BROADCAST engineering®

AN INTERTEC PUBLICATION

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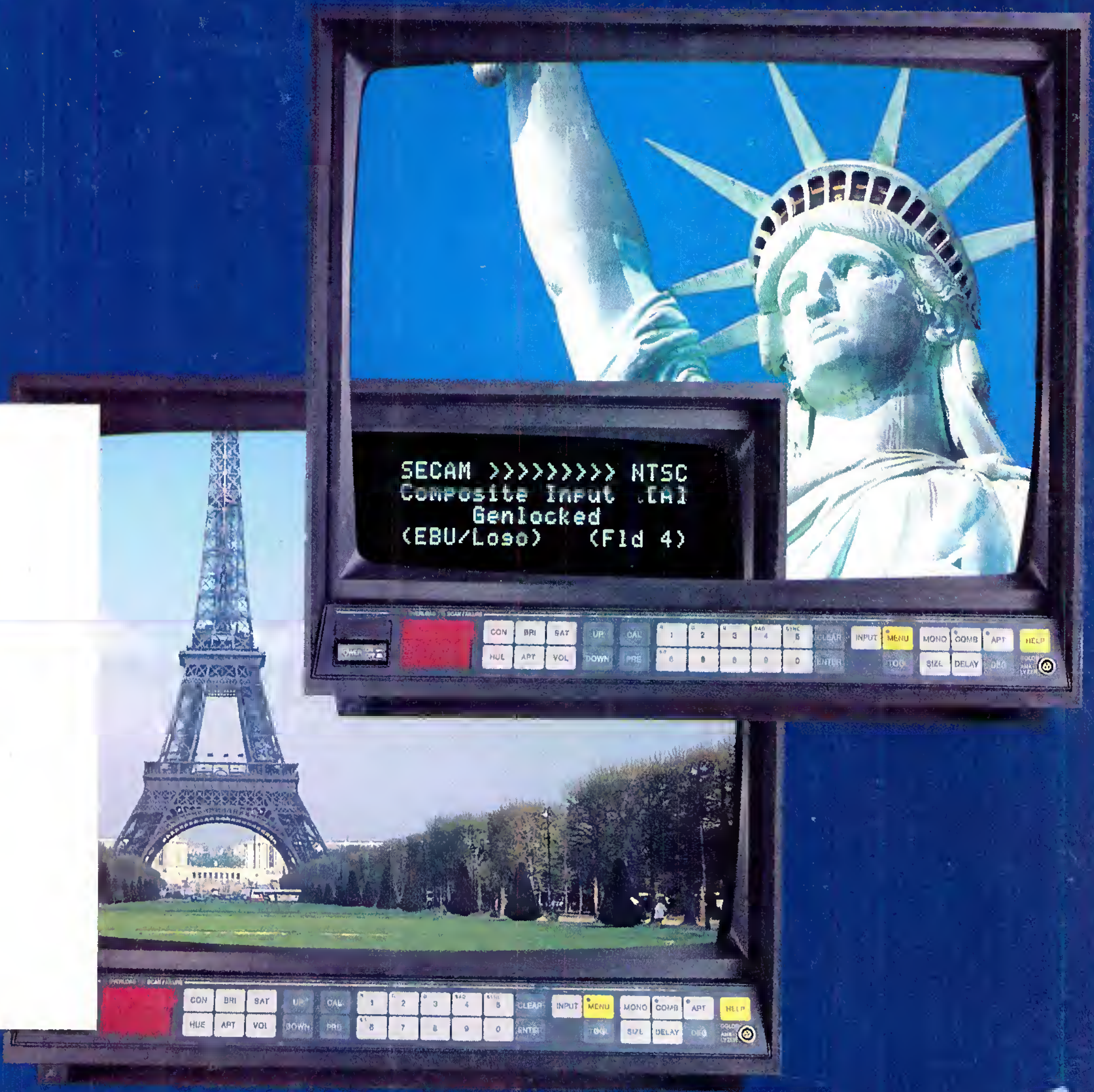

Video technology: moving into the '90s

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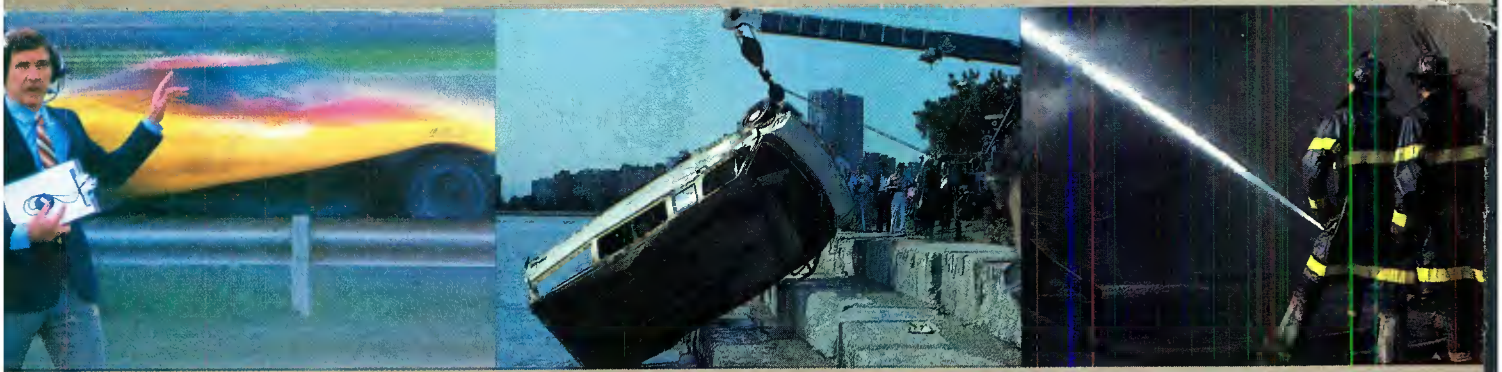

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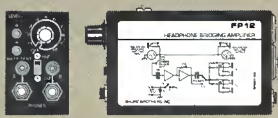

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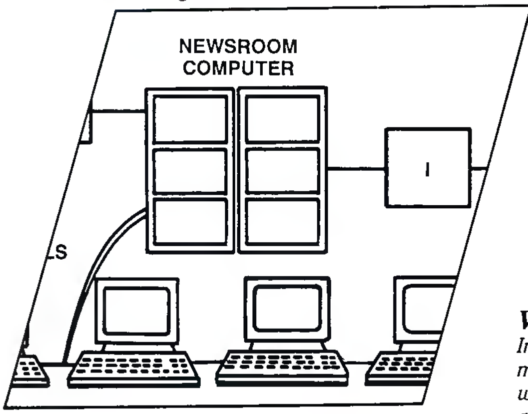

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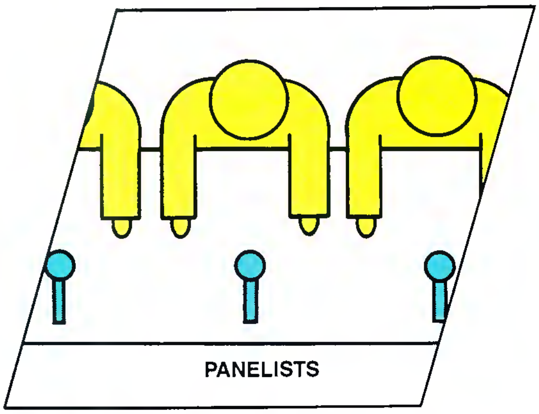

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BROADCAST ENGINEERING

ON THE COVER

Few areas of technology are moving as fast as video, providing new solutions to old problems. Our cover this month represents a key technology that makes program exchange possible — standards conversion. (Photo courtesy of Snell & Wilcox. Monitor photos supplied by Barco.)

DEPARTMENTS

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By Paula Janicke, staff editor

Experimental antenna under construction

Construction is under way on the National Association of Broadcasters' experimental AM tower in Beltsville, MD, a suburb of Washington, DC. The antenna, designed by Ogden Prestholdt, is intended to provide separate control over the skywave and groundwave radiation to produce minimal signal levels in the skywave pattern of a broadcast signal in a given direction. NAB will conduct tests to determine whether the antenna achieves this.

If this technology is successful, AM broadcasters with directional antennas could use it to achieve improved nighttime signal coverage by substantially increasing their nighttime power in a single direction.

NAB also plans to conduct general research into the behavior of medium-wave AM signals and test an antenna-grounding system that could dramatically lower ground-system installation costs. The ground system was developed by Al Christman and Roger Radcliff of Ohio University. The facility is being constructed by LDL Communications, Laurel, MD.

SMPTE issues call for papers

The Society of Motion Picture and Television Engineers has issued a call for papers to be presented at the 24th Annual SMPTE television conference, Jan. 26-27, 1990.

If you would like to have a paper considered, send your name, address, telephone number and a 100-word abstract of the proposed paper or an author form to: Marilyn Waldman, SMPTE program coordinator, 595 West Hartsdale Ave., White Plains, NY 10607. Author forms are available from SMPTE headquarters, at the same address.

The theme of the conference, which will be held at the Disney Contemporary Resort near Orlando, FL, will be "Television — Merging Multiple Technologies." For more information, call 914-761-1100.

IEEE to sponsor annual symposium

The 39th Annual Broadcast Symposium, sponsored by the IEEE Broadcast Technology Society, will be held at the Hotel Washington, Washington, DC, Sept. 21-22. Topics will include AM, FM and TV transmission systems, advanced TV systems and RF radiation.

Luncheon and banquet speakers will include Alfred Sikes, NTIA director and FCC chairman designate; James McKinney, ATSC chairman; and Thomas Stanley, FCC chief engineer. For more information, contact Steve Crowley, symposium chairman, at 202-223-6700.

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BROADCAST ENGINEERING

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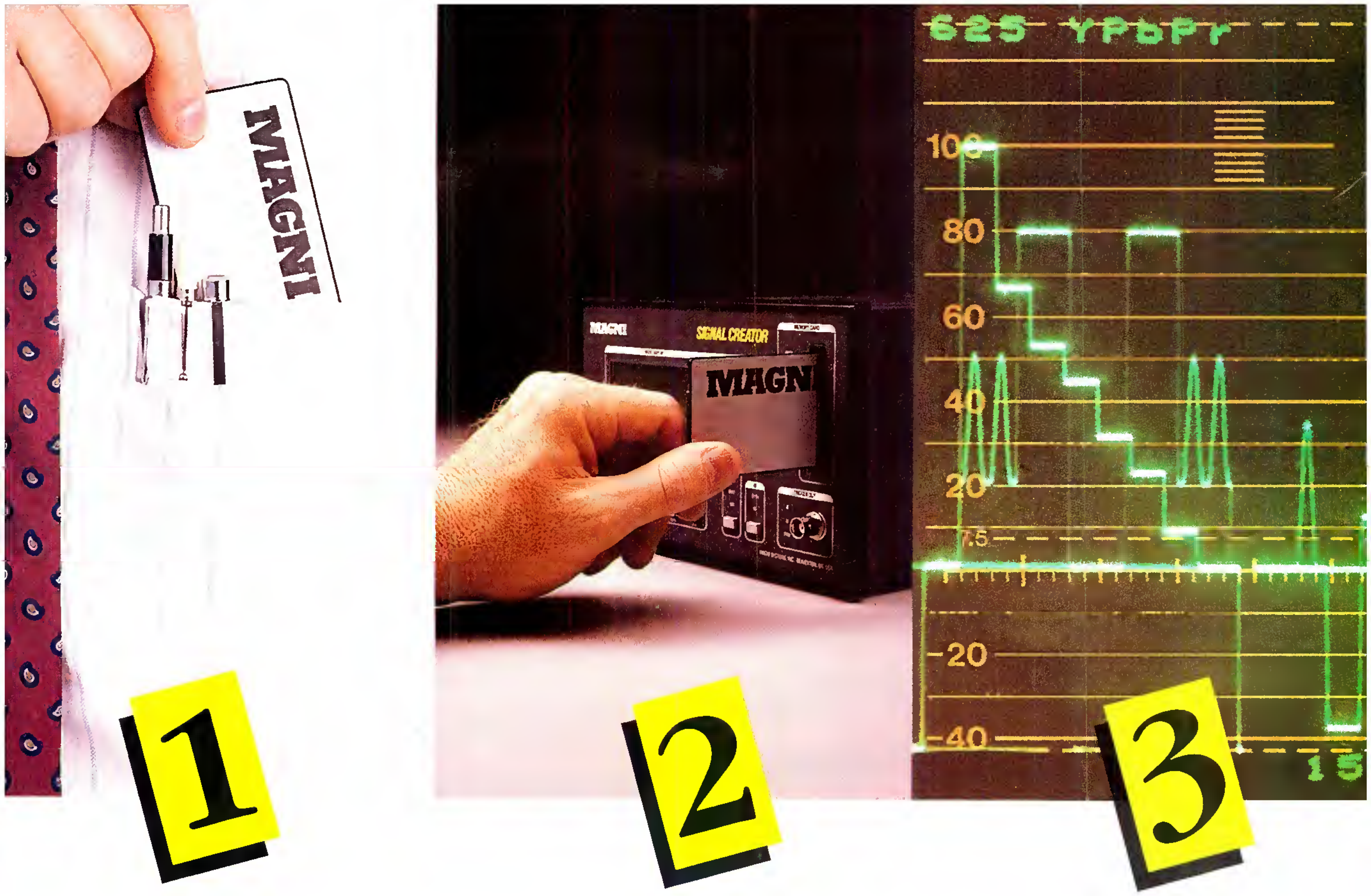

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Postcard from Montreux

Montreux, Switzerland, is a beautiful place. Situated on the shores of Lake Geneva, it is steeped in history and wrapped in excitement. It is a great place to go for a vacation, or to shop, or to get a tan, or to watch others get a tan. It is, however, a lousy place to hold a major trade show.

