BROADCAST engineering®

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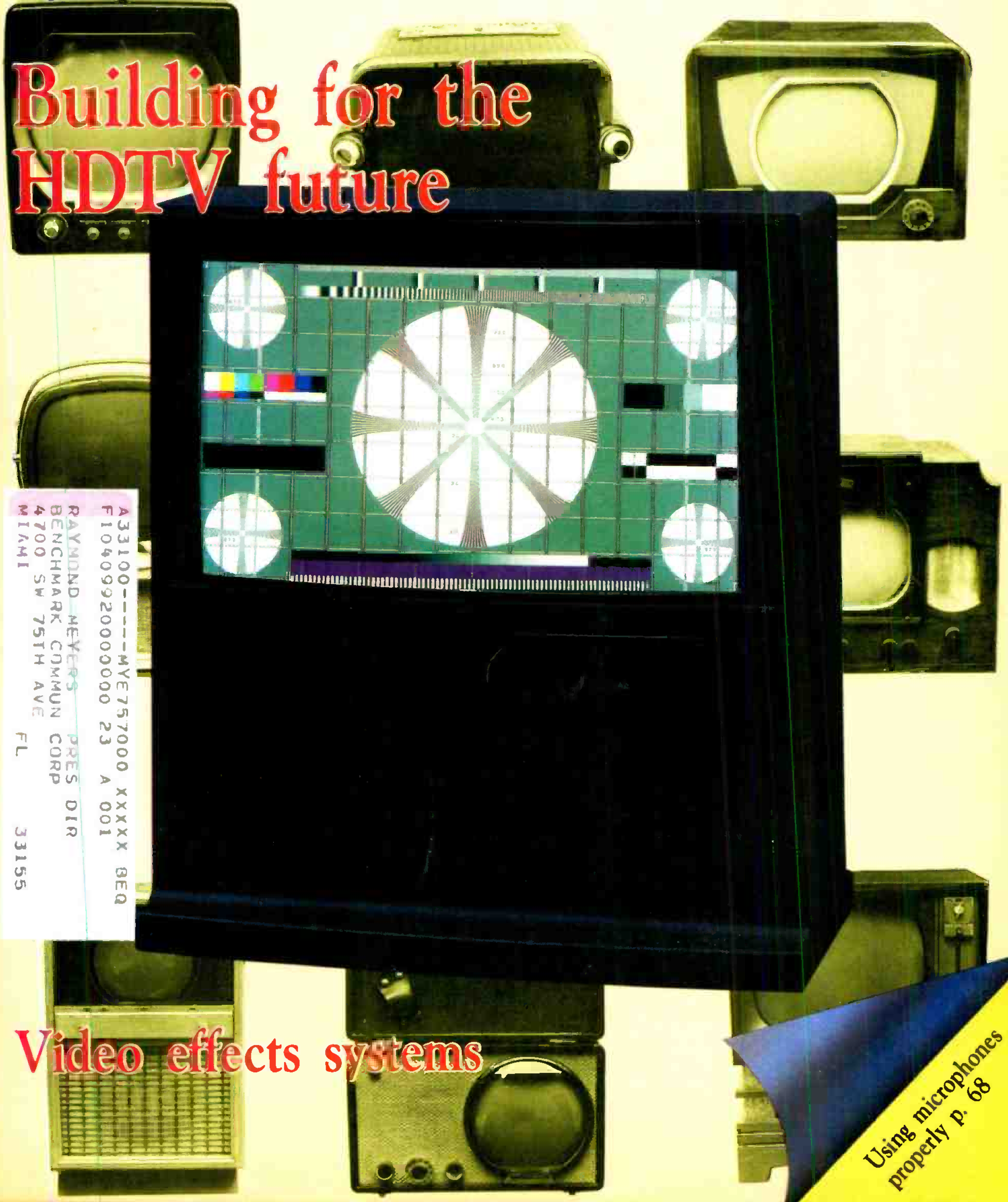

Building for the HDTV future

Video effects systems

Using microphones properly p. 68


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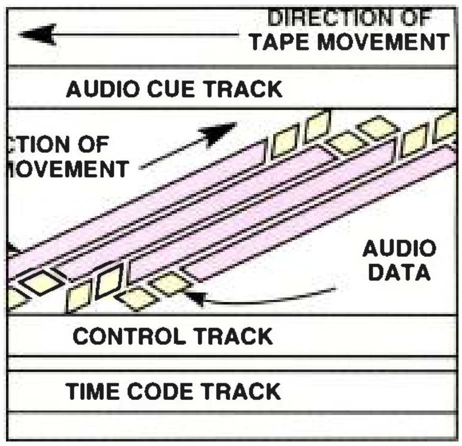

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VIDEO TECHNOLOGY UPDATE:

Trying to keep up with video technology is like trying to follow a 2-year-old child. It's moving so fast that you're tired after 10 minutes. One of the most rapidly changing areas of video technology is HDTV. Today, the question isn't how does it work, but how can it be implemented? Fortunately, this question can be answered. This month's feature articles provide insight into how broadcasters and video professionals can survive the transition.

FEATURES:

OTHER FEATURES:

DEPARTMENTS:

ON THE COVER

Those of us who can remember black-and-white television marvel at how far we've come in terms of video quality. (Cover design: Nenita Gumangan, *BE's* graphic designer. Vintage televisions provided from the personal collection of Tim Jenison, president of NewTek. HDTV receiver provided by Thomson Consumer Electronics. Test pattern provided by Tektronix.)

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News

By Dawn Hightower, senior associate editor

Field test proves long-distance HDTV broadcast

On May 28, Zenith and AT&T, in the first long-distance over-the-air field test of an all-digital HDTV signal, conducted a broadcast from WMVT-TV, Channel 36 in Milwaukee 75 miles to Zenith's technical center in Glenview, IL.

Zenith and AT&T proved that digital high-definition TV (HDTV) broadcasting can bring high-quality, snow-free, interference-free TV pictures to a broader area than can conventional TV broadcasts.

The late-night field test of the Zenith-AT&T "digital spectrum-compatible" HDTV system was the first terrestrial broadcast of digital TV signals using low-power over long distances. The test also proved that digital HDTV can provide high-quality, noise-free pictures in the presence of interference from conventional TV signals on the same channel.

The test showed that Zenith-AT&T system's digital compression and transmission technologies can eliminate the "cliff effect," which is a total and abrupt loss of the TV picture and sound that could be caused by errors in transmitted digital data at long distances from the transmitter.

The field test used a variety of program materials, ranging from HDTV studio camera images, still HDTV images, 60- and 24-frame film images, multimedia computer images and fast-motion sports. The test showed that even the most complex high-definition material can be compressed into a single 6MHz channel with excellent quality. The resulting compressed signal is extremely robust.

Newsgathering airwaves need to be protected

The Federal Communications Commission (FCC) should not waver from its proposal to preserve a part of the nation's airwaves for electronic newsgathering, according to a coalition of media groups and the National Association of Broadcasters (NAB).

NAB, the Association for Maximum Service Television, Turner Broadcasting System, Cable-Satellite Public Affairs Network and the Radio-Television News Directors Association filed joint comments applauding the commission's proposal.

The 1.99-2.11GHz band is part of the spectrum used by cable outlets and TV stations to produce live news segments from remote locations, such as the recent Los Angeles street riots. The FCC has proposed reallocating certain parts of the nation's spectrum to accommodate new telecommunications technology. As part of this measure, regulators also have decided to protect the newsgathering airwaves from reallocation.

The current newsgathering spectrum allocation should be preserved to ensure timely delivery of vital information to the public, NAB also said higher frequencies would not work for video newsgathering. It pointed out that other parts of the nation's airwaves can be used for new telecommunications technologies, such as the proposed personal communications system (PCS).

ATSC outlines activities to document HDTV standard

The Advanced Television Systems Committee (ATSC) filed information with the Federal Communications Commission (FCC) to outline proposed industry actions to fully document the selected HDTV standard.

After the FCC Advisory Committee on Advanced Television Service recommends the winning system to the FCC in early 1993, certain standard-setting organizations will immediately begin to document a wide range of specific standards for equipment to be used to deliver the high-definition TV (HDTV) signal to the public. These standards cover a broad area of technical issues from source coding of audio and video to HDTV receivers for the home and everything in between.

In the list of standardization activities, ATSC has been assigned responsibility for issues that must be resolved quickly for consideration by the FCC at the time it completes its work on the selection of an HDTV standard for the United States. The Society of Motion Picture and Television Engineers (SMPTE), the Institute of Electrical and Electronics Engineers (IEEE), the Electronic Industries Association (EIA), the National Cable Television Association, the National Association of Broadcasters (NAB) and the Satellite Broadcasting and Communications Association have been identified as appropriate organizations for the standardization work that will need to be done after the FCC selects the winning system.

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r e c r e a t i v i t y

Circle (4) on Reply Card

Editorial

HDTV: The FCC's version of Lizzie Borden

Technological progress is like an ax in the hands of a pathological criminal.
Albert Einstein

The above quote describes how many broadcasters feel about the FCC's proposal for HDTV. They see the requirement for HDTV as unneeded at best, and economic slaughter at worst. Yet, technological advances, like time, stand still for no one — let alone broadcasters.

High-definition TV transmission will take place, although maybe not on the FCC's timetable. The choice then becomes to either prepare now for HDTV, or risk your station's future by waiting until it is perhaps too late.

Unfortunately, a lot of misunderstanding surrounds what the commission's HDTV ruling will really mean. In the simplest of terms, it means that sometime after April 1993, the FCC will select a *transmission* standard. That is quite different from a *production* standard.

Many broadcasters believe that the commission's decision will require them to upgrade all of their studio equipment at the time they begin HDTV transmissions. That may not be necessary. Let's consider an alternative that would meet almost everyone's needs.

The key would be to allow stations to transmit less-than-HDTV-quality video on an HDTV RF system. Stations could meet the FCC's requirements by first building an HDTV RF system. The RF system would meet the specifications dictated by the selected HDTV proponent. With this approach, installing a new transmitter and antenna would be all that is required. A converter would then be used to upconvert the less-than-HDTV-quality images for transmission on the HDTV RF system.

The studio portion of a station's signal chain could then be converted on a stage-by-stage basis. This would allow stations to slowly (as funds permit) build the production side of their HDTV system. Also, *much of the equipment available today is already capable of recording or producing an enhanced 16×9 image*. This hardware, in addition to an HDTV pass-through satellite link, would form the basis for the HDTV channel's programming. This approach produces a win-win situation for broadcasters and the consumer. Requiring anything more is unnecessary and a disservice to the industry.

Brad Dick

Brad Dick,
editor

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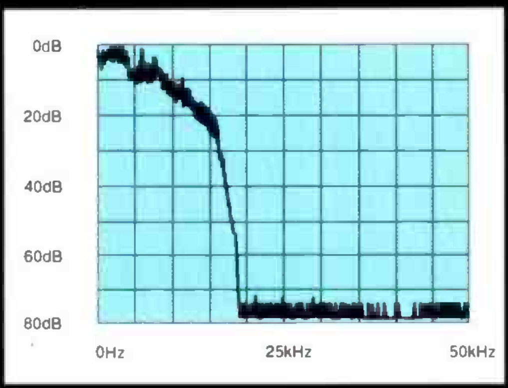

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FCC Update

Forfeiture standards affirmed

By Harry C. Martin

In June, the FCC affirmed the standards announced last August for assessing fines against rule violators. At the same time, it issued a new schedule of base fines; i.e., the general guidelines for fines to be applied to particular cases. (See Table 1.)

The forfeiture ceiling, which is assessed on a per-violation or, for a continuing violation, on a per-day basis, is $25,000 for broadcasters and cable operators or applicants.

Upward and downward percentage adjustments are applied to the base fine amount, depending on the applicability of the following factors:

Upward adjustment criteria:

- Egregious misconduct 50-90%
- Ability to pay/disincentive value 50-90%
- Intentional violation 50-90%
- Substantial harm 40-70%
- Prior violations of same or other requirements 40-70%
- Substantial economic gain . . . 20-50%
- Repeated or continuous violation . . . . varies

Downward adjustments:

- Minor violation (opposite of egregious misconduct) 50-90%
- Good faith or voluntary disclosure 30-60%
- History of overall compliance 20-50%
- Inability to pay . . . . varies

Example. In adopting its new standards, the FCC gave the following example of how they would be applied: For a licensee who uses unauthorized equipment for one day, a base fine of $10,000 is assessed. If the relevant upward adjustment criteria was determined to be a 70% increase for intentional violation and a 40% increase for substantial harm, each of which is within the range established in the standards, increases of $7,000 (70% of $10,000) and $4,000 (40% of $10,000) would be added to the base fine, for an adjusted fine of $21,000. If it was also determined that there should be a 30% downward adjustment for a history of overall compliance by the licensee, which is also within the established range, the fine would be reduced by $3,000 (30% of $10,000) to $18,000. If the broadcaster made a specific showing that an $18,000 fine would cause substantial economic hardship, the fine would be further reduced.

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

Fee collection program proposed

The FCC is planning to propose to Congress that the agency be allowed to impose annual user fees to cover the costs of the FCC's policy and rulemaking, enforcement, plus international and user information services activities. This proposal will require specific beneficiaries of the FCC's services, instead of the general public, to bear the costs of associated regulation. The FCC's proposals currently are being considered by the Office of Management and Budget, and will be forwarded to Congress this summer.

The new user fees are patterned on the fee collection legislation passed by the House of Representatives in 1991. The fees would apply to most current licensees and to other entities that benefit from the systems. None of the fees collected under the commission's new proposal would be retained by the agency. Instead, they would be deposited into the general fund of the U.S. Treasury. Examples of the proposed fee schedule will appear next month.

VIOLATION	BASE AMOUNT ($)
Misrepresentation/lack of candor	20,000
Construction and/or operation without an instrument of authorization for the service	20,000
Unauthorized substantial transfer of control	20,000
Violations of rules relating to distress and safety frequencies	20,000
False distress communications	20,000
Failure to permit inspection	18,750
Malicious interference	17,500
Failure to respond to commission communications	17,500
Exceeding authorized antenna height	15,000
Exceeding power limits	12,500
Unauthorized emissions	12,500
Using unauthorized frequency	12,500
EBS equipment not installed or operational	12,500
Transmission of indecent/obscene material	12,500
Violation of broadcast EEO rules	12,500
Violation of political rules: reasonable access, lowest unit charge, equal opportunities and discrimination	12,500
Fraud by wire, radio or TV	12,500
Unauthorized discontinuance of service	10,000
Use of unauthorized equipment	10,000
Violation of children's TV commercialization or programming requirements	10,000
Violation of main studio rule	10,000
Construction or operation at unauthorized location	10,000
Failure to engage in required frequency coordination	10,000
Failure to comply with prescribed lighting and marking	8,000
Failure to file required forms or information	7,500
Violation of public file rules	7,500
Violation of sponsorship ID requirements	6,250
Violation of requirements pertaining to broadcast of lotteries or contests	6,250
Violation of technical logs/time brokerage agreements file requirements	5,000
Broadcasting telephone conversations without authorization	5,000
Failure to make required measurements or conduct required monitoring	2,500
Violation of enhanced underwriting requirements	2,500
Failure to provide station ID	2,500
Unauthorized pro forma transfer of control	2,500
Failure to maintain required records	2,500

Table 1. *Base fines for broadcasters and cable companies.*

Strictly TV

What color is that?

By Mark Everett

You just finished installing a new video switcher. It works well, and has many convenient features. But something isn't right. Pictures are fine on the camera monitors and the video operator's vectorscope, but after those signals get to the switcher, everything goes wrong. Some don't show up with the right colors.

The extent of the problem

This situation can be quite involved, and can happen in almost any video installation with almost any switcher. This system consists of a master sync generator that provides sync pulses, color bars and blackburst signals to the other equipment. Major members of the system include two cameras, two VTRs with TBCs, a character generator and the switcher. The system includes waveform and vector monitors, a few picture monitors, audio processing and a VTR used as the master recorder. All video interconnections use one type of cable (66% velocity of propagation) from one manufacturer with one brand and type of video connector.

When the system was assembled and color bars were displayed, the bars appeared to be correct. However, the playback of a recording made through the switcher looks terrible. It is even possible that preview appeared to be OK on the picture and waveform/vector monitors.

The solution involves timing adjustments. First, we will examine why everything appears correct on the local monitor and on preview, but not on the program bus or record machine.

Why the variation?

Everything looks fine on the camera or VTR because the parts of the composite picture (sync, subcarrier and video) are correctly related and come from a single source. Cameras usually have an internal sync generator that makes sync, subcarrier and other drives for the rest of the camera to produce a video. When video from a camera is recorded directly to tape, the signal relations are maintained.

Playback of a videotape through a TBC is subject to error. Most TBCs remove and

Everett is product manager for Videotek, Pottstown, PA.

When video from a camera is recorded directly to tape, the signal relations are maintained.

discard the original sync and subcarrier. At the output, these two signals are replaced with ones developed in the TBC.

Fixing the phase

Typically, the first step in operation with a TBC is to play back color bars on the VTR. Adjustments of the hue, saturation, video level and pedestal controls make the output of the TBC look like the original video. The operator is actually adjusting the timing of the sync generator and amplitude of the processing amplifiers. The operator uses the waveform monitor to view sync, pedestal and video levels. A vectorscope shows chroma amplitude and phase of the color bars relative to refer-

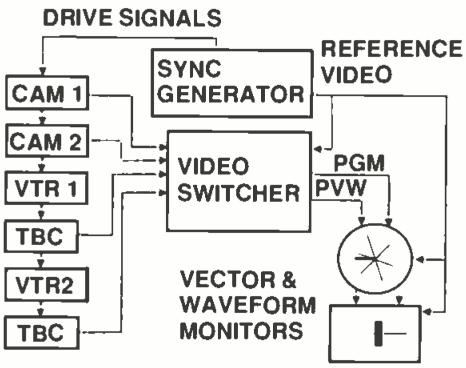

Figure 1. The effective electrical length from each source to the switcher must be the same for proper sync timing and color phasing.

ence burst.

When the output of the color bar generator, cameras and TBCs are connected to the production switcher, the problem becomes apparent. Nevertheless, this is not the source of the problem. When you select any input on the preset bus, everything looks perfect. When viewed through the program bus, however, color hue and horizontal picture position are shifted.

You could blame the processing amplifier on the switcher's program output, but that device only makes the problem apparent — it is not to blame. The fault is system timing, which means the timing of the color bar generator, camera and TBC gen-lock circuits, relative to the reference blackburst added to the switcher (and proc amp).

As serious as the problem may appear, it is not difficult to fix. Use waveform and vector monitors, connecting an external reference signal. Set the instruments to lock to that signal. Next, select black on the preview output of the switcher. Adjust the phase knob on the vectorscope to present the color burst at the normal location. Adjust the waveform horizontal position to place the leading edge of horizontal sync at an easily noticeable location (at center screen is convenient). Then, select other inputs one at a time to the switcher on the preview bus.

Do not adjust the waveform/vector monitor. If the burst is rotated relative to the blackburst signal, use the gen-lock burst phase control on the source to rotate the color burst back to the correct angle. If the horizontal position of the leading edge of sync is not at the correct location, adjust the gen-lock horizontal phase of the source to correctly locate the horizontal edge.

The exceptions to these procedures relate to devices with no controls or with two different signals from sources that are not in time with each other. In both cases, the cable lengths from the signal sources to the switcher must be altered. A vector monitor with vector phase cursors offers a convenient means to measure phase angle errors. From the error in degrees and a timing chart, it is easy to determine the appropriate length of cable to add to the shorter path to solve the problem. ■

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Part 2

re: Radio

Rules and radials

By John Battison, P.E.

Last month, we discussed procedures for obtaining field-strength measurement data. Although the rest of the process could be handled simply by entering that data into one of several available computer programs, this column will describe a more traditional approach, for purposes of exposition.

After taking the measurements, note carefully the distances on the map from the transmitter site to each data point, and enter them on your measurement sheet. Then plot each measured value on FCC field-intensity measurement log/log paper (available from NAB). Use the vertical axis for field strength and the horizontal axis for distance.

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

Now comes the delicate part. You will need a light table (however, a window or television tuned to an unoccupied channel also will work). Place the FCC chart of "groundwave field strength vs. distance" for the frequency you are studying (from Section 73.184(f) of the FCC rules) on the light table and tape it down. Next, place your plotted log-log graph over the FCC chart (aligned with the vertical axis) and carefully adjust your curve up and down until you find its best possible fit with one of the conductivity curves on the FCC chart. Trace that curve onto your graph paper and note its conductivity value (in milliSiemens [formerly millimhos] per meter [mS/m]).

Then, without moving your graph, lay a ruler along the inverse distance curve (a straight diagonal line) found on the FCC conductivity chart, and transfer it onto your graph paper. Note on the FCC chart that the vertical line representing 1km intersects this inverse distance curve at the 100mV/m level. (See Figure 1.) However, the transferred distance line most likely will not cross the 1km line at the 100mV/m point on *your* graph. Whatever value your graph's vertical axis shows at the point that the transferred inverse distance curve crosses the 1km line will be your radiation on that radial. After converting to miles, you can compare it with the proposed radiation in the original Form 301. Hopefully, it is whatever your original construction permit (CP) called for. (But don't count on it.)

This is the best RF measurement test that I know of. It tells you the measured field at given points, and shows clearly if your transmitter installation is operating as planned.

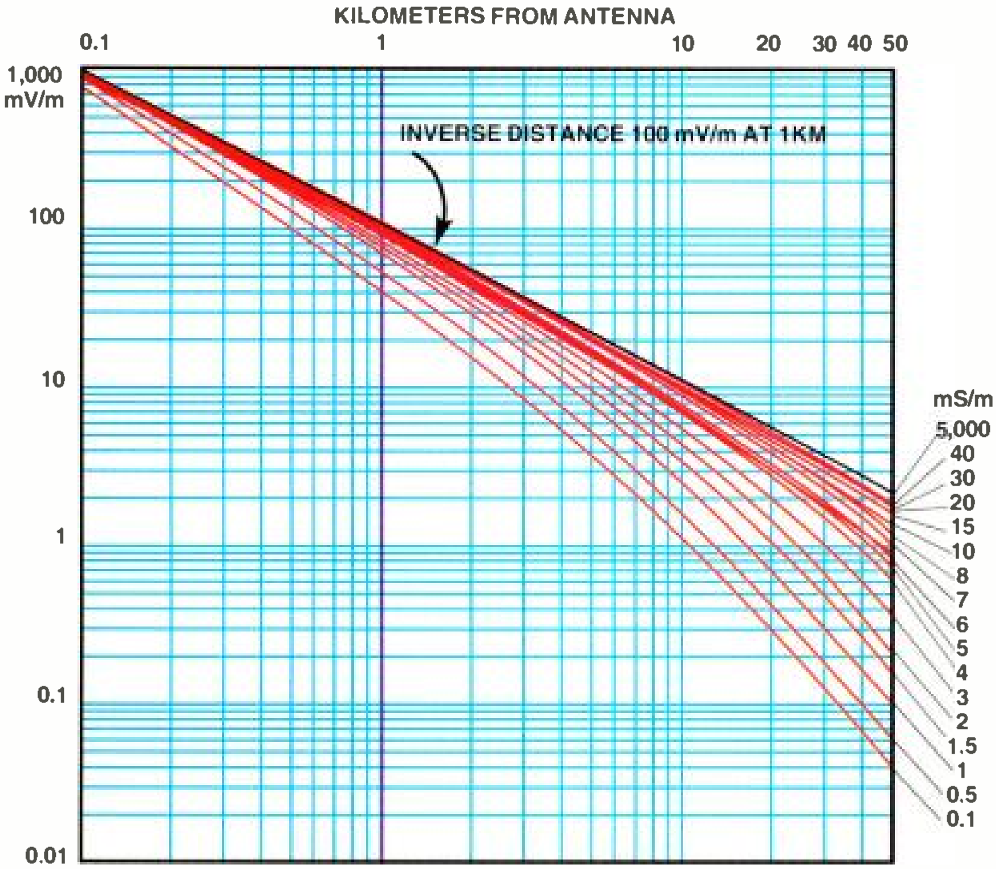


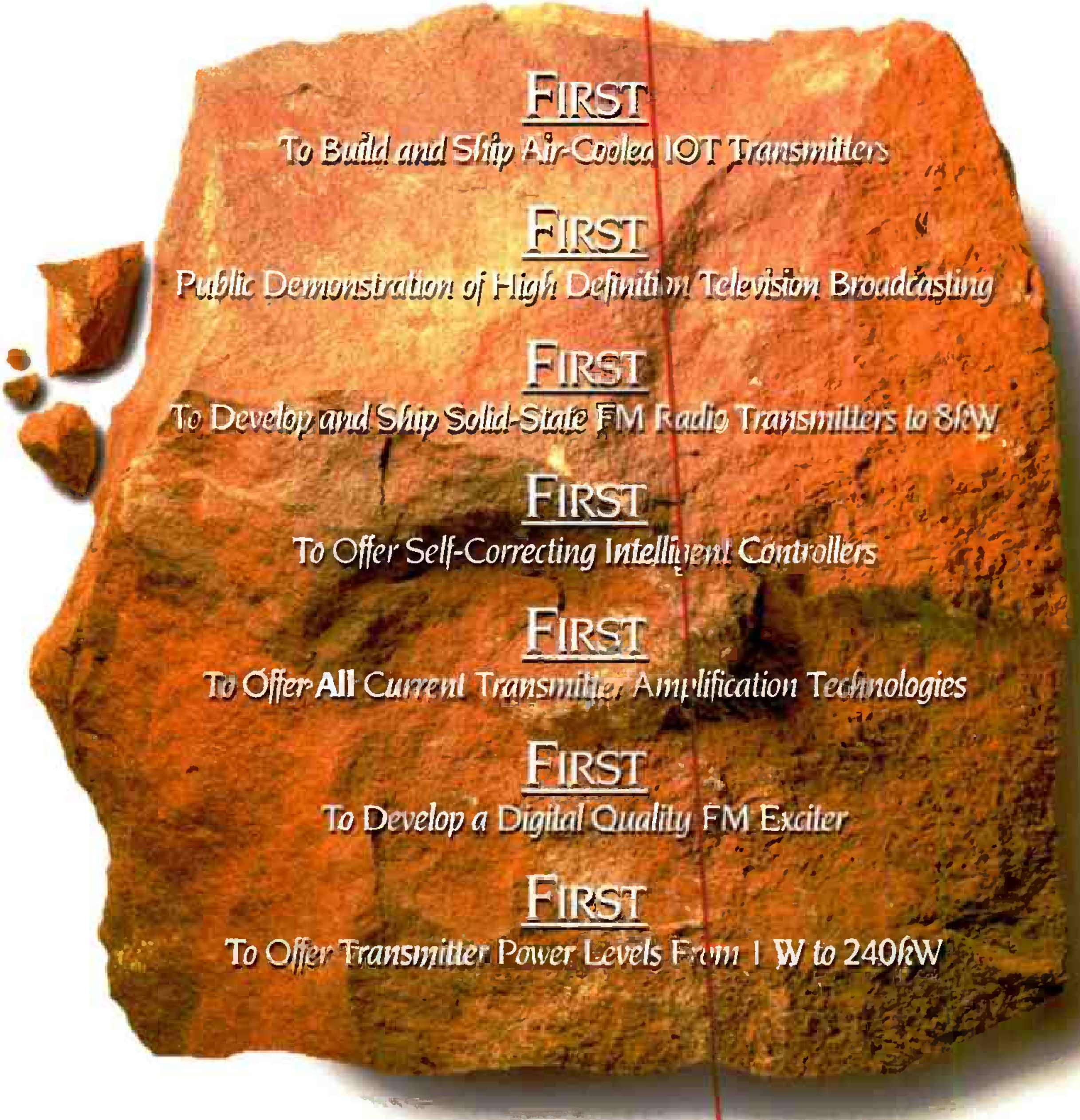
Figure 1. FCC log-log graph of groundwave field strength vs. distance for 660-680kHz. Values at right are ground conductivities in mS/m.

Polar plotting

If running one radial gave the answer you hoped for, you're lucky. If it didn't, it is worth running several others. In fact, if you have the time, eight radials in the eight normal directions (every 45°) will give you an excellent idea of your station pattern. It also will allow you to calculate your rms radiation by summing the squares of the eight radial values, and taking the square root of the result. This is an outstanding indicator of overall efficiency.

Plotting the pattern thus obtained on polar paper will allow you to show station management where the signal is going. A non-directional station should have a reasonably circular pattern, without any marked deviations, unless there are obvious impediments, such as large buildings or metal objects.

Drawing a polar plot is quite simple — it merely involves plotting the measured inverse field value on each of the eight radials on your polar paper, and joining these eight points with a carefully faired-out curve. Don't use straight lines to join each point. Instead, use French curves to obtain the smoothest pattern possible.



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Management for Engineers

Conflict resolution revisited

Constructive confrontation

By Judith E.A. Perkinson

Stardate 6397.4: The U.S.S. Starship Enterprise is on a routine mission in a remote quadrant of the galaxy when it encounters an unidentified ship. The Enterprise opens hailing frequencies and broadcasts in all known languages, but the alien ship makes no attempt to communicate. Sensor readings indicate that the alien ship has gone on alert and is arming its weapons. The captain of the Enterprise immediately sounds a red alert and brings up the shields. Suddenly, the alien ship launches an attack. The Enterprise responds with a phaser blast that destroys the alien ship. It is all over and no one has a clue as to what was wrong or how the destruction could have been avoided.

Most of us have heard the expression that no one wins a war. That is because the war is not over until someone has lost. Not all conflict has to escalate into war, however. How you handle the conflict in your life can affect the success you have in dealing with other people. Everyone has the ability to minimize the destructive effects of conflict. It depends on how you look at it and how you respond to conflict.

