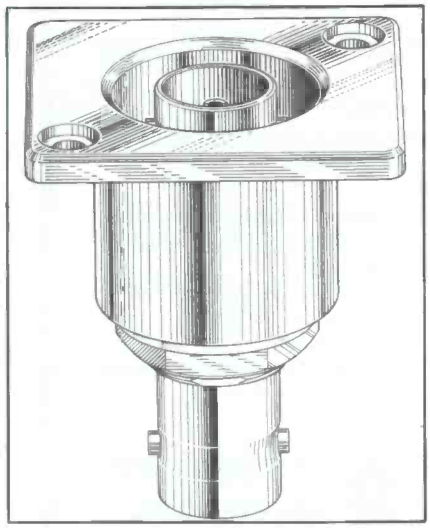
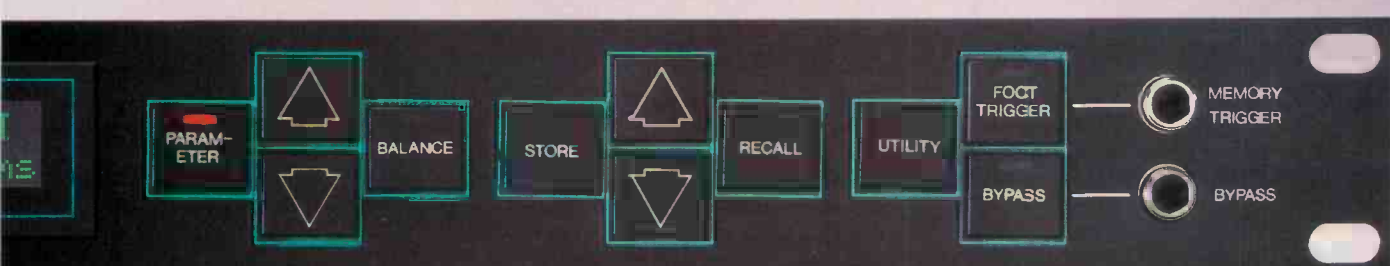
Line of BNC connectors



Canare Cable has introduced flush mount 75Ω BNC receptacles. Features include low VSWR characteristics (less than



1.1) up to 2GHz; correct impedance matching when 75Ω coax cable is used; compatibility with all other BNC connectors; and precision manufacturing to exact tolerances.

Circle (354) on Reply Card

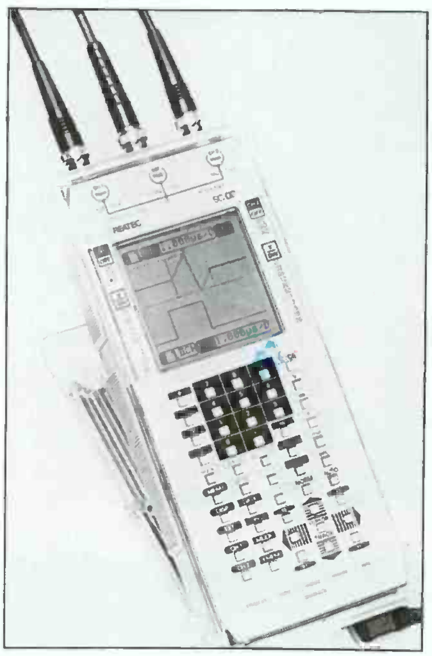
Computer-assisted programming system

Concept Productions has introduced the following products:

- The CAPS I is a computer-assisted programming system that features R-DAT, digital audiotape decks. The unit allows control of up to 12 DAT decks and full random access of all audio selections, music, spots and PSAs. The system may be used for automated, live or satellite programming.
- The CAPS II is a computer-assisted programming system that features R-DAT, digital audio tape decks. It provides 120 hours of fully random accessible storage. There is up to five days of walk away, plus interface to traffic systems for auto loading. The system may be used for automated, live or satellite programming.
- Radio formats for automated or live-assist radio stations are available on standard analog or digital audiotape. Formats include adult contemporary, CHR, AOR, country and contemporary MOR.

Circle (355) on Reply Card

Portable oscilloscope



Createc Signal Computer has introduced the SCOUT SC-02 portable oscilloscope. It features an analog-to-digital, digital-to-analog measurement system. It uses zener and quartz references and feedback from the microcomputer through a precision 12-bit DAC. Benchtop features include 2-channel, 20MHz digital oscilloscope; transient recorder with 46 data memories; 10 complete setup memories; dual timebase viewing; high contrast, supertwist LCD display; 1MHz true rms multimeter; compensated dc measurement; automatic frequency measurement to 7MHz; and computing functions on all input and stored waveforms. All measurement systems are self-tested and self-calibrated.

Circle (356) on Reply Card

Prefabricated voiceover booths

Acoustic Systems has introduced a line of prefabricated voiceover booths, designated as BB models. The models are available in 10 sizes, with a standard inside height of seven feet. They are constructed with 4-inch-thick panels that have an STC rating of 45. The booths are designed to be disassembled and re-assembled with no loss of acoustical integrity. A standard feature is an acoustical floor that is carpeted and mounted on vibration isolation rails to eliminate acoustical coupling to the existing foundation. Additional features include prewired duplex outlets, silenced ventilation system, prewired incandescent lighting, a recessed conduit run for cable management, splatter-coat platinum enamel paint finish and glazed windows in both the wall and the door.