Two years ago, at the 1987 International TV Symposium at Montreux, show organizers promised to fix several serious problems. They promised to increase exhibit floor space; they promised to replace the temporary convention center annex with a permanent structure; they promised to work on getting additional hotel rooms in the city; and they promised to increase the amount of parking available near the waterfront. Well, one out of four ain't bad. Now, wait, I'm being too harsh. Make it one-and-a-half out of four.

Based on the assurances of 1987, exhibitors and attendees alike decided to give Montreux another try. The assurances squelched talk of moving the show to Geneva, which has a *real* convention center with air conditioning, permanent buildings and all the comforts of home. The City of Montreux and show organizers were long on promises and short on actions.

The biggest improvement was a new parking garage, as promised, near the waterfront. This essentially eliminated most parking difficulties for attendees that had to commute to Montreux because there were not enough hotel rooms available in the city. Although the garage was quite a distance from the convention center, it was, nonetheless, a welcome addition to the scene.

The really big problems were to be found at the exhibition halls. If you've never attended a Montreux exhibition, it is difficult to explain the organization, or lack of organization, of the convention center itself. The building gives the appearance of having expanded incrementally over the years, which it probably has. Now, there's nothing wrong with that, except the result is a group of small halls, most with low ceilings. How low? Twelve feet or less in some areas! If that wasn't bad enough, the individual halls do not necessarily connect with each other directly. Going from one level to another might require that you traverse an intermediate space.

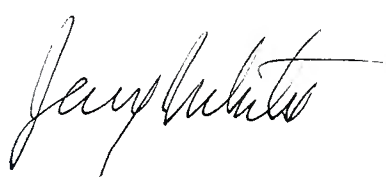
So much for the good news. The top two floors of the convention center, *Level 4* and *Level 5*, were unbelievable. They were not part of a finished building, as you would expect for a major convention. Instead, they were constructed temporarily, using a mixture of steel girders, scaffolding and plywood. I was told the structure was more sturdy than it looked. For that I am thankful.

No association or trade group in the United States would stand for the kind of facilities that were offered at Montreux. The permanent halls were nothing to write home about, but the temporary ones were downright scary. Levels 4 and 5 were a fire inspector's and insurance underwriter's nightmare. One open flame from any of the hundreds of pieces of electronic equipment in the building would have turned the top two levels into a deathtrap.

Then there was the heat. Air conditioning was installed at the center, but provided only marginal relief. Some halls, and parts of halls, were comfortable, but most were unpleasant, even unbearable. There's no doubt that the heat on the upper levels of the center kept customers away from those exhibits.

So what's in store for us two years from now, when we all return to Montreux? Well, more promises — for permanent convention halls, more hotel rooms and air conditioning. Maybe these promises will be kept. I hope so.

Don't get the wrong idea. Montreux is a neat place. I'll probably go back there this fall for vacation. But for a convention? No way.



Jerry Whitaker,
editorial director

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Congress urged to repeal copyright law

By Harry C. Martin

The FCC has recommended to Congress that it eliminate the compulsory copyright license for cable retransmission of both local and distant TV broadcast signals.

Under current law, cable TV systems may carry, or refuse to carry, any signal they wish. No copyright payments to TV stations or program producers are required in connection with carriage of local broadcast signals. When distant signals are carried, however, cable operators must pay a nominal copyright fee to the Copyright Royalty Tribunal, which distributes the proceeds to eligible program owners. The "compulsory" license system obviates the need for program-by-program negotiations with TV stations and program producers.

Criticism of this system has mounted since the Court of Appeals in Washington invalidated the commission's must-carry rules in December 1987. The compulsory licensing scheme was created, in part, as a way to offset the constraints put on cable by the former must-carry rules. Now, local TV stations find that cable systems operating in their markets can import, at little or no cost, the same syndicated programs for which the TV stations must pay a premium.

With cable no longer having any carriage obligations, the critics of the compulsory license system view cable as having an unfair advantage in the competition for local viewers. By imposing full copyright liability on cable systems for the programs they carry, Congress could create incentives for producing larger quantities of higher-quality programs.

The commission's recommendation to Congress that the compulsory license system be scrapped is based upon the prevailing view at the agency that competitive enterprise and free markets will do more than government constraints to promote program diversity. FCC Chairman Dennis Patrick issued a separate statement that read in part, "The compulsory license inhibits the free flow of information about consumers' tastes and programming preferences and weakens the incentives of producers to respond to such information. Moreover, by subsidizing program acquisition by cable systems, the compulsory license introduces a significant bias into the program distribution system, disadvantaging competitive alternatives to cable."

Commissioner James Quello recommended eliminating the compulsory license for distant signals, but advocated retention of the system for local signals. He thinks that, under full copyright liability, cable operators must choose not to carry local broadcast signals because of the costs of program retransmission rights. Quello, a long-time advocate of reimposition of must-carry rules for cable, thinks that the compulsory license system for local signals should not be retained unless legislation requiring cable systems to carry local signals is adopted.

"Absent must-carry rules and with a compulsory license, the cable industry is enjoying a free ride at broadcasters' expense, and this cannot continue indefinitely," Quello said. He pointed out that if Congress acts on the commission's recommendation to eliminate the compulsory license system before addressing the must-carry issue, it may have to reimpose both regulatory schemes.

The cable industry has enjoyed effective representation in Washington and has blocked efforts to repeal the compulsory license provisions of the Copyright Act. Broadcasters and program producers have been less successful in their lobbying, partly because of other legislative priorities such as license renewal reform. The commission's decision to advocate repeal of the compulsory license system will focus more attention on the issue.

Tax certificate decision reversed

The commission has reversed a December 1988 decision granting a tax certificate to a minority-owned St. Louis cable company that sold its assets to Tele-Communications.

Under Section 1071 of the Internal Revenue Code, if the sale or exchange of a communications facility is certified by the commission to be necessary or appropriate to further a policy goal, such as minority ownership of the media, such sale or exchange may be treated as an involuntary conversion of the property, thereby exempting the profit obtained from income tax. To qualify for this treatment, the seller must reinvest the sale proceeds in a like business within 18 months after the sale.

In its December decision the commission granted, for the first time, a tax certificate to the seller of a communications facility, reasoning that minority ownership of the media would be promoted if the minority seller could maximize the amount of money available to it for reinvestment in other communications ventures.

In reversing itself, the commission decided that deviating from its existing tax certificate policy was unwarranted because there is no basis for treating minority- and non-minority-controlled entities differently for tax purposes when they sell to non-minorities.

Repeal of 2-year affiliations limit

The commission has repealed the rules that limited to two years the terms of affiliation agreements between local TV stations and the networks.

The 2-year rule was adopted in the 1940s to ensure that emerging networks would not tie up the few existing TV outlets by entering into lengthy affiliation agreements. The commission thought this would foreclose the development of new networks.

In repealing the 2-year rule, the agency found that the current video marketplace provides so many opportunities for establishing alternative network-type systems for the delivery of video programming that existing networks no longer can block the entry of new networks. Moreover, the developing networks that the rule was intended to assist view the rule as counterproductive, because they cannot make the kind of long-term arrangements with their affiliates that are necessary to attract capital and advertisers.

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

Editor's note: For additional FCC information, !GO BPFORUM on CompuServe.

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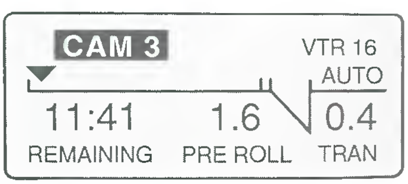

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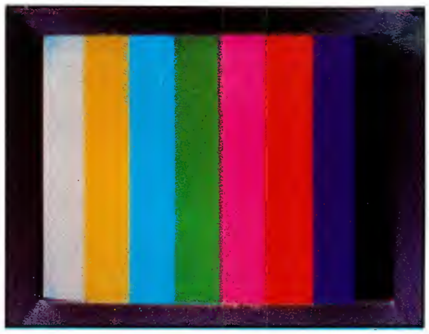


Designer test signals aid troubleshooting

By Rick Lehtinen, TV technical editor

If the bars don't look right, you know something's wrong near the encoder. If the multiburst rolls off too soon, you know there's an equalization problem. The test signals you enjoy today were developed carefully over the years to provide a quick way to diagnose equipment and system problems.

Test signals are supposed to highlight the problems in a picture that, if left uncorrected, would be most likely to degrade the image. The signal must test for something important. It is no good for a signal to diagnose a fault that has little effect on the overall quality of the picture.

Although these signals are quite functional for setting video and chrominance levels, they may not be particularly efficient when it comes to aligning equipment. Perhaps it is time to develop a new generation of test signals designed specifically to aid in equipment alignment and repair, especially now that analog component and digital formats are here. In some cases, the current test signals, designed to work with NTSC systems, lack relevance.

Too many formats?

Test signals aren't handed down from on high. Dedicated committees labor long over their development and standardization. Unfortunately, new generations of equipment are arriving faster than the standardization process can work. This does not speak poorly of the committees; actually, it reflects how seriously they take their work. But they face two huge handicaps.

First, they dare not give their blessing to a signal until they know whether it really does the job. As previously mentioned, the signal must test for a defect that really matters. Nailing down the exact parameters of a signal may require several iterations, and that takes time.

Second, video equipment manufacturers may not always consider it in their best interest to reveal information about upcoming products. This forces test-signal standardization into a reactive rather than a leading role. As a result, test-signal generators typically provide standardized signals, well after the need for them arises, or they provide the signal-generator manufacturer's best guess at a signal that could be of use for a given new format.

Factory-sealed

While servicing video equipment, perhaps you have stumbled across some test points that really don't seem to do much. Their circuit positions won't allow you to gain useful information. Or perhaps you find a test point on a schematic that corresponds not to a probe loop, but to a tiny coaxial connector. Chances are, what you have found is an injection point rather than a sample point. Manufacturers often align circuitry by using customized signals. These may not bear much resemblance to the test signals you are used to seeing.

For instance, if you wish to tune a circuit to peak at a given level, you could inject a signal having a null where you desire the peak. Tuning the circuit until an oscilloscope reads a flat line will peak the circuit, because if the circuit has overcome the null, it must be adjusted to achieve the peak. Such a setup is much faster than one that involves actually reading the scope. (See Figure 1.)

In the past, it would have been difficult for the average station to duplicate this arrangement. Customized generators were pricey. Also, the video equipment manufacturers might not have wanted you, the end-user, to know as much about their equipment as you would need to in order to duplicate the signals. Recently, however, new generators have appeared that allow the user to program the generator, or to play back preprogrammed custom signals.

One new offering uses a removable RAM card to provide the memory for up to 100 test signals, which then can be played back in essentially any analog or digital video format, depending on the options installed. Furthermore, this manufacturer is providing several basic signals as part of a royalty-free library, and it plans to encourage users to develop their own signals and even to trade them via modem. The device will accept signal description commands from PCs as well as accept input instructions from a variety of sources, including automatic measurement systems. This could result in a fast, automatic method of sweeping signal systems.

Hidden sword

Although this is good news for the engineer, it may be that technology's cutting edge is actually a double-edged sword. It leaves equipment manufacturers at a disadvantage. If any engineer is able to concoct signals that will expose the flaws in a piece of video equipment, the manufacturer has to be careful in equipment design. This might not be an altogether bad idea. However, it could lead to compromised performance in critical areas, simply to avoid the possibility of generating artifacts in areas that aren't nearly as important.

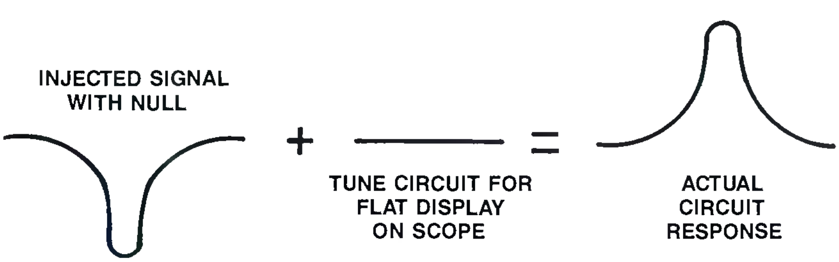
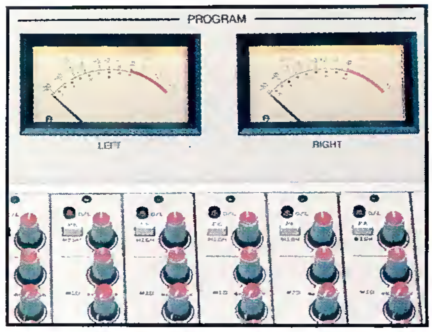


Figure 1. *Custom test-signal generator allows fast, automatic verification of signal systems.*

Part 1

re:Radio



Taking the measure of your station

By John Battison, P.E.