Unfortunately, we cannot eliminate all conflict in our lives because we do not have total control over the sources of conflict. There may come a time when we need to confront the people involved in the conflict. Constructive confrontation may make the difference between conflict resolution and war.

The beginning of constructive confrontation

Constructive confrontation begins in your head and in your heart. If you want to resolve the problem you must examine your own approach to confrontation.

What are you trying to do? Do you want to *blame, accuse, discipline, get back at someone or judge?* Or do you want to *resolve the problem, make sure it doesn't happen again, open communication or communicate how you feel?*

In constructive confrontation there is no place for blame, accusations, judgment or revenge. You will become embroiled in a war if you have to win by making someone else lose. You have constructive confrontation if problems are resolved, understandings are reached and everyone wins.

> ***In constructive confrontation there is no place for blame, accusations, judgment or revenge.***

What is constructive confrontation?

Constructive confrontation is a method of approaching a person or persons that you are involved with in a conflictual situation. The approach includes three steps:

Step 1. Present the problem.

Don't present the problem as an accusation. You should attempt to render the circumstances, facts and accounts in an objective and non-inflammatory manner. Many times we want to determine who was to blame and then solve the problem. Blame should not be the first step in problem solving.

If a piece of equipment in the station is not operating properly, your first priority is to fix it, not to determine who is to blame.

Avoid the use of the word "you." It is difficult for someone to hear "you" and not feel attacked. For example, "You didn't get the information I asked for so my report was late."

Try phrasing the problem in terms of the effect it has on you instead of what the other person has done. For example, "When I did not receive the information by Friday, I was unable to get my weekly report to the station manager."

2. Hear the other side of the issue.

In order to hear you must close your mouth and open your ears. Try to really listen. There may be issues or circumstances that you didn't know about. Perhaps you did not communicate your need as clear as you thought. Listening is an important aspect of constructive confrontation. If the other person does not feel heard, the process will not be successful.

3. Work together to reach a fair and reasonable solution.

If constructive confrontation is to be successful everyone must have a chance to succeed. It cannot happen if the conclusion of the confrontation is that one of the participants is viewed as losing, blamed, judged or tricked.

Remember, the solution cannot include blame. It should be fair and equitable, and it should be reached by consensus.

Making constructive confrontation work

Understanding the structure is not enough. It is also important that you avoid the pitfalls along the way.

- *All attacks demand a defense.*

When a person is attacked, communication ceases and defense begins. You have a choice. You can decide not to be the one that launches the first attack. When you feel attacked you can try to communicate that the purpose of the exchange is not to attack each other but to resolve a problem.

- *Assume honest intentions.*

You cannot be constructive if you assume the other person is dishonest. You need to start each constructive confrontation with a positive attitude. If you assume the worst, you will receive the worst.

- *Prepare for an unhonorable response.*

Approaching a constructive confrontation with a positive attitude is not the same as asking you to be vulnerable. It is important to be positive, but equally important to be realistic. Prepare yourself against being blind sided by making sure your information is correct. Bring all of the information you have and document all agreements reached.

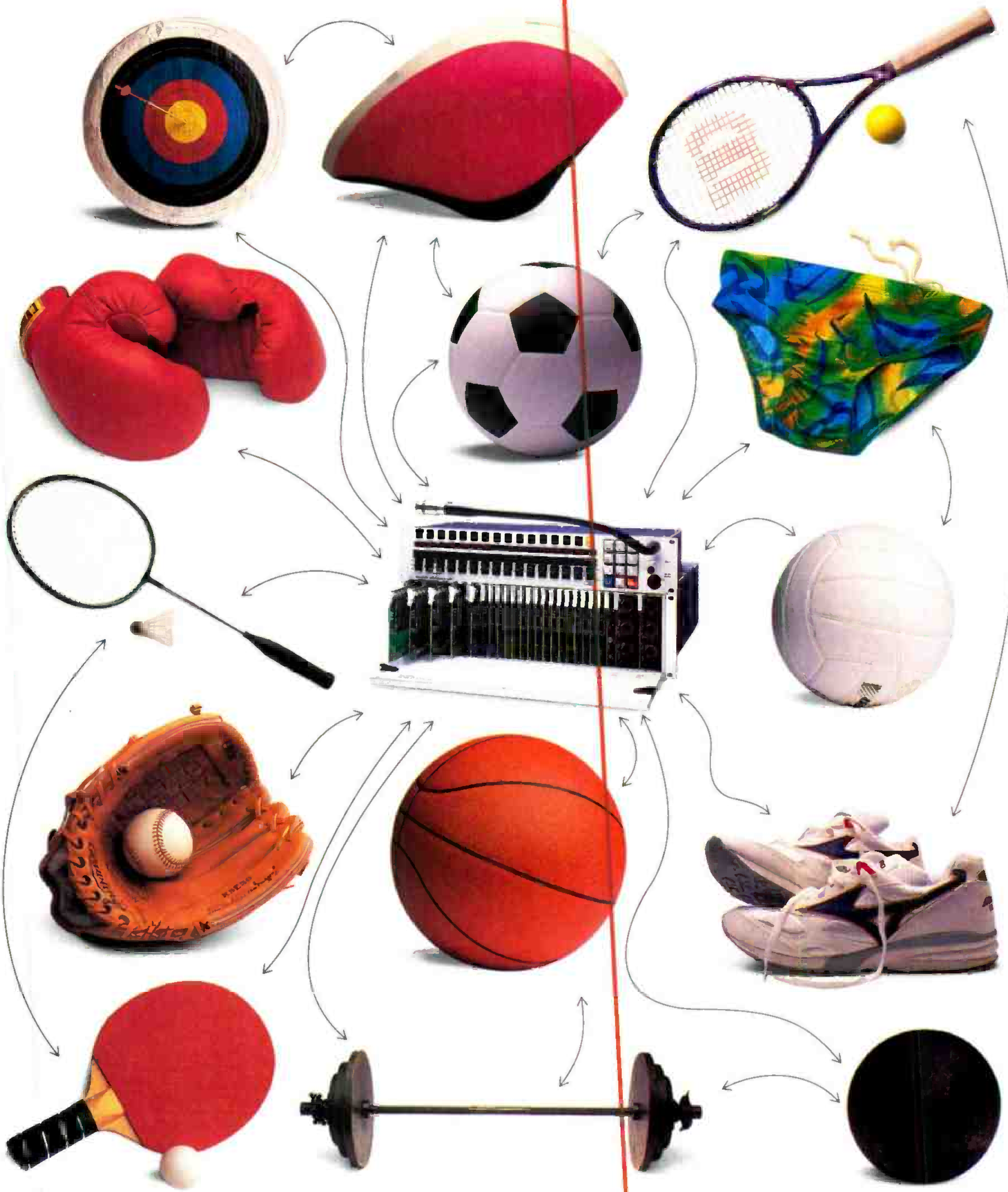
- *Use a non-threatening approach.*

Someone has to take the first step. If you have the problem, that step belongs to you. Conflicts involve emotions, so be as non-threatening as possible in your approach to others involved in the conflict.

Constructive confrontation works

Constructive confrontation works. But you must plan what you are going to do and say. When done correctly it can be one of your greatest people skills. ■

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



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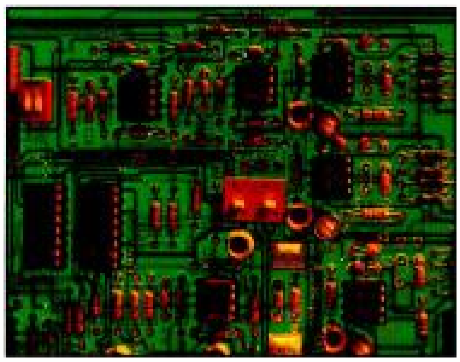
Part 1

Circuits



AC power basics

Power factor

By Roy Trumbull

When a load contains inductance or capacitance, the resulting reactance serves only to store energy, and then give it back to the circuit. Only resistance actually *consumes* power. Therefore, a device's rating in VA or kVA simply indicates the product of circuit voltage and current — it is *not* the power rating of the device. To determine the power consumption of this load, you must know its *power factor*.

Consider an inductor such as a motor winding. When t = 0, the inductive reactance will oppose the flow of current and cause a magnetic field to build. Thus, the current lags behind the applied voltage in the circuit. If the inductor was an ideal device, without resistance, this current lag would be exactly 90°.

In a purely capacitive circuit, when t = 0, current will be maximum and diminish as the capacitor charges. Here, current *leads* the applied voltage, again by an idealized 90°.

In the real world, all capacitors and inductors exhibit resistance and reactance, however. Their resistive components limit the current through the device to a certain value in every case. For an inductor, the *final* current is affected, and for a capacitor, the *initial* current (prior to charging) is influenced.

This tells us that there are really *two* current components in an AC circuit: A *reactive current* that either leads or lags the applied voltage, and a *resistive current* that is coincident with the voltage. The current read by a meter in the circuit is a vector sum of the two components. That value multiplied by the operating voltage is the volt-ampere (VA) rating of the circuit. To determine the actual power used by the device (in watts), the resistive current component must be identified.

Vectors and trigonometry

Figure 1 shows a triangle with the *x*-axis representing resistance (R) and the *y*-axis representing reactance (X). The hypotenuse therefore represents impedance (Z), because $Z = \sqrt{R^2 + X^2}$. By convention, in expressions of numerical value, the letter *j* is used to indicate reactive components, thereby noting their quadrature (90° out-of-phase) relationship. Inductive reactance uses a positive j factor and capacitive reactance uses a negative j factor.

For the example in Figure 1, the circuit has 3Ω of resistance and 4Ω of inductive reactance, written as 3 + j4. This is called a *rectangular* form of expression. To write it as a vector, values must be expressed in *polar* form, so a magnitude and direction must be determined. Magnitude is $\sqrt{3^2 + 4^2} = 5$, and direction is the angle whose tangent is $^4/_3$, or 53.13°. Impedance is therefore written as $5\angle 53.13$. To convert from polar to rectangular, trigonometry is used. The sine of angle Θ is X/Z or $^4/_5$, and the cosine is R/Z, or $^3/_5$. Because the magnitude of Z and angle Θ are known, the rectangular values can be found with this formula: Z(cosΘ + jsinΘ) = 5(0.6) + 5(j0.8) = 3 + j4.

Conversion between rectangular and polar makes it possible to calculate under reactive conditions such formulas as (Z1)(Z2)/(Z1 + Z2), which is used to find Z_{TOT} for two parallel impedances. In the denominator, Z1 and Z2 are first expressed in rectangular form, to allow the R's and j's to be summed. The resulting values are converted into polar form to allow division into the numerator.

Assuming source voltage is 120VAC, the current in Figure 1 is $120/5\angle 53.13$. In polar notation, division of angles is achieved by subtracting the denominator from the numerator. Multiplication of angles is accomplished by addition of their angular values. So the result is $24\angle -53.13$A. The circuit's VA value is (120)(24) = 2,880VA. This can be considered as the hypotenuse of another similar triangle whose *x*-axis is in watts and *y*-axis is in volt-amperes, reactive (VARs). If this VA value is multiplied by cosΘ, the result is in watts ((2,880)(0.6) = 1,728W). If sinΘ is used, VARs are computed ((2,880)(0.8) = 2,304VARs).

The number listed on a motor label as *power factor* is simply the cosine of the angle of current relative to voltage. It therefore expresses the proportion of resistive to reactive components in the load. Multiplying the VA rating by the power factor provides the wattage rating or true power consumption of the motor.

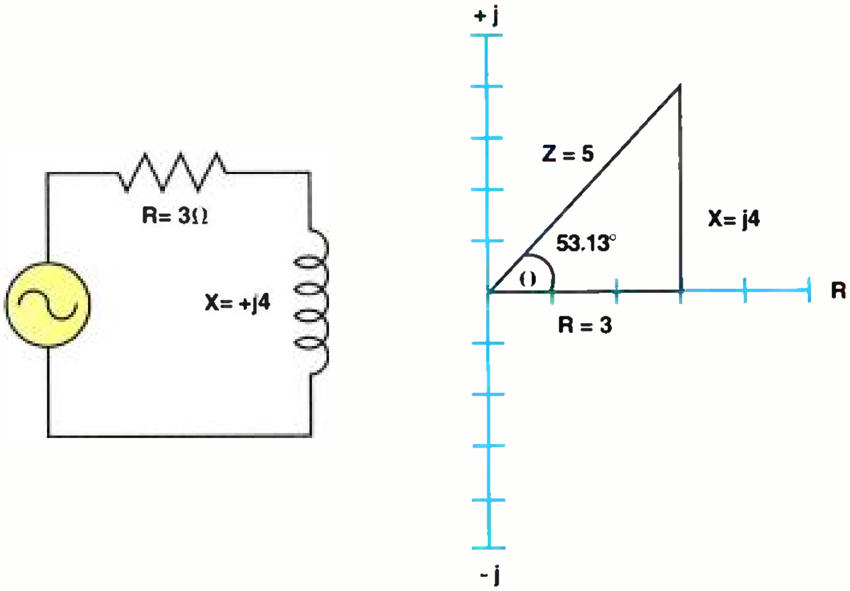


Figure 1. The resistive and inductively reactive values in the circuit shown at left are expressed in triangular form at right.

Trumbull is assistant chief engineer at KRON-TV, San Francisco, CA.

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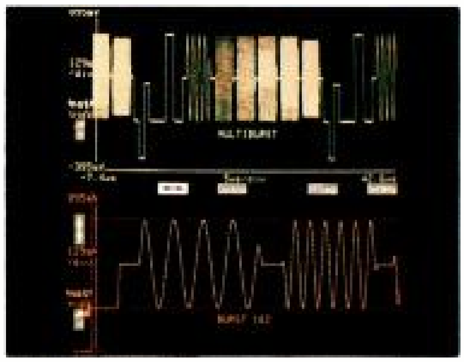
Part 6

Troubleshooting



Maintaining STLs

Solving interference problems

By Chris Durso

An STL system can be the cause as well as the recipient of RF interference. The frequency coordination required when licensing a Part 74 STL minimizes co-channel interference problems, so the most common form of interference in the 950MHz band comes from *intermodulation* (IM) products.

IM is most commonly caused when two or more signals are mixed in the power amplifier stage of a transmitter. Third- and fifth-order intermodulation products are most likely to cause interference because they generally fall in-band. Consider a dual-mono aural STL operating on 949.375MHz and 949.625MHz. The following third-order harmonics would be generated:

$$(2A\text{-}B) = 2 \times 949.375 - 949.625 = 949.125\text{MHz}$$

$$(2B\text{-}A) = 2 \times 949.625 - 949.375 = 949.875\text{MHz}$$

Although these IM products probably would not create problems in the STL system, other neighboring services might be affected. Meanwhile, as those neighboring services are factored in at the B-frequencies, the potential for interference *to* the STL system increases. Such neighbors include cellular telephones, operational fixed services and high-power paging systems, often found with broadcast STL repeaters at congested communications sites.

Calculate all possible third- and fifth-order IM products for the site with a computer before constructing the system. Allow a window around the repeater's receive frequency, because (unlike conventional 2-way systems) STL equipment is extremely wideband, and even a signal 25kHz away will appear on-channel.

IM products also can occur in the STL *receiver* front-end in the presence of too much signal. Here, the RF amplifier or mixer stages are driven into a non-linear condition. A coaxial pad ahead of the receiver input may reduce the input signal enough to allow operation within a linear range.

Durso is chief engineer at KPBS-FM, San Diego.

The most common form of interference in the 950MHz band comes from intermodulation products.

Interference reduction techniques

The first, and perhaps easiest, way to reduce IM is by minimizing the coupling of unwanted energy into the transmitter, antenna and feedline when *designing* the STL system. Careful placement of the transmit antenna can greatly reduce the amount of over-the-air coupling between transmitters. In addition, directional characteristics of antennas and tower shielding can be used to the engineer's advantage. Placement of coaxial cable also can affect coupling.

The use of cavity resonators and ferrite isolators is an effective way of eliminating unwanted RF energy. A ferrite isolator acts like an RF diode, allowing energy from the transmitter to be delivered to the antenna, while unwanted energy coupled into the antenna is directed away from the transmitter output and dissipated as heat in the load. (See Figure 1.) Typical single-stage isolators will exhibit approximately 30dB of isolation. Multistage devices can provide more isolation.

The load resistor connected to the isolator should be able to dissipate at least one-half of the transmitter output power. Because the isolator is a ferromagnetic device, care must be taken not to mount the isolator against a steel rack panel. This would detune the device and disturb its operating characteristics.

Well-designed isolators will have minimal insertion loss and present a VSWR of 1.1:1 or better. In some cases, an isolator will produce second-harmonic spurious energy. To protect against that, a low-pass filter should be installed between the isolator and the antenna. A bandpass cavity also may be installed after the isolator to reduce spurious emissions.

Another technique to eliminate interfering signals involves the use of resonate cavities. These are high-Q filters, typically constructed of metal cylinders. The filter is usually tunable over some range. It is designed to either pass a desired signal or reject an undesired signal (or both). Depending on its design, the filter will display some insertion loss, typically around 1dB per cavity.

The installation of a pass cavity after an isolator will reduce the amount of transmitter noise that reaches the antenna, and keep strong out-of-band signals from reaching the transmitter PA. At a congested communications site, this type of installation is good engineering practice.

Receivers also can be protected from out-of-band signals and front-end overload with the insertion of a pass cavity between the antenna feedline and receiver input. When the frequency of an interfering signal is known, a reject cavity can be used. Notch depth and cavity bandwidth will determine insertion loss.

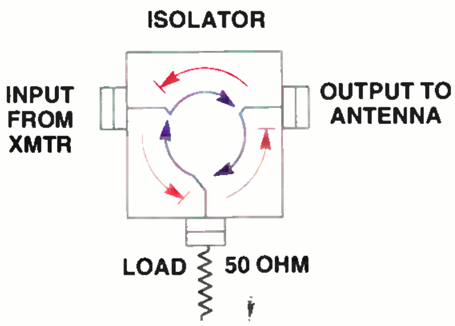
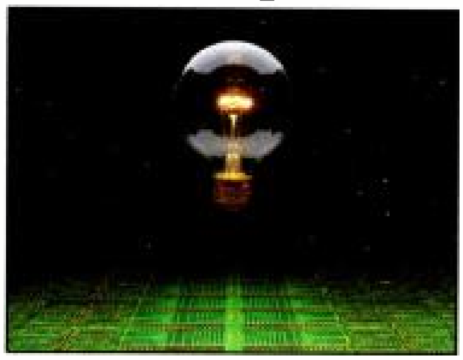


Figure 1. *An RF isolator. Energy entering the input passes to the output. Energy entering the output passes to the load.*

Remember that the newest user at a site is usually responsible for any interference created by his installation. Design your system with interference protection in mind. Even though these extra steps increase the system cost, they may eliminate significant time and money spent chasing interference problems.

■

Technology News



Previewing a multiformat VTR

By Curtis Chan

Within a few years, we can expect several new TV standards, which may include PAL-Plus, SECAM-Plus, D-2-MAC, ACTV, EDTV and HDTV. For these new signals, VTR manufacturers are looking for a cost-effective way to get into digital video recording now, while leaving room for future compatibility instead of planned obsolescence. One company's plans include a ½-inch component digital recorder, tentatively dubbed D-EXTEND. Some prefer to call it D-5, but SMPTE has yet to approve this designation.

Drawing from experience

The new format, drawing upon the D-3 platform, recording techniques and the D-3 media, employs the following strategies:

- All-digital solution in various video recording applications.
- Minimal potential requirements for future format changes.
- Compatibility for future TV standards.
- Simplified mixed composite and component systems.
- A range of cost-performance options.

The proposed D-EXTEND DVTR extends a proven format — D-3. Both use the same cassette and tape stock, mechanical transport, channel coding and error correction and concealment (ECC) philosophy. The recorded footprint and track pattern are similar to D-3. With similar track patterns, playback compatibility of D-3 tapes exists. Although current and near future production and transmission still use a 4:3 aspect ratio, the new format responds to a growing interest to establish a 16:9 ratio for EDTV, and the existing 4:3 ratio.

A comparison of technical details is given in Table 1. Additional preliminary details for the format suggest the following:

- Two hours recording time per cassette, using no bit rate compression.
- The recording data rate approaching 300Mbits/s.
- Full support for the 270Mbits/s serial digital interface standard.

Chan is a principal of Curtis Chan & Associates, Fullerton, CA.

- Operational features similar to the present D-3 platform.

Multimode operation

Three operating modes of a D-EXTEND recorder will include:

1. *Full 10-bit recording of digital component video, fully conforming with revised CCIR-601/656 standards.*

A 10-bit system minimizes posterization impairments sometimes seen in 8-bit quantization, because 8-bit potentially has four times the errors of 10-bit. Also, in 10-bit mode, the DVTR supports applications in digital component 4:3 and digital component 16:9 systems configured for 13.5MHz digital sampling.

D-EXTEND draws upon the D-3 platform, recording techniques and the D-3 media.

FORMAT	COMPOSITE	COMPONENT
Sampling/bits	$4\times F_{sc}/8$ bit	4:2:2 13.5MHz 10 bit 4:2:2 18MHz 8 bit
Tape	½-inch metal particle	1,500Oe
Maximum time	4 hours	>95 minutes
Analog I/O	NTSC RS-170A	Component analog, NTSC
Digital I/O	SMPTE 244M	SMPTE 125M/244M
Serial digital	Future feature	SMPTE 259M/143-, I/O 270-, 360Mbits/s
Imbedded audio	Yes	Yes

Table 1. Half-inch digital VTR parameters.

2. *Playback capability of D-3 recorded cassettes.*

Changes from the D-3 head-to-tape interface control system for D-EXTEND require an increased linear tape speed, redesigned head assemblies and higher-level VLSI processing devices. The system automatically selects the correct linear speed to reproduce D-3. Digital sample rate conversion and decoding allows composite and component output signals simultaneously.

3. *Recording and playback of digital audio and digital component video of an extended 4:2:2 nature, supporting dual sampling rates of 13.5MHz and 18MHz.*

The sample rate mode is manually selected for recording, with automatic control in playback. With both, D-EXTEND covers the chance that 13.6MHz sampling of a 16:9 image may not provide adequate performance. By the numbers, 13.5MHz sampling of a 16:9 image reduces horizontal resolution by 33%. At 18MHz sampling (13.5MHz×1.33), 16:9 resolution is equivalent to 4:3 images at 13.5MHz.

Why no compression?

Currently, different forms of data reduction serve a variety of applications. The manufacturer believes that compression is an immature technology. Any scheme risks being superseded before it can be introduced. This is a serious concern for a DVTR standard that should last at least 10 years. If needed, 4:1 compression could be used with D-EXTEND to record two hours of 1.2Gbit/s digital HDTV signals on the same cassette.

Editor's note: Phil Livingston, Johann Safer, Richard Scott and K. Suesada, all of Matsushita Electrical Industrial Corporation, contributed information for this column.

1984
- MultiController full-motion control system for four cameras. (The launching platform for the future family of AutoCam camera automation products.)

1985
- AutoCam HS-110P studio camera pan/tilt head.

1986
- Tandem operation of MultiControllers for enhancing operational flexibility.

1987
- AutoCam HS-105P ENG/EFP camera pan/tilt head.

1988
- AutoCam ACP-8000 touch screen, menu-driven eight camera controller.
- AutoCam SP-200 Servo Pedestal for HS-110P and HS-105P.
- AutoCam Newsroom Computer Interface for ACP-8000.

1989
- AutoCam SP-200/X-Y. The world's first "free-roaming," full-motion X-Y base.
- AutoCam SportsFocuser automatic focusing system.
- Patent awarded for SP-200/X-Y targeting system.
- Copyright for ACP-8000 touch screen software.

1990
- AutoCam Full-Motion control editing.
- ACP-8000 on-screen air tally.
- Real-time CCU control.
- MCB-1 local manual control box.
- ROP Remote Operating Panel.
- Battery Pack option for SP-200/X-Y.

1991
- AutoCam ACP-8000S, 486/33 controller upgrade.
- Real-time, collision avoidance and studio set mapping.
- Enhanced VGA graphics.
- Multiple screen files for quick transition for back-to-back shows.
- Powerful single screen operation.
- EMMY Award.

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- Production switcher interface for AutoCam operation by TD.
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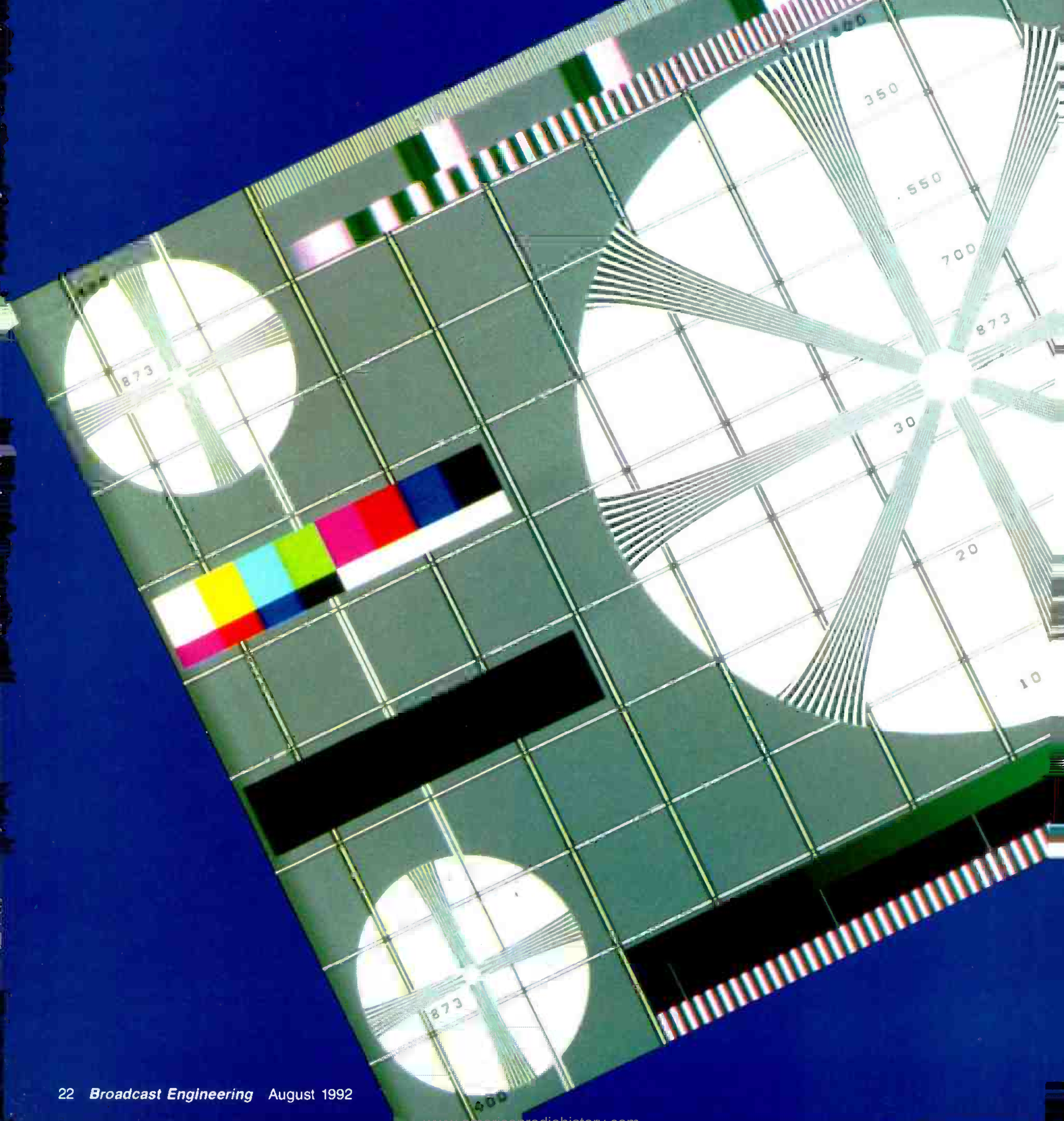
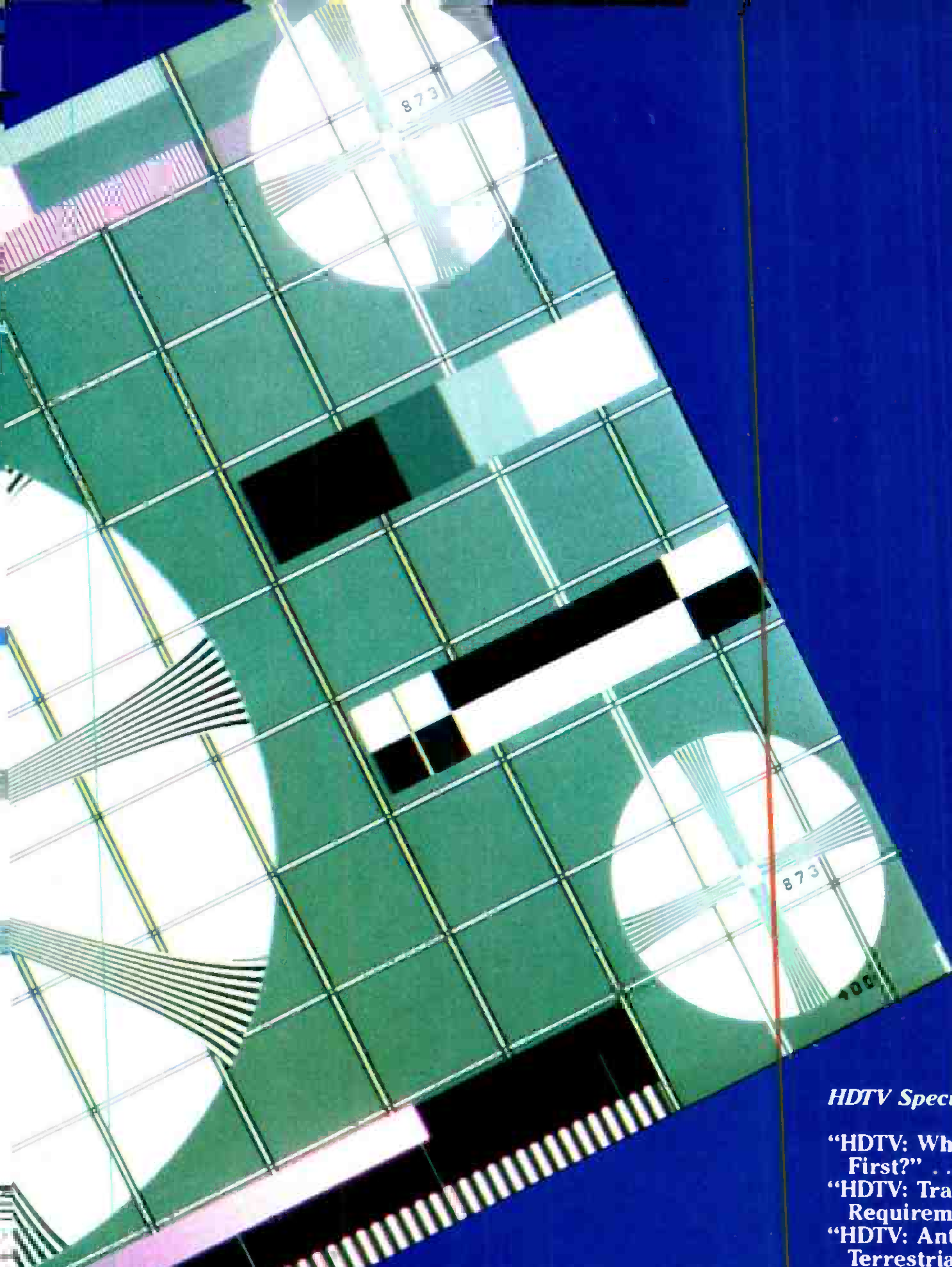
Building for the HDTV future

How will impending HDTV affect your station? The answer may be just around the corner.