Circle (357) on Reply Card

SCPC demodulator

AVCOM has introduced the following products:

• The SCPC-3000E, a fully agile single-channel-per-carrier demodulator. It features a high-performance synthesized 50MHz-90MHz tuning module. Frequencies are tunable in 800 steps of 50kHz

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Circle (82) on Reply Card

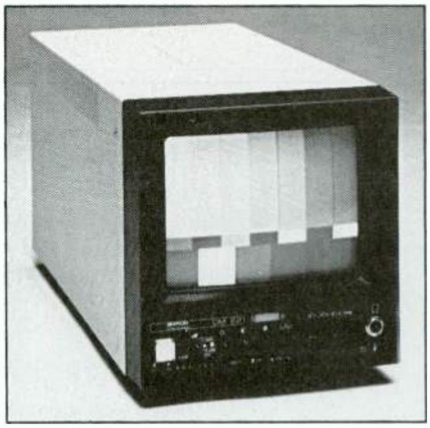
each. Standard expansions are 3:1 and 2:1, with other format expansion formats available. De-emphasis is switchable between 0μs, 25μs, 50μs and 75μs. Selectable low-pass 15kHz, 7.5kHz and 5kHz audio filters also are standard.

• The PSA-37D portable spectrum analyzer features frequency coverage from less than 10MHz to more than 1,750MHz, and from 3.7GHz to 4.2GHz in five bands. Frequency readout is shown in megahertz on a 4-digit LCD front-panel display. The unit has a built-in dc block with +18Vdc. Selectable vertical sensitivity of either 2dB or 10dB/div is standard.

Circle (358) on Reply Card

Broadcast monitor

Barco Industries has introduced the CM 22 9-inch, high-resolution, portable professional color monitor. It uses automatic kinescope biasing (AKB) and is available with a high-resolution dot mask in-line gun CRT. Preset front-panel controls set hue, brightness, chroma and contrast. The unit has inputs for two composite video signals and one RGBS signal.



Circle (359) on Reply Card

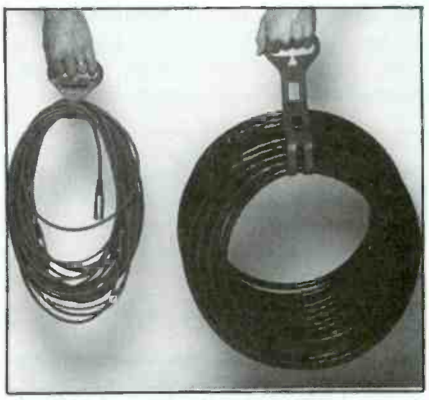
Tunable notch filters and low-pass filter line

Eagle has announced a series of tunable notch filters that feature coverage from 9.5MHz to 850MHz in six ranges. Each filter covers one range. The notch depth is 25dB minimum with some models having as high as 35dB. Insertion loss is ≤0.5dB up to 1GHz. A multiturn tuning element allows notch-frequency tuning. At TV frequencies, the notch is wide enough to suppress a modulated TV signal. Power rating is 50W outside the notch disturbance width and 10W at the center of the notch.

Circle (360) on Reply Card

Handle cable hanger

Canford Audio has introduced a handle cable hanger. It is easier and cleaner to use than gaffer tape, and it comes in four colors and two sizes. The small size accepts bundles up to 45mm, and the large size accepts bundles up to 130mm.



Circle (361) on Reply Card

Automated audio mixer

The Grass Valley Group has developed the AMX-170S automated audio mixer. Up to eight VCA (voltage-controlled amplifier) inputs can be routed simultaneously to any of four program channels permitting full use of the new generation of videotape recorders with 4-channel audio record and playback. The mixer features 4-band equalization and level trim for each of the eight mixing inputs. Control of the EQ, trim and filters may be delegated to any of the mixing inputs. The trim control adjusts incoming levels through adjustments or by presetting the input amplifiers. The mixer's E-MEM audio memory system permits complete storage and recall of panel settings including input levels, EQ and trim values. Crosspoint selection, including input sources and output routing, as well as transitions sequences may be controlled by the mixer or triggered by the edit controller. Monitoring is complete with independent amplified headphone output and monitor outputs.

Circle (362) on Reply Card

Frequency-agile subcarrier transmitter

ISS Engineering has announced the model FAST1 frequency-agile subcarrier transmitter. It can place an FSK data subcarrier on any frequency from 50kHz to 8MHz in 100Hz steps. Any deviation can be selected from 1kHz to 99.9kHz in 100Hz steps, and any data rate from 1b/s to 19.2kb/s. All frequency generation is through the use of a numerically controlled oscillator, eliminating phase noise and frequency drift. The unit can be used alone, combined with many units or summed with a video signal.

Circle (363) on Reply Card

Standby power source

Sola has introduced a standby power source (SPS) that provides off-line battery/inverter backup power for protection against power failures. This 1,800VA, portable, plug-in SPS unit provides protection by switching from line power to battery/inverter power within a half-cycle when line voltage drops below −15% of nominal. At that threshold, the load is transferred to the inverter within 4ms to 10ms. When ac voltage returns to within 10% of nominal, retransfer time occurs within 2ms to 4ms. When the ac line is present, the unit guards against transients and provides protection from electrical noise in frequency ranges of 10kHz and above.

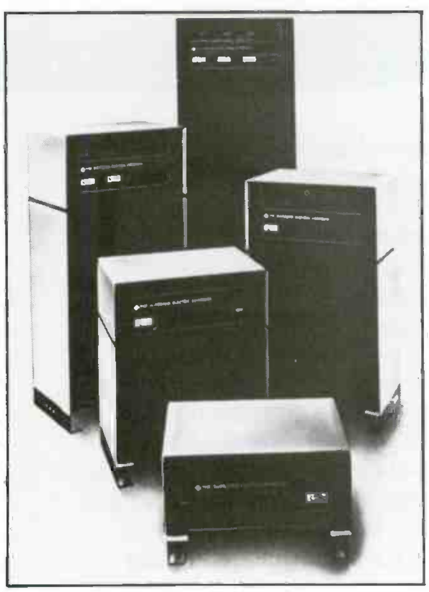
Noise attenuation is rated at 40dB minimum at 100kHz. When supplying battery/inverter power, the SPS provides clean sine-wave output with voltage regulated to ±3% of nominal and total harmonic distortion limited to less than 5%.