From time to time, I receive interesting letters from readers, which, incidentally, I greatly enjoy. They give me feedback and ideas for points of discussion. A recent letter from J.B. Crawley of Campbellsville, KY, was especially welcome because it brought up a subject I had been considering writing about — bandwidth compliance. Crawley also mentioned out-of-band radiation problems. He is not alone in wondering how to handle these phenomena without going broke buying specialized and expensive test equipment.

He asked how a small, 250W AM station that can barely afford a scope and modulation monitor could afford a spectrum analyzer, or even a splatter meter.

His question led into another important FCC compliance issue: How about measuring frequency? Now that the commission no longer requires the mandatory frequency monitor and its regular loggings, how do you know your station is on frequency, and how do you prove it? Let's discuss frequency measurements first.

Frequency measurements

Many of us remember the old frequency monitor readings that had to be logged showing operation within limits of ±20Hz. Then the commission removed the need for daily regular logging, saying that if an accurate frequency measurement were made every 40 days or less, the requirements would be met. Many stations opted to use outside measuring services that come into town, or near town, or can make more distant measurements, for a monthly charge of about $5.

The certification arrives monthly, showing that the carrier is, let's say 1.3Hz high or low. The report then is clipped to the transmitter log, in the case of a DA station. The report should be filed with the maintenance log in the case of non-DAs.

The rules are the same for FMs and AMs as far as regular frequency checks are concerned. Many stations probably don't even bother to use an outside measuring service, and they may not even be aware that the rules require regular checks.

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

Counter accuracy

Many contract engineers and chief engineers use frequency counters to keep check of their stations. This is acceptable if the accuracy of the frequency counter is known, and the counter is calibrated.

Larger stations may have a cesium standard; in fact, some state networks use one to keep control of all their microwave and AM/FM transmitters. They use such a standard to calibrate a high-quality frequency counter, then check their operating frequencies.

How do you know your station is on frequency, and how do you prove it?

As far as I know, any good frequency counter can be used, provided it has been calibrated properly. I don't know how long the cheaper ones will remain in calibration, but it probably will be necessary to recalibrate regularly and, of course, before every reading.

How can a counter be calibrated if a standard is not available? There is always good old WWV or one of its relatives, depending on where you are. The signals from these stations can be used to calibrate a frequency counter, and they are always available.

Another excellent source of standard frequencies is television. If your station is a network TV affiliate, you can select one of the many test tones sent down the line, and calibrate against that. A TV station's sync generator often can be a good source.

Now that satellites have proliferated, many stable signals are available if your station uses a downlink for programming. Be aware that there is a caveat with the use of satellite signals; there could be a form of Doppler shift under some circumstances.

Actually, the regular measurement of frequency deviation is not difficult, and it can be managed either by an owned or borrowed frequency counter. You also could use a receiver capable of receiving the WWV stations and rely on the use of beat frequency techniques. Whatever method you use, remember that a check at intervals of fewer than 40 days is required.

Performance of the monthly frequency check easily could pay for itself through an additional small fee for the use of the counter. In my opinion, this service should not be performed as part of a contract engineer's regular work, but only for an extra fee.

Emission bandwidth

Many engineers do not seem to be aware that the commission still requires proof that an AM station's emission bandwidth does not exceed certain specified limits. The introduction of NRSC-1 does not remove this requirement, but provides a built-in means of complying with this requirement.

Section 73.44 of the rules calls for an annual emission bandwidth measurement to be made at intervals not exceeding 14 months. If your station has installed an NRSC-1 filter, measurements no longer are required.

The commission has said that any station installing an NRSC-1 filter will be assumed to be in conformity with the rules until NRSC-2 is required in the early '90s. AM stations have until Dec. 31, 1989, to install the NRSC-1 filter to remain in compliance.

Can a selective receiver with a crystal filter be used to check bandwidth compliance? I don't believe that such instrumentation would be adequate to satisfy the requirements. In addition, the setup and tests would require considerable time.

Any kind of measuring device can be used to check emissions, but only readings from a spectrum analyzer will be accepted in the event of a disagreement. Another type of measurement device now is available to check your bandwidth emission. We'll talk about that product next month.

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The making of a space station

By Elmer Smalling III

The National Aeronautics and Space Administration (NASA) has begun work on Space Station Freedom. Plans call for a first-element launch in early 1995. The space station will be a cooperative effort of the United States, Japan, Canada and the European Space Agency.

NASA's program objectives are to accomplish the following:

- Establish a permanently manned space station by 1996.
- Stimulate technologies of national importance, especially automation and robotics, by using them to provide space station capabilities.
- Promote substantial international cooperation in space.
- Create opportunities for private sector activity in space.

Space Station Freedom will be assembled in low Earth orbit, and will consist of four pressurized modules mounted on a truss backbone with solar panels at each end. The station is the prototype for a device that will support missions to the moon or Mars. The space station truss structure lends itself to simple expansion into a dual-keeled unit (with two spines) where spacecraft can be assembled, fueled and checked out for manned missions. Such spacecraft could be berthed, refueled and repaired at the space station without disturbing work on the other keel.

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

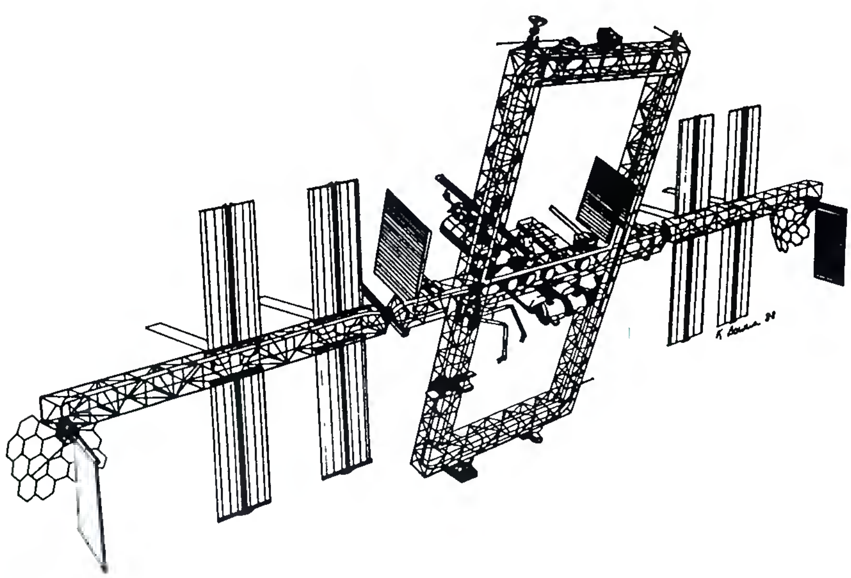
Multiple design centers

Various NASA centers have been chosen to work on the space station.

Marshall Space Flight Center in Huntsville, AL, along with subcontractor Boeing Aerospace, will design and manufacture the living quarters, the U.S. laboratory module, the logistic elements, the node structures connecting the modules, the environmental control and life support systems, and the thermal control and audio-video systems within the pressurized modules.

Johnson Space Flight Center in Houston and its subcontractor, McDonnell Douglas Astronautics, will manufacture the truss assembly, the propulsion assembly, the mobile transporter system, the EVA system, the thermal control system, the space shuttle attachment systems, the communications and tracking system, the data-management system and the airlocks.

Goddard Space Flight Center, with the Astro-Space division of General Electric, will manufacture the servicing facility, the flight telerobotic servicer, the accommodations for attached payloads, and the U.S. unmanned free-flyer platforms. The Lewis Research Center, Cleveland, and its prime contractor, Rocketdyne, will manufacture the electrical systems.



Drawing courtesy of NASA

Figure 1. Space Station Freedom will evolve from a simple, unmanned platform into a permanently manned research facility, and then into this mammoth platform capable of servicing spacecraft on missions to the moon and to Mars. First-element launch date is set for 1995.

Multiple launches

The first section of the station to be launched will be a fully functional spacecraft that will be used as a "cornerstone" for the complete station. This first element will include solar panels and radiators, power module, S-band communications pallet and antenna, reaction control systems, tank farm, mobile transporter, and associated truss and support structure.

By the end of 1995, and after at least four major launches, the station will be ready for human visitors. It will include a thermal control system, robotic servicer, gyro pallet, propulsion thrusters, power- and fluid-management pallets, a TDRS (tracking data relay satellite) antenna, first-phase mobile service center and a pressurized docking module.

NASA is hoping for the space station to have permanently manned capability status by the fourth quarter of 1996. This will include additional support truss structures, inboard power modules with additional solar panels and radiators, more tanks, additional reaction-control modules and attached payloads for the aft node structures with cupolas, airlocks and a habitation module.

The initial size of the space station crew will be four, expanding as additional international modules are added (Japan, Canada and the European Space Agency).

The fourth and final phase of the space station will be complete by early 1998. It will include the international modules, additional solar panels and power modules.

The completed space station will be operated on a day-by-day basis from the Earth and onboard the station. Completion of Space Station Freedom should require about 20 assembly shuttle flights.

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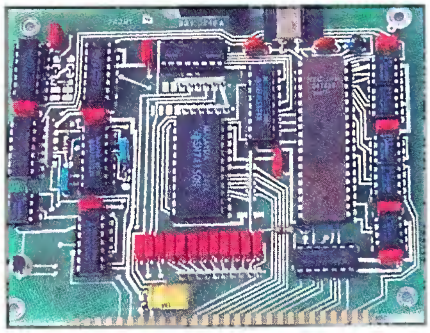

Thermistors used in temperature control

By Gerry Kaufhold II

Thermistors are semiconductors that exhibit a large variation in conductivity when exposed to a small variation in operating temperature. Positive temperature coefficient (PTC) thermistors increase in resistance as temperature rises. Negative temperature coefficient (NTC) thermistors decrease in resistance as temperature climbs.

For most applications, NTC thermistors are preferred. Many national temperature standards laboratories use NTC thermistors as primary reference materials. Broadcast engineers will benefit by learning how thermistors can be useful for measuring temperature, for controlling and protecting electrical circuits, and for measuring microwave power emanations.

Temperature parameters are controlled by measuring the resistance of the thermistor against a known reference using a high-impedance bridge circuit. Current-sensing and time-delay circuits are implemented by measuring current vs. time, or I vs. T. Microwave power and overcurrent indications are determined using voltage vs. current measurements, or E vs. I.

Choosing a thermistor

Thermistors are produced according to a variety of processes. Each "recipe" produces a family of products that are optimized for a particular application and range of temperatures. To control the crystal oven at its correct temperature, the thermistor selected must exhibit its maximum resistance change near the operating temperature of the oven.

A chart showing resistance vs. temperature usually is shipped with each thermistor. This chart is developed by factory engineers who have worked for many years with each type of thermistor. Several mathematical formulas have been derived to permit calculation of resistance vs. temperature. Most of them involve higher mathematics, and none of them completely solves the problem. The R vs. T chart remains the best way to choose a value.

Once a thermistor is chosen, the circuit is created using high-input-impedance circuitry, so that almost no energy travels into the thermistor. This helps avoid self-heating.

To observe self-heating, connect an NTC thermistor between the leads of a volt-ohmmeter, with the display set for resistance in kilohms. The reading will begin high and gradually decrease as current flows through the thermistor from the reference voltage supplied by the meter.

When analyzing or troubleshooting a thermistor-based temperature controller, take care to completely understand the circuit before test equipment is connected. Most thermistors used for temperature applications use 4-wire leads and operate between a reference voltage and electrical ground. If test leads are referenced to true ground, the sensitive bridge circuit might become unstable and oscillate, producing incorrect readings.

Temperature-measurement circuits

Let's look at a typical application for controlling temperature. (See Figure 1.) This circuit might be found in a temperature controller for a crystal oven used in a frequency-stable transmitter.

The first problem to be overcome is mechanical. The thermistor probe must be coupled tightly to the crystal to assure thermal accuracy. Heat tends to radiate down the thermistor lead-wires, acting as a small heat sink that will cause slight errors. To minimize this kind of error, thermistor lead wires are quite thin.

Because energy flowing through the thermistor will cause self-heating, the temperature controller uses high-impedance-sensing amplifiers. Such circuitry works well in electrically quiet environments, but can be quite sensitive to EMI, RFI and inductively coupled noise.

The most common temperature-control circuits use a variation on the Wheatstone bridge. The reference resistor is chosen so that its resistance is close to the expected resistance of the thermistor at the operating temperature. The two voltage-divider resistors are chosen to divide the reference voltage across the bridge, and to give good common-mode noise rejection. The voltage at the input of the measurement circuit should be approximately half the power-supply voltage, to permit maximum voltage swing of the controller output.

The thermistor probe usually uses four copper wire leads. Two provide the drive current to the thermistor, and the other two carry the measured signal back into the bridge. Notice that the circuit that drives the thermistor appears to be complicated. The buffer op-amp is used to compensate for the voltage loss due to the resistance of the lead wires.

In operation, the circuit acts like a closed-loop servo system. As the temperature increases with the heating element on, the resistance of the thermistor lessens. This causes the output of the bridge to decrease, turning the heating element off. As the crystal cools, the thermistor resistance goes up, causing the bridge to unbalance, and the heating element to go back on. Using such a circuit, temperature can be controlled to within fractions of a degree.