As engineers and managers scramble to keep up with technology, users delight in the innovations. To the former, changes are headaches; to the latter, sheer joy. This month's issue targets several areas where technology brings pain as well as pleasure.

Perhaps no other topic has received so much coverage, and so little and useful information as HDTV. Stations and video professionals still want to know how the advent of HDTV will affect their facilities. When to buy, what to buy, and how to integrate NTSC and HDTV together are all valid issues.

However, the first step in the process will be mandated by the FCC when it sets forth the requirements for the RF transmission system. For that reason, this month's issue examines potential solutions to building an HDTV transmission facility.

Two other important video topics are featured this month: videotape formats and video effects systems. If you're involved in any area of video production, read on. The answers to your questions may lie just ahead.

HDTV Special Report:

Other Video Features:

Brad Dick

Brad Dick,
editor

Part 2

HDTV: transmitter requirements

Broadcast TVs' RF requirements are about to change.

By Nat S. Ostroff

The Bottom Line

TV stations of tomorrow will use the same spectrum and channel bandwidths as they do today, but the similarity ends there. New forms of modulation being considered will require extremely different transmission parameters. Because these transmitters will at first operate alongside existing NTSC systems, they will need to be extremely efficient to minimize their added operating expense. And to properly deliver the increased resolution of HDTV, optimum transmission quality will be essential. Here's a first look at how HDTV transmitters may accommodate those needs.

Ostroff is president and CEO of Comark Communications, Colmar, PA.

Under most current scenarios, digital HDTV will become a reality in the 1990s. In the United States and probably the rest of the western hemisphere, the next several years will be crucial in the adoption and implementation of a digital HDTV standard.

The transmission of a digital HDTV signal will place new demands on traditional RF equipment. It will create new generations of hardware while obsoleting much of what is used today. In some cases, specifications and techniques used for decades in NTSC formats will have no meaning in the digital world. In other cases, the digital world will be easier to measure and understand.

The digital RF signal

Most of the current digital systems that are under evaluation by the FCC use some variety of multistate quadrature amplitude modulation (QAM). This modulation system places data on the RF carrier waveform in the form of amplitude and phase. Simply put, in a 16-state QAM system, there are 16 combinations of amplitude and phase, each one representing a data point on the RF sine wave. If the RF waveform is at the proper amplitude in the appropriate time window, the receiver will determine that a bit of data is present. If the waveform is not of the proper value, then an error will occur. The bit error rate (BER) will be a defining factor in picture quality and coverage area. Thus, the amplitude and phase *linearity* of the RF transmission equipment — including the power amplifiers — is critically important.

The time and frequency domain characteristics of the QAM signal closely resemble a noise signal. There is no sync pulse, black level or white level reference. Thus, the digital HDTV signal is best characterized by its *average* power and its peak-to-average power ratio.

Digital HDTV system requirements

The entire RF transmission path in a digital HDTV system requires extremely linear transfer characteristics. Consider first the digital HDTV antenna. The need for excellent amplitude and phase characteristics all the way to the receiver's decoder places some restrictions on transmit-antenna gain. The high-gain, single-channel transmitting antennas in common use today exhibit pattern distortions in amplitude and phase with respect to the receiving antenna's location. These distortions can be dealt with by reducing antenna gain, broadening vertical beam width and extending frequency response. So dig-

In some cases, specifications and techniques used for decades in NTSC formats will have no meaning in the digital world.

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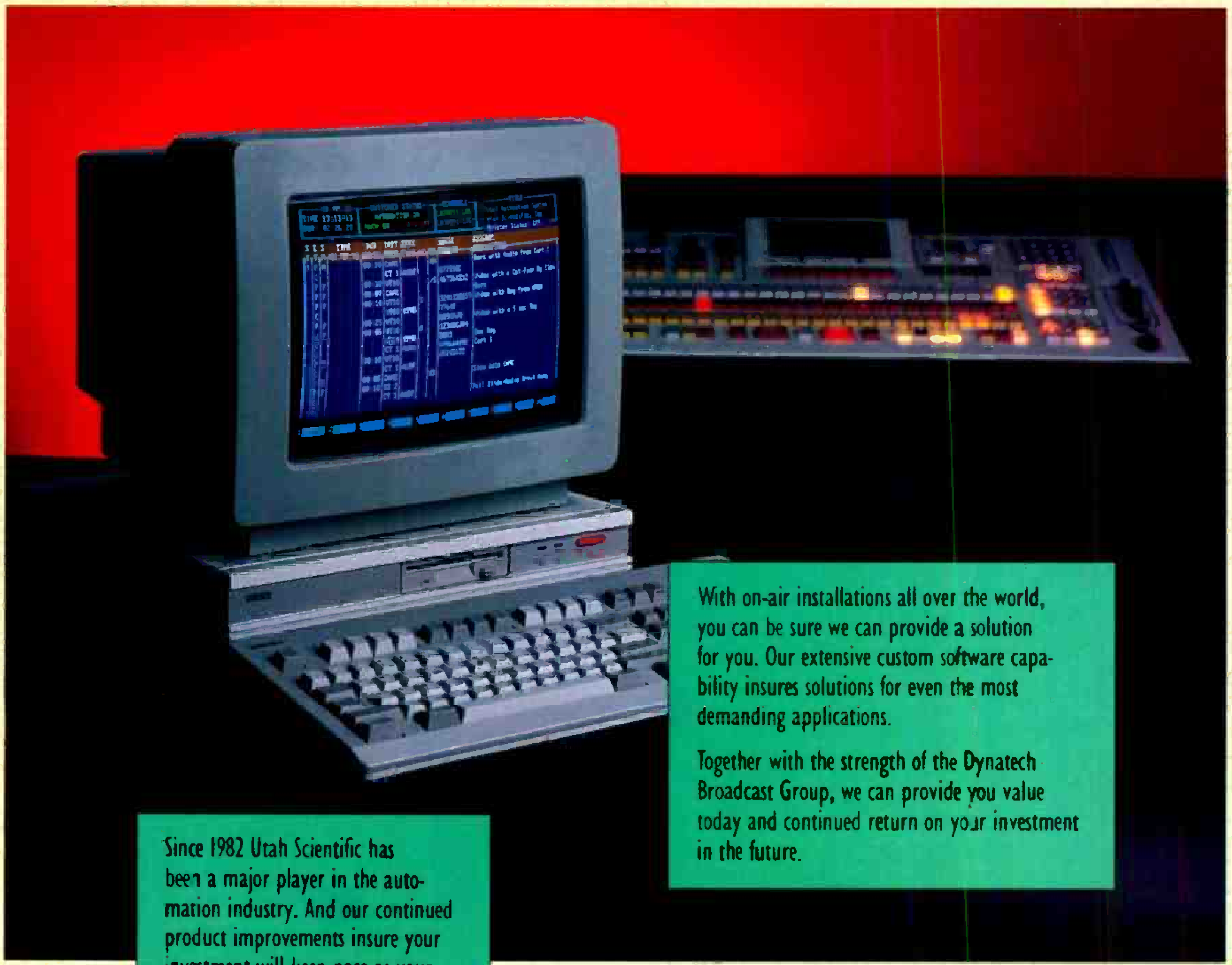

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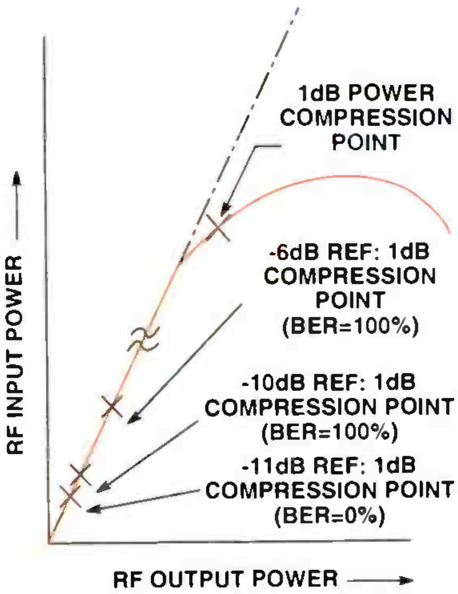

Figure 1. A typical linear amplifier transfer characteristic, showing 16QAM BER vs. power back-off level. Note that a 1dB change in power level makes the difference between a 100% BER (no data received) and a 0% BER (full data received). As a result, safe operating margins will require even lower back-offs. (From computer simulation in Hewlett-Packard's "IQ Tutor Digital Microwave Communications Guide.")

ital HDTV will use lower gain antennas than NTSC. Gain may be reduced by as much as 50%.

Although a digital HDTV signal may require less field strength at the receiver to be successfully decoded, the lower transmitting antenna gain will require higher transmitter output power.

Next, consider that the peak-to-average power ratio of a digital HDTV signal is between 8dB to 15dB (depending on the system selected). Thus, while *average* HDTV transmitter powers may be measured in the 5kW to 20kW range, the *peak* powers will be perhaps 10 times higher or more.

Following this reasoning, you can see why a digital HDTV transmitter may be required to deliver peak powers on the same order of magnitude used in today's NTSC equipment. The linearity demands of the multistate QAM signal further require the HDTV transmitter to maintain high linearity through full peak output power. Therefore, RF power amplifiers for digital HDTV will require a *large and linear dynamic range.*

Error rates prove the point

Bit error rate is one of the parameters that will become a common measure of system performance. As an example of the linearity required for a 16QAM signal, consider the derating required of a linear amplifier to pass the 16QAM signal with zero BER.

Figure 1 shows a typical linear amplifier transfer characteristic. Using the 1dB compression point of the amplifier's transfer curve as a reference, the following results are achieved when reducing the average output power demanded from the amplifier. At an average output power 6dB below the amplifier's 1dB compression point, the BER is 100%. This means no data. At 10dB derating, the BER is still 100% — no data. At 11dB, the BER is zero. Data is transmitted.

The implication of amplitude distortion on the 16QAM signal is clear. This example confirms the RF power amplifier's need for a large linear dynamic range. In practice, the power back-off level may have to *exceed* 11dB to accommodate a distortion budget in the rest of the system.

Class of operation

Three classes of amplifier operation could be considered for digital HDTV applications: Class A, Class B or Class C.

In Class C, where the amplifier operates with zero signal cutoff bias, the severely non-linear characteristics that result render such operation unsuitable for HDTV application.

Class A, biased continuously at full peak power output levels, is certainly linear enough, but also highly inefficient.

Class B (or its practical derivative, Class AB, in which the device is biased above cutoff, but below Class A levels) is linear and efficient. Given a signal with random-

Most of the current digital systems use some variety of multistate quadrature amplitude modulation (QAM).

ly occurring peak power demands but low average power, Class B and Class AB are ideal choices. It is likely that these classes will become a standard amplifier configuration for digital HDTV. Such operation is used by VHF and UHF tetrodes and UHF inductive output tube (IOT) devices.

Amplifier device choices

Because it is likely that the majority of the simulcast channels will be assigned in UHF, power devices that operate in this band should be discussed.

- *The klystron.* Today, the most widely used power amplifier device in UHF is the klystron and its derivations: the multistage depressed collector (MSDC), energy-saving collector (ESC) and Philips

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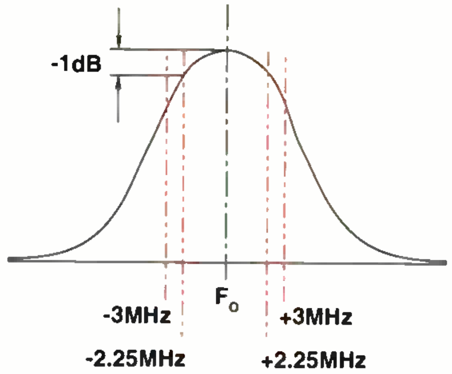

Figure 2. *Typical power bandwidth of a 60kW klystron. Note that –1dB points occur at a bandwidth of 4.5MHz.*

depressed collector (PDC) klystrons.

The klystron is fundamentally a Class A device. It is biased to support the highest peak output power on a continuous basis. The use of pulsers to change the klystron's bias point between sync levels and video levels is not possible in digital HDTV, because there is no such reference point in the signal. Thus, the conventional klystron

The bit error rate (BER) will be a defining factor in picture quality and coverage area.

will have to be biased at full DC peak levels *continuously* to support the random peaks of the multistate QAM signal.

As an example, the 1dB compression point of a 60kW peak sync-rated klystron is approximately 50kW when biased for saturation at 65kW. The DC input power to support 65kW saturated is approximately 130kW. Thus, for a 50kW peak signal with a 10dB peak-to-average power ratio, the efficiency of a klystron will be:

$$\frac{\text{5kW RF average output}}{\text{130kW DC input}} = 3.8\%$$

This is not reasonable or acceptable.

The situation becomes even worse when the power bandwidth of today's klystron is considered. The power bandwidth is narrower than the small-signal bandwidth, because it requires that a conjugate impedance match be maintained at the tube at all frequencies in band. Today's 6MHz bandwidth klystrons do not deliver full power at all frequencies in the total bandwidth. At frequencies away from the carrier, the klystron's cavities are actually stagger-tuned, and it operates as a small-signal amplifier.

Figure 2 shows the power bandwidth of a 60kW klystron. Note that the 1dB bandwidth is only 4.5MHz. Thus, the output power rating and the 1dB compression point for a 60kW klystron will be significantly less at the band edges than at midband.

The effect of the narrow power bandwidth further reduces the already poor efficiency and performance of a klystron for HDTV service.

What about the MSDC-type klystron? Although it is more efficient than its less-sophisticated brother, it still cannot be pulsed. It also has power bandwidth limitations and requires Class A bias. Some of the Class A bias is recovered by the MSDC collector, but the effect still does not make the MSDC an attractive candidate for HDTV.

• *The tetrode.* The tetrode has found applications in UHF at peak sync power levels of 25kW and below. It can be operated in Class AB and therefore offers good DC-to-RF efficiency — well above that of the klystron in a digital HDTV application. The tetrode is usually incorporated into a cavity assembly that uses a double-tuned output design and therefore has at least a 6MHz 1dB power bandwidth. Given the power ratings of today's tetrodes, a digital HDTV signal with a 10dB peak-to-

Amplitude and phase linearity of the RF transmission equipment will be critically important.

average ratio could be rated at up to 3kW average output. This assumes a 1dB compression point for the most powerful tetrode at 30kW.

The tetrode is a good candidate for low-to medium-power digital HDTV applications, where average powers of less than 3kW are needed.

• *Solid-state.* Solid-state UHF transmitters using multiple transistors operating in Class AB are available at power levels up to 30kW peak sync in NTSC. The solid-state transmitter will provide a reasonable choice for digital HDTV applications at low powers (up to 1kW-2kW average output) for a 10dB peak-to-average signal.

The solid-state transmitter will be significantly more costly (because of the number of parallel devices needed to satisfy

The entire RF transmission path in a digital HDTV system requires extremely linear transfer characteristics.

the peak power demands of a digital HDTV signal) and less efficient than a tetrode, but it will offer system redundancy.

• *IOT.* Today's IOT technology provides Class AB amplifiers with the power capability of klystrons. But the enlarged cathode design of the IOT permits even higher *peak* outputs, well above their continuous power ratings. The IOT approach is therefore well-suited for higher-power digital HDTV application. Its capability for high peak output under Class AB bias conditions provides the large, linear dynamic range required.

Figure 3 shows the power bandwidth of a 60kW IOT. Unlike the klystron (Figure 2), the 1dB power bandwidth is in excess of 6MHz, which allows full peak power rating at any frequency in the TV channel. This is important because the multistate QAM signal can have its peak energy appear *anywhere* in the channel.

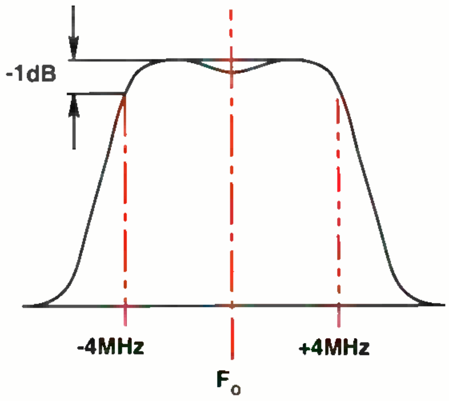

Figure 3. *Typical output power bandwidth of a 60kW IOT. Here, the –1dB points define an 8MHz bandwidth.*

Conclusion

The multistate QAM signal under consideration for transmission of digital HDTV is extremely vulnerable to non-linearities in phase and amplitude. In order to pass data without loss, a wide and highly linear dynamic range is critical in an HDTV transmitter, as is a 1dB power bandwidth in excess of 6MHz.

A review of available devices for RF power amplification at UHF reveals that low-power applications (under 2kW average) may use solid-state or tetrodes, medium-power (1kW-3kW average) may use tetrode or IOT devices and more than 3kW average will be best served by IOT technology. Today's klystron transmitters will not be useful or attractive in HDTV applications because of their poor bandwidth and efficiency characteristics.

Today's klystron transmitters will not be useful or attractive in HDTV applications.

Today's IOT- or tetrode-equipped transmitters appear to be compatible with tomorrow's digital formats without major modifications or system changes. This is especially true of IOT systems operating with common amplification, where no bandwidth-limiting devices (such as diplexers) are used.

Adapting today's understanding and experience to tomorrow's needs will clearly be the quest of TV transmitter manufacturers in the high-definition world ahead.

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

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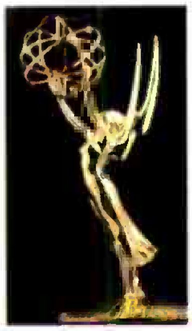

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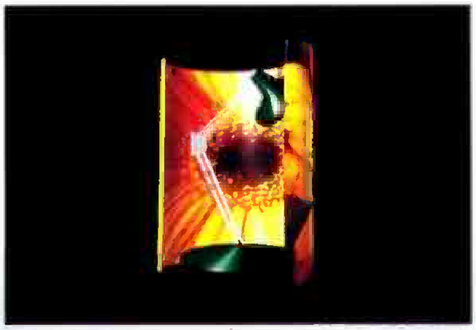

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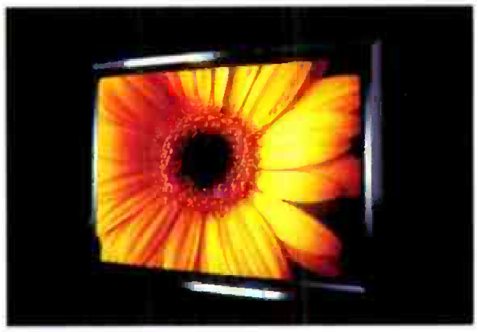

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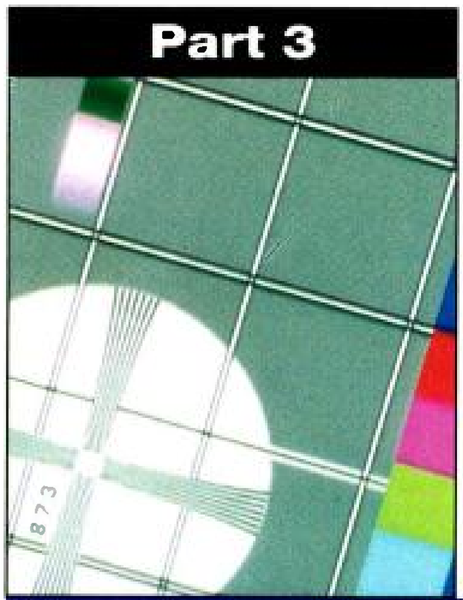

HDTV antennas for terrestrial service

Determine your station's needs and options when it comes to converting to the HDTV world.

By Thomas J. Vaughan

The Bottom Line

HDTV has been a controversial subject from the day it was first demonstrated. How to make this technology available to viewers also has met with numerous ideas and arguments. Although the decision on the system of choice could be less than a year away, questions still persist. No matter which proponent's system is used, terrestrial transmission of the signals will require an antenna.

Vaughan is president of Micro Communications Inc., Manchester, NH.

Implementation of high-definition television (HDTV) as a terrestrial medium in the United States has been a long time in coming. To the eager, the wait has seemed endless. The reticent, no doubt, continue to believe we have been railroaded into an unnecessary technology that will eventually bring an end to TV broadcasting as we know it. Nevertheless, the response from 1992 NAB convention attendees indicates better pro-to-con ratios than in previous years. A more practical attitude surrounded discussions of those looking into their future in HDTV.

Questions and assumptions

This year's conventioneers probably left NAB with a better understanding of HDTV than in previous years. However, they continue to ask questions that have not yet received firm answers:

- Will HDTV require a new transmitting plant?
- What requirements will be placed on an HDTV transmitter?
- Can the HDTV equipment be co-located with existing facilities?
- Can the necessary additional equipment be installed in a reasonable time frame without interrupting current NTSC service?
- Can any additional antenna equipment be mounted on the existing transmission tower?
- What will it cost?

Because uncertainties exist, every question cannot be given an absolute answer at this time. However, HDTV channel allocations for all current full-service NTSC stations could begin sometime in 1993. When the assignments are made, the second channel will likely be a UHF frequency and may carry a digital signal.

Obviously, alterations to existing facilities will be required to accommodate a second transmitter, transmission line and antenna. There is no reason to believe that the HDTV transmission equipment would not be co-located with existing facilities. If the two are not co-located, a maximum

Perform a rigorous structural analysis before new equipment is installed on the tower.

separation of only a few miles would be required. From a practical viewpoint, co-location is important if the NTSC analog signal and the HDTV digital signal are to serve the same viewing audience.

Tower issues

Several conditions beyond the coverage area could impact the decision to co-locate the two systems. The most important question concerns the transmission tower. Can the existing structure support the added weight and withstand greater windloading of additional feedline and a second antenna? At least half of the towers

Continued on page 42

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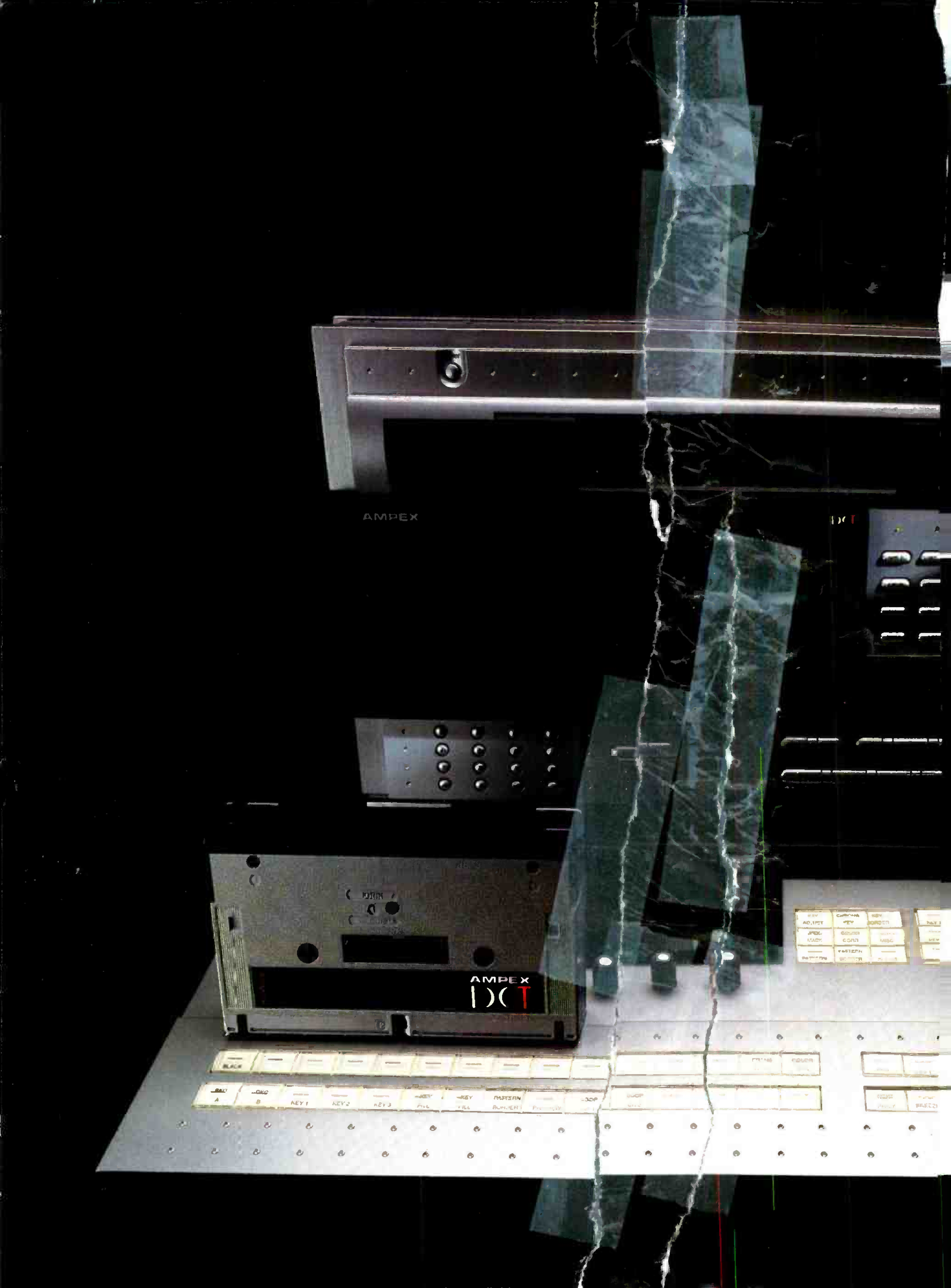
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Continued from page 38

now in use have been standing for 20 years or more. A rigorous structural analysis is essential before any new equipment is installed. Because of their height and preferred locations, many TV towers support antennas for other occupants, thereby earning some revenue for the tower owner. However, the added equipment may have been installed without benefit of a structural analysis. Adding an HDTV antenna could result in an overloaded tower.

If the existing tower or transmitter facility is unsuitable for additional equipment, then a search for a new location will be in order. Often, suitable new locations are difficult to find because of metropolitan area growth and concern over health hazards stemming from non-ionizing radiation.

A recent survey based on 1,000 TV stations indicated that 95% want any new HDTV antenna to be located on the current tower. Responses further suggested that stations now sharing tower space would prefer to share an HDTV antenna if possible. These preferences could simplify the conversion to HDTV. In the case of a shared antenna, however, a new antenna system will need to have broadband characteristics capable of handling the desired channels. Specific allocations may determine if a single multi-user antenna will be sufficient.

If the current location is acceptable, the installation of much of the new equipment should be possible with minimal interruptions to programming schedules. If a complete change of antennas is part of the plan, an off-air period is inevitable. It is expected that stations wishing to take advantage of the new channel assignments will have to complete their construction within three years.

The question of cost factors eludes a fixed answer. Although the costs will be less than proposals offered a few years ago, only educated estimates can be made. Many factors must be considered.

Making room

Those interested in implementing HDTV should start making plans now. Current full-service NTSC stations will presumably be offered second channels first. As of earlier this year, 1,308 UHF and VHF full-service stations are in operation. An additional 1,210 LPTV facilities also are transmitting. If full-service facilities were assigned second channels for a digital HDTV transmission, a total of 3,826 stations would be operating. Undoubtedly, some interference will result.

The LPTV service is currently considered a secondary service. As such, priorities regarding any conflicts or interference problems will favor full-service operators.

Priorities regarding any conflicts or interference with LPTV will favor full-service operators.