The unit's design also incorporates fuse-protected input circuitry to prevent damage to the unit in case of a short-circuit or extreme overload conditions. An audible alarm sounds to signal line failure, and repeats approximately every 20s. The SPS operates on 120V, 60Hz input and plugs into any standard ac electrical outlet. Included are a 6-foot power cord with a NEMA 20-P input plug and four NEMA 15-R output receptacles.

Circle (364) on Reply Card

Automatic voltage regulators

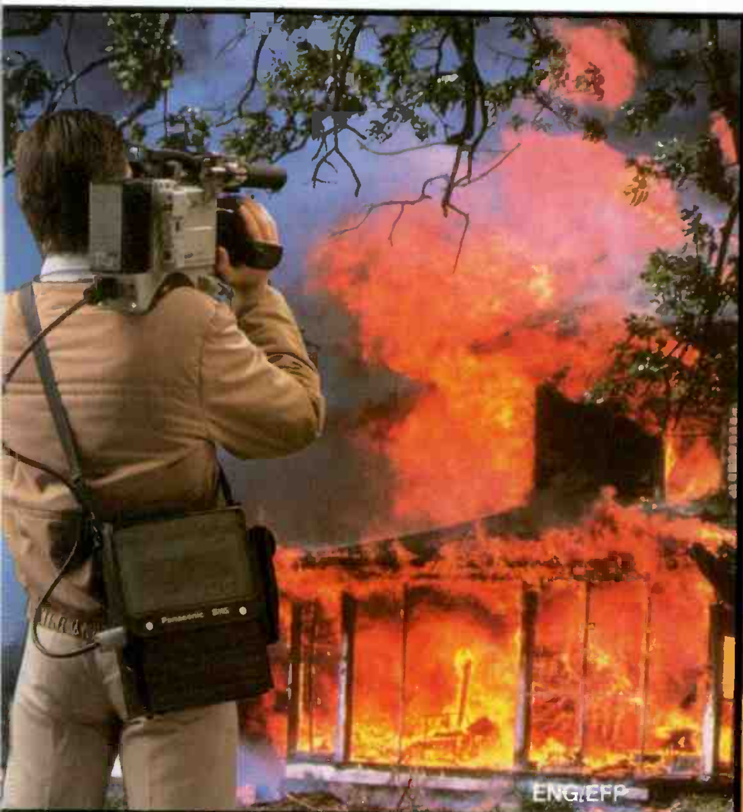
The Superior Electric Company has introduced the WHR series Stabiline automatic voltage regulators. They are high-power units that correct the fluctuations in input voltage that can cause computer memory loss or damage to components in sensitive electronic equipment. Typical input correction models +7.5%, −15% narrow range; +12.5%, −25% wide range. Depending on the model, single- and 3-phase types may have one control for all phases or individual control for each phase. An input circuit breaker is standard. Features include 99% typical efficiency and less than 0.25% added harmonic distortion. Because the units are insensitive to the magnitude and power factor of the load, they can be used even with loads having high inrush currents. Ratings are available from 2kVA to 1,680kVA.

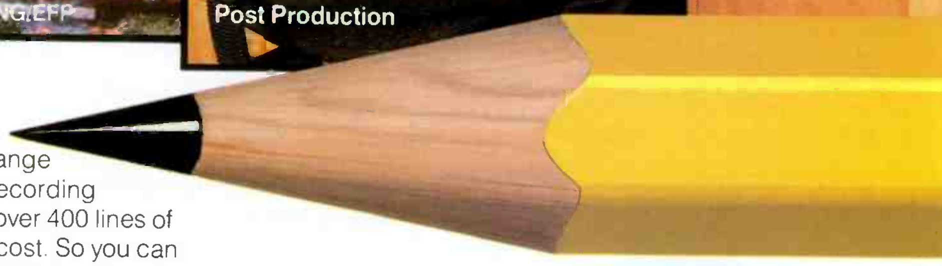


Circle (365) on Reply Card

Circle (91) on Reply Card

Get a sharper image...





The SVHS format behind the Panasonic® Pro Series will change the way you look at half-inch recording systems. Because it delivers over 400 lines of horizontal resolution. At an affordable cost. So you can get a sharper image even as you sharpen your pencil.