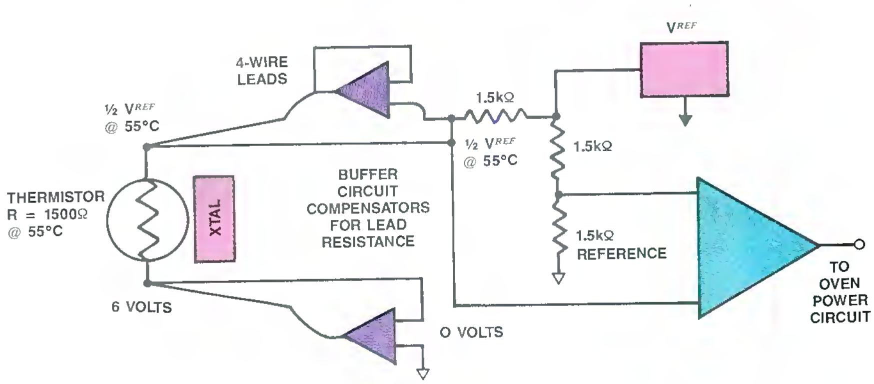

Figure 1. A crystal oven control circuit that uses a thermistor.

Kaufhold is a market development engineer for SGS-Thomson Microelectronics, Phoenix.

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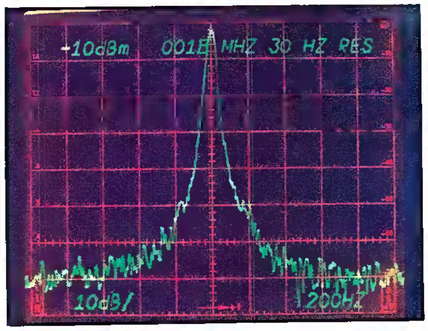
Part 3

Troubleshooting

Learn to spot CD defects

By Brad Dick,
radio technical editor



Making a high-quality CD is a demanding process that brings plenty of opportunities for problems. This month's column will discuss some actual CD defects. By the time you finish reading this page, you should be able to recognize the more common types of manufacturing defects in your own station's CD library.

"Red Book" standards

The manufacturing specifications for CDs are contained in what is called the Sony/Philips "Red Book." Although CD manufacturers are supposed to adhere to these specifications, reports from users suggest that may not always be the case.

The "Red Book" recording standard recommends that CDs not be recorded with more than about 74.6 minutes (74 minutes, 42 seconds). This allows enough tolerance in the manufacturing process that the produced discs still can be tracked properly. However, some record companies require that the recording time be extended to as much as 80 minutes. To get that much material on a CD requires altering the cutting parameters (pit profile) on the disc.

For instance, track pitch is specified to be 1.6μm $\pm$ 0.1μm. Reducing the track pitch to 1.5μm allows the disc to still meet "Red Book" specifications, but now more audio can be placed on the CD. Even with the 1.5μm spacing, most players probably would be able to play the disc. The problem surfaces as tolerances in other areas of the manufacturing process come into play. For example, the smaller 1.5μm track pitch combined with a slightly off-center hole may cause a player to mistrack.

Outer-edge damage

The outer disc edge is a critical playing area. Disc warp, fingerprints and edge damage are more likely to occur here than anywhere else. As long as this area doesn't contain audio, the damage doesn't cause any problems. However, when the player is forced to track audio to the outermost limits of the disc, even minute manufacturing defects and user damage can cause failure. It's important to recognize that a player that fails to properly track an 80-minute CD may not be defective. In this case, it's the disc that does not meet the CD specifications.

To see where the audio is recorded on the disc, hold the CD up to a bright light and look for a rainbow-colored reflection. The top photo shows the light reflecting from the surface of a CD. If you look closely, you can see where the color pattern changes. This is where the actual audio portion on the disc ends. Any scratch outside the audio portion will not affect playback.

Because every disc cannot be played during the manufacturing process, some of the resulting problems will not be caught in the quality-control process. This may mean that a 2% defective disc rate increases to perhaps 20%, which again emphasizes the importance of understanding the interrelated nature of manufacturing tolerances.

Pinholes and black spots

Let's look at some other examples in which tiny imperfections in the manufacturing process can cause problems even for a properly aligned player. Pinholes in CDs are not necessarily the sign of a defective disc. In fact, small pinholes are relatively common. If it is located across tracks or in a radial direction, a pinhole as large as 300μm should not affect a player's ability to track. It's when the hole becomes too large or is located parallel to the tracks to the disc (along the tracks) that problems may develop.

These types of problems are called *local defects*. The "Red Book" recognizes only three types of local defects:

- Air bubbles must be less than 100μm in diameter.
- Black spots within the program area must be less than 200μm in diameter.
- Black spots outside the program area must be less than 300μm in diameter.

Although many specifications are related to CD quality, local defects cause most of the problems for users.

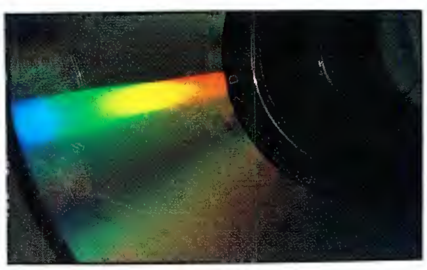
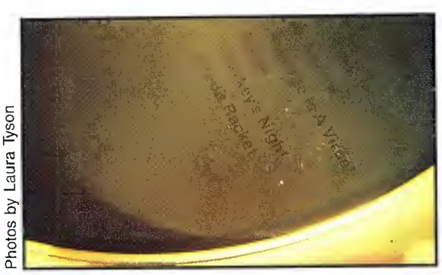


Figure 1. Use the color of reflected light to locate the data area on your CDs. Mistracking on the high-numbered cuts may indicate edge damage.



Photos by Laura Tyson

Figure 2. These large pinholes caused the player to mistrack. Pinholes this large are not typical for a new disc.

Look for damage

With a bit of training, you can learn to identify some of these defects. Look closely, and you will be able to see the rings of silence that separate the cuts. This will help greatly in the troubleshooting process. Suppose, for example, a disc repeatedly fails on track 7. If you examine the disc and can identify a large pinhole in that track area, you've eliminated the player as the problem. The bottom photo shows a disc with large pinholes. They were discovered when the player began to mistrack.

With practice, you should be able to identify pinholes as small as 150μm. Learning to recognize such defects can save you several hours of wasted time trying to repair something that's not broken.

Next month, we'll look at how your own staff may be responsible for causing CDs to fail. By implementing some of the suggested practices, you could cut your complaint rate in half.

Acknowledgment: Appreciation is expressed to the following for their help with this article: Laura Tyson, sales engineer, Denon America; Martin Ledford, quality control manager, Denon Digital Industries; and Dave C. Bowman, director of professional products, Studer Revox.

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Part 5

Management for engineers

On being a leader

By Brad Dick,
radio technical editor

"Gee, I don't know how he does it, but Ben seems to be on top of everything. I've yet to hear about a problem he couldn't resolve. He's the best engineering manager we've ever had."

Wouldn't it be great to be perceived in such glowing terms? The key to Ben's success is not that he's exceptionally smart, or that he has a great deal of academic background. What Ben has going for him is his ability to involve others in developing solutions to the technical problems within his station. Ben uses the management team approach to problem-solving.

More heads are better than one

Management teams allow a supervisor to bring the skills of each team member to bear on the problem. The result: problems are solved quicker, and the solutions are of higher quality.

Being a supervisor or manager doesn't mean you have to solve every problem yourself. Instead, your task should be to see that problems get solved. There's a big difference.

Using management teams to handle problems has several advantages. A major benefit of using this approach to problem-solving is that you don't own the problem. A second benefit is that you don't necessarily need to know the solution; you just have to know where to find it. An important advantage is that people support a decision they had a part in making.

The team approach to problem-solving is but one facet of generating good solutions. The second is the use of a structured plan to generate answers. Let's see how you can combine the use of management teams with another technique to generate quality solutions.

Six steps to solutions

The problem-solving process can be broken down into six steps. No matter what the problem is, resolution follows the same pattern. Whether you are trying to get the news department to return broken equipment to maintenance for repair or to get the accounting department to pay bills promptly, the problem-solving process involves the six steps shown in Table 1.

The roles taken by the leader and the subordinates vary with each particular step. Some problems, especially personal problems of employees, require you, the leader, to be less involved in the development of solutions. In such cases, you act primarily as a facilitator as the other person works through the problem-solving process.

- *Step 1. Define the problem.*

As the leader, you are often in the best position to identify and define the problem. However, if you are involved emotionally with the problem, accurately defining the situation is much more difficult.

- *Step 2. Develop alternatives.*

Because they operate on the front line, subordinates often are better-equipped than you to suggest changes and offer solutions that will alleviate the problem. Given the chance, they often develop scores of creative alternatives. The key here is to come up with as many solutions as possible. At this stage, suggestions should not be debated or eliminated.

- *Step 3. Evaluate alternatives.*

This step requires the use of the subordinates' varied experiences as well as their cognitive skills. Each of the alternatives must be examined carefully. The goal is to find the optimum solution — not to satisfy a leader by selecting his or her predetermined resolution. This is the stage at which you make the case for the alternatives you desire. Be careful, however, of arguing too strongly for a certain solution. The group should select the best alternative, not simply rubber-stamp the leader's ideas.

- *Step 4. Choose a solution.*

The resources and expertise of everyone in the group are essential in completing this step, because this is when a decision is made. It's imperative that the solution be decided upon by the group, not the leader. If you pull the rug out from under the group by overriding its decision, you will have lost their respect and, more important, destroyed any reason for them to help you resolve problems in the future. Overriding the group's decision also will destroy the team's spirit and lead the members to believe that they have little power to effect change and control their own destinies.

You may have good reason to disagree with the group's decision. However, you should have proposed the alternative and the justifications during Step 3. Never mandate a different solution after the group has worked through the problem.

- *Step 5. Implement the decision.*

This step is crucial because most decisions must be implemented by the group members. For example, the station has to install new master-control room equipment over the weekend. There is not enough weekend staff to handle both the installation and on-air operations. This means that some people are going to have to work overtime. Who does what and when now become the critical issues.

- *Step 6. Follow up.*

In the follow-up evaluation, the solution is assessed. This is not a case of finger-pointing. Rather, the staff or leader may assemble data showing the effectiveness of the group's solution. As the team evaluates the results of the selected solution, a relative report card is produced. This can be a great learning experience. It's likely that even better solutions will be generated next time.

Next month, we'll discuss the technique of *active listening*. The process can eliminate the broadcaster's typical communication problem, which goes something like this: I know you believe you understand what I think I've said, but I'm not sure you realize that what you heard is not what I meant.

Identify and define the problem.
Generate alternative solutions.
Evaluate the alternative solutions.
Make a decision.
Implement the decision (solution).
Follow up to evaluate the solution.

Table 1. *Problem-solving can be broken down into six basic steps. Combining these steps with the team approach generates high-quality solutions.*

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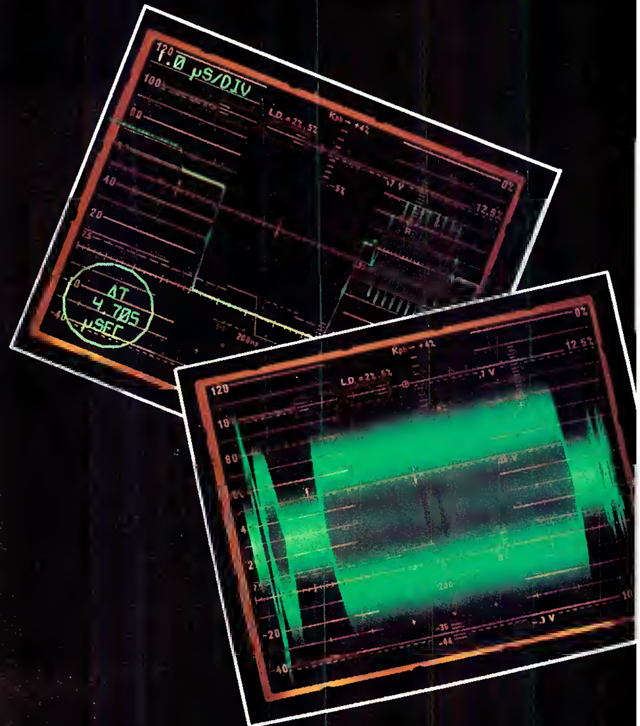
Video technology update



Will new equipment be analog or digital? Yes!

As video products become more sophisticated, the requirements for specialized test instruments also increases. Measuring the performance of video products today can best be accomplished by a combination of analog and digital techniques. (Displays shown are taken from a Tektronix 1780-R video measurement set. Courtesy of Tektronix Television Division.)

Video is a moving target. The power of the computer has given us a new set of opportunities and challenges. Our TV plants are beginning to look like large local area networks, with interconnection on the signal layer through routing switchers and patch panels, and interconnection on the control layer via station automation systems. But some of today's advances are on the analog front. New ICs and techniques make today's analog equipment the best that has ever been.

The most significant inroads are made when equipment designers recognize the inherent strengths of both the analog and the digital worlds, then build on those. This hybridization is evident in much of the latest equipment.

Our video technology update touches on three areas. "Easing Into Newsroom Automation" provides guidelines for computerizing a newsroom without getting in over your head. "Inside Standards Conversion" looks at the algorithmic core of standards conversion devices. "Advances in Analog Instrumentation" reveals how digital techniques can be used to convey facts about analog signals.