At present, certain conditions (the UHF channel taboos) exist that limit the assignments of some UHF channels. Also, an existing co-channel spacing rule requires more than 100 miles between two channels on the same frequency. If a digital HDTV system is implemented, it may permit the FCC to relax the taboo conditions and reduce spacing requirements. If those concessions are allowed, new assignments can be made for at least 98% of all stations. Considering the number of possible allocations, delaying initial steps toward HDTV conversion could leave a station out of the HDTV service.

New equipment

What new equipment will be required to add HDTV capabilities? The current NTSC system can be thought of as an exciter, visual power amplifier, aural power amplifier, diplexer, transmission line and antenna. The digital HDTV equipment will consist of an encoder, upconverter, power amplifier, bandpass filter, transmission line and antenna. Power amplifiers for the digital system will be similar to those used in modern NTSC systems. The major difference will be one of power level.

The quality of a received NTSC signal is a function of signal level. In essence, a stronger signal means a better-quality received picture. In the case of digital HDTV, signal level is not as critical. However, if the level is too low, the signal disappears. Studies show that for an analog system with a 74dBu Grade A signal, an equivalent digital HDTV signal need only be 53dBu. The difference in level comes from modern receiver performance, high gain receiving antennas and lower loss transmission lines. Many receiver improvements have been made since the NTSC contour curves were developed in 1952.

Because lower power levels appear workable, the FCC is expected to authorize allocations of 250kW to 500kW ERP. A study of all stations in the United States regarding ERP, HAAT and HAG parameters shows that of today's NTSC facilities, 50% of all UHF stations are radiating less than 1.5MW (compared to a maximum allowed 5MW). If the reasons for initially selecting a lower ERP still apply, the average ERP level for HDTV should be 100kW.

In case of replacements

Depending upon current and new equipment, several possibilities may exist for HDTV antennas. (See Figure 1.)

1. A single top-mounted all-band antenna could replace a current single-channel antenna.
2. A top-mounted NTSC/HDTV array could replace the current antenna.
3. A side-mounted system could be installed in conjunction with the existing top-mounted antenna.
4. A wraparound HDTV system could be installed below the current top-mounted antenna.

Some UHF facilities will find replacing the antenna with an all-band unit to be an effective approach. For example, a UHF station now using a top-mount single-channel antenna could reduce possible tower limitations by using a top-mount all-band system. Broadband transmission line and waveguide material can accommodate two UHF channels spaced up to 120MHz.

Existing VHF facilities will be unable to enjoy such simplicity. For VHF, all-band antennas typically span channels 2 to 6 or 7 to 13. Unfortunately, no antenna de-

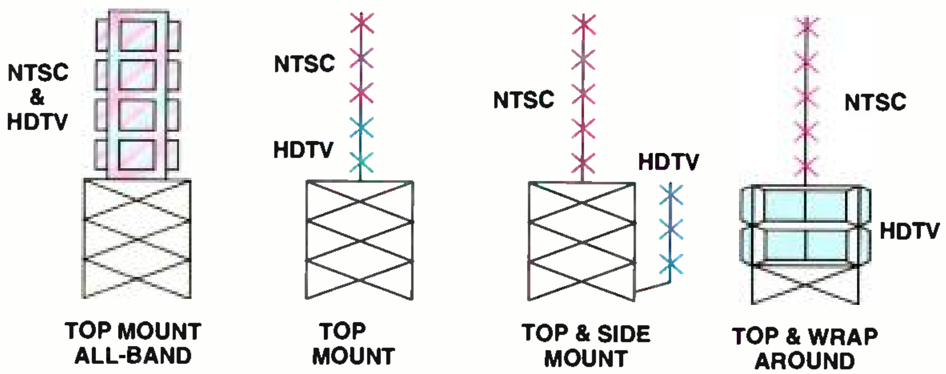

Figure 1. *Four options are suggested for configurations combining NTSC analog and HDTV digital antenna systems.*

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signs simultaneously service VHF and UHF channels. In such cases, the HDTV operation will require additional hardware. However, in the case of two VHF stations sharing a tower, an all-band UHF HDTV system could conceivably simplify the installation.

The majority of antennas used in the United States are single-channel systems. It is worth noting, however, that broadband technology is well developed. Multichannel antenna systems have performed quite well throughout Europe since the early development of television.

The transmission line for driving the new antenna systems will probably be semi-rigid coaxial material. In many instances, waveguide offers a high wind area. It is also highly dispersive, exhibiting significant group delay over a 6MHz band. To meet the compromises of windload and the lower power-handling requirements, the line size of $3^1/_8$-inch coax may be sufficient.

Dollars per decibel

Two schools of thought exist regarding the ERP. Some seem to prefer driving a low gain antenna with a higher transmitter output power level. Others consider driving a high gain antenna with a lower power level a more efficient approach. There are trade-offs between the two. Table 1 compares parameters of three systems designed for a 250kW ERP.

Given the three system options outlined in Table 1, we can consider estimated costs. (See Table 2.)

For an analog 74dBu Grade A signal, an equivalent digital HDTV signal is only 53dBu.

	1	2	3
ERP	250kW	250kW	250kW
Transmitter power	60kW	30kW	10kW
Power into antenna	45kW	14kW	7.8kW
Antenna gain	5.5	18	32
Tower height (ft)	1,000	1,000	500
Feedline size	$6^1/_8$	$3^1/_8$	$3^1/_8$
Efficiency	75%	47%	78%
Feedline length (ft)	1,000	1,000	500

Table 1. Transmitter power vs. antenna gain.

In these figures, note the obvious substantial power loss with the $3^1/_8$-inch line over the 1,000-foot length. (See Table 1.) Over time, this spells higher power expenses. On the other hand, the higher cost of the antenna and other initial expenses (see case 2, Table 2) are nearly half a million dollars less. In case 3 — assuming the 500-foot length would be feasible — costs and performance are more favorable. Every installation will be unique. And so will the true operational costs for those facilities when the installations are completed.

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	1	2	3
Transmitter cost	$600,000	$350,000	$180,000
RF components	$200,000	$100,000	$60,000
Transmission line	$150,000	$45,000	$25,000
Antenna	$50,000	$140,000	$80,000
Tower analysis	$15,000	$15,000	$5,000
Tower modification	$100,000	$80,000	$70,000
Totals	$1,215,000	$730,000	$530,000

Table 2. *Projected station upgrade costs.*

that within 15 years, HDTV will be the only TV transmission medium in the United States. With that and various business aspects in mind, it makes sense to start planning for HDTV soon. The following points are offered as guidelines during the planning process:

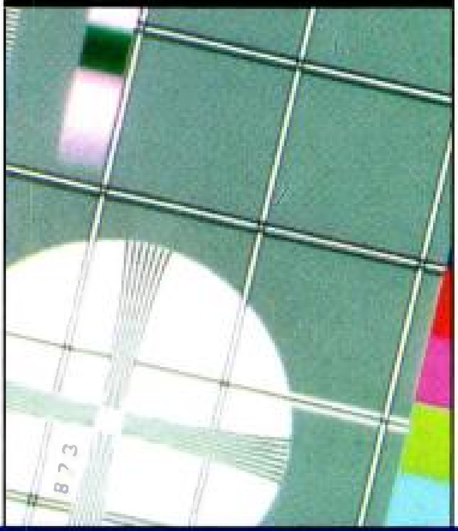
- Establish the degree of station commitment to HDTV (from a business point-of-view).
- Outline all short- and long-term objectives.
- Determine if other stations in the market would be interested in a multichannel arrangement.
- Examine available information on population movement, coverage and pattern changes, tower history and original design criteria.
- Determine possible antenna systems to achieve the desired coverage pattern according to population counts and the contours based on HDTV-quality criteria.
- Consider designs for more than one antenna/feedline configuration. Realize that any design should be open to reconfiguration before the project is completed.
- Arrange for a complete rigorous structural analysis of the existing tower structure, all attachments and the proposed new configuration. The analysis by a qualified firm or professional of all proposed configurations and the final design can be done even before the new channels are assigned.

The view from here

Approximately 15 years ago HDTV was first demonstrated to the industry as a vision of the future. Our path has been a circuitous one, but the journey has brought us within reach of a significant improvement in visual communications. New revenues can be derived from this technology, particularly for those facilities getting in on the ground floor.

➡ *For more information on HDTV antennas, circle Reader Service Number 303.* ■

Part 4



Digital routing switchers

Serial digital routing of HDTV signals gets real.

By Daniel Martinez and Greg Shreve

The Bottom Line

The facility upgrades faced by TV stations over the next decade or so are staggering. Digital NTSC today and HDTV conversion tomorrow look like a one-two punch to many broadcasters. One way to avoid getting knocked out of the ring is by making first-round purchases that can serve well in the later rounds. A digital switcher that can handle HDTV signals is one big-ticket item that could keep broadcasters off the financial ropes. $

Martinez and Shreve are signal processing engineers at TRW Space & Defense in Redondo Beach, CA.

As HDTV production equipment becomes increasingly digital in its implementation, key building blocks are becoming available. Some of these components' feasibilities are technology-driven, and the HDTV serial digital routing switcher is one of them. Made possible in part by recent developments in government and military programs, the HDTV serial digital routing switch is no longer just a possibility, but a current reality.

An example of a high-speed signal distribution system is one developed by TRW (see Figure 1), which is capable of routing HDTV-rate serial digital signals. Built for a government program using a 1.2Gbit/s system, the switch portion itself is capable of routing signals at rates approaching 1.5Gbit/s (the upper limit of the SMPTE 260M 10-bit serial component HDTV standard). This technology has now trickled down to the commercial world, and provides a switching implementation that had previously been considered unattainable for several more years.

Hardware description

The key element of the system is the high-speed switch (HSS), consisting of two 16×16 switch board sets configured in a 16×32 matrix.

Data is transmitted over distance to and from the switch in serial form over single-mode optical fiber. Parallel switch sources and destinations are equipped with parallel-to-serial converters (PSCs, see Figure 2) and serial-to-parallel converters (SPCs, see Figure 3), respectively. Inherent in the design is data scrambling/descrambling. This increases transition density for easier clock recovery inside the SPC (with no increase in bit rate).

Serial data rate requirements for HDTV are up to 1.2Gbit/s for 8-bit samples (EU95 = 1,152Mbit/s and SMPTE 260M = 1,188Mbit/s) and 1.5Gbit/s for 10-bit samples (EU95 = 1,440Mbit/s and SMPTE 260M = 1,485Mbit/s). Any overhead bits required will put an even higher demand on the data rate.

The HDTV serial digital routing switcher is no longer just a possibility, but a current reality.

As a sample calculation of bit-rate requirements for 10-bit operation, SMPTE 260M defines HDTV component parallel digital sampling frequencies in the following format:

E_Y'	Luminance channel	74.25MHz
E_{PB}'	Color-difference channel	37.125MHz
E_{PR}'	Color-difference channel	37.125MHz
	Auxiliary data channel	74.25MHz

Ignoring auxiliary data for the moment, the serial data rate required to transmit all

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A 512 × 512 digital switcher incorporating fiber-optic I/O and operating at up to 1.2Gbit/s rates. (Courtesy of TRW.)

three 10-bit components on a single line is shown:

(74.25 + 37.125 + 37.125) = 148.5Mwords/s × 10bits/word = 1.485Mbit/s or 1.485Gbit/s

Consider also that transporting 10-bit component E_G', E_B', E_R' (RGB) and an associated auxiliary data channel requires a bandwidth of 2.97Gbit/s (74.25Mwords/s × 4 × 10bits/word).

The 8-bit, 1.2Gbit/s performance requirement for E_Y', E_{PB}', E_{PR}' is easily attainable by the HSS, with 1.48Gbit/s as its upper operational limit. For reliable 10-bit operation, more margin is needed, which is expected within a few months. This estimate is based on the predicted capabilities of imminently available, fast fiber-optic driver/receivers, and further development of gallium arsenide (GaAs) switch chips and application-specific integrated circuits (ASICs).

Fiber-optic link implementation

Cable runs of 200 feet or more are common in TV production studios. At high rates, digital signals rapidly lose their signal quality over such extended lengths of coax. To effectively carry high-rate digital signals for longer distances, cables must

often use heavy gauge coax and/or equalization. This increases the cost and makes for unwieldy bundle sizes as cable counts increase.

HDTV serial digital signals of 1.2Gbit/s to 1.5Gbit/s will strain cable performance abilities even more than the existing PAL and NTSC 10-bit component serial rates of 270Mbit/s. This is where the superior bandwidth capability of fiber-optic (FO) links can pay off.

The advantages of fiber optics over coaxial cable include wider bandwidth and elimination of RFI/EMI effects, ground loops and crosstalk. (See "Building Fiber-Optic Transmission Systems," November 1991.) All of these considerations are operative in a studio environment because of the large number of video source and destination devices.

FO cables' smaller size can also present advantages. FO cable diameters can be typically ½-inch for a 10-cable bundle with protective cladding and jacket, far smaller than an equivalent coax bundle.

Fiber optics are capable of extremely long runs with little loss in signal quality and bit-error rate (BER) performance. As an example, a single-mode FO link was tested at three different cable lengths and various frequencies. (See Table 1.) The data eye width measured varied negligibly when the differences in length were considered.

The following are some of the key parameters to consider when implementing fiber in the studio:

- *Fiber types.* For data rates in the 1.0Gbit/s range, single-mode fiber is required to minimize *pulse spreading*, which occurs more readily in multimode fiber, especially at longer distances. However, for lengths up to a few hundred feet, the cheaper multimode cable can perform adequately.

- *Transmitter types.* Also required for data rates in the Gbit/s ranges are laser transmitters (lower rates can use less-expensive LED transmitters). Lasers with wavelengths of 1,300nm are well-suited for distances of less than 10km, and fall into the moderately expensive price range of several hundred dollars.

For longer runs, 1,550nm lasers provide better performance, but at a healthy price penalty over the cost of 1,300nm versions.

Two laser designs commonly employed are Fabry-Perot and distributed feedback (DFB) types. Fabry-Perot lasers have a typi-

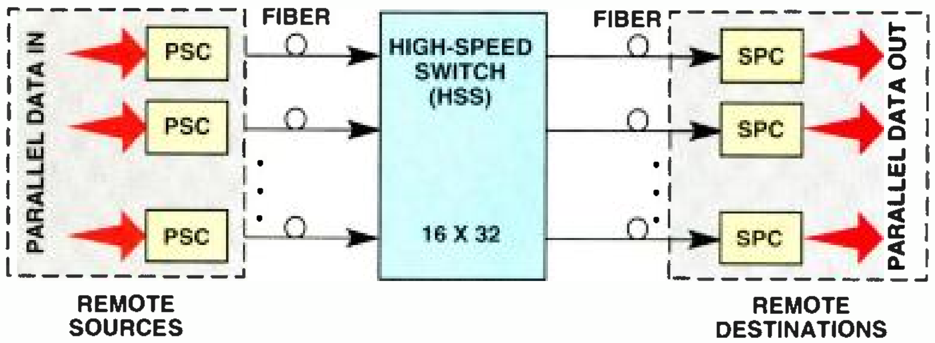

Figure 1. *Basic block diagram of a high-speed signal distribution network. (PSC = parallel-to-serial converter; SPC = serial-to-parallel converter.)*

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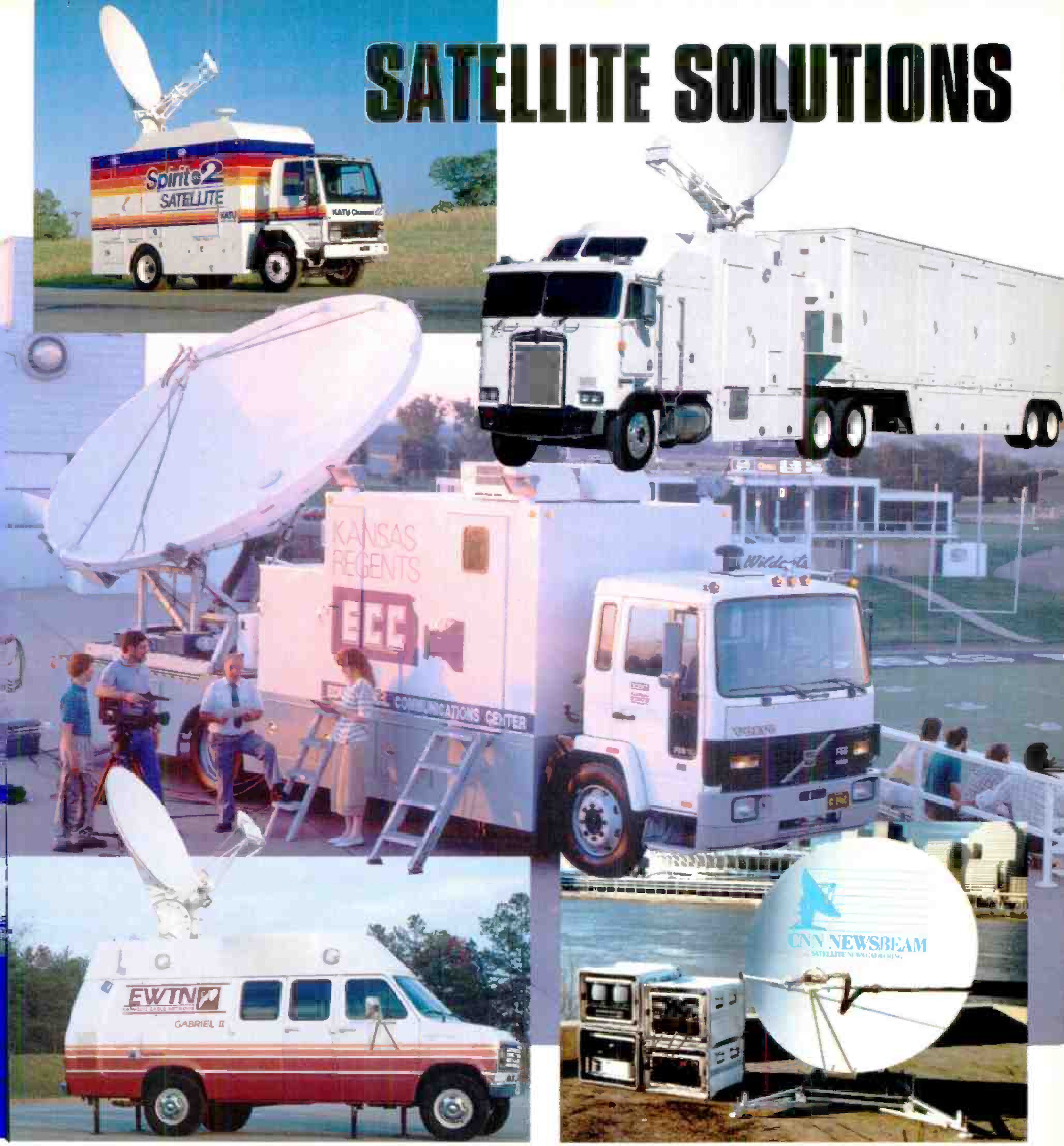

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cal spectral width of 5nm, while DFB lasers have a spectral width of 1nm or less, causing less pulse spreading. However, Fabry-Perot lasers are simpler and less expensive to build. They also have been found to be satisfactory for data rates in the 400Mbit/s to 1,500Mbit/s region.

• *Optical link performance parameters.* Some of the key performance issues to consider for high data rates are jitter, optical and electrical rise time, duty cycle distortion, extinction ratio, optical output power and optical input sensitivity.

• *Connectors.* Snap-on (SC) and screw-on (FC) connectors have been found to be effective for single-mode fibers at high data rates. Many telephone companies are standardizing on SC connectors. Connectors should be evaluated in regard to these parameters: return loss, insertion loss, repeatability of return loss and insertion loss results, connection stability, ease of mechanical implementation and cost.

• *FO connector maintenance.* Maintenance of FO connectors requires properly trained personnel. Use the manufacturer's fiber maintenance kits and follow instructions carefully. Higher data rates require higher quality connections. Once learned, however, FO cable repair and assembly can become a routine task.

Keeping fiber connector ends clean is important for optimum performance. To maximize the reliability of optical interfaces, reconnect cables as infrequently as possible, keep unconnected fibers capped, and clean the tip of the fiber every time a new connection is made.

Laboratory measurements show variations in optical power each time a connection is made. Differences from 0.1 to 4dB have been observed. In most cases, a proper system design will accommodate that amount of variation within its nominal operating range of optical receiver sensitivity. Where margins are low, however, such a connector loss might be enough to cause signal losses. Fiber system manufacturers might consider including a received-power readout option for hardware on such critical links.

• *Downtime reduction via fault isolation.* Fault detection/isolation capabilities in a fiber system are critical to minimizing costly studio downtime. A fiber-optic system that can detect low light levels and report fault locations is essential.

• *Standby cables.* Just as with coaxial cables, having available spare FO lines allows for immediate signal reconnection if a fiber goes dark.

System performance testing

To validate the integrity of a system after installation, error performance must be checked. Consider the following issues

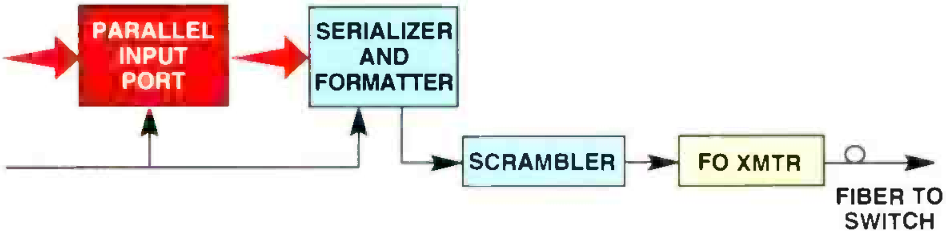


Figure 2. *Basic block diagram of a parallel-to-serial converter (PSC).*

when doing so:

• *BER vs. eye width.* Data *eye patterns* are often used to measure the quality of a digital system. The actual width of the data eye can be a subjective issue. It is more accurate to use a BER measurement system that measures data eye width based on empirical error rates.

Under such examination, it is observed that a change in the acceptable error rate only affects the maximum frequency slightly. In other words, the zone where errors start to occur is defined by a brick-wall function, and allowing a higher error rate will not obtain much better eye-width performance.

• *Crosstalk.* Switches typically exhibit crosstalk from adjacent signal paths. In a digital switch, crosstalk does not result in leakage of another signal, but simply creates another source of data errors. Therefore, real world crosstalk conditions must be established for any meaningful BER performance measurements.

Other design/cost issues

A key design issue for transport of digitized 10-bit RGB is whether to use a single wavelength at 2.97Gbit/s or to use *wavelength* division multiplexing (WDM) of two wavelengths, such as 1,300nm and 1,500nm, running each at 1.5Gbit/s. (See "Fiber-Optic STL Systems," November 1991.) The former approach is simple but expensive, whereas the WDM approach only adds about $400 at each end for the multiplexers.

Some other influential issues are the lowering in cost of 3.0Gbit/s links and a continuing trend toward lower-jitter and higher-bandwidth optical components, such as lasers and transimpedance amplifiers. In the opinion of some fiber-optics developers, a reasonably priced (approximately $2,000) 3.0Gbit/s link should be available within a year, given the current pace of R&D improvements and production volumes.

What will the future hold?

Digital realization of non-HDTV production systems (NTSC, PAL) has reached a high state of development. For example, complete 4:2:2 component digital production facilities are in operation today. (See "Building a Serial Digital Facility," March 1992.)

Although the majority of current HDTV production equipment uses analog I/O, a significant portion of the internal operations of CCUs, signal processors and other hardware is performed digitally. In some cases, existing HDTV equipment can

Continued on page 93

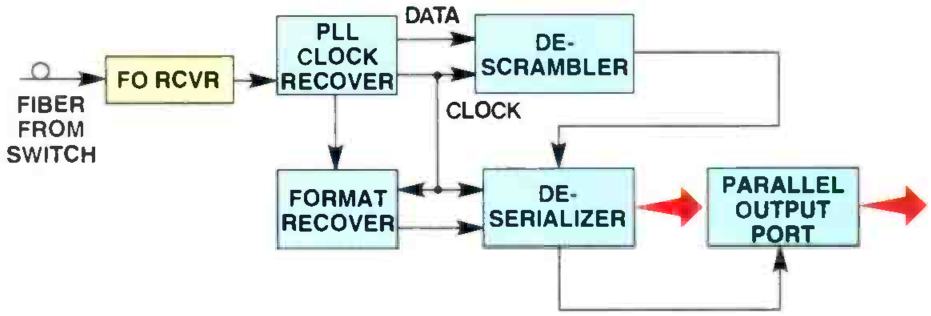
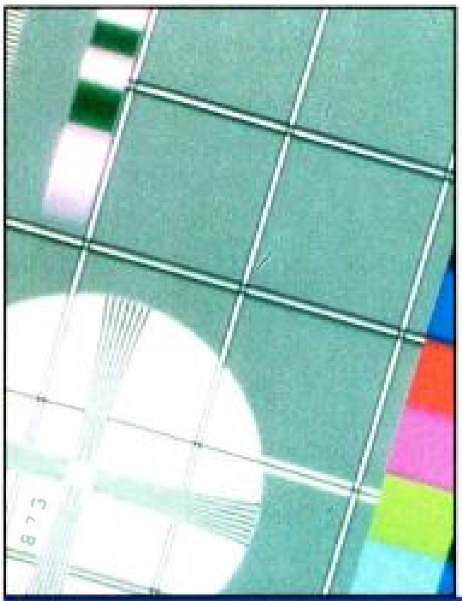


Figure 3. Basic block diagram of a serial-to-parallel converter (SPC).



Selecting a digital video effects system

Selecting a digital video effects system is no easy task, so choose wisely.

By Walter Werdmuller

The Bottom Line

Few video production projects are completed without the use of digital video effects. Today, a wide range of choices exist, from desktop systems to products integrating mixing and editing systems, to stand-alone units that may be linked to production switchers and editing suites. Selecting a digital video effects system is no easy task, especially with the number of systems on the market from well-known manufacturers with excellent credentials and years of engineering tradition. Begin by sorting out the right combination of hardware and software for your needs.

$

Werdmuller is vice president of Pinnacle Systems Inc., Santa Clara, CA.

When choosing a digital video effects system, look carefully at the user interface and design of the control system. Does the system use a high-resolution color monitor that offers a simple, linear menu structure? Remember, a fast learning curve lets you get results sooner.

An important feature to consider is the input/output signal format flexibility. A composite option is desirable in addition to the ability to switch between component and composite inputs — a real time saver when dealing with several formats. A/B switching between any of the sources should be easily accomplished. An integrated downstream linear keyer allows the manipulated image to be keyed over a composite background video source.

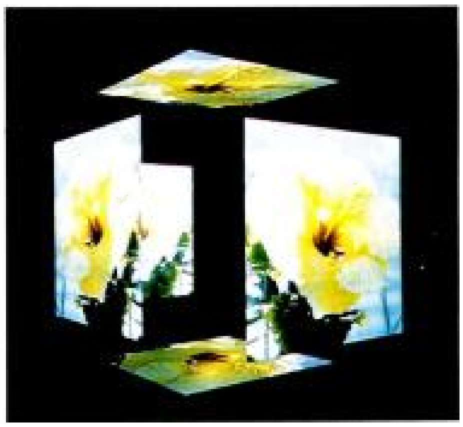
Signal processing with component Y, R–Y, B–Y/RGB inputs should be standard with composite and digital I/O facilities available. Be sure the equipment incorporates the operating power and capabilities provided by application-specific integrated circuits (ASICs).

Operation and signal interfacing

A broad array of system interface capabilities is important. Multiple GPI inputs and outputs as well as RS-422 should be standard. Can the RS-422 capability permit the system to be operated from an editing controller as if it was a VTR? Are there RS-232 and integral SCSI ports that can be used for a still-store option interface? All inputs, whether composite or component, should be automatically timed and phase matched, making it easy to switch between input sources — even between different signal formats — without the need for manual adjustment.

Also, know how many channels are offered. Dual channels, allowing manipulation of two compressed live images at the same time using two systems, and a combiner extend the capability of a single-channel system and allow the user to create advanced, complex sequences.

Look for a system in which the operating environment conforms to industry



Can the system provide cube functions, including placement of an image on the inside and outside of surfaces? Is true perspective permitted in the side of the cube? (Courtesy of Pinnacle Systems.)

THE ASSAULTS:

...635A thrown in the path of a Seattle Transit bus and ran over repeatedly.

"Next time have exact change, pal."

...635A entombed in a watermelon and hurled off a three-story building.

"A splattering experience."

...635A attached to a basketball, bounced, and then slam dunked.

"No harm, no foul."

...635A run over by a ten-ton steamroller.

"Major headache."

...635A blasted by a Seattle Police shotgun.

"Only a flesh wound."

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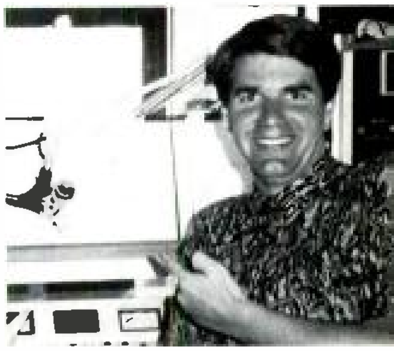
Kent – DJ from KPLZ, in Seattle.



"You Can't Keep a Good Mic Down"

...635A devoured by the jaws of a car crusher.

"Job stress."

...635A eaten by a lawn mower.

"Just a little off the top please."

...635A teed off by a wicked one wood.

"Par for the course."

...635A watched a bowling match from atop a headpin.

"Cheap seats."