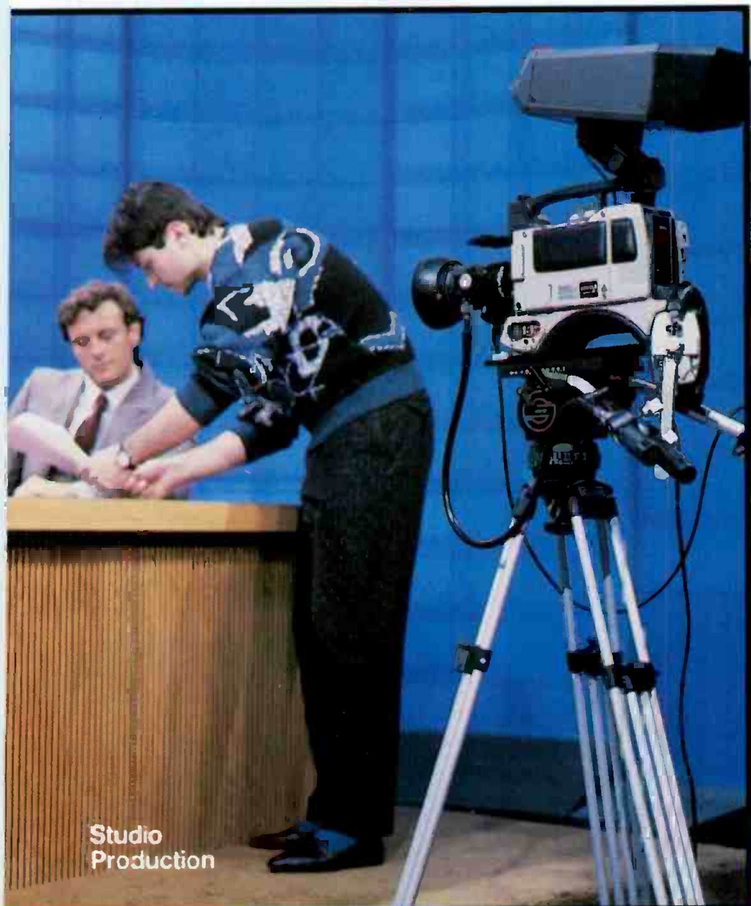
In the field, the Panasonic Pro Series offers you a host of benefits existing formats fall short on. Like two hours of recording time on a single cassette with Hi-Fi audio capability. In a highly portable package. To capture more action and sound on fewer tapes. Which means you'll have less to carry in the field and on your budget. And the Pro Series easily interfaces with a variety of existing component or composite cameras and VCRs. So you can easily integrate the Pro Series in your present field operations.

For editing and post-production applications, the Pro Series takes full advantage of the SVHS format as well. With easy to use features and high performance capabilities. Such as digital framing servo circuitry to provide highly stable edits. And time code input/output facilities for frame accurate editing. The Pro Series editing VCR also features 7-pin dub capability to maintain component signal integrity throughout the system.

For studio production, Pro Series components are designed with flexible operations in mind. With VCRs and monitors outfitted for total systems application. And cameras designed for use both in the field and in the studio. To help minimize your investment without limiting your capabilities.

For duplication, Pro Series monitors and VCRs provide you with the convenience and versatility of half-inch cassettes. And the performance of SVHS. When duplicating, you can maintain excellent picture quality thru component or composite signal transfer. And dub Hi-Fi audio simultaneously with the video signal. There's even a Pro Series cassette changer to help increase the efficiency of your duplicating system.

even as you sharpen your pencil.



Whether it be a small or large operation.

For video network applications, the Pro Series produces high quality images on both large projection systems and small screen monitors. With features like auto repeat playback for unsupervised presentations. And the system is upwardly compatible with standard VHS. So you can continue to use your existing library of recordings without any type of conversion.

Pro Series VCRs also incorporate a number of features designed for network automation. Such as video sensor recording. So you can transmit video programs to your network locations during off-peak hours. And save on both transmission and personnel cost. You can even interface Pro Series VCRs with computers for interactive training programs.

So whether you're looking for high performance field recording, post-production, studio, duplication or networking systems. The Panasonic Pro Series can sharpen your image while you sharpen your pencil.

For more information, call Panasonic Industrial Company at 1-800-553-7222. Or contact your local Panasonic Professional/Industrial Video dealer.

S VHS

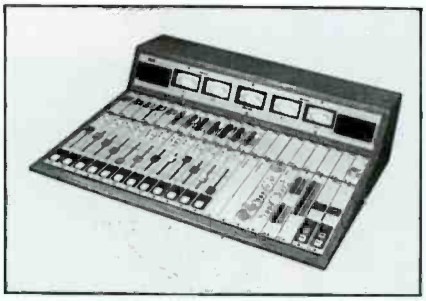
Panasonic

Professional/Industrial Video

Circle (92) on Reply Card

Console system

RAM Broadcast Systems has introduced the series SX console system, compatible with McCurdy Radio Industries' series S modules. It is a motherboardless design for flexibility. The console interfaces with any peripheral equipment and has its own matching studio turret system that is simple to hook up.



Circle (366) on Reply Card

Line-operated unit

Audio-Technica U.S. has developed the AT8506. It is a 4-channel, line-operated unit that produces 48Vdc to microphones that require phantom power, but are operating in systems that lack this facility. The unit operates from 100Vac-120Vac, 50Hz-60Hz. A constant-voltage source is maintained with no channel interaction. Each channel can provide up to 14mA. Other features include internally protected regulator IC to prevent overheating or damage, and locking XLR-type connectors with silver-plated beryllium copper contacts. The unit comes with a 6-foot line cord with grounded plug, power switch and LED power indicator.

Circle (367) on Reply Card

Configuration wiring devices

Bryant Electric, a division of Westinghouse Electric, has introduced Studio-Tech, a line of NEMA configuration wiring devices. The devices are available in masking black to minimize visibility. Nylon materials increase impact resistance and heat deflection. Wire adapter sleeves have been designed to accommodate nonstandard wire sizes. Also included in the line are incandescent lampholders for applications that require that light source at the focal point of the reflector. The devices range from 15A, 125Vac through 30A, 277Vac.

Circle (368) on Reply Card

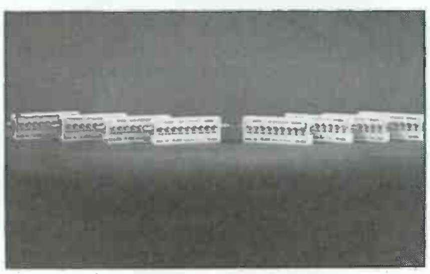
Frequency extension product

Gentner Electronics has introduced the EFT-100 frequency extension product. The unit's digital process, called frequency extension, improves telephone audio quality by extending the low-end frequency response and reducing noise.