As video technology moves relentlessly forward, **BE**'s goal, as always, is to provide a monthly status report to help you keep abreast of the changing world of broadcasting.

Rick Lehtinen,
issue editor

Once again, S
the art of cuttin

Leave it to Sony to keep the simplicity of a childhood art form in the sophisticated art of video editing.

For the fact is, we've made technological advances that have added both precision and speed to editing, without adding complexity. And that holds true for all our editing control units.

The Sony RM-450, BVE-600 and BVE-900 clearly demonstrate this approach. They all share Sony's operating feel and philosophy. For one thing, they all share key common features. Such as Auto Detect, which automatically identifies the type of Sony VTR being used, and automatically sets the appropriate control parameters through its RS-422 serial control port.

In addition, they also share the ability to read Control Track and Time Code. As well as the ability to perform video/audio split edits. Yet they also offer a range of other features to accommodate every budget.

For two machine editing, you don't have to think twice. It's the Sony RM-450.

Two-machine editing has never been as smooth, effortless and flexible. The RM-450 comes equipped with both 33-pin and 9-pin RS-422 remote control interface connectors, for comparably equipped VTRs.

What's more, mixed operation is possible using any combination of 33-pin and 9-pin VTRs.

The RM-450 can work with Time Code based editing (with 9-pin VTR connections) as well as CTL editing. It will also do split audio/video edits.

In fact, every aspect of the RM-450 has been designed for stress-free operation. This includes a keyboard layout which allows for a minimum of key strokes, a JOG/SHUTTLE dial on both the player *and* recorder side for convenient search, and dynamic tracking operation, and more.

Indeed, it is difficult to think of a dual-VTR editing task for which the RM-450 wouldn't be perfectly suited.

RM-450

The BVE-600.
A/B Editing from A to Z.

The BVE-600 goes beyond the capabilities of the RM-450 to offer three VTR control (two players and one recorder). This makes A/B roll editing possible, when used with the optional plug-in video switcher boards and an external MXP-29 Audio Mixer. With either composite or component/composite boards in place, you have dissolve, wipe, superimposition at your fingertips...with no

ony elevates g and pasting

BVE-600

need for an external video switcher.

In short, there is simply no more adaptable, efficient tool for use with U-matic® and Betacam® VTRs than the BVE-600.

The BVE-900. Created to be at home in any post-production house.

The BVE-900 was created with a clear strategy in mind; design the most expandable, easy-to-use, economically sound editing system possible. And make it meet Sony's rigorously high standards, and your high demands.

This editing control unit controls up to four VTRs in any A/B roll edit, enabling you to perform sophisticated editing chores like sync roll, sync play, and more.

The BVE-900 gives you sweeping control of video switchers; and of audio mixers, including fader selection and VCA control, for automated split audio/video edits.

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Beyond any individual feature, all Sony editing control units are built with a full recognition of your post production demands. That's why all our units, when connected to Sony VTRs, switcher, audio mixer and video monitors, form a *system* which is capable of satisfying the most difficult editing needs. Yet if you need help or service, you only have to remember one name, Sony. What could be more convenient and efficient than that?

For more information about Sony's entire line of editors, call the Sony Information Center, at 1•800•523•SONY. There's a lot more to learn about the editing control units that bring new technological innovation and performance to cutting and pasting.

BVE-900

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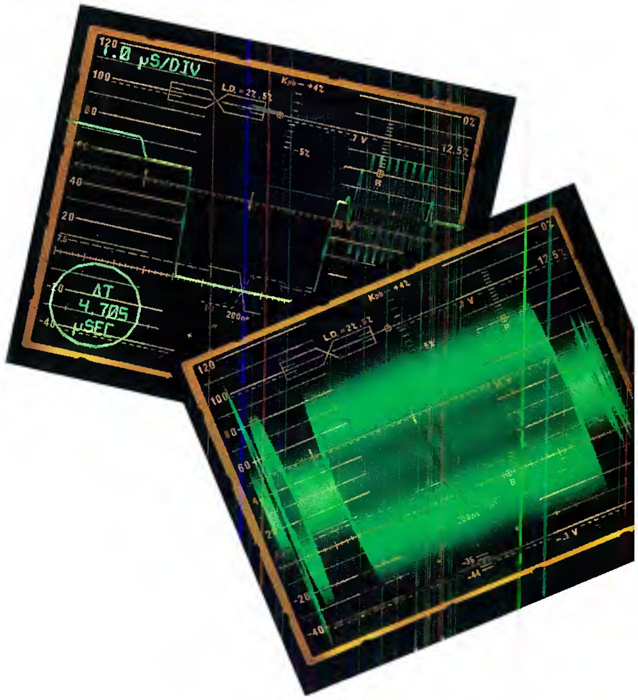
Easing into newsroom automation



By Rick Lehtinen,
TV technical editor

When it comes to automation, wade in slowly to keep your head above water.

Jumping into newsroom automation with both feet is like diving off a cliff before you know how deep the water is. Automating a newsroom today requires a substantial commitment of station resources and demands decision-making that may lock you into or out of other choices down the road. In some cases, it may compel you to remain loyal to a particular team of manufacturers.

This suggests the need for a phased approach to automation. With this type of approach, you can concentrate on the automation items that provide maximum return on investment. At the same time, by getting your feet wet, you gain some perspective for evaluating subsequent automation steps. Let's explore the process of easing into newsroom automation.

The robotic toolbox

In the first place, automation is not about robots or computers; it is about tools for people. You are introducing ways to help produce newscasts. It follows that the tools actually should help the news team do its job. Forcing technology on the news department makes as little sense as choosing engineering test equipment by throwing darts at a catalog. The needs of the operation first must be considered carefully, for now and for the future.

To buy the right tools, you need to know the jobs they'll be used for. This requires analysis. You might set up a task force, including members of both the news and engineering departments, to conduct this research. It is likely that news managers would be resentful of engineering department representatives nosing around uninvited. It also is likely that the news department may be too close to the process to tackle the analysis objectively. Together, however, you should be able to come up with an accurate portrayal of how news stories travel through the station. In your research, you might seek answers to these questions:

• *How do you do things now?*
What is the flow of information through the news department? How does a story go from being a lead or a hot tip into a finished package on the 6 and 10 o'clock news? What paths does a story take in the production phase, from field tapes through editing to on-air playback? How do name supers get from the reporter's story to the screen? Where do weather images come from, and how do they make it to the chroma-key device? How do you file and retrieve materials in the archive?

Study the information and signal flows until you can draw them in the form of flowcharts, including charts for emergencies and exceptions to the rules. You then should be able to isolate and identify the areas in which automated processes would allow the news staff to do more work in less time, and involve fewer people.

• *Is it the way you would want to do things?*
Once you know the path information travels through the news department, ask yourself whether it is the way you'd like

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Joe Alvin, Chief Engineer
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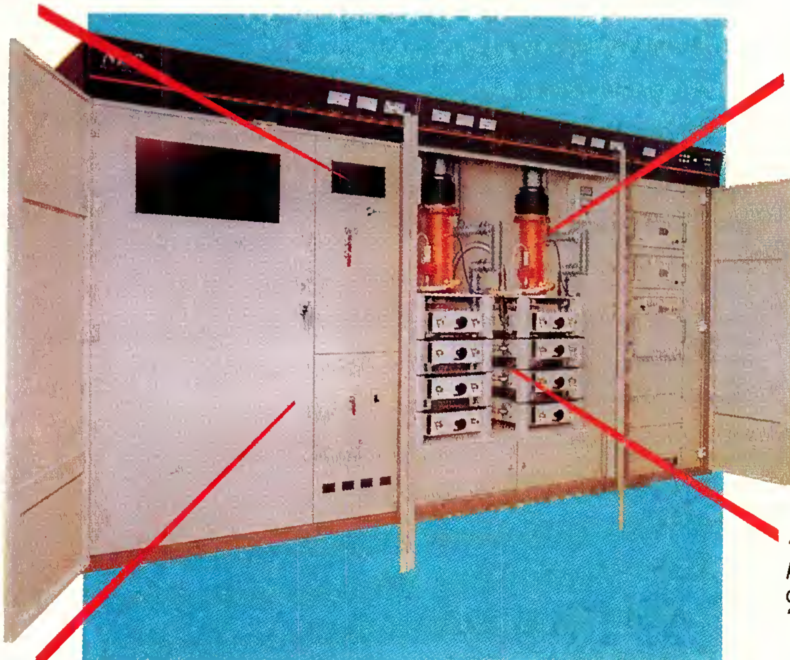
White River Junction, VT



"NEC has bent over backwards to help us with any questions about the transmitter. We've had a wonderful association with them. We're very impressed with NEC quality."

Karl E. Paulsen, Chief Engineer
KTZZ-TV
Seattle, WA

"We were impressed with its 'turn key' performance. It's easy to operate and doesn't require any 'tender loving care.' It's reliable."

Bob Hollinger, Assistant Chief Engineer
WQEX-TV
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'heir technical support is always ɜre. You can just call Chicago 'd get the information you need. ɪd the transmitter's good. We're ry satisfied with its performance."

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WTKK-TV
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If you want a clear picture of just how good an NEC UHF transmitter is, take a look at what people who use them are saying. They're talking about reliability. Stability. Excellence in design. Low cost operation. And there's no comparison when it comes to maintenance. They require very little attention.

They're also saying that NEC people are always there when needed. With suggestions. Ideas. Answers to questions. Replacement parts. Or whatever it takes to keep a transmitter running smoothly.

What they're telling us is what we'd like to tell you. If you need a transmitter that's built to be reliable year after year, that's known for stability, and that's not power hungry, take a look at what NEC is offering. Better yet, take a user's word for it.

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For more information about NEC transmitters, contact NEC America, Inc., Broadcast Equipment Division, 383 Omni Drive, Richardson, TX 75080-3545. Or, call 214-907-4710. Fax 214-907-4711.

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things to be. Personalities, traditions and habits have a way of changing the course of operations from something rational to "the way we do things here." One of the benefits of automation is that it forces you to think through your procedures, giving you a chance to clear out obstructions and bottlenecks. You also are likely to find several ways to improve the works that have little to do with automation. More phones, different radio procedures, or additional (or fewer) intercom stations might bring about great benefits.

Two questions

Automation also is about economics. You don't automate because it's fun; you do it to make money. Perhaps there was once a time that automation could have been justified because of its "gee whiz" factor, the same way helicopters were justified because they sported station logos. But television is changing from show business into just plain old business. It should be approached like any business plan — long on planning, short on spending.

When weighing any aspect of news automation, ask these two questions: *Will it save money?* and *Will it make money?* If you can answer "yes" to both questions, you've got a justifiable expenditure. Think harder if either answer comes up negative. Any move toward automation must offset the costs associated with it. Jump in over your head, and the payback might take excessively long.

If the expense seems justifiable, you can quantify its desirability by working through a simple worksheet, as shown in Table 1. Remember, the purpose of the exercise is not to provide rigorous financial analysis. Rather, it is to provide a way to rank automation purchases by their benefits. Apply both questions and your worksheet to each area you think could benefit from automation.

The equipment of automation

The newsroom computer system is the heart of an automated newsroom. The computer is used for script preparation, script review by supervisors and wire service ingest — getting news and information out of the national wire services and into the station. Other chores that are natural for computers but may or may not fall to the newsroom computer, depending on its capabilities, are database service access, archive access and automated data input such as election service tie-ins. Another capability is the automated interface with station production devices, such as CGs, still-stores, cart machines and camera robotic equipment.