Result of these heinous crimes:

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inflict 'serious damage' was a blast from a Seattle Police ***shotgun.*** To fix this serious damage, we had to go to the trouble of hooking up a wire. ¶ ***Frustrated*** by our attempts at physical damage, we decided to try a ***psychological*** approach. A life insurance salesman gave our 635A an hour-long presentation, but the mic emerged ***unfazed.*** There were no noticeable effects or damage. ¶ The microphone looks and ***sounds just fine*** after going through these torture tests. Of course, it's bent and twisted a bit, but then again, aren't we all? The *635A* ***'Hammer'*** *from EV* is truly one incredible, indestructible microphone."

Alan – DJ from KPLZ, in Seattle.

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The background is constructed of multiple cubes, each showing three sizes. Images are mapped onto the different surfaces with different luminance values provided from each direction. (Courtesy of Pinnacle Systems.)

standards. The MS-DOS environment is a well-known and proven operating system, for example, that can assist with easy interface and non-obsolescence. The majority of systems include integrated floppy drives to facilitate field installation of new software features and ensure that capabilities can remain updated. If such drives are not available, investigate how upgrading is accomplished.

Next, check to see if the software control of user adjustments is available directly from the control panel. Does it permit standard default positions, thus allowing the user to set personal preset parameters that can be stored by name, session or other criteria? Such features simplify the user's interface for various specific conditions, sessions or applications.

Architecture considerations

Some systems are hardware-intensive special-purpose boxes. Although these systems have advantages, computer-based architecture can give you more flexibility to add features. This is a key advantage for systems using the workstation concept.

For instance, a montage feature allows an image to be deposited into a separate frame buffer. Multi-images or collages can be created with the touch of a button, making the creation of unique effects simple. The montage capability provides an additional layer of video for a total of three layers — manipulated video, montage and background video. The ability to create trails, decaying trails and sparkles (recursive effects) and motion blur are important features.

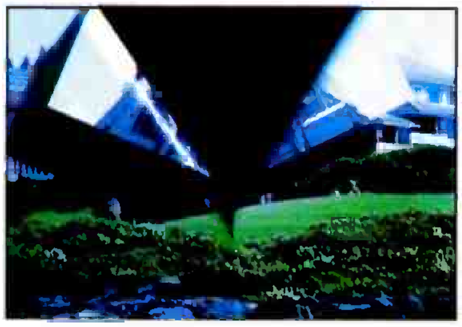
Does the system provide linear keying? A linear key channel permits the flying of characters, logos or other objects created from a graphics system or character generator. An RGB input is advantageous in importing objects directly from a graphic system, camera or character generator into the DVE with full image quality.

Storing stills a plus

Another important advantage is the still-store capability. This feature, when present, offers a unique ability to integrate stills within DVE sequences and to perform multilayering. It can be used as a production tool, as well as for storing often-used slides, charts, graphs and logos. The still-store should provide fast storage and access of stills, search and sort functions with significant storage capacity.

If the system has image composition capability, multilayered images can be created, stored, then retrieved, manipulated and added to the next layer.

Does the system permit real time mapping of live video onto animated 3-D models and surfaces? This capability is becoming attractive because it adds a level of realism. Multiple light sources, intensity variations, shadows and flares can be added to produce unique effects, such as bevelled edges, toroids and cylinders.



Can the system perform page turns with live video on both surfaces? (Courtesy of Pinnacle Systems.)

Can the system provide cylindrical objects and map live video onto the outside and inside of the cylinder? (Courtesy of Pinnacle Systems.)

Paint, graphics and live video manipulations can be accomplished in a single pass. Two live video sources can be manipulated in one pass. Can ready made effects be purchased? Is a separate kit necessary to allow users to create their own unique sequences?

The plus factor

Be sure your choice of DVE manufacturer can provide you not only with regular software upgrades, but also with creative new effects that are equal to or perhaps better than other available effects.

Also, make certain the manufacturer has a solid track record of support, including training programs. Consider what arrangements are available should technical support be required.

You already know to look for value. The savvy buyer will realize that now, more than ever, leading-edge manufacturers will deliver incredibly capable effects systems at a fraction of the cost of a few years ago.

As this revolution continues, software and hardware upgrades are the sure way to protect your investment against obsolescence.

➡ *For more information on digital video effects systems, circle Reader Service Number 305.*

A check list to evaluate effects systems

By Steve Mayer

Selecting a digital video effects system should be made after logical considerations of present and future needs. The following check list suggests points that should enter into the selection process. Noting any limitations for each of the major points may help assist you in making a decision based on your requirements.

Mayer is president of Digital F/X, Mountainview, CA.

System application:
- On-air
- Post

What functions are included?
- Repositioning
- Transitions
- Effects
- Others

What signal formats are supported?
- Composite (analog, digital D-2, D-3)
- Component (Y/R–Y/B–Y, Y/C, digital D-1)
- Multiple format I/O
- Graphics/live
- Key channel input/output

What standards are available?
- NTSC, PAL, switchable

What level of image quality can be ex-

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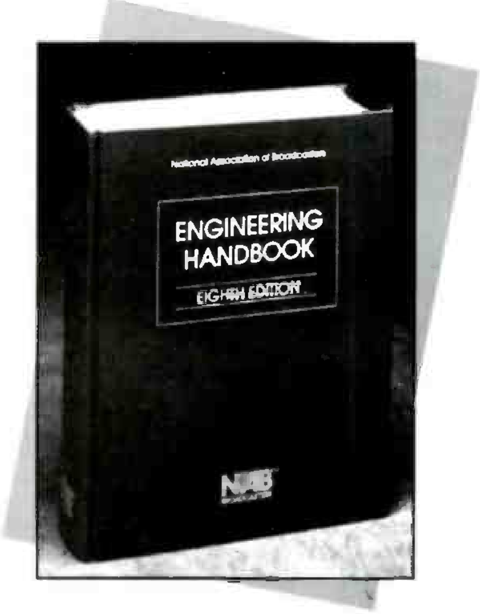

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pected?
- Adequate/transparent
- Smoothness of movement
- Jaggies on diagonal elements
- Flickering of picture when moving

What system control capabilities are included?
- From a local panel
- Remote control from switcher or editor
- GPI, No. In/Out
- RS-232 signal I/O
- RS-422 from editor
- RS-422 of VTRs by effects machine

What is the extent of operator interface?
- Suitable for live or post use
- Degree of complexity vs. functionality
- Graphical vs. numeric type of operator interface

What does the system cost include?
- Initial purchase
- Warranty
- Installation
- Additional equipment needed — upstream timing equipment, other
- Additional remote control and panels
- Are upgrades mostly software/cost of upgrades
- Additional channels
- Training programs

How does system performance rate?
- Usable for real time operation
- Fast enough that it doesn't slow down an edit session
- Too slow; suggested for off-line work

Examine a demo tape.
- What effects were performed in one pass?
- What other equipment was used?

What on-air features are included?
- Shot box with numerous presets
- Logical, easily understood control panel
- Off-line programming functions

What post-production features are included?
- Wide range of shot box capabilities
- Flexible programming of moves
- Flexible programming of shapes
- Editor control interface

What types of effects are available?
- 2-D DVE
- X–Y squeeze and reposition
- X–Y zoom
- Z Rotate
- 3-D DVE
- Non-perspective X,Y rotate
- Real perspective X,Y rotate
- Advanced
- True 3-D
- Create 3-D objects based on number of surfaces
- Number of moving objects
- Defocus
- Multiple light sources
- Types of borders
- Cropping
- Mosaics
- Trails
- Montages
- Intersection of planes in 3-D
- Number of pre-programmed effects
- Ability to program and save effects
- Number of keyers — linear, non-linear, chroma
- Still-store
- Paint capabilities
- Front-back priority control

What limitations are placed on:
- Pictures larger than full screen
- Part of an image off-screen
- Separate video image on front/back
- Flat or curved objects
- Abilities to control curved shapes

What programmability is permitted for?
- Moves, shapes
- Number of key frames
- Type and control of splines
- Ability to edit splines
- Ease images in, out, hold, bounce
- Control of overshoot, speed
- Passing through reference points
- Ability to save programs on disk, cards

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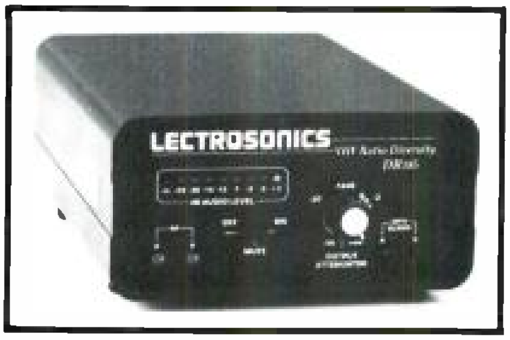

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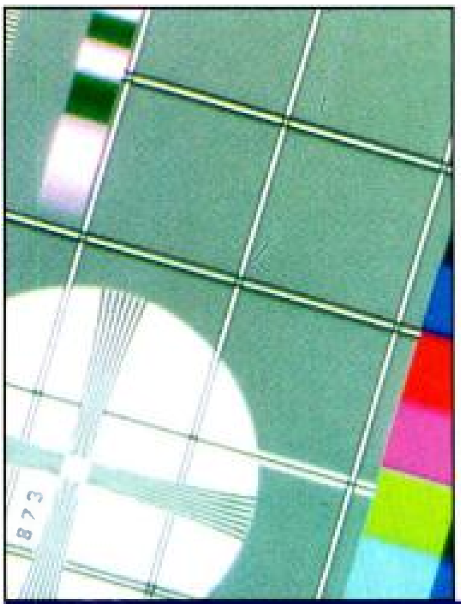

Digital videotape formats demystified

Know the advantages of each format.

By Curtis Chan

The Bottom Line

Demonstrations have shown the advantages of digital video over analog signals in every aspect of video production. In recording procedures, however, the current and predicted formats have created a good deal of confusion for equipment buyers. Before you roll the dice to decide which is best for you, consider these questions: Is one format better than another for certain applications? Is one format preferable as an interim step from an analog to a fully digital facility?

Chan is a principal of Curtis Chan & Associates, Fullerton, CA.

Approximately five years ago, the first commercially available digital component tape format, D-1, was introduced. Since that time, two additional digital formats have emerged, the D-2 and D-3 digital composite formats. Within the next year, a digital recording product — described as the industry's first practical CCIR-601 digital component production system — will be offered by one manufacturer. Another ½-inch format looming on the horizon suggests an ability to operate in either digital component or composite format. Mix the touted performance attributes of these formats to the number of manufacturers producing digital videotape recorders and peripherals, and you may need a bottle of aspirin when it's time to decide what format to buy into and from which manufacturer.

Fortunately, beneath the gloss of marketing features, each format offers its own advantages for a given application and market. For example, is it true that the D-1 or Ampex DCT format has the best multigenerational video quality performance, or is it marketing hype? Is D-2 or D-3 the most cost-effective approach for a transition between the analog composite world to the digital world? Comparing some of the attributes of the digital tape formats available today may help answer these questions.

D-1, D-2, D-3

Before deciding which format is best for a particular application, let's compare some of the differences between the formats. The main distinctions can be differentiated if the format parameters are divided into several groups.

Basic concepts

Rather than launching into a discussion on the tape formats, let's examine some basics about digital videotape recording.

- *Eliminating guardbands.*

In classical recording formats using saturated recording, a guardband provides two benefits. First, it reduces interference from adjacent tracks if the playback head should deviate from its intended scan path.

> ***Each format offers its own advantages for given applications and markets.***

Second, a guardband provides protection from DC or long wavelength fringing fields extending beyond the track edge. This means trouble if the playback head mistracks and picks up adjacent-track long wavelength fields, causing an interfering signal at the head output.

One solution is a separate erase head upstream from the record head to pre-erase the track before recording. The D-1

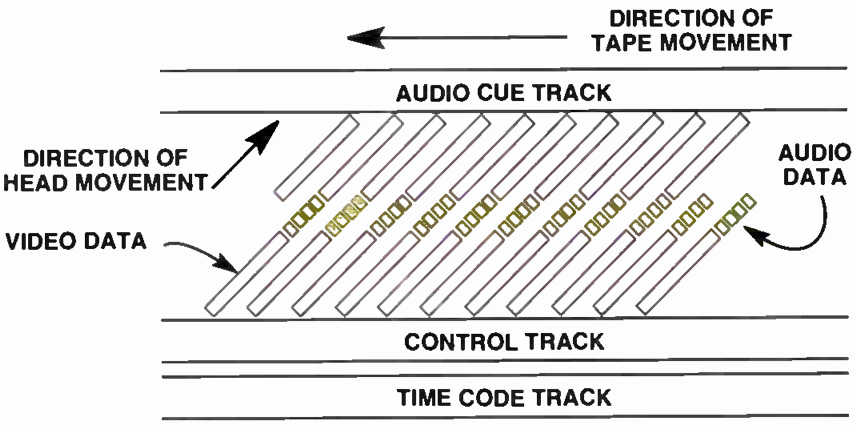

Figure 1. *The D-1 magnetic footprint. Notice guardbands between the tracks and a constant azimuth angle on all tracks. (The azimuth is parallel to the end of the recorded tracks.)*

format has four audio and one video channel all independently editable. The necessary separate record/erase heads require a 12-head scanner (four advance heads, four confidence heads and four record/erase heads). This structure results in a separate DC erase head gap, displaced from the record head. However, the guardband in D-1 absorbs the unavoidable mechanical tolerances of the system, particularly noticeable during insert edits. This makes the D-1 format more robust for insert editing.

The D-2 and D-3 formats combine azimuth recording, metal particle tape and the proper selection of channel coding to eliminate guardbands. Briefly, in channel coding, the data to be recorded is modified to obtain the highest density permitted by the limiting characteristics of the magnetic recording channel. In D-2, Miller-Squared code is used. In D-3, an 8-14 code is used. In each case, the codes have no DC component, and the low-frequency energy present within the code's spectrum is small enough to prevent the recording of long wavelengths. This helps eliminate the fringing fields. An additional benefit of reducing the guardband width is that greater packing density can be achieved. Combine this with azimuth recording and the guardband can be eliminated altogether, leaving more tape area for the recording of data, actually a 30% increase in packing density.

Finally, by using metal particle tape with a coercivity of 1,500Oe, shorter wavelengths can be accommodated. It can then be guaranteed that the recorded track width equals the track pitch by making the record head gap slightly bigger. To ensure a wider margin for the recovery of data, the playback head width is also made wider than the track pitch.

- *Channel coding.*

D-1, D-2 and D-3 use different channel coding schemes to optimize the recording of data to the specific system. However, there are differences that translate to technical and performance benefits and limitations. In D-1, scrambled NRZ code is used with the advantage of a relatively modest high-frequency bandwidth requirement. Its limiting factor is that the code has a low-frequency content that may cause two potential obstacles: 1) It is not impossible to have intersymbol errors occur frequently; and 2) Error rate is influenced by the content of the input signal. In either case, careful design minimizes such occurrences.

Miller-Squared, on the other hand, is DC-free with excellent low-frequency characteristics, but has large frequency demands. S-NRZ and Miller-Squared schemes use real time polynomial mathematical manipulation of the signal, which is implemented in the hardware/firmware topology of the system.

By contrast, the D-3 8-14 coding is a code book scheme using four different look-up tables, each with a 14-bit equivalent for every 256 8-bit words. The data written to tape has no DC bias, because word selection is based upon the digital sum value (DSV) of the preceding word, and that individual words and word "junctures" will have neither less than two nor more than seven identical bits in succession. This approach results in a DC-free code, but requires only (14/16) 87.5% of the high-frequency requirements of Miller-Squared. These approaches ultimately simplify the equalization process while using azimuth recording.

- *Why segmented tracks?*

Each of the three digital formats uses a segmented writing scheme, compared to Type C, where one scan equals one video field. In D-1, the smallest recordable wavelength is approximately 0.9μm, which is equivalent to 2.2bits/μm. Because the 601 standard defines the data rate to be around 216Mb/s, the average data density per field is 3.6Mbit. With 2.2bit/μm, a track length of approximately 180cm is required to record a single field of video. Accordingly, if one field of video was recorded on an unsegmented track, the diameter of the head drum would have to be more than 50cm, which is impractical for a VTR. For the same reason, all three digital formats employ a field segmentation and channel distribution scheme to record the video and audio data.

In the D-1 format, the 250 lines/field are segmented into 10 helical tracks (525/60). The 250 lines/field are first divided into five segments of 50 lines each. Two of the 10 tracks are thus available for each segment. However, the working group decided to distribute the incoming video signal among four adjacent tracks. Because it is impossible to divide two (tracks available for each segment) by four, it was decided to form two video sectors within each helical track. For each segment, two pairs of video sectors are available for recording. These are located in four adjacent helical tracks, with the upper adjacent video sectors on the first pair of tracks and the lower adjacent video sectors on the second pair of tracks.

The scan contains four audio data sectors sandwiched between the two video sectors. (See Figure 1.) Audio data is processed in segments corresponding in duration to four helical tracks or one-fifth of a frame. Each segment has approximately 320 samples, each with a length of 20 bits, including associated data. Because the audio data is duplicated, 16 sectors are needed (4 audio channels × 2 for odd, and even samples × 2 for double recording). The audio data location in the center of the scan reduces the chance of track straightness errors that may be more prevalent at the ends of the tracks. This can be particularly noticeable during audio and video inserts.

In a similar manner, the D-2 and D-3 formats perform track segmentation to avoid a large diameter scanner and problematic mechanical obstacles that follow. The

CATEGORY:	D-1	D-2/D-3
1. Video quality	CCIR 601/657 standard 13.5MHz/2×6.75MHz	SMPTE 244M $4F_{sc}$=14.318MHz
2. Audio quality	AES/EBU standard	AES/EBU standard
3. Tape error	Meets SMPTE 4:2:2 DVTR tape error model	Error correction and concealment

Table 1. *Parameters for format performance.*

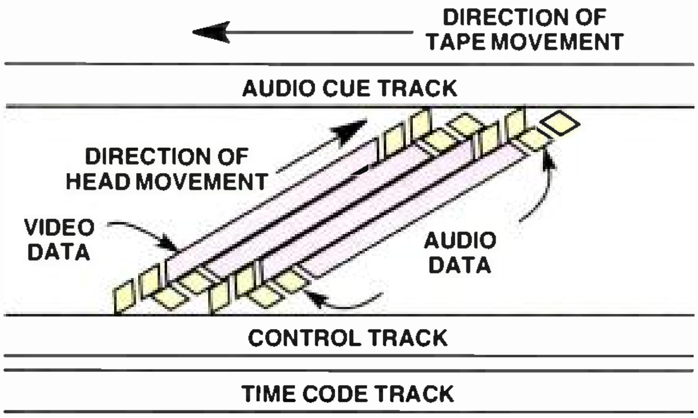

Figure 2. The D-2 magnetic footprint. There are no guardbands, and the azimuth angle alternates between tracks. (The azimuth is parallel to the end of each track.)

digital composite formats, however, reverse the locations of the video and audio portions of the recorded tracks, placing redundant copies of the audio at each end, with video occupying the center. (See Figures 2 and 3.)

- *Azimuth recording.*

A significant difference between the digital component and composite recording systems is that the D-2 and D-3 formats use an azimuth type of recording where the tracks are overlapping, hence guardbands (as in D-1) are unnecessary. One exception is edit guardbands/gaps in D-2 and D-3 formats to accommodate timing errors during editing. These guardband/gaps minimize the error rate at the editing points and throughout the entire edit.

The azimuth recording technique has a better tolerance for tracking errors. This advantage over D-1 is useful during stop motion, slow motion and reverse motion playback, when the audio signals are not required. Some D-2 DVTRs offer an automatic correction of scan tracking for picture recovery. When the head is not yet in contact with the tape, the mechanism steps the head so that it is in line with the next track to be recovered. The RF that the head first encounters is from the unused audio segments, allowing the scanner tracking servo to position the head to read video data optimally. The video error-correction code outer check data is placed at the beginning of the video sector, giving additional time for the head to settle in non-real time playback modes. Last, because the end of the field corresponds to the end of the track, the need for high-speed on-tape jumps is eliminated, giving greater performance in stop and slow-motion playback.

- *Tape format performance.*

The principal parameters of the D-1, D-2 and D-3 formats can be grouped into three categories that are based on video quality, audio quality and the tape error characteristics. For generalization purposes, the format categories may resemble those shown in Table 1.

Category 1 specifies that video quality conforms to encoding parameters set by CCIR Recommendation 601, which established an agreement on a system compatible with 525- and 625-line operation. In short, the format requires that luminance be sampled at 13.5MHz and is locked to sync, being 864 times the horizontal frequency in 625 and 858 times in 525 systems. Color-difference signals are sampled at 6.75MHz. (Both frequencies are integer related to 2.25MHz.) The active samples/line in both systems are 720 luminance with 260 of each of the color-difference signals. Similarly, for the NTSC D-2 and D-3 formats, a $4F_{sc}$ sampling frequency of 14.31818MHz quantized to eight bits produces a respectable signal/noise of 54dB and 768 active samples/line.

Category 2 specifies that audio quality conforms to signals sampled at 48kHz with 16 of the 20 allowable bits/sample used. The audio is recorded with the same heads that record video to maintain sync. The data transmission is based on the AES/EBU standard that meets the requirements of ANSI S4.40-1985.

Category 3 deals with error-correction codes (ECC). Unlike analog, the DVTR requires a more robust scheme to recover lost data. The data recovery can be impaired by a number of artifacts added during the record and playback process. For example, random errors can be generated because of noise, interference or tracking imperfections. Burst errors may occur as a result of head-to-tape contact failures, oxide/video dropouts, tape scratches, head clogging and lodged foreign substances along the tape path.

Two sub blocks width (including ECC)	2+2+85+8+85+8=190 bytes
Total data block width	190×3=570 bytes
Depth of data array	64+4=68 bytes
Total size of data array	570×68=38,760 bytes

Table 2. Calculated size of the ECC-protected data array for D-2.

Audio concerns

Digital audio signals are more susceptible to degradation than video because human hearing is more attuned to errors than the eye. This problem compounds in editing because the audio sectors at the edit in/out points adjacent to the prerecorded sectors are affected as well as all of the adjacent audio sectors in between. This makes the new and old sectors subject to degradation because of tracking errors. Therefore, digital audio requires a more robust ECC scheme than video.

- *D-1*

The error code used in the D-1 DVTR is a 2-D Reed Solomon type, consisting of an inner and outer code. The code analyzes and corrects errors within 8-bit symbols that are aligned with databytes. The structure uses an inner code to correct random errors and an outer code to correct for burst errors. In the D-1 format, an inner code block contains 60 databytes and four checkbytes to correct for single byte errors and to detect multiple byte errors. The outer code block, interleaved to a depth of 10 blocks, contains 30 databytes and two checkbytes. The outer code can correct burst errors up to 1,340 bytes long. Longer errors are processed by error-concealment methods, which do not form part of the 4:2:2 format standard.

- *D-2*

In D-2, the DVTR records six tracks/field with 204 sync blocks per video track. The sync block is organized with two bytes as the sync sequence, two bytes of ID code and 85 bytes of data. Following that are eight bytes of inner ECC, followed by another 85 bytes of data, followed again by eight additional bytes of inner ECC. This is a total of 190 bytes. From this, the number of recorded bytes is 204×190 = 38,760 bytes/track and 38,760×6 = 232,560 bytes/field. The data is organized in arrays, with each data array divided into six sub arrays. The sync sequence is not protected, but is added to the array. Each data sub block is 85 bytes wide by 64 bytes deep. At the bottom of the array are four bytes of the outer ECC protection. The size of the ECC protected data array for D-2 is shown in Table 2.

These numbers are valid for the video sector. This means that each recorded track stands on its own, and the product block content is equal to the content of one track of recorded data.

- *D-3*

In D-3, to maintain reliable interchange

Continued on page 88

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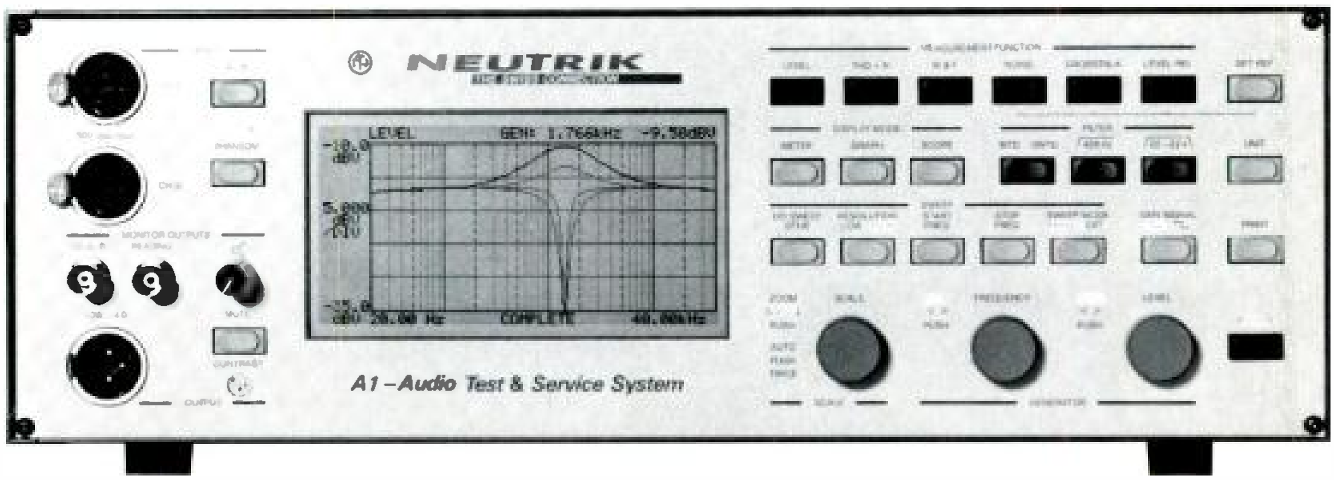

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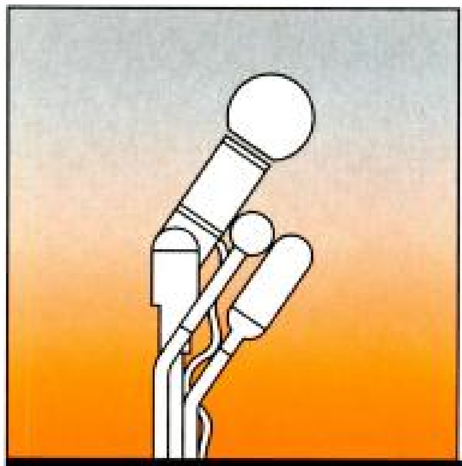


Using microphones properly

The buck starts here, and there are no second takes.

By Flawn Williams

The Bottom Line

No matter what equipment a facility may have on hand, nothing can take the place of a good original recording. Getting it right the first time in the field requires the proper tools and their sensible application. In terms of bang for the buck, microphones are probably a broadcaster's wisest investment — nowhere else will a dollar spent make as much audible difference. As with any other investment, these precision instruments should be protected and treated with proper care. **$**

Williams is a technical producer and trainer for National Public Radio, based in Chicago.

A microphone is a delicate thing. It can sense displacements of air molecules that would require an electron microscope to perceive visually.

You'd think that we would respect and cherish this delicacy — and in the recording studio, we often do. We put our best mics away in velvet-lined cases, and we bristle if someone even comes close to blowing smoke into a microphone.

When it comes to sound recording in the field, however, all bets are off. Suddenly, we're exposing these fragile instruments to dust, dirt and dampness that might compromise their mechanical workings and electrical connections.

Our mics get jostled around with other gear in the backs of 4-wheel-drive vehicles with poor suspensions. We stick them on the ends of reels and go fishing for sound bites in the rain. In a pinch, we've been known to use them as hammers. And after all this, we still expect them to be sensitive to tiny sound waves. Remarkably, most of the time they still work.

The need for reach

Microphone use in the field often includes scrambling to follow the sound of the news: politicians holding impromptu press conferences in a cornfield, soft-spoken interviewees walking around in a steel mill, a child at the bottom of an abandoned well. In such situations, you need some *reach*, the ability to pick up weak or distant sounds from one direction while excluding sounds from other directions.

If you're getting audio for television, or if you're a radio reporter in the midst of a pack of TV crews, you discover another need for reach. Although everyone is trying for good sound, nobody wants to *see* microphones in the video shots.