Circle (369) on Reply Card

In-line step attenuators

Kay Elemetrics has introduced a line of step attenuators. They feature a 3W power rating, as well as extended frequency range of up to 3GHz.



Circle (370) on Reply Card

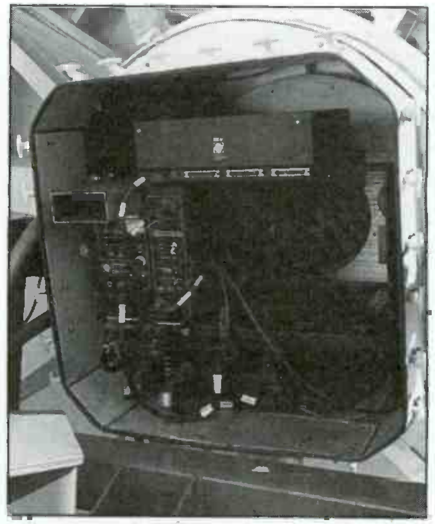
Automatic satellite locator

Midwest Communications has introduced the following products:

• The RC-8097B automatic satellite locator. The "B" version of the unit combines the function of automatic satellite locator with those of an antenna controller giving automatic pointing of the mobile Ku-band antenna. The system uses Loran-C navigation signals to determine the location of the uplink truck. It also determines the truck heading and attitude. The operator selects the satellite to which access is desired, and the system finds the correct azimuth and elevation for the antenna.

• The DPS-270 time base corrector. It operates with U-matic and S-VHS tape machines. It has an S/N ratio of 58dB, luminance signal bandwidth of 5.5MHz, and less than 2° differential phase and 2% differential gain. The unit employs true component processing and provides a 16-line correction window. The unit is remote controllable.

• The Video Scamp employs either a Vertex 4.6 meter or 6.1 meter Ku-band antenna and houses the uplink electronics in the antenna's hub. When the power amplifiers are placed adjacent to the antenna's feed system, virtually no line loss is incurred. The system is controlled by a computer from a remote location.

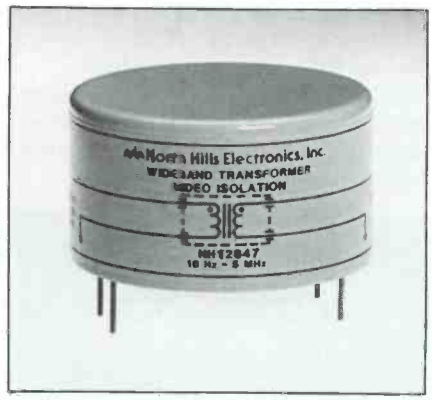


The Video Scamp

Circle (371) on Reply Card

Video isolation transformer

North Hills Electronics has introduced the model NH-12847 video isolation transformer. The unit provides 110dB ground isolation at power-line frequencies and 500Vrms isolation between input and output and ground. Its bandwidth of 10Hz to 5MHz makes it NTSC and PAL compatible.



Circle (372) on Reply Card

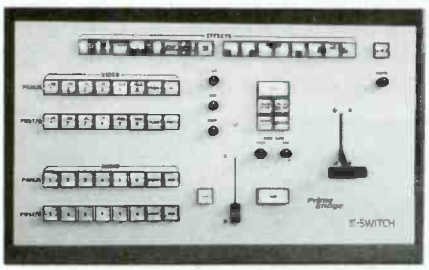
Director's case

K and H Products has introduced the Porta-Brace "Director's Case." It is a compact Cordura briefcase. It features a large inside pocket and an outside zippered compartment. Outside slip pockets can accommodate a clipboard, as well as smaller items. A Cordura camera case attaches inside with Velcro, or can be used separately. There also are interior pockets, and a strip of Velcro tape allows a calculator and other small items to be arranged securely. The case is equipped with leather-covered handles and lightweight shoulder strap.

Circle (373) on Reply Card

Video production switcher

Prime Image has introduced the S-Switch, true component video production switcher. It accepts Y/C (S-VHS), Y/688 (U-matic) and composite inputs; transcodes between formats; and provides output in any of these modes. The unit provides 16 video transition effects; it also provides six video inputs and seven stereo audio-follow-video inputs.



Circle (374) on Reply Card

Tape recorder stand

Solid Support Industries has introduced the TR-10, a tape recorder stand. It is designed for standard 19-inch rack-mount tape recorders. It features a 20-position top piece, allowing for either edit or record positions. The top piece is 14 rack spaces high with an open back, to allow bigger machines to fit within the confines of the rack.

Circle (375) on Reply Card

Audio level meter

Solutec has introduced the SOL-20/20 audio level meter color keyed in video. It offers stereo or mono switch selectable; VU or PPM switch selectable; L+R or L−R center bar indicator; vertical and horizontal positioning; luminance and chrominance level adjustments; and alarms for audio loss and overload.