Newsroom computer systems fall into two main topologies. They may consist of clusters of personal computers connected by a LAN (local area network), or they can

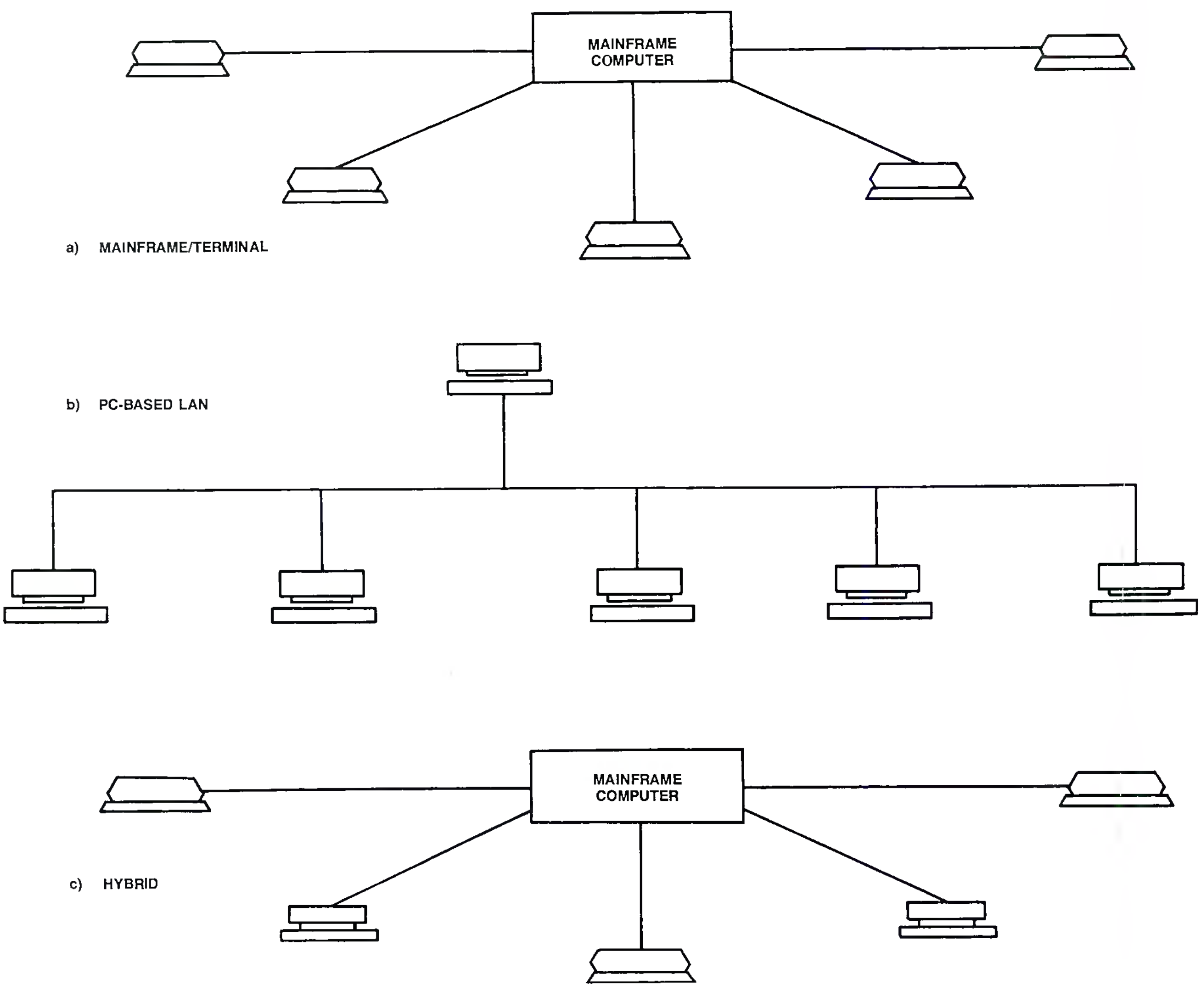

Figure 1. Block diagram of newsroom system terminal topologies.

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Directing Traffic In The Heart Of NBC.

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be a mainframe with a multitude of terminals. There are strong arguments for going either direction and, in fact, some mainframe systems allow PCs to sign on as terminals. (See Figure 1.)

Engineers are not likely to have a great deal to say when it comes to evaluating the purchase of a newsroom computer as a creative tool. Some technical questions need to be asked, however, and engineering may be a logical place to generate some answers. How reliable is the equipment? How will the system's performance degrade as users sign on? What is the manufacturer's track record for dealing with service problems?

An interesting and important study is to determine the price per terminal. Note any large jumps in that price, perhaps because of the need to buy a new interface card every eight or 12 terminals. Answers to questions such as these may help to make good decisions for both today and tomorrow.

Connective issues

When it comes to evaluating a system for interface to production equipment, the engineering department probably will have a great deal to say.

A fairly complex newsroom automation system is shown in Figure 2. You can't go on the air with promises. A news automation system has to work *now*. Although it is true that many of the subsystems shown in the figure are available today, often these devices work best free-standing. Technology isn't yet to the point that all the equipment interconnects for control or data transmission. Is this a bad situation? Not if you are happy with the equipment and don't mind waiting for interfaces to become available. If lack of an interface is holding you back, or if a key link in the chain turns out to be "vaporware," then you have just hit bottom. This is one of the big reasons to wade slowly into the waters of automation.

The universal acceptance of RS-170A may have spoiled station engineers. For years, American TV plants have operated under the premise that a given box, whatever its function, has standard video inputs and outputs. If a still-store purchased yesterday isn't adequate today, the cure is to disconnect the wires, swap it out with a newer model, reconnect the coaxes and time it into the system. If station leaders have shopped carefully, and if the unit performs as advertised, it will integrate nicely.

Similarly, in the high-tech world of telecommunications, open-system architectures have developed wherein the functionality of each layer is defined, along with the access into and out of that layer, leaving the elements inside the layer free to evolve as technology advances.

Unfortunately, the station automation system's data and control protocols are not yet standardized. There simply hasn't been time. These signals drive devices that, in many cases, didn't exist two years ago.

Worse, the development of automation equipment often has stretched the manufacturers' resources. Any time or energy the manufacturers have is likely to be spent on completing and improving their own products, saving handshakes with other systems for a later day. Also, developing a universal protocol might mean tipping one's hand, and some manufacturers are fearful of revealing their plans to a competitor or of exposing hidden weaknesses in their systems. This delays implementation of completely automated newsrooms.

One approach to solving this problem has been seen recently in the field of robotic cameras. At least one manufacturer has published the protocol used in its system. Although the task remains for the other manufacturers to write an interface for that protocol, at least half the roadblock is removed.

Let's work through the issue of adopting some recently introduced technologies.


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An important topic in newsroom automation is that of robotic cameras. Automating one or more of the studio's cameras may make good sense. For instance, a high camera that provides an overview of the studio as a cover shot, or a tower-mounted weather camera, is a natural. It makes money because you can provide unique, interesting video on a regular basis. It saves money because the cost of installation easily is offset by the safety and convenience of not having to put a photographer into such awkward positions.

Full-fledged studio automation requires a more careful look. One station is proceeding at full speed with a major camera project that will pay for itself in about 2½ years. Another station is holding back, however, because if automated cameras were installed, there would not be enough production work to keep the crew busy, and that would force the closing of a production studio.

Bit by bit

The automation of a newsroom should be a carefully controlled series of events. Gradually acquiring automated techniques will make for a painless and cost-effective transition to automatic operations. Automate by all means, but think clearly, buy deliberately, and do what you do according to a well-considered master plan.

Continued on page 36

Newsroom automation expense worksheet

Equipment name: ____________________

1. Will it save money? ________
2. Will it make money? ________
3. What is the price, including cable, extra cards, etc.? ________
4. How many years will you use it? ________
5. What is the cost per year (line 3 ÷ line 4)? ________
6. How will this save money?

Equipment savings:

____

____

____

____

____

Personnel savings:

____

____

____

____

____

How much will this save us each year? ________

Rating: ________ Priority: ________

Table 1. Sample worksheet to rank newsroom automation projects by the benefits they would bring to the station.

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One look is all it takes. And you'll see why more and more people are lining up for the Panasonic® SVHS Pro Series. Because anyone in the market for a high-quality professional video production system, simply can't afford not to look at what the Pro Series can do for them.

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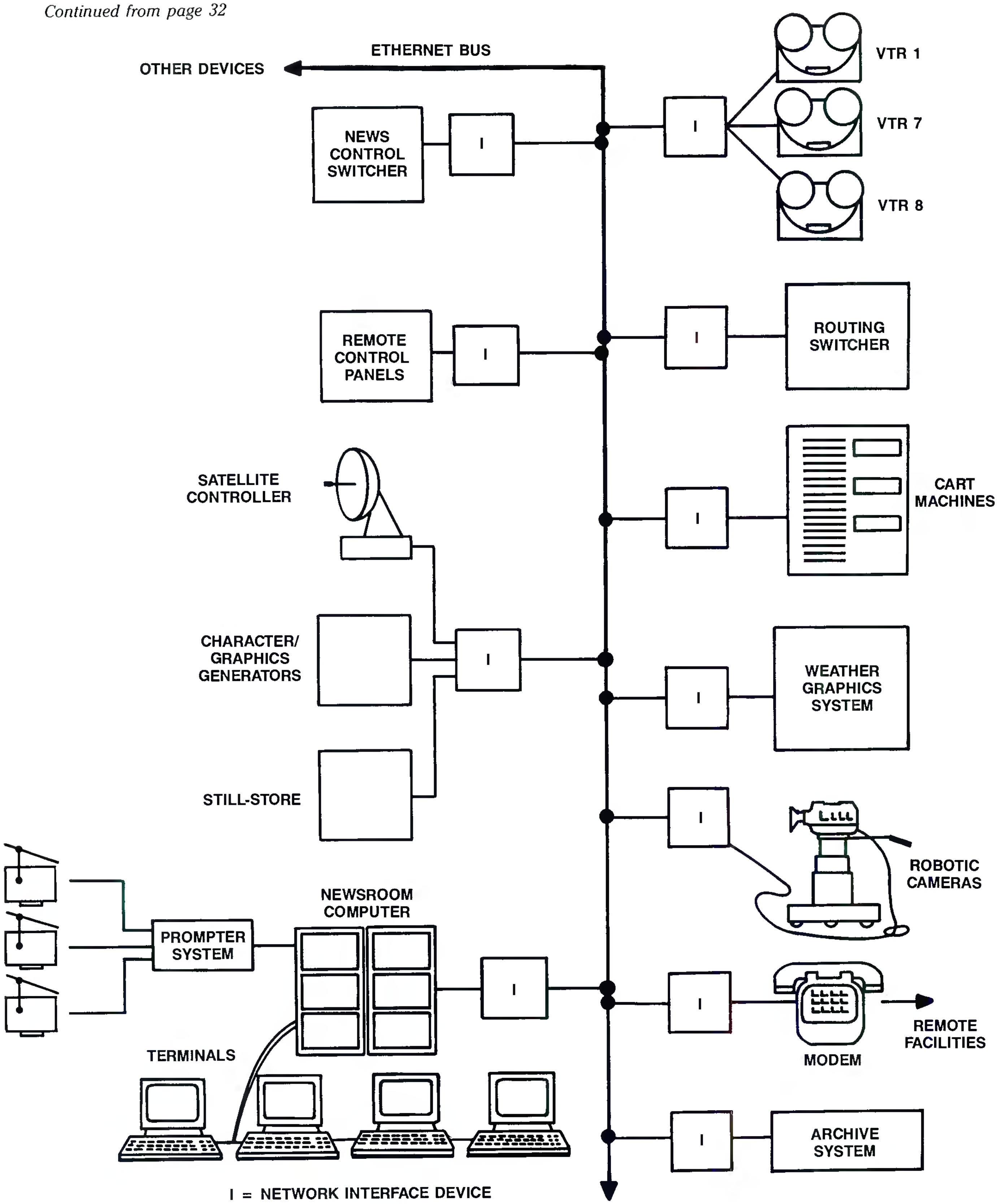

Figure 2. Fairly elaborate control network manages a variety of production devices. Not all the interfaces are fully developed.

How Good is Our 3rd Generation? Take a Look at Our 5th!

PERFORMANCE DATA (AG-7500A)

	1st Generation	3rd Generation w/o TBC	3rd Generation w/TBC-200	5th Generation w/TBC-200
Horizontal Resolution (Color Mode)	400	370	360	350
S/N Ratio (dB)				
Luminance (Color Mode)	57.2	51.7	52.0	49.0
Chrominance (AM)	51.8	47.5	51.4	44.5
Chrominance (PM)	44.3	40.1	43.8	35.2

Data represents measurements by independent engineering evaluation. VCRs taken at random from inventory.

- Signal Source: Shibasoku TG-7/1
  - Luminance: 50 IRE flat field w/burst
  - Chroma: 50 IRE w/100 IRE p-p
  - Resolution: Monoscope Shibasoku 58A/1
- Noise Meter: Rohde & Schwarz UPSF2/UPSF2E2
  - Y-S/N: 200 kHz HPF, subcarrier trap on 4.2 MHz, LPF, weighted
  - C-S/N: 100 Hz HPF 500 kHz LPF, unweighted

From the first to the third, even to the 5th generation Panasonic® SVHS Pro Series specifications speak for themselves. And they say "outstanding." Here are some of the reasons:

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Our TBC-200 time base corrector has a 16-line correction window, chroma plus/enhancement, chroma noise reduction and no-roll circuitry. To make multi-generation recordings even better.

The UTP-1 signal transcoder is more than ready to transcode virtually any component signal into any other component signal. Saving you an extra generation.

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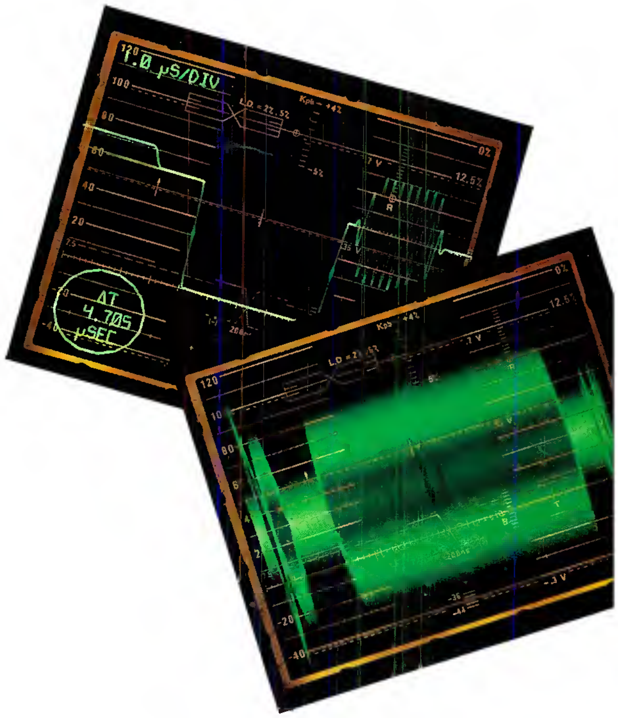
Inside standards conversion

By Rick Lehtinen, TV technical editor



Interpolating filters are the soul of standards conversion.