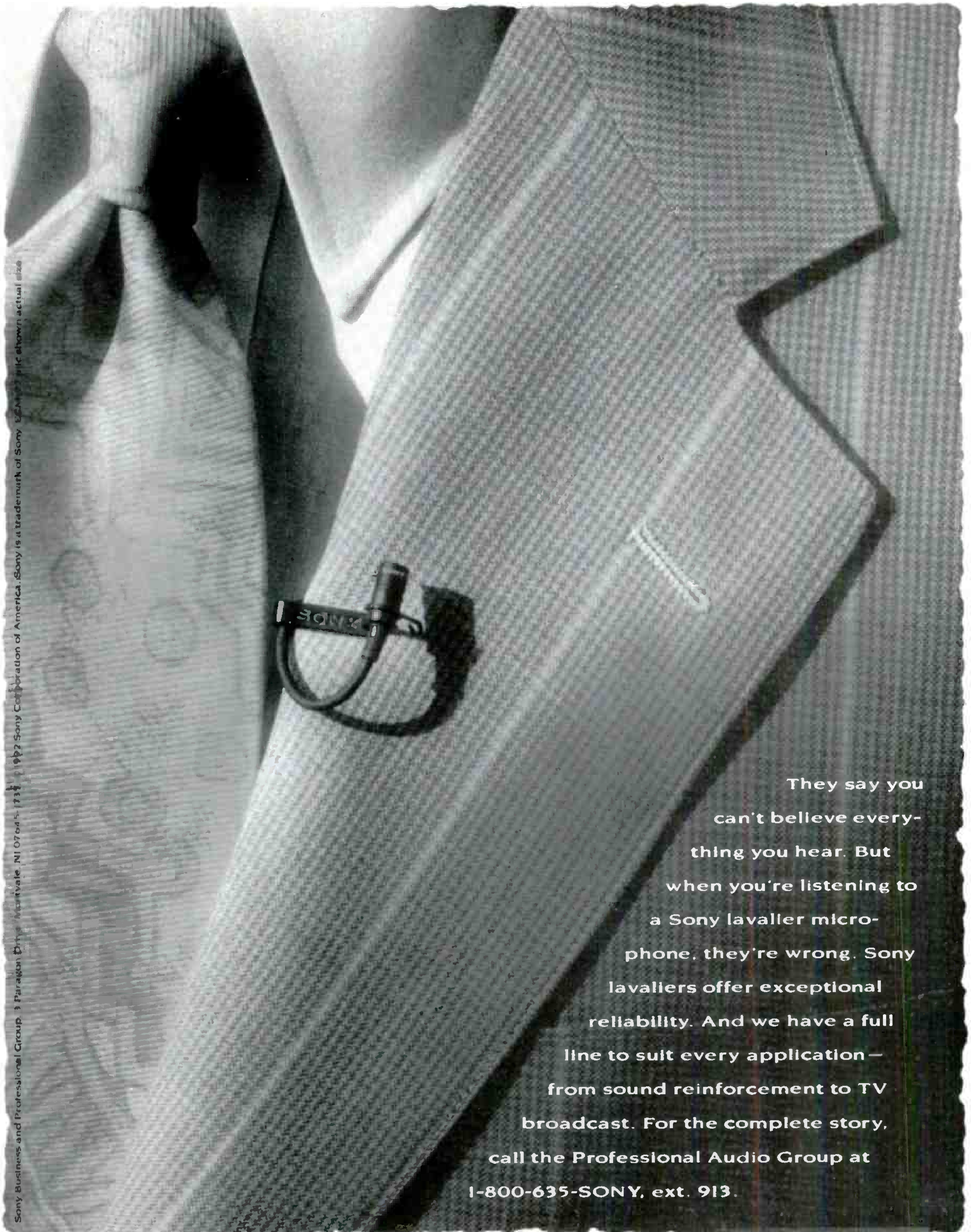
This has given rise to a trend away from omnidirectional mics toward microphones with more directionality: cardioids, hyper- and supercardioids and small shotgun mics.

Unfortunately, many drawbacks accompany the advantages of directionality. The special acoustic labyrinths and interference tubes that are used to attenuate the volume of off-axis sounds also make these mics less sensitive to low-frequency vibrations coming from any direction (on-axis included). Therefore, to obtain *any* acceptable low-frequency output from a directional microphone, its transducing elements must be made overly sensitive to low-frequency sounds in general to compensate for the losses induced by directional elements.

Microphone use in the field often includes scrambling to follow the sound of the news.

This added bass sensitivity creates a set of problems for directional mic designers and users: handling noise, wind sensitivity, plosive distortion, proximity effect and uneven off-axis response all increase in approximate proportion to the directionality of the microphone.

How to make certain the news always comes from a reliable source.



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Handling noise

Any kind of rubbing or mechanical movement on the microphone housing or cable is picked up by the transducing element as a close noise. Unlike the typical case of airborne sound waves moving the microphone diaphragm, this structure-borne vibration moves the microphone *housing* while the damped diaphragm stays relatively still. To the transducer, however, either function produces a net diaphragm motion, and an output voltage is generated.

To avoid the transmission of these structural vibrations, designers of hand-held microphones try to physically decouple the transducer element from the microphone casing, using internal elastic suspensions of various sorts.

This isolation is particularly critical in remote applications. Unlike studio situations where microphones are usually held in stands, you are often the only practical support for the microphone out in the field. Although you may be able to hold an omnidirectional mic without noticeable handling noise, you'll need either a lot more self-control or more mechanical isolation for noiseless recordings with a hand-held *directional* mic. Any microphone can benefit from an isolation mount, but directional microphones absolutely require it.

An isolation mount needs to be solidly made and carefully maintained so that none of its own creaks or jangles is transmitted to the microphone. This is more challenging than it might seem, because even a rubber band stretching against a support point can make noise.

The best mount for a particular mic will depend on the microphone's weight, shape and center of gravity, as well as how noticeable the shock mount can be. More effective shock mounts tend to be larger and more visually obtrusive.

There is also a trade-off in longevity: woven elastic cord will last longer than rubber bands before the elastic fatigues and needs replacement.

Many manufacturers make separate shock mounts for each model of mic they sell. But with a bit of experimentation, you may find one that works better for your mic than the one the manufacturer specifies. A number of generic shock mounts are on the market that will work fairly well with a broad array of mics.

Wind sensitivity

Any air turbulence hitting the microphone element is sensed as a strong low-bass sound. This is not the pleasant sound of wind through the trees; it sounds more like Godzilla tiptoeing through the tulips. Wind noise picked up by a directional mic can easily become strong enough to overload a microphone pre-amp.

It's not just the *velocity* of the wind that matters. The amount of *turbulence* around the microphone element affects the severity of a wind-induced sound problem.

Any kind of physical barrier added to the microphone to keep the wind from pushing the pickup element will lower the high-frequency sensitivity of the mic, and also may affect directionality.

However, any microphone that ventures beyond the walls of a climate-controlled studio requires some wind protection. As a rule of thumb, the more directional the mic, the more susceptible it is to disruption by wind.

One common method of protection is *open-celled* foam plastic. This material allows most sound to pass through, but breaks up the coherence of a moderate wind blast so it is not as disruptive when it reaches the mic. (Remember, sound is air *vibration*, wind is air *movement*.) Some high frequencies will be absorbed as they travel through the foam, resulting in a somewhat duller sound from the microphone.

Incidentally, if cheaper *closed-cell* foam is used, high-frequency loss will be far worse. Be sure to find open-cell foam if you want to try making your own windscreens.

For better protection against wind with less effect on high frequencies, a microphone can be enclosed in some kind of baffle, such as a thin felt cloth. However, cloth by itself doesn't have the physical strength to stay sufficiently rigid (starching it enough to keep it in place would block high frequencies again). So, the fabric must be suspended on some type of open lattice. This is the function of the large external windscreens commonly referred to as *zeppelins* or *blimps*. A sonically porous fabric is attached to a frame of plastic-coated wire, which is shaped to minimize any turbulence-causing sharp edges. The microphone element is totally enclosed within the frame.

Leaving some free airspace between the inner surface of the blimp (or any windscreen for that matter) and the microphone helps even more, because it allows more area for any remaining air motion to be dissipated. The larger the amount of air within the blimp, the better. Once again, there is a trade-off between effectiveness and obtrusiveness. How will someone react when you shove a microphone at him that's larger than his head?

For even windier conditions, additional materials can be pulled over the surface of the blimp. Ideally, these materials should be acoustically porous but should act to further diffuse any wind turbulence across the surface of the blimp.

One lesson learned from nature is that fur is fairly light in mass but can trap tiny air pockets, thus keeping air turbulence from reaching the skin. Drawing on this, several manufacturers of blimps make faux-fur accessory covers that can be slipped over the blimp for added wind protection, but with moderate loss of high-frequency sound. (No animals were mistreated in the recording of this program.)

Plosive distortion

Adequate windscreening also can help protect you from those little microbursts of wind that are produced by people pronouncing P's, B's, T's, K's and other plosive consonants. These look like shock waves to a microphone when they strike it head-on. (They are actually short-lived, 70mph to 80mph wind gusts.) For directional mics with more bass sensitivity, these shock waves are translated into loud, low-bass popping or thumping sounds.

The worst effects of plosives can be mitigated by careful microphone technique, taking care to avoid putting the mic directly in front of the mouth where the main path of the plosive shock wave lies. If your microphone winds up on a podium where you can't control how someone speaks into it, some foam windscreening is wise to help cut down on plosives. Don't expect a small windscreen on a directional microphone to totally solve direct-hit plosive problems, though. (To gauge the plosive prevention of a particular microphone and screen, consider how well they would do in a hurricane force gale — that's the wind velocity you're confronting.)

Ideally, a windscreen should fit snugly around the edges of a microphone, but should leave some protected air space between the inside of the windscreen and the front of the microphone. Also, avoid pulling the windscreen on so tight that the foam plastic becomes compressed. Squashed foam will block high-frequency sounds, and can turn that protected air-space into a resonating chamber. Putting on the windscreen until you feel resistance and then pulling it back off a bit is a recommended practice.

Proximity effect

Another low-frequency artifact of directional microphone design is the disproportionate boosting of bass frequencies. This generally occurs when low-frequency energy arrives at the microphone from one direction (especially on-axis) at a significantly *higher level* than it arrives from elsewhere. The most common example of this takes place when the microphone is spoken directly into at extremely close range, although *any* sound that occurs close to a directional mic (within a foot or less) will be transduced by the microphone as not only louder, but also more bass-heavy than distant sounds. This rise in low-frequency energy becomes more pronounced as the microphone gets closer to the sound source.

At close range, even small changes in micing distance can alter the tonal quality of a directionally miced sound. This

Which type of player is right your station?

Denon.

With its hugely successful DN-970 and DN-950 CD Cart™ Players, Denon helped make CDs the broadcast media of choice. Given the success of these industry-standard players, there were only two things Denon could do: 1. Make a CD Cart player that is smaller, faster, smarter and better; 2. Make a pro CD player that is *not* a Cart player. Denon did both.

ACD-5B CARTRIDGE WITH ATS BAR CODE

The new DN-961FA Drawer-Loading CD Player is Denon's answer to the many broadcasters who *formerly* had to choose between the drawer-type player they needed and the Denon performance they wanted. Its Eject-Lock during play adds another most-wanted feature to its list of attractions. Meanwhile, the new DN-951FA CD Cart™ Player dramatically improved functionality with its Auto Track Select (ATS) system, which reads bar-coded carts to *lock-in, lock-out* or *auto-cue* to a specific track.

That's not all; three-in-a-rack mounting, true instant start, and end-of-message signals with selectable time-to-end are just a few more key features of these cost-effective new players.

The DN-961FA and DN-951FA. Denon just made it twice as easy to decide which CD player is right for you.

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Circle (67) on Reply Card

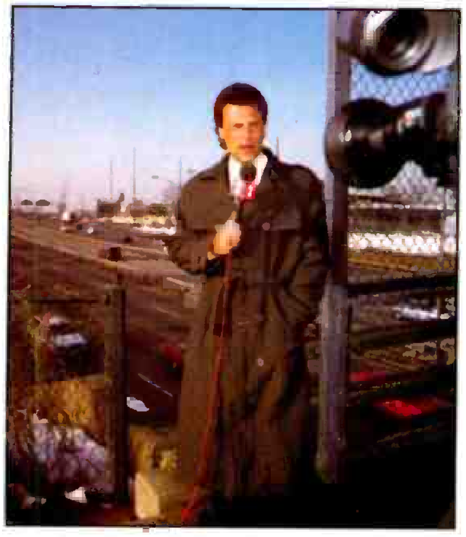

Photo courtesy of Shure and WBBM-TV, Chicago.

makes keeping a uniform microphone placement distance critically important if the timbre of the recorded sound is to stay consistent. It is also a good reason to consider using an omni (or at least a cardioid) rather than a highly directional mic, if you can get within a foot or so of the sound source. And it is why you should be cautious in micing sounds from less than a foot away if you *are* using a highly directional mic. Listening under reliable headphones can help keep the aural perspective and tone quality consistent.

Off-axis response

All microphones, including those sold as omnidirectional, exhibit their smoothest and widest frequency response only for sounds that arrive on-axis and from a given distance. The windscreens and protective grilles on omni mics, and the slotted tubes and other barriers that directional mics use to cancel sound arriving from off-axis, tend to muddy things up a bit.

In general, directional mics are only able to attenuate off-axis sounds at middle and high frequencies. Most directional microphones are essentially omnis below approximately 200Hz. (See Figure 1.) Therefore, the off-axis sound picked up by a directional mic is often bassy, hollow and indistinct.

Even in the middle and upper frequencies, directional microphones (especially those with larger diaphragm diameters) can exhibit widely varying frequency responses at different axes of incidence. Again, this argues for stable orientation of the microphone throughout a recording to maintain uniformity of tonal quality.

Giving the devil his due

Many problems related to bass response can be mitigated. One design solution is the addition of a switchable high-pass filter that can be used to roll off excess bass energy. This compensates for proximity effect and makes the other bass-related problems less audible.

But the amount of bass cut off by the internal filter is often too severe. Much of the naturalness of low-pitched voices and sounds can be compromised by excessive brute force filtering. If you have the option to filter out bass later in the studio during post-production, where you can better judge how much filtering is enough, then it is better not to do it in the field. Alternatively, some microphone designs offer multiple low-cut settings on their filters.

A method for minimizing proximity effect is the use of a large number of widely spread out rear-entry ports, rather than one or two in the same general place on the microphone. Be careful not to cover any of these ports with your hand or any mounting hardware in order to maintain proper frequency response and directionality. For outdoor use, all of the ports on a variable-directivity mic must be adequately windscreened to prevent wind breakup.

Smaller diaphragm microphones generally exhibit more of these low-frequency problems (wind and handling noise, plosive sensitivity, proximity effect), while larger diaphragm microphones are more likely to have problems in the areas of off-axis response and directionality. Also, microphones that use interference tube (shotgun) design are generally less prone to low-frequency problems than an equally directional microphone that uses a small capsule design employing the *pressure gradient* principle. Conversely, the shotgun will typically not perform as well as the pressure gradient in frequency and off-axis responses.

The need for power

Dynamic microphones have proven their ruggedness and reliability for decades. But when you look at the market for high-quality, highly directional microphones, such as *short shotguns*, you'll find that almost all of them are condensers or electret condensers, not dynamics. Condensers offer better frequency response, higher output and sensitivity and lighter weight.

On the other hand, condenser microphones need power to polarize the condenser (the capacitor that serves as the pickup element) and to drive a small preamplifier in the mic. Electret (or *prepolarized*) condenser mics have a permanently charged condenser membrane but still need a small trickle of power to run their internal pre-amps.

Condenser microphones require DC in the range of 9V to 52V, drawing current at a few milliamps. True condenser units generally can tolerate only a small range of variation around their nominal voltage (most are 12V or 48V designs). Electret models can operate across a wider volt-

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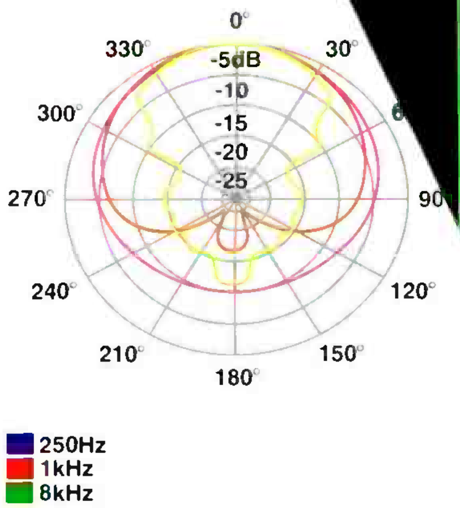


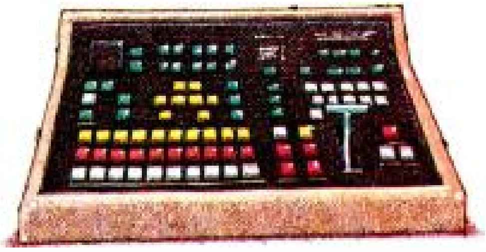
Figure 1. *Polar plot of a popular directional microphone at several different frequencies. Note the nearly omnidirectional characteristic at 250Hz.*

will the extra power being consumed by the microphone affect the battery life of that equipment?

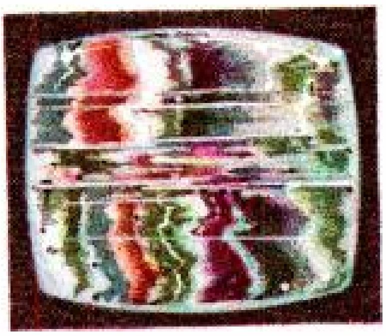
Knowing that the equipment can supply phantom power may not tell you all you need to know. Some of the newer condenser mics consume substantially more current than their older counterparts. Some phantom supplies also provide only 9V, 12V or 25V, not the full 48V that many condenser microphones require. So check the voltage and current requirements of your microphone(s), and verify that both parameters are satisfied by your supply.

If your recorder or mixer can't supply the needed power, and the microphone has no option for internal battery power (only a few do), then you'll need an external power supply, which is inserted in-line to feed the needed power up to the microphone. This increases the number of cables and connectors in the path, and also means that you'll have to monitor the

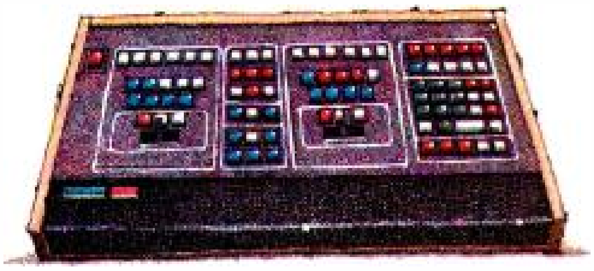
B-rolls



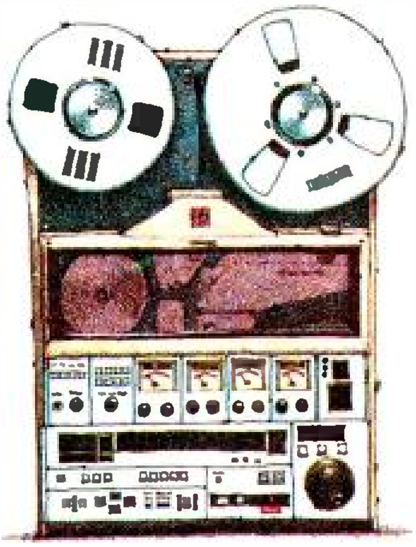
Production Switchers



Fuzzy Freeze Frames



Separate Edit Controllers



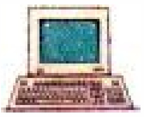
Multiple Source VTRs

Costs

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

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

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



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

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

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

NEC

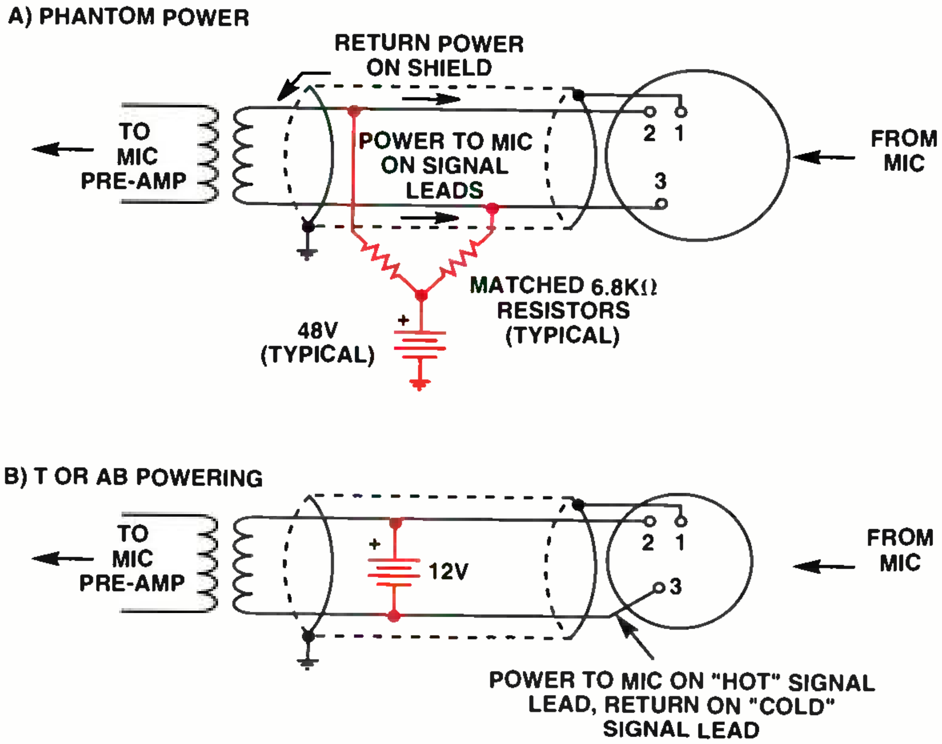


Figure 2. *In (A), phantom power sends the same DC voltage up both wires of a balanced audio circuit. In (B), T-power sends power up just one wire. In both cases, the same wires that carry AC audio signals away from the mic carry DC power to it.*

condition of one more set of batteries. All of this lowers the reliability in the field.

Outboard power supplies can be problematic when used with unbalanced microphone inputs, because they typically ground the low side of the balanced line (usually pin 3), which shorts the DC supply if it is directly coupled to the input. To work in these cases, the supply must be capacitively decoupled from the microphone input side, thereby offering a DC-free output to the pre-amp, while sending DC power upstream to the microphone. (Just because an input is fitted with an XLR connector doesn't guarantee that it's balanced.)

If your microphone can run on its own internal batteries, you'll be able to avoid many of these powering pitfalls. But make sure that you have spare batteries with you, and know the likely lifespan of a battery in the mic. Does the mic have an on-off switch, and does that really disconnect the battery from the circuit? Or does it simply mute the audio output from the mic? Some mics have switches built into the XLR connector housing, so whenever a cable is plugged into the mic, the battery is being drained.

If your recordings involve loud sounds, and you're using a mic that can run from either phantom or battery power, check the mic carefully to see how it handles those loud peaks. Although it may be generally more convenient to run the mic on its low-voltage battery, the pre-amplifier in the microphone may be able to handle higher sound pressure levels with less clipping distortion if it can draw on the higher voltage supply rail provided by phantom or T-power. (Usually, if internal battery and phantom power are supplied to such a microphone, it defaults to the phantom and only switches to the battery if phantom goes down.)

Also, some mics that have a battery compartment suitable for holding a 1.5V AA cell may operate with greater headroom if two Type N 6V cells are inserted into the compartment instead. (Two Type N's fit in series where one AA would normally go. Check with the manufacturer of your mic before trying this to make sure the higher voltage won't damage the circuitry in the mic.)

The need for dryness

The constant electrostatic charge required by condenser microphone transducers becomes difficult to maintain in damp conditions, because it is easily dissipated onto water molecules in the air. Therefore, using some condenser microphones outdoors is a risky business, inviting pops and clicks and generally degraded performance.

Check the specs of your mic carefully. If the manufacturer is unwilling to specify performance at relative humidity of more than 96% or so, it's best to be cautious with that mic outdoors.

In practice, the onset of a humidity problem can be gradual, particularly if the mic is enclosed in a zeppelin. It takes time for the humidity to permeate to the pickup element. Taking advantage of this, some sound recordists who work extensively in rain forest environments report that they use two sets of mics.

For half of each day, while one set of mics is being used, the second set is stored in a sealed bag full of silica gel dessicant. Midway through the recording day, the sets are switched. Because there is little air movement within the front of the microphone housings and little difference in temperature, moisture doesn't rush in.

For extremely wet situations, where the mic runs the risk of being soaked or even submerged, you may have to take drastic action. Some mics retain a good deal of their sensitivity and frequency response even when covered with a stretched latex covering. Don't count on much directionality, however. In general, this technique works better if you start with an omnidirectional unit.

The need for maintenance

Microphones and accessories that are used frequently outdoors are far more likely to fail as a result of dirty electrical contacts, broken connectors or sliced-up cable insulation than their studio-kept brethren. Careful routine maintenance should include cleaning and examination of cables, testing and tightening shock-mount suspensions, brushing the kinks and debris out of zeppelin covers, checking those set screws in the XLR connections, and listening to mics under headphones for any mechanical problems that can translate into obtrusive noises.

Losses in a microphone's frequency response also can occur so gradually that you might not notice them without direct A/B comparison to a less well-used unit. Generally, this results from diaphragm aging or dirt accumulating on the transducer surface. (Again, some condenser models with high electrostatic charges on their outer diaphragm surface readily attract dust and dirt particles. Windscreens can act as air filters in these cases.) Furthermore, internal shock-mounting components can degrade over time. Many microphone manufacturers and service facilities offer cleaning and restoration services that can return microphones to their original capacities. In many cases, the audible improvement from such maintenance is astounding.

Keeping up with all of this won't stop your field microphones from getting dropped in a mud puddle occasionally. But it may help them stand a better chance of working when they're pulled out.

➡ For more information on microphones, circle Reader Service Number 307. ■

Field Report

The ITC Series 1 cart machine

By Chriss Scherer

When was the last time you heard someone say that analog audio sources are dwindling, and that cart machines will soon go the way of (analog vinyl) turntables? If that were true, new broadcast cart machines would not be introduced. I'm not suggesting that you scrap your CD players and resurrect record players, but carts have proven to be reliable, relatively inexpensive and they have decent sound. The ITC Series 1 line offers a reproducer and recorder/reproducer model, both of which are one-third rack units wide and four rack spaces high (when mounted in the ITC rack-mount unit). This line offers the user features found on many top-of-the-line cart machines, but at a lower cost.

The ITC Series 1 was developed for those stations that want quality, but are on a reduced budget.

Another cart machine?

Numerous cart machines are available today. The addition of one more machine must provide something more or different than the rest. The Series 1 offers some innovative design ideas in tape handling and solenoid engagement, with a more compact design in the recorder and an even more economical price. One of the primary reasons for introducing the Series 1 was to offer the user a product with outstanding features, but not the high price.

Some of the features available on the cart machine include three internal cue tones standard, with the 1kHz cue being defeated or added; cart replay indicator with lockout (if desired); cue track recording and playback available; multiturn level and EQ pots; selectable motor on/off control; and a low-voltage, low-power solenoid.

The front panel

The layout of the front panel of the recorder is simple. The LED metering display has dual 10-segment indicators, with the input level set pots located next to them. These pots are recessed, and a tweak tool screwdriver is required for their adjustment. Some feel this is better than the knobs that appear on many other machines, because curious hands can be kept out of the works.

The right side of the face has the play, stop and cue (fast forward) buttons. The record switch is located on the lower left. All of these switches have LEDs inside of them, so changing bulbs is not necessary. However, the indicators are rather small and not as easily seen as bulb-lit switches.

The switch indicator LEDs also are red. I believe the record lamp is the only indicator that should be red. Most people are comfortable and accustomed to green being play, yellow being stop/ready and blue being cue. This is a semi-standard that has appeared on all ITC machines since the Premium series. So far, there have been few problems with acceptance. Because the face labeling is clear, their function should not be confused. It may take some time to become used to the intensity of the indicators. These switches are readily available in the United States, and the red color is the brightest intensity. The other colors that are offered are not as easy to see. Because one of the advantages of this machine is its cost-effectiveness, this should not be a crucial drawback.

Four smaller switches control the three cue tones, and one controls the meter select. The meter can display audio playback or recording, cue track audio or recording bias. Some operators have mentioned that the switches do not feel solid, and that they might break easily. The transport switches use the same switch mechanism as those used in the Delta machines. The meter and cue tone switches are the same mechanisms that are used in computer keyboards. The other LED indicators are labeled audio, sec, ter, loop and pwr. The audio LED indicates that the audio is not muted (in play or listening in fast cue). Sec and ter indicate the sensing of the appropriate tones. When selected, loop is a function that will ignore the commands of all cue tones. When it is enabled on the logic card, it is selected by pressing play a second time, lighting the loop LED. This can be toggled back and forth as desired. The front-panel electronics are contained on a PC board mounted on the rear of the face, which can be easily removed.

Performance at a glance:

- *Three cue tones standard*
- *1kHz add and defeat functions*
- *Optical detector remote signal*
- *External stereo/mono switch*
- *Replay indicator*
- *Lockout capable*
- *Cue track recording and playback access*
- *Multiturn level and EQ pots*
- *Low-voltage, low-power solenoid*
- *Motor on/off control*

The rear panel

The rear panel is basic. It includes the connections for power, audio and control. Power is connected via an IEC line connector. The line connection also has the fuse holder and power switch. Although the power switch may seem to be an unnecessary item, it is a flat rocker style that is slightly recessed. This should prevent accidental switching. All of the audio and remote connections are made with DB connectors. The panel connections are play remote -- DB 25 female, audio out -- DB 9 female, record remote -- DB 15 female, and audio in -- DB 9 male.

DB connectors are used because of the connection density available. This stereo recorder takes up one-third of a rack width. XLR audio connectors would take up considerable room and make the unit either deeper or wider. The cue audio ins and outs appear on the remote connectors. Several unused pins also are on the remote connectors. DB connectors are becoming more commonplace in audio applications all the time, so users should not feel uncomfortable using them. Furthermore, a lug for connecting to the chassis ground is on the rear panel.

The inside story

The cover is detached by removing four screws located on the bottom of the unit. The top cover then slides off the machine. It is interesting to note that the machine has no slots for ventilation. The solenoid doesn't produce as much heat as expected, so the machine runs fairly cool.

Scherer wrote this article while he was chief engineer for WYCL-FM, Reading, PA. He is now a consultant for Avalon Enterprises, Reading, PA.

The recorder has four circuit cards, and the reproducer has only two. All the boards are edge-card mounted to a motherboard. The cards use the same connector, so only one extender board would be needed to service any card if necessary. The sockets are keyed to prevent misplacement. The DB connectors are directly mounted to the PC boards and are held securely to the rear chassis by a machine screw. After removing these screws, the boards can be lifted out of the machine. The motherboard has no active components, it merely connects the rest of the machine together.