Circle (376) on Reply Card

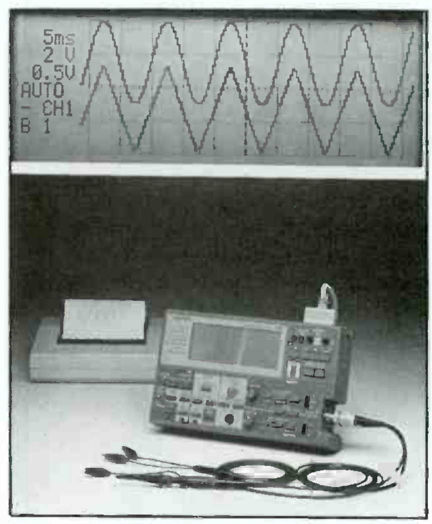
Circle (98) on Reply Card

Video noise meter

Leader Instruments has introduced the following products:

• The LSN-9044A video noise meter. It performs fast and accurate signal-to-noise measurements based on true RMS noise metering. Measurements are based on internally generated 50 IRE unit gray signal that is applied to the unit or system under test. Cameras also may be evaluated by adjusting the iris opening for a 50% flat field. A front-panel LED readout confirms correct input levels to the metering system. Measurements range from −27dB to −65dB in three scales with 0.3dB ±1% of full-scale accuracy. Presettable GO/NO-GO indicators speed high-volume checks. High-pass and low-pass filters with selectable corner frequencies are provided, as well as switchable subcarrier trap and weighting filter. An added feature is a field-1-field-2 selector to evaluate individual video-head channels in VCRs and VTRs. Sag compensation is built in to remove the effects of signal sag on the noise measurements. Both NTSC and PAL systems are accommodated.

• The model 200 combination 2-channel digital storage oscilloscope/digital multimeter. The portable problem solver line consists of the single-channel unit, LCD-100 and a single-channel unit with a printer, model 100P. Features include dual-channel operation. The oscilloscope section is equipped with 3MS/s maximum sampling rate, and is auto-ranging. A printer interface is standard. There is an on-screen display of setting conditions, which include sensitivity, time base, trigger source and slope and display mode. The memory can store three waveforms per channel and is battery backed up to provide long-term storage to all six waveforms. The auto-ranging DMM has a manual override as well as audible continuity and overload indicator. The DMM section offers ac and dc measurement functions, resistance and a low ohm mode.



Model 200 2-channel DSO/DMM

• The model 2100R 100MHz CRT oscilloscope with cursors. It allows the user to observe waveforms, setting conditions and measured values on a single display. It reduces setup time by displaying the salient setting conditions such as scale factor, input coupling, vertical mode, main and delayed sweep time and triggering controls. The on-screen cursors provide the user direct reading of measured values as well as make the unit user-friendly and simple to operate. Two cursors provide readout of voltage and time-difference frequency, phase as well as voltage and time-difference ratios. The unit offers 3-channel capability, alternate triggering for simultaneous display of two asynchronous signals, alternate time base and 6-trace capability. The vertical input sensitivity of the oscilloscope is 0.5mV, and a CH-1 output is provided on the back panel so that additional instruments can be connected.

Circle (377) on Reply Card

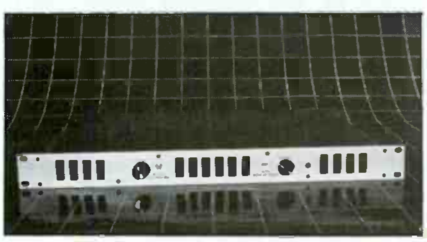
Portable recorder packs

Telepak has introduced the "Broadcast VCR Paks." They are portable recorder bags and are contoured to custom-fit the various video recorder/player systems of Sony, JVC, Panasonic and others. They are constructed of lightweight materials and have double-layered padding for protection on the inside and access to all connectors and controls on the outside. All pockets and clips have been designed to hold batteries, cables and connectors while keeping camera and microphone cables organized. All straps and handles are double-stitched and reinforced. They are weather- and stain-resistant.

Circle (378) on Reply Card

Stereo audio monitor

Wohler Technologies has introduced a self-powered stereo monitor speaker system in a single-rack-space package. The bi-amp design uses four 10W power amps to drive three speakers, with each channel's bass region combined into a center channel. Response extends below 100Hz and above 10kHz. Only three connections are needed: ac power and the two audio feeds.



Circle (379) on Reply Card

Audiocassettes

Ampex has introduced the 672 industrial audiocassette. It features an improved tape formulation. The tape also features a pad design that provides azimuth tracking for high-end response. A color-coded leader tape is included on bulk product.

Circle (380) on Reply Card

Scan converter

Folsom Research has announced the MONARCH CGC (color graphics converter). It allows the user to convert interlaced or non-interlaced graphics to NTSC format. The converter features real-time capability. The unit is compatible with all graphics imaging systems up to 72kHz scan frequency. The unit features RS-170A as an output, as well as the scan-converted NTSC. The signal is gen-

Circle (100) on Reply Card

lockable. Loop-through circuitry is standard. The conversion is based on a line interpolation technique.

Circle (381) on Reply Card

Audio-follows-video interface

Amek has introduced the ESM32 edit suite control interface. It enables audio levels on the BCII to be assigned as crosspoints from the host editor. Transitions between one crosspoint and another can be either instant or gradual. The EDL allows the start time, end time and duration to be preselected, and then implemented by the BCII console under audio-follows-video control. Communications between the controlling video editor and BCII console is via ESAM II. In addition, BCII mixers can be interfaced with Grass Valley and For-A video systems using a preprogrammed version of the interface unit.

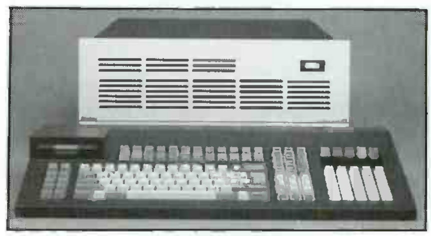
Circle (382) on Reply Card

Font enhancements and interface option

Abekas Video Systems has introduced the following products:

• Two enhancements to the font attributes of the A72 digital character generator include Soft Characters and Soft Shadows. Additional features of the character generator include instant sizing and font creation; full-color RGB scan-in; character animation; variable roll and crawl speeds; unlimited fonts and color on-line; and single- or dual-channel configurations.