Standards converters. Who needs 'em?

We do. In the early 1960s, the world failed to come to terms on a color TV standard and, as a result, several were used. Today, as HDTV standards proliferate, we might see standards conversion equipment become even more important.

Most of the broadcast material that undergoes standards conversion today is finished production, and for the most part, it is in a composite format. Analog component formats, such as Betacam or M-II, are increasing in popularity. In the future, it is likely that a great deal of standards conversion will take place in the D-2 (composite digital) arena.

How standards converters work

Briefly, you input composite, decode to component, interpolate and store the video in memory to take care of line- and frame-rate differences, read video back out of the memory, and encode it to the desired format. (See Figure 1.)

It sounds simple in principle, but there is certainly more to the story. Standards converters are akin to sophisticated digital effects devices. In fact, they can be said to go a step beyond; an effects device maps video pixels to new screen locations, but standards converters can map video to new points in both space and time.

Decoding

The first step in standards conversion is decoding. The input composite format, which is usually a function of the tape's country of origin, is broken down into one luminance channel and two color-difference channels, or YUV. The decoder can be analog or digital, and the choice splits standards converter manufacturers into two camps.

Those of the analog persuasion maintain that their technology is proven and that it is more than capable of handling the task. The digital camp claims that newer techniques are better. Analog decoding requires essentially a new front end for each format used. Digital merely requires reloading some new coefficients into filter taps, but usually at the cost of converting and carrying an extra bit or two.

If you were to feed your converter with an analog component signal, the issue of analog vs. digital decoding becomes moot. (See Figure 2.) As digital formats increase in popularity, various other front ends can be provided. Whichever is chosen, the result at some point must be digitized YUV in order to process the signal further.

Filtering

Getting from one format to another involves far more than dealing with the differences relating to choice of subcarrier frequency and treatment of phases. By the time decoding is completed, those items are out of the way. The magic of the conversion process is in the filtering. A brief review might first be in order.

You can filter a signal digitally by performing a weighted average on a series of adjacent samples. This is done by

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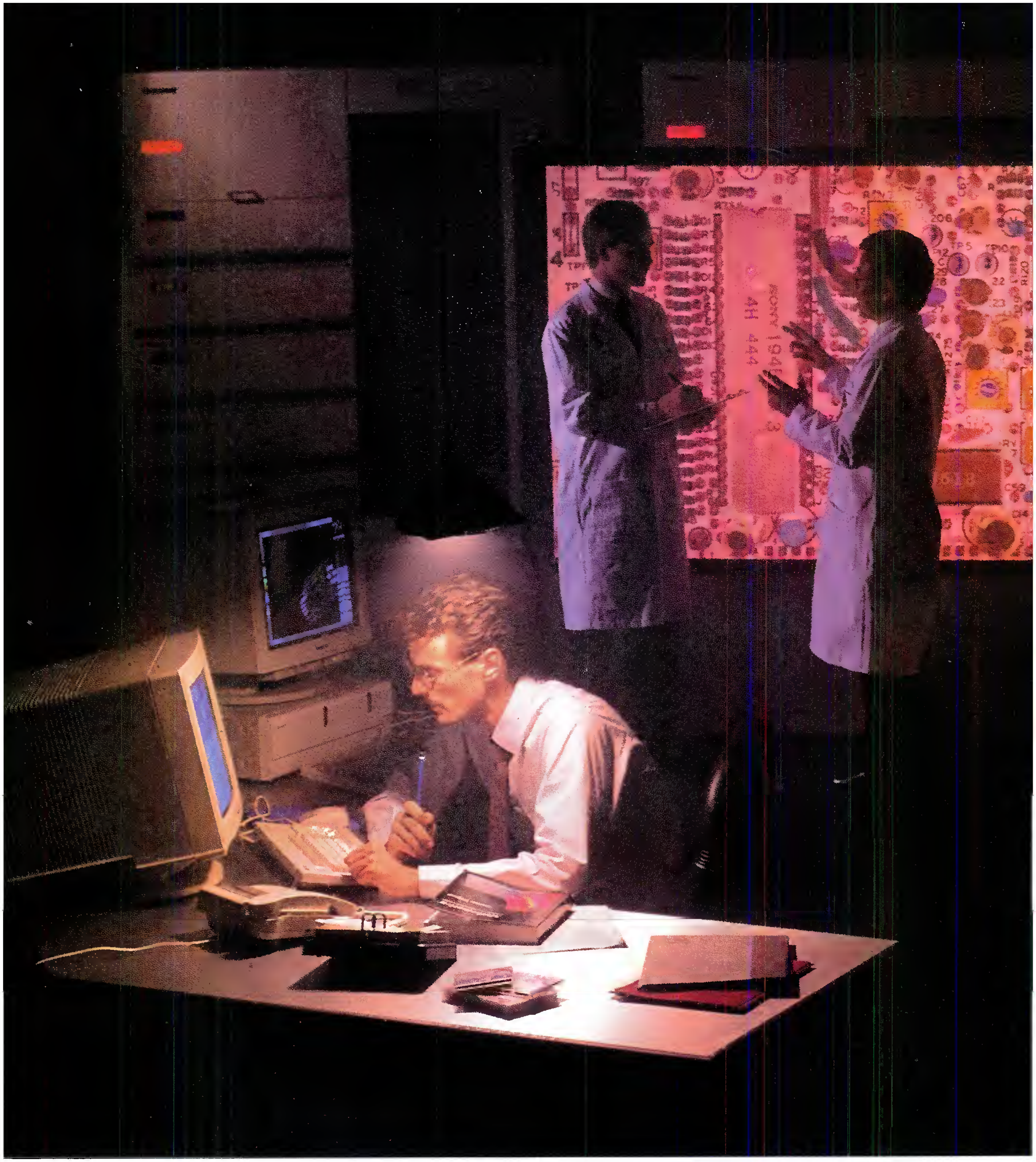
THIS IS NOT THE MOST IMPORTANT ADVANCE IN BROADCAST OPERATIONS.



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multiplying each of the samples by a coefficient, which incorporates a weighting factor (which determines the response of the filter) and a division factor (which does the averaging). Each of the multiplication sections is called a tap, a term left over from the days of resistive voltage dividers. (See Figure 3.) By carefully choosing coefficients, you can use the filter to determine what the value of a sample would be if one were taken at a certain location. This is the essence of interpolation, which is the soul of standards conversion.

Filtering in three directions

Imagine what has to happen to get from the line length of a PAL signal (52μs) to the line length of NTSC (51.3μs), or vice versa. A certain number of samples must be either derived or discarded. This process is called horizontal filtering, as shown in Figure 4. This operation is similar to the expand-and-compress operations performed by many digital effects devices.

Looking in another direction, PAL has 625 horizontal lines per picture, and NTSC has 525. Each sample cannot simply be mapped to a new location, because several of the locations are "phantom." Figuring out what to write on each new line is the goal of spatial, or vertical, filtering. (See Figure 5.)

At first glance, this seems manageable, but there is a difficulty. The goal is to take information off the existing lines and map it onto new lines, but the existing lines must first be revealed. Because of interlaced scanning, images are constantly divided over the current frame and the previous one. In other words, at any mo-

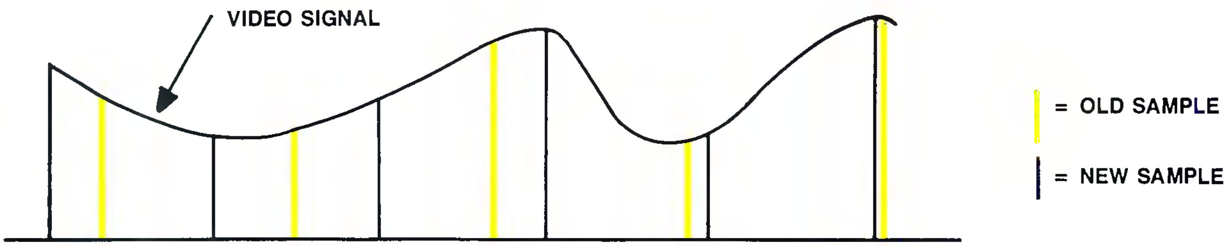

Figure 4. Filters interpolate value for new samples on a horizontal TV line. The new samples are in the correct position for the destination format's line length.

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ment, you have available only half the information needed to interpolate the new lines. The solution, of course, is to use some field storage to build up a frame, and sample across the complete image. But there is a complication here, too.

PAL has 50 fields per second, and NTSC has 60 (actually 59.94). This means that there is no way to simply map fields on a one-to-one basis. Instead, you must guess what a given frame might contain if it were viewed at a given point in time. (See Figure 6.) This is called temporal filtering.

So, vertical or spatial filtering requires a complete frame of lines to filter from, but temporal filtering is needed to develop those lines. This sets up a chicken-or-egg situation. Neither the frames nor the lines can come first. They must come along together. This means they are non-separable, and any processing must work on both directions at once.

The equations to describe these multidimensional transformations have not been formulated completely. To date, many of the coefficients to perform these operations have been developed on an empirical, "try-it-and-see" basis. It is interesting that many manufacturers perform the temporal and spatial filtering operations together, and perform the horizontal filtering either before or after those operations, depending on which route requires the least memory.

Moving targets

The conversion process is difficult enough even if the images are standing still, but video moves. The ultimate test for a standards conversion system is how well motion survives the conversion process. It seems it is fairly easy to get a high-resolution image or one that has good motion characteristics. It is beastly hard to get both.

The scanning frequencies video uses are actually a bit too slow to do a good job

Continued on page 53

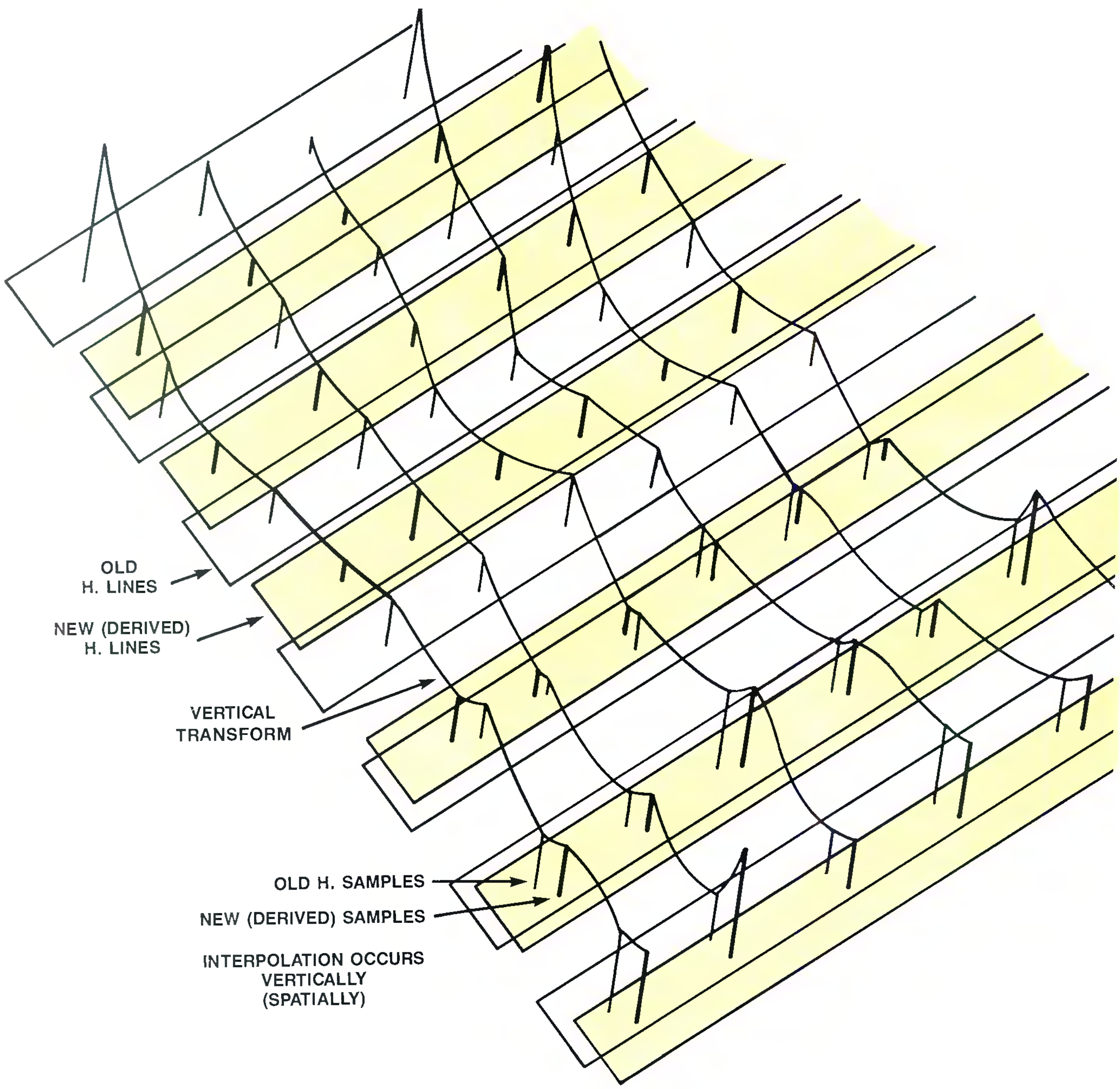

Figure 5. *Spatial filtering interpolates information from the old lines to form new lines, spaced correctly for the destination format (such as 525 or 625 lines per frame).*

3/4

THE PROFESSIONAL VIDEO MAGAZINE FROM SONY

FOR DYSLEXIC READERS U-MATIC SPELLS SUCCESS

At Texas Scottish Rite Hospital for crippled children in Dallas, Sony U-Matic SP™ equipment is helping young students overcome dyslexia.