In addition, the cards have lifting ears for easy removal. The deck is machined aluminum, which is then electrolys-nickel-plated. The machining process ensures proper dimensions and angular relationships for the mechanical operation. The nickel plating gives a smoother surface for the cart to glide in and out on, and will wear longer than aluminum. This will keep the tolerances in line for quite some time. Part of the machining process is placing the cart stops. Because these are part of the deckplate, they will not move, thus providing a constant reference for the insertion of the cart. Furthermore, the cart will not slam against the head block each time it is inserted.

The Series 1 offers some innovative design ideas in tape handling and solenoid engagement, with a more compact design in the recorder and an even more economical price.

Also on the deck plate is the optical sensor. If a cart has a reflector placed on the bottom, it will activate this switch. This can be used to operate the machine in mono if desired, with the placement of an internal jumper. The machine will take the left channel audio and put it on both outputs. This sensor activates an open collector output on the rear panel, so it could be used to activate noise reduction or some other function.

The power supply is located on the side wall and is fully shielded by the side chassis and a separate cover. This will protect the audio circuitry as well as the user from any high voltages. The power supply is a single-ended supply, providing 24V for the machine. The 15V CMOS supply is regulated on the individual logic cards. Because of the single-sided supply, output transformers must be used on the audio lines to remove the DC component. Some people may not like the fact that they are required to use transformers. In Europe, the standard requires their use. Although any transformer will present some artifacts into the signal being passed through them, the transformers used here are of high quality. The specifications show how good they actually are. However, don't place too much importance on this.

Remember, the main reason for developing this machine was to provide stereo capability in a compact size in a high-quality unit that is cost-effective. Many options are available to the user, including equalization curve for play and record (NAB '64, NAB '76, IEC '71), tape speed ($3^3/_4$, $7^1/_2$, 15ips), EOM indicator, loop play, recorder input impedance and record input level. All of these options are changed with PC board jumpers. The manual clearly describes these functions and the location of the jumpers.

Cart loading is accomplished smoothly and accurately. There is a spring-loaded guide for the left side, holding it securely against the right side of the deck. The top guide is a bar with two roller guides. This spring-loaded bar keeps the cart against the deck plane.

The head blocks are completely adjustable and independent of the tape guides. Three guides are included, two on either side of the play head and one next to the record head. These guides are mounted to the deck plate, and are adjustable for height. The pinch roller is engaged differently than other ITC machines. The solenoid pulls its shaft directly back. As the shaft pulls back, it is drawn over a cam that is attached to the pinch roller pivot bar. This cam resembles those used on Nautilus training machines. Therefore, the solenoid has to perform less work once the roller is engaged. The 24V solenoid has a center tapped winding in it, which two switching transistors control. When the solenoid is engaged, the entire winding is energized for a brief period, long enough for it to pull up. After it has

reached the top, one transistor shuts off, thereby removing the supply to part of the winding. The second transistor keeps the solenoid engaged. In other machine designs, the voltage is actually dropped by the logic switching network. This is more complex and expensive than the scheme used in the Series 1. The method used here should also be more reliable because no power has to be dissipated or reduced.

The ITC Series 1 was developed for those stations that want quality, but are on a reduced budget. It includes many of the features that are available on more expensive machines. The compact size and reduced heat generation also allow for close quarters in the rack. If your station needs quality and reliability, but does not have a large capital budget, the Series 1 may be right for you.

Editor's note: Field reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company.

These reports are prepared by the industry and for the industry. Manufacturer's support is limited to providing loan equipment, and to aiding the author if requested.

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

News
Continued from page 4

Digital radio policy must be developed

The Federal Communications Commission (FCC) should deny a proposal granting a part of the nation's airwaves to start a satellite digital radio service. According to the National Association of Broadcasters (NAB), it would undermine later development of a comprehensive broadcast DAB system.

NAB noted industry interests are still perfecting digital audio broadcasting (DAB) technology, and said that the U.S. policy course for this CD-quality radio service is uncertain and undeveloped.

According to NAB, an FCC okay of the Satellite CD Radio proposal doesn't make any sense and "would represent an unnecessary leap to allocate satellite DAB frequencies... pushed only by one fledgling applicant." Instead, NAB asserted an overall U.S. policy on DAB must be developed first by the FCC and other government agencies before any piecemeal or conditional grant of the nation's airwaves is made for satellite DAB.

In its filing, NAB said no pressing need or consumer demand exists for a satellite radio service. NAB also said the recently concluded World Administrative Radio Conference (WARC-92) left many DAB issues unresolved for U.S. policymakers. These unresolved issues supply no impetus to approve the Satellite CD proposal, despite the fact that WARC leaders allocated the 2,310-2,360MHz band for broadcast satellite sound (BSS).

NAB asks regulators to revise radio ownership rules

The National Association of Broadcasters (NAB) has asked the Federal Communications Commission (FCC) to revise its newly adopted radio ownership rules. It recommends measures that would increase minority ownership opportunities, preserve a viable marketplace for small market broadcasters, and eliminate the use of ratings services to govern station ownership transactions.

NAB's petition for partial reconsideration and clarification to the FCC comes after its Radio Board voted to ask regulators to revise the new ownership rules.

NAB found certain FCC rules troublesome, portions of which rely on radio ratings data from companies, such as Arbitron. The new rules tie audience shares and other audience data to multiple ownership limits.

NAB also said the new rules fail to provide adequate relief and flexibility to station owners from small markets. NAB said small stations must compete against an excessive number of newly allocated radio stations, face stiff ad competition from local cable TV franchises, and many dread cable's entry into CD-quality audio services.

NAB also expressed concern about the new rules' failure to maintain an incentive for minority ownership of broadcast stations. The petition asked the commission to advance minority ownership in radio by expanding the tax certificate and distressed sales policies.

■

Field Report

AKG DSE 7000

By Chriss Scherer

Your production studio has a problem. Everything in it works, but the staff wants multitrack. Station management is not convinced. What you need is an affordable way to increase production output and decrease production time.

The AKG DSE 7000 may be the answer. It provides 8-track production capability, and allows production in less time than ever before. This gives your production staff the time and inclination to try new ideas (and even produce spec spots), thereby helping to boost sales. This device is more than a reel-to-reel recorder or mixing console, and is worthy of evaluation by everyone who uses the production studio at your station.

Getting acquainted

The DSE 7000 combines the functions of an 8-track digital audio recorder, an 8-channel mixer and a computer editor. It was designed by radio production people for radio production work. It differs from most other workstations because it stores all of its audio data in RAM, thus providing instant access to any point.

Four physical components make up the system:

- the mixer/controller
- the video monitor
- the tower (CPU and other hardware)
- a QWERTY keyboard.

Although it sounds like a computer, it doesn't act like one. You don't need to know DOS, or even how to type. Furthermore, the production staff won't look at it and wonder how they will ever use it. More than likely, after a couple of days, they'll wonder how they ever got along without it.

The user's only real prerequisite knowledge is how to record audio and edit sound. And although you're looking at a video monitor, you still use your ears to guide your work, just as you always have. The video simply helps you work faster. The QWERTY keyboard is only used to add text to your production for notes and labels (on-screen and/or printed out), and occasionally as a safeguard when deleting files.

Scherer is a consultant for Avalon Enterprises, Reading, PA.

> ***Performance at a glance:***
> - *8-track digital recording, editing and mixing on a single platform*
> - *32kHz sampling, 16-bit linear PCM*
> - *RAM storage for fast operation*
> - *20Hz to 15kHz, ±0.5dB*
> - *S/N >90dB unweighted*
> - *Distortion <0.005%*
> - *Intuitive, familiar design for simple operation*

The tower houses the real brains of the system. It is based on an Intel i386 microprocessor, running at 25MHz. It stands upright, and is about 24-inches tall, 7.5-inches wide and 17-inches deep (without connectors). On the front are six XLR connectors (left and right inputs, left and right monitor outputs, and effects send 1 and 2 outputs), the system's power and reset switches and a 3.5-inch floppy disk drive. At the tower's rear panel are multipin connectors for the video monitor, keyboard and controller. A hard disk is also contained inside the tower.

The floppy drive is used primarily for loading software into the system. All operations are accessed through the hard drive. The tower is relatively quiet, but there is a fan that causes some noise. This should be considered when deciding on where to install the tower. It could probably be placed in a ventilated cabinet with acoustically absorbent lining, allowing it to be kept in the room without the fan noise creating a problem. The cables for the keyboard, monitor and controller can be extended to approximately 50 feet without additional hardware. For longer runs, standard computer line drivers can be used.

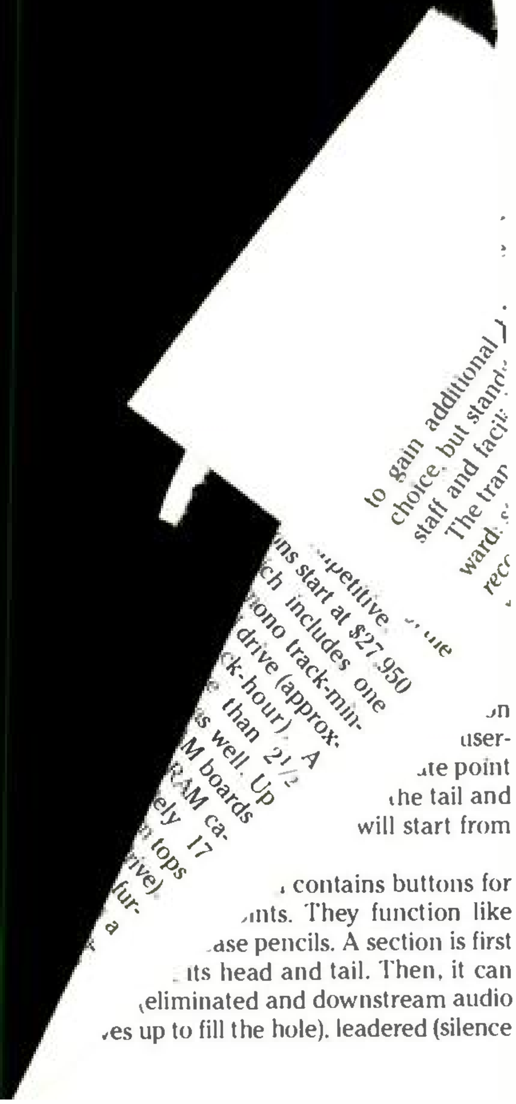
The system's main control surface, the mixer/controller, is about 24-inches wide by 16-inches deep, without connectors. Because it is configured to resemble a typical console, the layout is familiar and easy to understand. There are four sections to the controller: the mixer, transport, autolocator and editor.

Control surface detail

The mixer is used only to mixdown the multitrack recordings made on the system. It has eight channels, one for each recorder track, with channel-mute buttons over every fader. Above the mutes are the record-ready indicators for that track. Line-level audio is loaded onto these tracks at a maximum of two tracks at a time (which makes sense because only two audio inputs are on the tower). To the left of the track faders are two additional faders controlling the input monitor level, with input mute buttons above them. Notice these are called input *monitor* faders, not input level. The input signal level to the recorder track(s) is not affected by these faders. The input level is controlled only at the output of the external source (for example, a console, tape deck or mic pre-amp). Dip switches inside the controller adjust the inputs to accept reference levels from −10dBu to +8dBu. The unit is shipped set for a +4dBu level.

> ***This device is more than a reel-to-reel recorder or mixing console.***

Keeping in mind that this is a digital system, it shouldn't come as a surprise that the input meter is *peak reading*. A "0-level" input is the *maximum* reading. Digital recording is not as forgiving on peaks as analog, and if your operators tend to run levels hot, they will get a nasty sounding distortion. The best solution is to encourage your operators to run levels conservatively. Remind them that with digital recording there is no longer anything to fear from low meter readings (within reason). When interfacing with a device equipped with VU meters, use the standard rule that 0VU on the analog device equals −15 on the digital device. Alternatively, 0VU = −18 (or −20) can be used



...on user- ...ate point ...the tail and will start from

... contains buttons for ...nts. They function like ...ase pencils. A section is first ... its head and tail. Then, it can (eliminated and downstream audio ...es up to fill the hole), leadered (silence inserted in its place and downstream audio moved further down) or erased (eliminated and downstream audio stays where it is). A copy of a marked section also can be placed anywhere. Incidentally, when audio is copied, no additional memory is used. The control system simply notes an additional track/time address for those audio samples to be associated with.

The DSE 7000 combines the functions of an 8-track digital audio recorder, an 8-channel mixer and a computer editor.

Furthermore, you can vary the location of one track in relation to the others at any time. You do not need to punch in at exactly the right place when uploading audio, because it can be shifted later in time (by adding leader or cutting silence). This is probably the biggest single difference between workstation and analog multitrack tape production.

Another useful feature is the *undo* button, and it does (or undoes) just that. If you try an edit and don't like it, press undo and the original unedited audio returns. Press undo again, and you go back to what you just undid (a toggle function).

The system also offers a help function. Pressing the help button calls up information on the current operation on the screen. It starts with the most current action you have performed, and then moves on to other aspects of the machine. This is useful during the heat of production.

The editor section includes other functions that we don't have enough space to discuss, including 3-point editing, track swap, channel phase-invert and more.

Display screens

The video monitor has only two screens, further facilitating operator training. One is the *mixer* screen, providing a "virtual console" for control and display of track level, pans and effects sends. The other is the *editor* screen. This one presents a visual representation of the peak audio level on each track, displayed in a time

The mixer screen, one of two displays used by the AKG DSE 7000. Audio levels are displayed on the lower left, and the menu windows are on the lower right. The upper half of the screen is all that changes between this display and the other editor screen.

line from left to right across the screen. The "now cursor" appears down the center of the screen, allowing a view of 10 seconds of audio in either direction from the current point.

Unlike some digital audio workstations, this unit features a virtual (on-screen simulation) and a hard (real) console for mixing control. As a result, some interaction between the two exists, and it may take some experience to understand which controls what and when. But here again, the system's intuitive design helps: Once such operations are explained, they are easily retained.

Pros and cons

The greatest strength of the DSE 7000 is its ease of use. You can actually sit down and start working without reading the manual. Although this is not recommended (because the manual does contain some important, useful information), the system was designed to act like the analog counterparts it is replacing, and it does. Therefore, the learning curve is exceptionally fast. There are no computer-language commands to learn, no waiting for files to be called up from disk, and no time consumed by number-crunching on commands or edits. Users are free to try infinite variations without the machine delaying things.

The downside of using RAM for storage involves its volatility (loss of memory with loss of power) and its cost relative to magnetic storage formats. The volatility problem is solved here by the DSE 7000's use of shadowing (explained later). In regard to cost, because this unit is designed specifically for short-form radio production, only a modest amount of on-line memory is required during any production session so the system price is not adversely affected. Long-term (or off-line) digital storage can be retained on the built-in hard drive (or elsewhere), allowing RAM to be kept free for only the current production. The amount of system memory available in RAM and hard disk varies with the system configuration. Possible systems and prices are listed later.

Performance in real life

I installed the DSE 7000 in a radio station's production studio in place of an existing 2-track recorder. The system's optional stand has a footprint of about the same size. It was plugged in, using the same audio connectors from the recorder. Then, the staff was allowed to use it. After a basic demo, the system was in productive use within a short time. All the operators were going strong before the end of the day.

Before calling up or starting a production, a selection of *make new, make temp, edit old* or *edit temp* is made. The first two cover new works, and the second two are for existing works. The make new and edit old both enable the shadowing function of the hard drive, while make temp and edit temp do not enable it. Shadowing makes the computer automatically and continuously back up everything you do. You don't have to stop and manually save your work every few minutes. If power fails in the middle of production, don't worry — it will be there. The shadowing is a few seconds behind you all the way.

The DSE 7000 is fast, easy to use and reasonably priced.

The system manual is well written, and is authored by a production person. It is printed in a loose-leaf binder format, allowing later incorporation of programming updates' documentation. When loading a software update on the 3.5-inch drive, computer literacy is not required. Updates are supplied on system disks, so simply turning the unit on with the update disk in the drive will boot the system and automatically load the new software.

Conclusion

The DSE 7000 is fast, easy to use and reasonably priced. Your production staff will be able to do the basics in minutes. By the end of the day, they should be working faster than ever before. RAM storage provides blazing speed, and shadowing counters the RAM's volatility. Library retrieval lets you store and use frequently required sounds without the hassle of loading a reel every time.

The co be installe in your pro the unit actu track recorder track recorder a 8-channel mixing cost of assemblin same features and o system's price is qui

Available configurat for a basic setup, w 16Mbyte RAM board (4 utes) and a 210Mbyte har imately one mono tr 676Mbyte hard drive (mo mono track-hours) is offered to three additional 16Mbyte R can be added, for a maximum pacity of 64Mbyte (approxima mono track-minutes). Such a syste out at $37,600 (with the larger hard

Each day, digital audio moves a littl ther into radio. The AKG DSE 7000 natural step in this process. When your s tion is ready to upgrade to digital, ad multitrack or replace an existing multitrack, the DSE 7000 should receive serious consideration.

Editor's note: Field reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company.

These reports are prepared by the industry and for the industry. Manufacturer's support is limited to providing loan equipment, and to aiding the author if requested.

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

Preview

September...

AUDIO AND VIDEO PRODUCTION SYSTEMS

- **Desktop Video**

A look at PC-based video editing, production and effects systems. The article will emphasize the use of small, non-proprietary platform-based hardware.

- **Audio Console Technology Update**

A review of modern audio consoles. The article will consider the various features available in audio consoles, including automation and digital control and processing.

- **Inside Video Graphics Systems**

A look at the technology used in modern video effects hardware. The article will take a peek behind the front panels and show the readers how today's dazzling effects are created.

- **Production Suite Technology**

Tremendous power is available in today's production equipment. From desktop graphics and editing systems to sophisticated DVEs, a wide range of production equipment is available.

- **Talk Radio Technology**

Talk radio is enjoying a comeback. Although this is fine for stations, it creates headaches for the engineering staff. It's no longer a case of one caller and one announcer.

- **SMPTE Show Preview**

- **SBE Show Preview**

October...

MANAGING TECHNOLOGY

- **Annual Salary Survey**

A review of the salaries paid to broadcast technical personnel. This is a highly sought-after issue.

- **Software for Production Facility Management**

A look at a relatively new area for stations and production houses. In an effort to maximize profits, facilities need to keep their equipment and rooms as busy as possible,

- **Video Facility Management Hardware**

What do you get when you marry a broadcast monitor to a microprocessor? It might be a powerful and sophisticated video test monitoring system.

- **Making Money With Technology**

In what has become an increasingly popular topic, we will show how to make money with technology. A related article will deal with radio and how to make money with technology.

- **Contracting for Maintenance Services**

It's a fact of life — stations and production facilities don't have enough on-staff technical support. The feature will show technical and business managers how to find qualified technical support and the advantages this approach offers.

- **Studio Camera Update**

A review of the technology used in modern studio cameras. At the end of the article, a list of manufacturers of studio cameras will be provided along with a Reader Service Number.

SBE Update

SBE president speaks to Korean broadcasters

By Jerry Whitaker

Richard Farquhar, president of the Society of Broadcast Engineers, was a featured speaker at the Korean International Broadcast and Audio Equipment (KOBA '92) show in Seoul, June 26-29. He was invited to attend by Hong-Ryun Kim, president of the Korean Broadcasting System and president of the Korean Broadcast Engineers and Technicians Association (KBETA).

Farquhar spoke on two topics of interest to the Korean engineers in attendance: "New Technologies in American Broadcasting" and "Broadcast Quality." The exhibition was organized to update the Korean engineers on the latest technical developments in broadcast equipment and video technologies. Korea and other areas of the Far East are aggressively updating their radio and TV broadcast services. KBETA was pleased to have the assistance of SBE in helping them move forward. The KOBA '92 also served as a forum for technical cooperation between Korean and foreign investors.

Farquhar welcomed the opportunity to speak to the Korean group, emphasizing, "This trip demonstrates the benefits of cooperation between the SBE and other allied organizations around the world. Engineering has always been a 2-way street; there is much that we can learn from each other. I look forward to continued cooperation with KBETA and the other engineering groups with which SBE has affiliated."

Ennes Foundation gifts

Funding for the Ennes Foundation comes, in large part, from group and individual donations. Jim Wulliman, foundation executive director, is pleased to report two SBE chapters have recently made donations to further the educational efforts of the foundation. The donations came from the Central New York chapter (No. 22) and from the Seattle chapter (No. 16).

Donations large and small are appreciated and needed in order for the work of the foundation to move forward. The Ennes Foundation grants scholarships to students entering the field of broadcast technology, and works to further the continuing education of SBE members. Information on the scholarship program may be obtained by calling or writing the SBE office in Indianapolis.

Questions regarding donations to the foundation should be directed to executive director Jim Wulliman.

Chapter liaison committee

The goal of the SBE Chapter Liaison Committee is to improve communication and coordination between the SBE national office and the 100 or so local chapters throughout the country. The committee includes the following members:

- Terry Baun, chair, Milwaukee, WI
- Troy Pennington, Birmington, AL
- Jim Bernier, Syracuse, NY
- George Randal, Portsmouth, VA
- Keith Kintner, Sylmar, CA

The geographical diversity represented by this group is intended to help in the coordination of liaison efforts nationwide.

It is the hope of the committee that chapters with questions or comments on issues facing the society will communicate with the committee member closest to their area. Through regular telecommunications meetings, the committee can obtain a better understanding of the concerns at the chapter level, and make those concerns known to the national board.

The areas of particular interest, which the committee intends to focus on, include:

- Establishing a regular electronic means of chapter communications via CompuServe, MediaNET or some combination of local chapter bulletin board systems. The goal is to be able to deliver industry news and SBE information electronically to every chapter to simplify the task of writing and editing local newsletters.

- Encouraging increased use of telecommunications by the SBE national office in order to distribute information quickly to the chapter level. The goal is to make sure that SBE chapter chairs and newsletter editors are the first to receive important information.

- Increasing the contact of local chapters with national officers through an active effort to encourage board of director and membership liaison committee members to attend chapter meetings throughout the country. The goal is to have a representative of the national SBE visit each chapter at least once a year.

- Establishing a "quick response" capability at the national and chapter level to accelerate the exchange of important information. The goal is to get a definitive answer to a chapter question within 24 hours, and to get required chapter information back to the Indianapolis office within a similar time frame.

The strength of the SBE lies at the chapter level. It is imperative that everyone learns to communicate better. That's what the chapter liaison committee is all about.

SBE Job Line

In today's economy, jobs are a hot commodity. If you're a broadcast engineer who is out of work, you know how important it is to find job openings in a timely manner. If you are a manager trying to fill a hole in your engineering department, you can appreciate the frustration of doing "double duty" while you are trying to fill a staff position. If you are in either of these positions, the SBE Job Line may be your answer.

The Job Line links employers and SBE members to help fill employment vacancies. The service is free to members.

Just call 317-253-0474 if you are looking for a job. You will hear descriptions of the jobs currently available. A code will also be given for each position. If one of the job descriptions interests you, note the code and call Elberta at the SBE office (317-253-1640). She will provide additional information on the position.

If you have an opening in your organization, call Elberta and she will take the information and include it on the next recorded update. ■

Whitaker, a technical writer based in Beaverton, OR, is vice president of the Society of Broadcast Engineers.

Station to Station

Retrofitting a tower-light monitoring system

By Richard W. Abraham

The need for accurate and consistent records on tower lighting has never been greater. When Multimedia Cablevision recently moved to a new tower site that was shared by a half dozen other users, we had an opportunity to re-evaluate our approach to how we monitored tower lights.

At the time, the industry press was abuzz with the news that *all* users on a shared tower were individually responsible for inspection and proper operation of tower lighting. We also had received notices from our legal department, warning us about trends toward tougher enforcement of tower lighting regulations by authorities. So, our consideration of this issue seemed timely and well-founded.

Abraham is a regional engineer for Multimedia Cablevision, Wichita, KS.

Part 90 of the FCC rules sparked an idea. It allows one party among users of a shared tower to be responsible for maintenance and inspection of the tower, and for keeping the inspection log, as long as a copy of a written agreement to such an arrangement is on file in each licensee's records. If Multimedia volunteered to be that party, we would at least be in full control of those things for which we were to be held accountable.

Using the site's security system

A monitored security system was to be installed at the site for our use. Along with the usual entry, heat and smoke alarms, others were added for sensing ambient temperature, waveguide pressure, commercial power, emergency power and deadbolt lock, and there were still enough zones remaining to add a beacon fault and an obstruction lamp fault.

Finding a current-sensing device ideal for the application proved to be more of a challenge. Isolated fault contacts were available on new tower light designs, especially the strobe units. Retrofitting these onto the tower, however, would have been viewed by management as overkill (and rightfully so, because nothing else was wrong with the existing tower lights). I had run across some circuits for op-amp inputs that would interface 0-5VDC to a fault-reporting system. It was known that some broadcast chief engineers had built these into their transmitter remote controls. But there was no remote-control device in place.

Short of jury-rigging something, the situation did not look good until we contacted SSAC. This company makes the solid-state flashers used in many tower lighting systems today. It also manufactures many solid-state devices for under- and overcurrent sensing. When the company heard of Multimedia's dilemma, SSAC informed us about a new product under development. Before long, we received a flyer in the mail describing its new SCR430T. It looked as if it had been custom made for Multimedia's needs.

An elegant solution

The power conductor feeding the beacon or range lights is passed through a toroid on this $2^1/_2$-inch × $3^1/_2$-inch block, which senses the current traveling in the wire. The sensor includes DIP switches for selecting 620W or 116W, 120V or 130V bulbs, and the number of those type bulbs (1-4) you are sensing. It has isolated 10A SPDT output contacts, which provided the interface required by our alarm company. The relay activates only after a 5-second delay, making it usable for flashing beacons.

Because the sensors also receive their power from the tower-lighting circuit, they are powered only when the tower lights are on, and therefore cannot send false alarms during daylight hours. By using one unit for range lights and one for beacon monitoring, faults could be monitored on a tower of up to 450 feet in height.

The monitoring package was completed with the addition of a 120VAC relay located after the photocell control on the switched tower light power. (See Figure 1.) The contacts of this relay fed a *separate* dialer supplied by the security company. Via this path, the on and off times of the tower lights were relayed to the security company's computer, where a log accumulated in a data file.

Reports and records

Be sure to provide your security company with detailed written instructions to cover every alarm condition. Include what to do for a given alarm, and an order list of whom to call. Don't forget to include the number for the FAA station to which you must report certain problems within 30 minutes of their occurrence, including loss of power, if the tower lights are not on an emergency supply.

At the end of each month, Multimedia receives a printed log of the on/off times of the tower lights, and another sheet showing all alarm activity. After a quick glance to verify that all days of the month were included, and that proper entries explaining any faults concerning tower lights were made, it can be filed, confident that the tower is in compliance. The alarm system is tested as required during the quarterly tower-lighting system inspection.

The total equipment cost of adding this project to Multimedia's existing security system was about $300 per site.

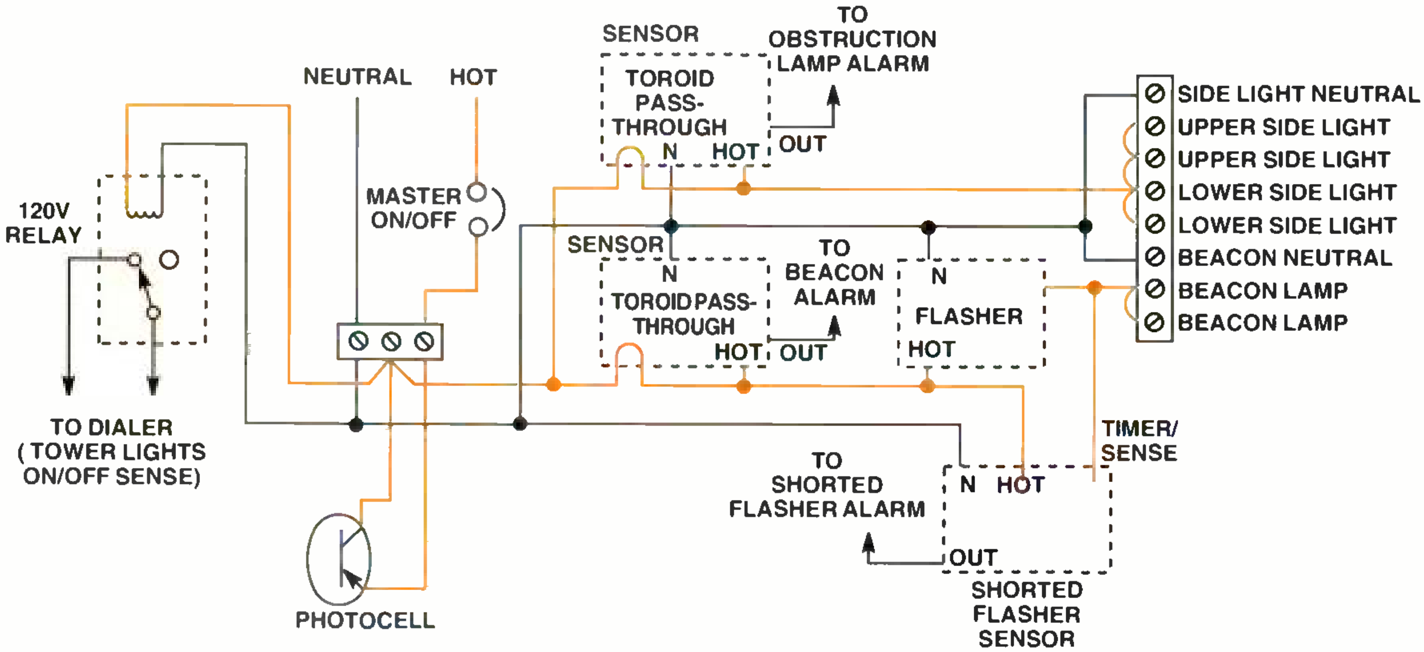


Figure 1. Block diagram of tower-light monitoring system. Current sensors each feed isolated zones on the site's existing security system. The on/off sensor (at left) feeds each separate auto-dialer or remote reporting system. ■

Industry Briefs

BUSINESS SCENE

BTS, Simi Valley, CA, has sold six Betacam SP VTRs to Wisconsin Public Television, Madison, WI. The purchase includes three BCB 70 studio editing recorder/players, a BCB 65 studio player and two BCB 50 portable field recorder/players.