• With the Touch-Up option for the A60 digital disk recorder, a Quantel Paint Box operator can record video onto the A60 in real time, then randomly access it with the Paint Box a field or a frame at a time. Touch-Up also provides complete VTR control for quick transference of video between the A60 and a VTR.



A72 digital character generator

Circle (383) on Reply Card

Automatic gain control module

Wegener Communications has introduced the model 1694-02 automatic gain control (AGC) module. The unit features 600Ω balanced audio interface, low-level gating and selectable time constants. The automatic gain control module is a single printed circuit board that can be configured for stereo or dual mono operation. Up to 16 monaural channels can be installed in one standard model 1601 mainframe.

Circle (384) on Reply Card

Custom wood consoles

Winsted has introduced custom finishes with wood trim for production, editing or duplicating consoles. The heavy-gauge steel-frame consoles are available with special side panels in decorator colors and solid wood trim in a choice of light oak, dark oak or walnut.

Circle (385) on Reply Card

‘

IS MUSIC TO OUR EARS AND EYES.’

Any way you look at it, this was no easy assignment for National Video Center Recording Studios: two nights of Carly Simon in concert had to be edited down to a one-hour HBO special. The schedule was tight; there was no room for error. That's why EASTMAN EVT-2000 Broadcast Video Tape was chosen for this assignment by senior colorist Bill Willig and editor Chris Hengeveld.

Bill: "The hard part was matching colors. The concert was filmed at dusk, with big arc lights for keys. And we had lots of reds, the toughest color in video. But our Eastman tape held up fine. Actually, we went to four generations with this tape. Film transfer, editing, master, then dubbing. The quality was amazing. A technical person might see the generation differences. But you couldn't see it on the broadcast."

Chris: "Some tapes have tremendous dropouts. Especially saturated color. But when we use Eastman tape for a job, we never have those problems. Our clients love the color."

Bill: "We were really pushing to get it done. HBO was running promos, and actually had it in the program guide before it was shot. That kind of schedule called for Eastman tape reliability."

Chris: "We've been using it for two years for a lot of different jobs. It's one of the many tapes we use that's never let us down. We trust it."

Find out how EASTMAN EVT-2000 Broadcast Video Tape can star in your next production. For information call 1 800 44KODAK, Ext 814 (1 800 445-6325, Ext 814).

Senior colorist Bill Willig (left) and editor Chris Hengeveld.

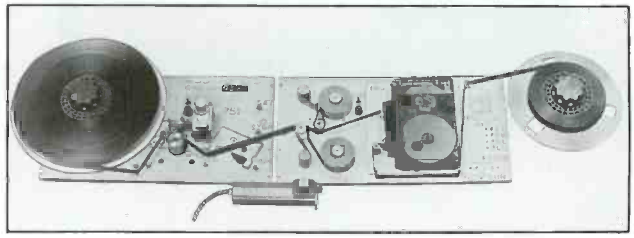
Eastman
Professional Video Tape

Kodak

Circle (102) on Reply Card

Video loader/reloader

Audico has introduced a videocassette tape loading system. Interchangeable plug-in modules, available for U-matic, VHS, Beta, 8mm, M-II and Betacam, allow users to change formats in less than five minutes. The same system can be equipped to rewind, wipe and verify the length of tape in existing cassettes, and to transfer tape directly between cassette housings.



Circle (386) on Reply Card

Wireless mic series, antenna distribution system and lavalier mic

HME has introduced the following products:

- The 50 series of wireless microphones feature 2-channel body pack and hand-held and 2-channel switching diversity receiver. An RF link improves the capture ratio for dropout-free performance. Additional features include mic-mute and power switch lockouts on the hand-held, and operator-selectable RF frequency selection on the body-pack system.
- The System 515 body-pack and System 525 hand-held wireless systems are designed for portable or fixed installations.

They also are rack-mountable. The system 515 consists of the RX522 receiver and TX550 body-pack transmitter. The System 525 consists of the RX522 receiver and the TX555 hand-held transmitter. Receiver features include NRX II noise-reduction circuitry and ac or dc power. The body-pack transmitter features mic-mute switch, mic-gain adjust, low-battery LED indicator and reversible belt clip. The hand-held transmitter features locking mic-mute and power-on switch, integral antenna, low-battery LED indicator and ABS housing.

• The DN100 antenna distribution system allows an operator to operate four of its RX520 switching diversity receivers in a rack-mount with only two antennas. It has the same design and front panel as the RX520 switching diversity receiver, and it takes up only one space in a 19-inch rack. The system speeds up setup time of multicompatible systems. The DN100 antenna distribution system comes standard with one DN100 antenna distribution unit, one ac adapter and locking clip, and eight RG58 BNC-to-BNC 4-foot coaxial cables.

• The RP733 rack-mountable power station is compatible with the 700 series line, as well as most other 3-wire intercom systems. It features two independent channels with two headset stations that have communication access to one or both channels. Two auxiliary inputs allow microphones and line levels to be fed to one or both channels. The unit can power up to 32 belt packs, with call lights, or up to 100 belt packs without the call light feature. Both electret and dynamic headsets can be used.

• The EM43 omnidirectional electret microphone comes with mic clip, windscreen and case.

Circle (387) on Reply Card

Circle (110) on Reply Card

Circle (105) on Reply Card

Component video version of character generator

Knox Video has introduced the K40S, the component video version of the K40 microfont character generator. It features full-bandwidth signal processing for Y/C inputs and outputs and uses industry standard Y/C DIN connectors for S-VHS compatibility. The unit is switchable between either composite or Y/C operation. In Y/C mode, a separate composite output is provided for a local monitor.

Circle (388) on Reply Card

High-resolution CCD camera

The Broadcast Equipment Division of *NEC America* has introduced the SP-30 CCD video camera, a high-resolution, high-end electronic news-gathering camera with low-light sensitivity. It features interline-frame transfer CCD chips that employ high-density arrays with 380,000 elements. The chips are arranged in an RGB configuration. The camera uses ⅔-inch format lenses. It may be operated as a stand-alone camera with external cable connection through the NTSC adapter to a VTR. It also may be combined directly with the Beta SP format camcorder or, via an M-II adapter plate, to the M-II format AU-400 recorder. The camera may be gen-locked when it is connected to an on-board VTR. The head also contains a full-time RS-170A NTSC composite video output to a BNC connector.

Circle (389) on Reply Card

Important correction

A feature article in the July issue contained an error that readers should be aware of. In the article, "Display Technology Update," page 68, it was stated that the *dot mask/delta gun* approach used in many professional picture monitors was being phased out. This is not true.

The delta gun/delta dot mask gun system has been refined over the years to a point that it defines the state-of-the-art for video monitors. Picture monitors using the delta/delta CRT are available—and will continue to be available—for purchase.

This problem points out the need for additional discussion of CRT types and their use in professional picture monitors. We will explore this important topic in the "Circuits Column" of the September issue.

We regret the incorrect information contained in the article. Please mark this correction on page 68 of your July issue.

The Editors

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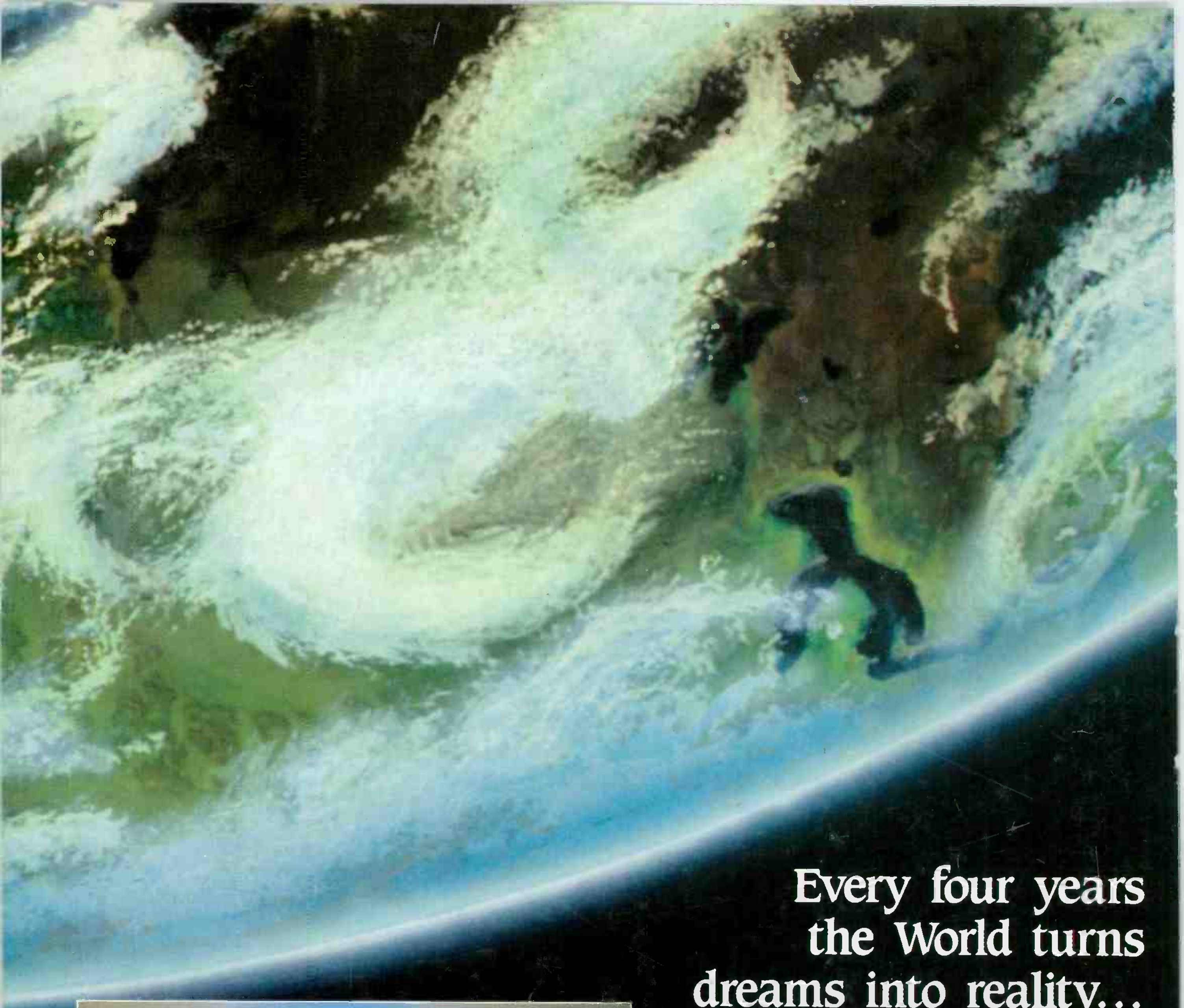

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