Panasonic, Secaucus, NJ, has delivered three AJ-D350 ½-inch composite digital studio VTRs to Intervision Studios, St. Louis.

In addition, Georgia Pacific Television has outfitted its new edit suite with two AJ-D350 ½-inch composite digital studio VTRs. An AJ-D350 ½-inch composite digital VTR digital studio also was purchased by AME, Burbank, CA. Panasonic has delivered four additional AJ-D350 ½-inch digital studio VTRs to VDI, Hollywood.

Neve, Herts, England, has sold a post-production console to Films At 59, Bristol, England.

AVS, Surrey, England, has delivered a Floating Point real time 3-D character generator to TVP, London.

Digital Audio Research, Surrey, England, has received an order for a fourth SoundStation SIGMA to be installed at YLE, the Finnish Broadcasting Company in Helsinki, Finland.

Solid State Logic, Oxford, England, has installed a ScreenSound digital audio-for-video editing/mixing system at Digital One, Portland, OR.

Shook Electronics USA, San Antonio, TX, has delivered three mobile production vehicles to Television Networks, Seoul, South Korea. A Shook Model 27-34 mobile production vehicle also has been delivered to Chinese Television System, Taipei, Taiwan.

Symetrix, Seattle, has supplied AT&T with several SX203 telephone interfaces for use in demonstrating AT&T telephone systems at trade shows and exhibitions.

Itelco, Orvieto, Italy, has won a bid to supply Norwegian Telecom with TV equipment. The equipment will be used to broadcast the first commercial Norwegian TV network, TV2.

QTV, New York, provided prompting and script services for the Democratic National Convention, which was held July 13-16 at Madison Square Garden.

Shook Electronics USA, has relocated its headquarters and manufacturing facility. The address is 18975 Marbach Lane, Building 200, San Antonio, TX; phone 512-651-5700; fax 512-651-5220.

Microwave Networks Inc. (MNI), Houston, has extended its agreement with Telcel Cellular C.A., a Venezuelan cellular operator, to provide microwave systems, including full engineering and installation services. This second phase extends Telcel Cellular's network coverage throughout Venezuela.

Vistek Electronics, Bourne End, England, and **Digital Vision** (DV Sweden AB) were jointly presented with the 1992 award for Research and Development by the Royal Television Society at its annual awards ceremony in London. The award was in recognition of the Vistek-Digital Vision project to develop vector motion-compensated standards conversion, which resulted in the Vistek Vector VMC standards converter.

Kodak, Rochester, NY, has chosen the CINEON Film System as the name for its new line of high-resolution electronic intermediate products.

PRS Corporation, Los Angeles; **BBC World Service**, London; and the **Voice of America**, Washington, DC, have agreed to cooperate with an application of the ID Logic automated station identification and scan system for shortwave radio broadcasting.

Vyvx, Tulsa, OK, has issued a request for proposal (RFP), which calls for equipment that would provide a high-quality signal at a rate of approximately 6Mbps over the company's nationwide fiber-optic TV transmission network.

Strassner Editing Systems, Hollywood, has donated a top-of-the-line Strassner PRO editing controller to the Department of the Arts at UCLA extension in Westwood, CA. In addition, Strassner reconfigured the school's existing hardware to create a high-quality integrated editing system. Norm Strassner, president of the company, also has agreed to speak at seminars on post-production.

Graham-Patten, Grass Valley, CA, has entered into an OEM agreement with the **Grass Valley Group** (GVG), Grass Valley, CA, that allows them to offer the D/ESAM 400 in systems with other GVG video post-production equipment. The agreement provides advanced audio for video functions to the Grass Valley video post equipment.

Neve Electronics International's headquarters in Litlington, Hertfordshire, England, was officially opened on May 20 by Prince Edward C.V.O.

Spider Systems, Edinburgh, Scotland, has sold its local area network (LAN) monitoring and analysis product line to Telecommunications Techniques Corporation (TTC), Germantown, MD.

Pacific Recorders & Engineering Corporation, Carlsbad, CA, has founded a European operation in Langenfeld, Germany. The new organization, Pacific Recorders Europe, is a joint venture of Pacific Recorders and the German company Thum + Mahr Audio GmbH.

Sachtler, Freeport, NY, received a Scientific and Engineering Award from the Academy of Motion Picture Arts & Sciences for the fluid damping system used on its camera support equipment.

Two products from **RE Technology**, (Westlake, OH), the RE531 RDS encoder and the RE331 RDS decoder, have passed stringent standards put forth by the ARD, the official German broadcasting association. RE Technology is the first RDS manufacturer to conform to ARD standards in a second round of testing.

Thomson Tubes Electroniques has relocated its headquarters. The address is 13, Avenue Morane Saulnier, Bâtiment Chavez — Vélizy Espace, BP 121, 74148 Velizy Cédex, France.

A new production facility, **Vision Factory**, has opened in St. Louis. The address is 2240 S. Brentwood Blvd., St. Louis, MO

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... Rangel Television Systems,
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...ymond Bouchard has been named
...st Coast regional sales manager for Prime Image, Saratoga, CA.

Marc S. Yaxley has been appointed director of engineering for Channelmatic, Alpine, CA.

Patrick Ryan has been chosen as assistant sales manager for Toshiba, Tokyo.

Mark Hiner has been named chief engineer at WHOK-FM, Columbus, OH.

William A. Berry and **Wayne R. Lasson** have been appointed to positions with Compression Labs Inc. (CLI), San Jose, CA. Berry is senior vice president of finance and administration and chief financial officer. Lasson is senior vice president and general manager, Videoconferencing Products Group.

Paul Brett, Bill Dumm and **Christina Kallay** have been named to positions with RF Technology, Norwalk, CT. Brett has been promoted to director of sales and marketing. Dumm is national sales manager. Kallay is sales administrator and manager of the company's Faraday products line.

Evan H. Krachman has been named sales specialist, video products, for Nikon Electronic Imaging, Melville, NY. ■

Continued from page 66

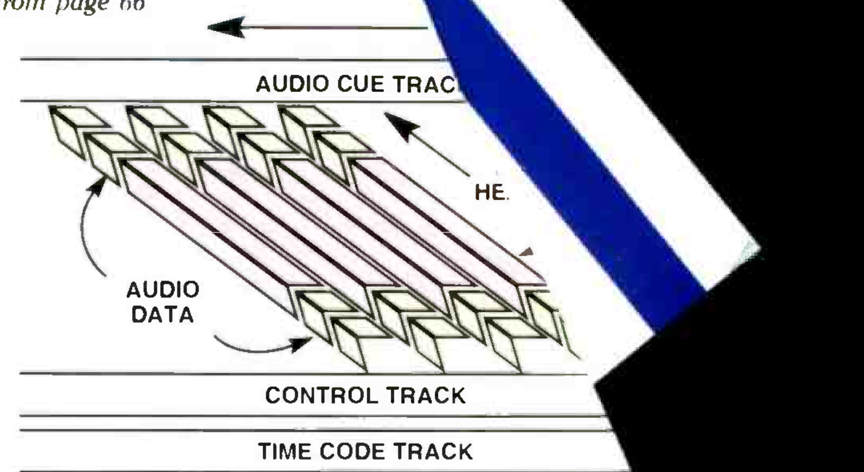


***Figure 3.** The D-3 magnetic footprint. There are no guardbands, and the azi nates between tracks. (The azimuth is parallel to the end of each track.)*

with a track pitch approximately half that of D-2, several areas needed improvement: 1) the 8-14 code and azimuth recording resulted in the reduction of interchannel crosstalk and intersymbol errors; 2) improvements in the ECC structure helped to handle the digital audio data. Shuffling distributes data over one field, redundancy of audio data is accomplished by recording with head pairs, and the use of guardbands at the edit point employ flying or rotary erase heads. 3) improving the recorded footprint after editing; and 4) the improvement of random and burst ECC capabilities to handle the reduced track pitch enhanced the D-3 system.

The same calculation procedure for D-3 can be used for D-2. The D-3 VTR also records six tracks/field. Each portion of the video track contains 408 sync blocks. The first two bytes are the sync sequence. The second two bytes are the ID code followed by 85 bytes of data. Following that are eight bytes of inner ECC. This totals 408×97 = 39,576 bytes/track and 39,576×6 = 237,456 bytes/field. Each data array is divided into nine sub arrays. The sync sequence is not protected, but is added to the data array. Each sub block is 85 bytes wide by 128 bytes deep. At the bottom of the data array eight bytes of outer ECC protection are attached. The size of the ECC protected data array for D-3 is shown in Table 3.

Therefore, the total size of the data array is equal to half of the total number of bytes/field, and each data product block is recorded on three tracks. This represents a half field of data standing on its own.

Error handling

The D-2 and D-3 formats eac Reed Solomon product code block ECC method. The eight checkbyte code is the same for video and au both formats. However, the video and dio outer code contains eight checkby for D-3, which is twice that of D-2. Mor important, the D-3 product code block for audio and video covers one field, whereas that of D-2 covers one-third of a field. This one field physical distribution on the tape results in a correctable burst error length approximately three times longer than that of D-2.

Finally, in all of the three formats, the concealment methods can take on many different forms. These concealment methods can be muting, previous value hold (replace error word with the one word before), mean value interpolation (recalculate a lost word using words before and after) or *n*th order interpolation (use N number of surrounding words to approximate).

Looking beyond

At IBC, a CCIR-601-compatible format was officially introduced. One interesting aspect of this introduction was a tape drive integrating a CCIR-601 digital component signal system with the 19mm transport technology. The drive accepts any of the three standard sizes, with an advanced acicular metal particle formulation for improved output at shorter wavelengths. The cartridges range from 15 minutes to more than three hours. To round out the product line, switching, editing, effects and in-

Continued on page 94

One sub block width (including ECC)	2+2+85+8+97 bytes
Total data block width	97×9=873 bytes
Depth of data array	128+8=136 bytes
Total size of the data array	873×136=118,728 bytes

***Table 3.** Calculated size of the ECC-protected data array for D-3.*

New Products

Digital edit suite mixer

By Graham-Patten

• **D/ESAM 400:** A flexible edit system control for audio mixing functions in a manner similar to conventional video switchers; modular input architecture with digital signal processing; fully integrates digital/analog ATRs and VTRs in a single editing suite.

Circle (404) on Reply Card

Enhanced CAD software

By American Small Business Computers

• **DesignCAD 3-D Ver. 4.0:** upgraded user-interface; greater operating speed in photorealistic rendering, keyframe animation; texture, control of eight lights; DCFILES utility for import, export transfer functions; MS-DOS, 2Meg RAM, hard drive required.

• **EasyEST:** estimating program reads CAD drawing to make spreadsheet to generate bids, realistic cost estimates; useful for floor layouts, space design.

Circle (356) on Reply Card

Digital audio system

By ENCO Systems

• **DAD486x:** digital audio distribution system for multi-user access to CD/DAT stereo audio stored digitally on shared data network; capability as stand-alone workstation to multi-user, multichannel per user; 16 bit with adjustable sampling to 50kHz; hard disk storage, selectable data compression; programmable playlists for auto play sequencing.

Circle (366) on Reply Card

Fiber transmission product

By MERET Optical Communications

• **HR VIEW 6000 series:** fiber-optic systems for high-resolution graphics using bandwidths to 150MHz; transmits individual R, G and B video signals as well as two channels of RS-232 or RS-422 data to 900 meters; sync on green or sync on all signals.

Circle (381) on Reply Card

Low loss cabling

By Clark Wire & Cable

• **Digital audio series:** data cables for use with digital audio transmission; lower capacitance to handle 60kHz clock rate frequencies; meets AES/EBU, S/PDIF, IEC specifications; available in specified lengths, pre-terminated with appropriate connectors.

Circle (364) on Reply Card

Editing software

By Timewave Corporation

• **soundGRAPHIX Ver 1:** for Soundmaster machine control system; efficient operation with simplified user interface includes VGA graphics; expanded display features on-off control for each machine; individual SMPTE time code for each machine; time-code calculator; enlarged EDL area; individual channel safe, ready, record indicators.

Circle (400) on Reply Card

ENG/EFP mic system

By Panasonic/RAMSA

• **WX-RP410, RP700:** UHF transmitter with diversity receiver; receiver may be mounted on camera; 30mW output from transmitter; 6-hour operation from alkaline AA cells; subminiature condenser mic, clip accessories.

Circle (390) on Reply Card

EMI shielding fabric

By Maxwell Safety Products

• **Naptex:** cotton and polyester material that may be tailored into protective clothing; up to 40dB reduction of electric field radiation; can suppress unwanted EMI in measurements with sensitive instruments; product developed in Germany.

Circle (380) on Reply Card

Product catalog

By Panduit Network Systems

• **Publication P-NET-1:** PAN-NET network wiring systems for phone, data, video; specifications, application information.

Circle (391) on Reply Card

Editing system interface

By Paltex International

• **NewTek Control package:** for direct control of Video Toaster switcher and effects functions from Paltex EDDi desktop video production center; effects preview feature; wipe pattern codes available for EDL programming, recall; paint and text functions remain under control of the Amiga platform.

Circle (389) on Reply Card

Portable mixer

By AEQ SA

• **Model MP-10:** ENG and reporter's audio mixer; includes telco touchpad, integral hybrid; five transformer-coupled inputs for line or mic level sources with phantom powering; operates from NiCad battery or 125/220VAC with charger circuit; four headphone outputs; solid-state audio recorder, reproducer with 32s capacity.

Circle (354) on Reply Card

Indicator devices

By Lumex Opto/Components

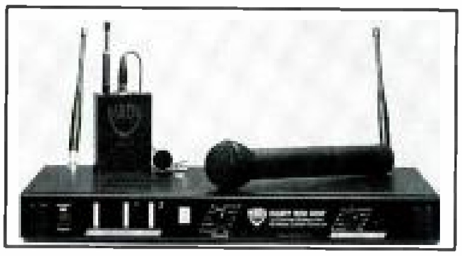
• **Pure green LED:** emits pleasing 550nm wavelength; available in popular shapes and package styles; 1.36 lumen/W visual efficiency.

Circle (378) on Reply Card

Wireless systems

By Nady Systems

• **Nady 950 UHF:** rack-mount wireless receiver featuring true diversity; companding noise reduction; operates with lavalier, hand-held or musical instrument mic transmitters; all designed with SMT devices; 490MHz and 800MHz frequency ranges, 950MHz and UHF frequencies for international operation.



Circle (385) on Reply Card

FO technical notes

By Telecommunications Techniques Corporation

• **"Reflection Testing in Fiber-Optic Systems:"** 8-page publication explains the effects of reflections and the methods and equipment needed to overcome the effects.

Circle (397) on Reply Card

Mil Spec connectors

By Tru-Connector Corporation

• **Triaxial series:** various devices including bulkhead jacks, plugs, receptacles, terminators; 50Ω, 75Ω, 93Ω impedance for BNC, TNC, Triax-C, N-Triax and 7/8-20 or 11/16-24 thread size connections; meets MIL-C-49142.

Circle (401) on Reply Card

Video projection system

By Telex Communications

• **MagnaByte 3000 series:** high-resolution video projector used with LCD display; single lens design; 240×3 horizontal, 479 vertical pixel resolution; connects to any NTSC connection; no convergence adjustments; Model 3000V has integrated VHS player; all include amplifier with 5W speaker; audio, video control panels.

Circle (398) on Reply Card

Equipment consoles

By The Winsted Corporation

• **System/90 series:** flexibly designed consoles for editing, production, security systems; based on concepts developed from manufacturer's European sales office; wraparound consoles fit 45-90° corners; carpeted footrests; numerous accessories; custom designs for any studio decor.

Circle (399) on Reply Card

Technology reference

By A-R Editions

• **"MIDI—A Comprehensive Introduction:"** handbook by Joseph Rothstein discusses functions, principles and applications of MIDI technology from basics to advanced topics.

Circle (351) on Reply Card

Editing accessory

By A/Z Associates

• **Summertone time-code monitor:** detects and logs time-code errors; integral printer records the information; senses 10 types of time-code errors; retains 800 error events in non-volatile memory for review or printout.

Circle (352) on Reply Card

Expanded weather information

By Accu-Weather

• **Accu-Weather fax:** service provides 10 regional satellite pictures, six regional radar pictures; hourly updates, 24 hours a day.

• **Watches, Warnings:** special service automatically transmits official watches, warnings, advisories, damage reports by fax; includes severe weather, flooding, air stagnation and other potentially disruptive weather conditions, summaries.

Circle (353) on Reply Card

Video delay trimmer

By Allen Avionics

• **TDL488-T:** video signal delay device to incorporate computer video equipment with broadcast and post-production systems; to 487ns delay with ±1ns trimmer and binary switching to 64 delay steps to aid in adjustment of color with Video Toaster or Amiga PCs.

Circle (355) on Reply Card ■

Continued from page 28

mon reference. Additional examinations of audio performance is provided via tape at the Westinghouse Science and Research Center.

The joint efforts between these organizations in evaluating systems have accelerated the process by overlapping among successive systems, sharing costs and widening the base of information for what is necessary for a North American standard.

The test center

The sole purpose of developing the ATTC was for evaluation of HDTV systems. It represents a commitment of $17 million by the TV industry, including broadcasters and receiver manufacturers. It is sponsored by Capital Cities/ABC, CBS, NBC, PBS, the Association of Independent Television Stations, the Association for Maximum Service Television, the Electronic Industries Association, and the National Association of Broadcasters.

FCC EVALUATION CRITERIA

1. Video and audio quality
2. Coverage area
3. Accommodation percentage
4. Transmission robustness
5. Scope of services and features
6. Interoperability
7. Extensibility
8. Cost to broadcasters
9. Cost to alternate media
10. Cost to consumers

Table 2. *A list of the FCC evaluation criteria.*

The lab is a $5 million facility with capabilities to manage five different TV formats: NTSC and the scanning formats used by the ATV proponents. Only a portion of the costs (less than 10% of the true cost of testing) is covered by a test fee paid by the proponents.

Although much of the equipment used to perform the tests was available from off-the-shelf sources, other units were designed for specific needs. One of the special devices is an ATTC format converter, which permits any of the signals to be recorded on a high-definition digital video recorder. The converter digitizes signals in any of the four scan formats and provides the recorder with an acceptable (recordable) input. During playback, the converter also unscrambles the digital information and reconstitutes the signal to its original parameters.

Another special development for the center is the RF test bed, which allows simulations of the numerous possible sources of channel interference and other impairments to which any broadcast service would be subjected. Because the simulations provide tighter control than real world conditions, the test bed provides key channel interference information for spectrum planners when allocation of HDTV channels begins.

Test results

The ATTC plans to publish a report of the test results on each of the systems. As these reports are completed, they will be available for purchase at a cost of $400 as individual items. A reduction in price will apply for orders of multiple copies of one report or for a package of more than one report.

There should be enough channel allocations to permit an HDTV slot for nearly every existing TV station. Stations that wish to get in on the ground floor should begin planning now. Those plans will include a variety of aspects of the station facility that may require modification. Readers should see the related articles "HDTV Transmitter Requirements," on page 30, and "HDTV Antennas for Terrestrial Service," on page 38.

Editor's note: Anyone interested in purchasing the reports should contact the ATTC directly at 1330 Braddock Place, No. 200, Alexandria, VA 22314; phone 703-739-3850; fax 708-739-8442. ■

Continued from page 55

be modified to provide digital ports. HDTV digital interface standards have been written (e.g., SMPTE 260M) and digital HDTV recorders and framestores are already in production.

More digital interfaces can be expected to appear on HDTV equipment within three or four years, if current manufacturers' plans are any indicator. Serial HDTV

DATA RATE (Mbit/s)	DATA EYE-WIDTH (psec)		
	5 ft.	5,000 ft.	10,000 ft.
600	1,345	1,315	1,290
1,100	595	572	540
1,400	400	423	393

Table 1. *The effects of optical fiber length on data eye width at 1.4Gbit/s. Note the relatively small degradation of eye width against large increases of fiber length.*

interface development will bring HDTV to the same level of implementation as component 4:2:2 systems.

Despite advances in compression technology, a need will still exist for transport of full-bandwidth HDTV digital signals. One certain application of this will be in the studio quality control area, where comparison of signal quality will be made in reference to the baseband signal.

Technology developments have proven the feasibility of digital HDTV production systems. Growing use of this hardware will continue to lower its cost. This has great impact on the upcoming HDTV conversion faced by broadcasters. Although camera-to-CCU interfaces are likely to remain analog, fully digital and affordable HDTV production systems are imminent. Many broadcast facilities may therefore never experience an analog era for HDTV distribution. Widespread digital production of HDTV could be just around the corner.

Acknowledgments: Thanks to engineers Lou Bardfield and Frank Garety at KTLA-TV, Los Angeles, for their valuable technical advice

➡ *For more information on HDTV signal routing, circle Reader Service Number 304.* ■

Continued from page 88

	D-1	D-2	D-3
Applications	Layering	Production/post	Production/post
	Multi-effects editing	Transmission	Transmission
	Mastering/replication	Mastering/replication	Mastering/replication
	Film-to-tape	Multicassette	Multicassette
		Cart systems	Cart systems
	Data storage/archive	Storage for disk-based graphics	Storage for disk-based graphics
	Storage for DVE or paint box	Multi-audio VTR	Multi-audio VTR
Video I/O			
Analog	RGB;Y/R-Y/B-Y; Betacam	(Non) composite analog	(Non) composite analog
Digital serial	Proposed SMPTE 259M	Proposed SMPTE 259M	Proposed SMPTE 259M
Digital parallel	SMPTE 125M/Tech 3246E	Proposed SMPTE 244M	Proposed SMPTE 244M
Audio I/O	4-ch AES/EBU	4-ch AES/EBU	4-ch AES/EBU
	4-ch analog	4-ch analog	4-ch analog
	Single/pairs' 4-ch	Pairs only	Pairs only
Casette	19mm S/M/L	19mm S/M/L	19mm S/M/L
Play time			
Small	11 min.—13 min.	31 min.	64 min.—50 min.
Medium	34 min.—41 min.	93 min.	95 min.—125 min.
Large	76 min.—94 min.	207 min.	185—245 min.
Tape formulation	850Oe metal oxide	1,500Oe metal particle	1,500Oe metal particle
Video			
Sampling rate	13.5+6.75+6.75 (28MHz)	$4F_{SC}$ = 14.31818MHz	$4F_{SC}$ = 14.31818MHz
Coding form	Uniformly quantized PCM 8-bit	Uniformly quantized PCM 8-bit	Uniformly quantized PCM 8-bit
TV lines/field	250 (525/60); 300 (625/50)	255	255
Sampling structure	Orthogonal	Orthogonal	Orthogonal
Sampling phase	...	(I,Q)	(I,Q)
Samples/active line	1,400 (Y/R-Y/B-Y)	768	768
Audio			
Sampling rate	48kHz	48kHz	48kHz
Resolution	16-20 bit	16-20 bit	16-20 bit
Overall			
Avg. data rate	227Mbits/s	127Mbits/s	125.2Mbits/s
Tracks/field	10	6	6
Wavelength	0.9μm	0.85μm	077μm
Track length	170mm	150mm	117.67mm
Track pitch	45μm	39μm	20μm
Effective track width	35-40μm	39μm	18-22μm
Azimuth	0°	15°	20°
Audio	4 sectors in center	2 sectors each end	2 sectors each end
Channel code	Randomized NRZ	Miller-Squared	8-14
Edit guardbands	Yes	No	Yes
Edit gaps	Yes	Yes	Yes
Video burst correction	1,340 bytes	2,280 bytes	6,984 bytes
Audio burst correction	198 bytes	380 bytes	...
Control track		Pulse doublet servo, video frame	
		video frame, color frame	
	Field sequential		
Time code	Unresolved double	Single standard	Single standard
Tape speed	286.95mm/s	131.7mm/s	83.88mm/s

Table 4. Digital video recording format parameters.

terconnect peripherals all will be produced by the same manufacturer.

We also can expect to see an additional ½-inch system that will offer compatibility with two digital signal types — composite and component — from a single transport. (See "Technology News" on page 20 for additional details.)

One for all?

A universal tape format that meets the needs of the professional broadcast and teleproduction industries would be ideal, but at present seems impractical. Unfortunately, different standards, economics and requirements of each application have caused multiple tape formats. End-users ultimately must decide whether to use a single format for all of their needs, and accept the compromises in quality and performance. Or, they can match each application to a format that was designed for that particular need and create a cost-effective interformat environment. Each of the three formats have their merits.

Thus, we can only conclude that there is no single best format overall, because each format can lend itself well to certain applications. The CCIR component formats will serve applications for high video and audio quality in the post community, while D-2 and D-3 will gain market share in the broadcast and post communities. The D-2 format does include a portable recorder, but some speculation suggests the D-3 camcorder may eventually attain an edge in EFP/ENG applications, based on error handling, equipment and media costs and user convenience. Only time will tell.

➡ *For more information on digital videotape formats, circle Reader Service Number 306.*

■

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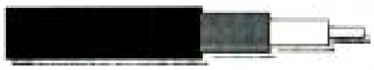

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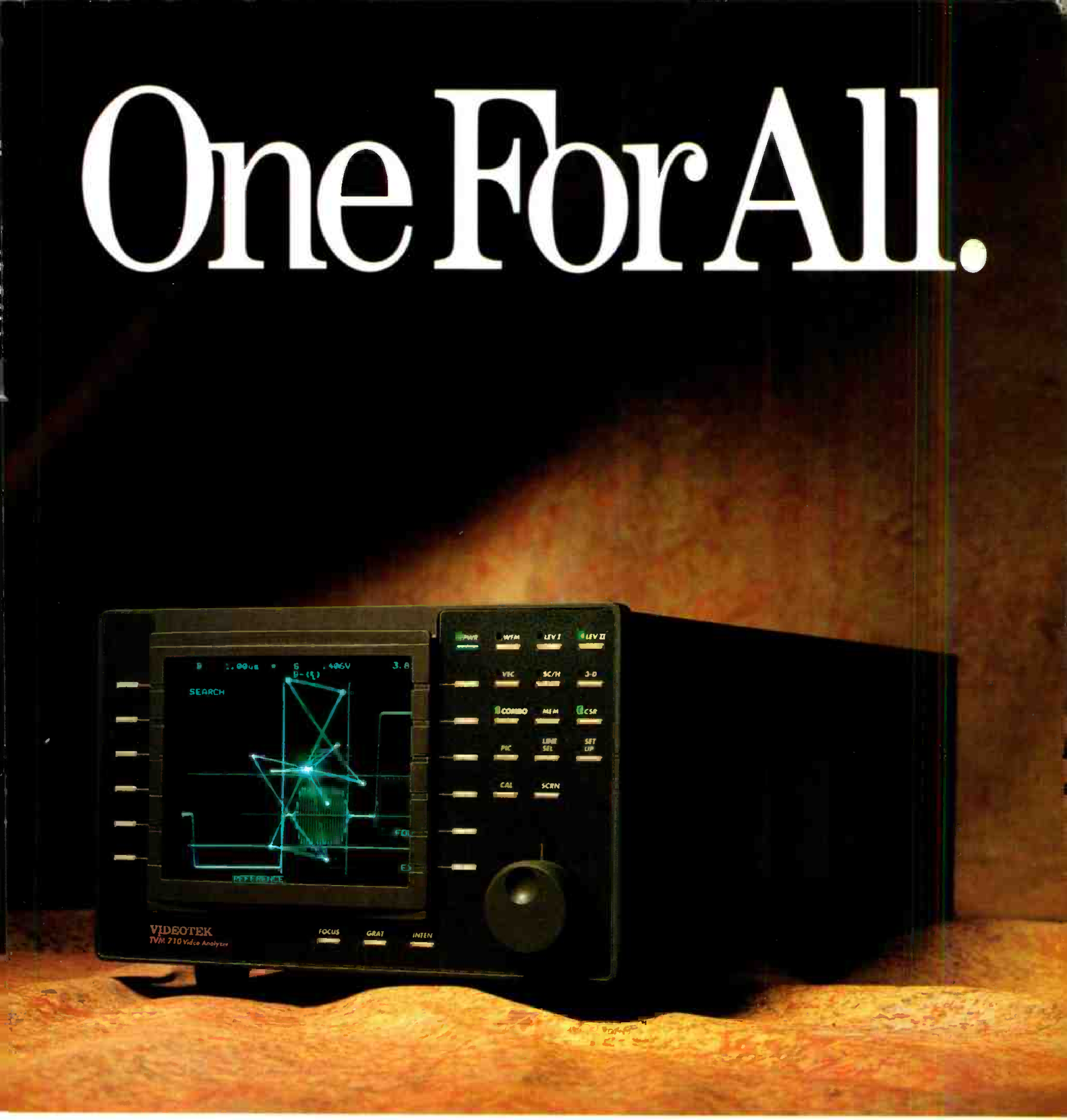

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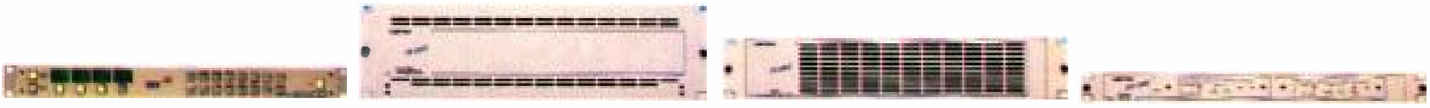

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