This puzzling disability is of special interest at the Hospital, which is actively treating more than 10,000 disabled children today. Dyslexia makes it difficult to learn the alphabet correctly. Even very bright dyslexic students have difficulty learning to read, write and spell.

Doctors and dyslexia therapists at the Hospital have developed a successful teaching technique. Today, cameras in a studio classroom transmit lessons via closed-circuit television to the dyslexia laboratory. And the training is provided on cassette to 140 school districts in Texas.

As video services manager Alexander Carduff explains, "the program consists of 350 one-hour videotaped sessions, with instruction in reading, writing and spelling using multi-sensory techniques. We use three floor cameras and an overhead camera—plus prerecorded graphics, a video writer and character generator. A crew of five works under my direction.

"We edit each master tape on-line before it's duplicated."

The editing and recording at the Hospital include two Sony BVU-850 U-Matic SP Recorders, a Sony BVU-870 with Dynamic Tracking™, a Sony BVE-900 Editor and an SEG-2550 Special Effects Generator.

"It is a demanding production," Mr. Carduff notes. "What makes it possible is the controllability and picture quality of U-Matic SP. And the still-image capability of BVU." ■

INSIDE

AT BOEING, THE FIRST TAKE IS
THE ONLY TAKE

When it tests a jetliner, Boeing Commercial Airplanes goes to remarkable lengths.

The flight test division must be certain to capture every instant of every test and record it with the fine detail they need for evaluation. So they use video equipment that's made with the same rugged precision as a Boeing jetliner: Sony U-Matic SP™ players and recorders.

By the time flight tests are over, nearly every inch of these huge craft has been scrutinized by video camera, and each image preserved on tape by a Sony Recorder/Player—one of two BVU-950s or a VO-6800 Portable. To do the job, these Sony recorders must stand up to some tough environments: vibration, violent temperature swings, and breathtaking altitudes.

In one procedure, the pilot tests the landing gear and brakes of a 747 by deliberately applying maximum braking just as the jumbo jet reaches takeoff speed. The test group videotapes this so they can later observe, in detail, the response of the landing gear to the stress of the aborted takeoff. In another ground test, Boeing engineers apply loads to the wings of an airplane until they fail, to confirm that the design specs have been met.

"Like many of our tests," photo administrator Pat Johnson points out, "these are costly ones. So it's

important to capture them on tape the first time. That's why we put a premium on recorder reliability.

"We need sure-fire performance, and we get it from Sony U-Matic SP equipment.

"We have to edit these tapes before we can evaluate the tests—yet we've also got to hold fine detail. That's why we edit on Sony BVU-950s."

Not all of the tests performed at Boeing are so dramatic. One procedure monitors the exterior skin of the aircraft in flight: small cones are attached to the skin and watched by a camera feeding the VO-6800 Portable Recorder/Player. If the tape shows any cone to be vibrating, it means that there is an airflow disturbance at that site.

Airborne cameras monitor the movements of the control surfaces—the flaps and ailerons. Other cameras, on the ground or attached to the exterior of the aircraft, monitor the landing gear as they retract, extend, and make contact with the runway.

Boeing engineers resort to ingenious strategies to videotape some elusive physical effects. For example, they release dyes to make air flows around the craft visible to the camera. On the flight deck, a camera monitors many cockpit instruments, including a small CRT which displays status and warning messages. Since some messages are on the screen too fleetingly to be read, they are captured on video and viewed with still-frame.

"We go to great lengths—and great expense—to test our product thoroughly," Mr. Johnson adds. "We've got to squeeze every last drop of useful information out of those tapes.

"That takes quality and reliability—which is exactly where Sony U-Matic SP equipment shines." ■

THE LONGS DRUG Rx FOR THE VIDEO BLAHS: U-MATIC SP

"In the '70s, store employees who were rank beginners at production made our first videos. It was the age of stone knives and bearskins—for us and for our video equipment."

The speaker is Kyle Westover, vice president for training and communications of Longs Drug Stores, based in Walnut Creek, California.

"Today our videos are fully professional in quality. And Sony products brought us along at every step.

"Stores are run autonomously," Westover emphasizes, "and are scattered from Arizona to Alaska. So video is a vital link for consistent training and communications.

"This is the 'Star Wars' generation," he notes. "If your videos don't match television's production values, your credibility suffers.

"At Longs, we're determined to find and train qualified people from the stores to do production, rather than hire outside professionals. And, so far, that's just what we've done.

"Today," he says, "we use the very best to do the very best." Longs has a studio and editing suite centered on Sony U-Matic SP™ equipment—two BVU-950 Recorder-Players and one BVU-900 Player.

"The idea is to be creative, to avoid on-camera lectures. We use dramatizations, shooting a lot of footage in the stores."

"We were told we were crazy to hope to produce at a professional level," says audio-visual supervisor Max Timms, "but we found a helpful supplier who encouraged us.

"Today, this is a department of fully qualified professionals—and all of us came from the stores." ■

U-MATIC AND YOU

Don't confuse longitudinal time-code with Vertical Interval Time-Code (VITC). The former, available in all BVU and Type IX machines, is recorded on a dedicated address track above the audio tracks. (VITC, used in one-inch VTRs, is part of the video signal.)

In U-Matic™ format, this track overlaps the vertical blanking (harmlessly). A dedicated head reads it at a fixed point in the tape path, for a consistent offset between time-code and video.

In BVU, you can put time-code on an audio track. But you lose an audio channel and there are some other limitations. ■

TYPE IX IS HERE!

Three new pieces in Sony's value line of U-Matic SP™ equipment are here. Today.

Wait till you see them: The VO-9850 Editing Recorder, VO-9800 Recorder/Player, and VO-8800 Portable Recorder.

Now you can have SP quality at prices you can afford. As well as time-code and self-diagnostics, among other functions. And a lot more. While your existing U-Matic tapes remain compatible.

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SONY®

PROFESSIONAL VIDEO

Continued from page 48

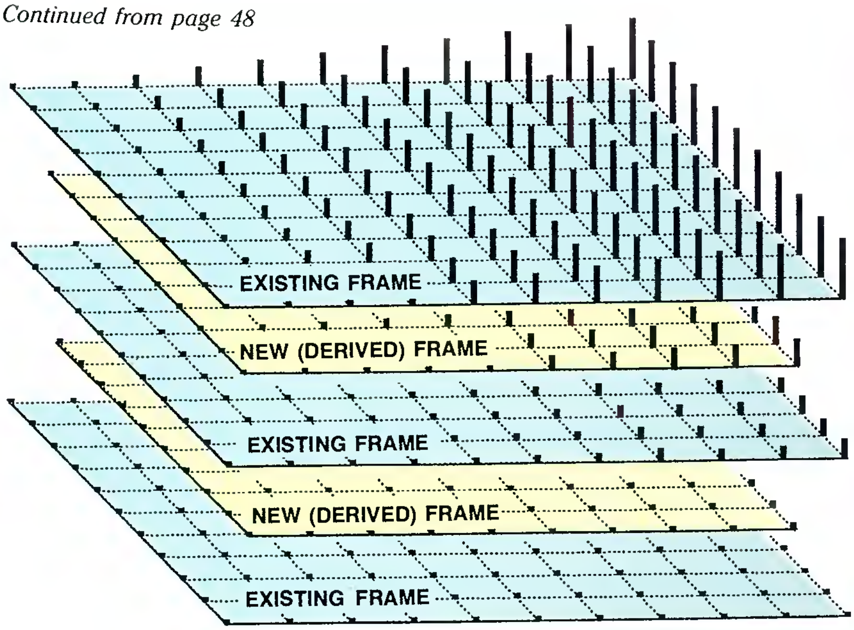


Figure 6. Temporal filtering calculates what a new frame would look like if that frame were viewed at the point in time the frame was required for the destination format.

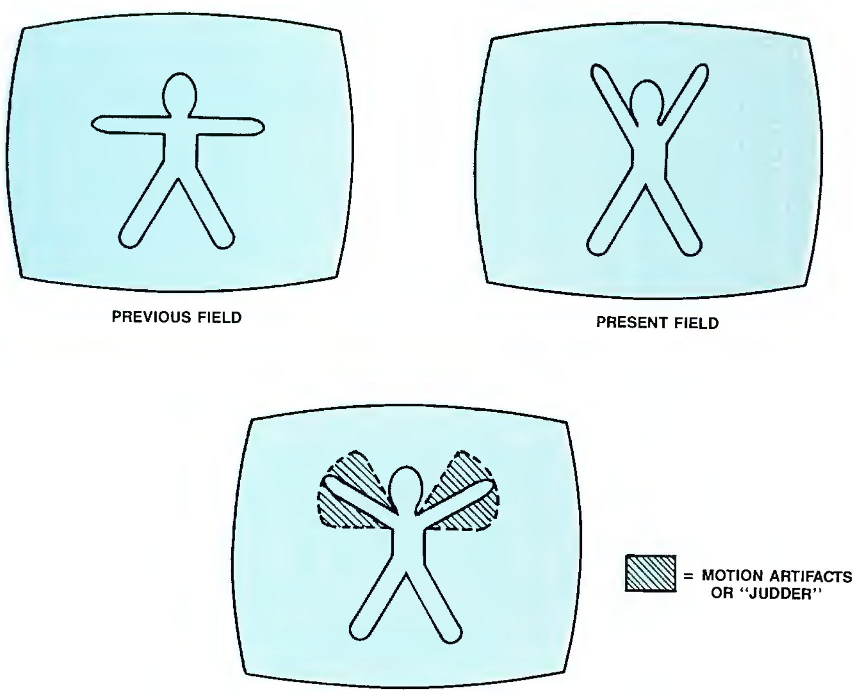


Figure 7. Motion artifacts, in some cases called "judder," occur when the exact position of an image between fields is ambiguous, hence unpredictable, due to video's low field-sampling rates.

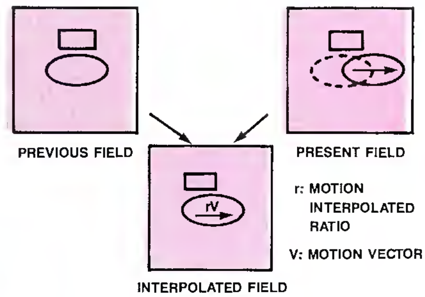


Figure 8. Motion-compensation systems sample the screen for movement, then "slide" portions of the image by multiplying them by the "motion vector."

of representing moving images. You could prove this by jogging a reel of videotape and noting how much difference exists between fields. When the tape is played back at the same speed as it was recorded, however, your eyes can be fooled into seeing smooth motion. Video that is standards-converted has no such advantage. Because of differences in frame rates and difficulties in interpolating motion, converted video is full of motion artifacts or aliases, sometimes called "judder." (See Figure 7.)

One cure for motion problems is to use some form of adaptive algorithm in the filtering process. Presumably, such a system could sense which sections of the screen are full of detail, and which sections contain motion, and dynamically optimize the coefficients in the filters for each section.

A second technique is to use motion interpolation. In this system, a picture is broken down into sampling blocks, which are compared to detect motion. A vector describing the motion is calculated. This vector is used to "slide" portions of the image around the screen. (See Figure 8.) Advocates of the motion-interpolation process claim that it works great and allows savings by using 2-field instead of 4-field storage. Others aren't so sure. They wonder, for instance, what the device is supposed to do when the background and foreground elements of a picture move at different rates, or when the camera zooms in or out, in which case virtually every pixel in the screen is moving.

Future moves

Overcoming motion artifacts is the next great step for standards conversion. The solution must challenge the human eye in determining what is right and wrong. Unfortunately, at this point, the eye and brain have a lot more experience than the equipment designers. Some experts say the successful solution to motion problems in standards conversion must provide good answers to these three questions:

- What level of performance is practical?

• Will any added processing degrade the picture?
• Are the improvements worth the cost?

Broadcasters would do well to pay close attention to the solutions that develop. Conversion technology is likely to be a major component of future HDTV systems.

Acknowledgment: The author wishes to thank James Grunder and Associates and the Oki Electric Industry Company for assistance in preparing this article. Special thanks to David Lyon, technical director, Snell & Wilcox.

Never twice the same color

The year was 1964. A special meeting of certain members of the IEEE had been called in New York. The agenda: to determine a color system for all of European telecasting. For 10 years the United States had been in color, using NTSC. Now Europe was examining NTSC, PAL, SECAM and a host of others now forgotten. Some hoped that a single international color system would emerge to simplify program transfer.

One participant in the conference was the late Joe Roizen, at the time an engineer for Ampex Corporation. Roizen's assignment was to illustrate how Ampex could produce tape machines in any of the proposed formats.

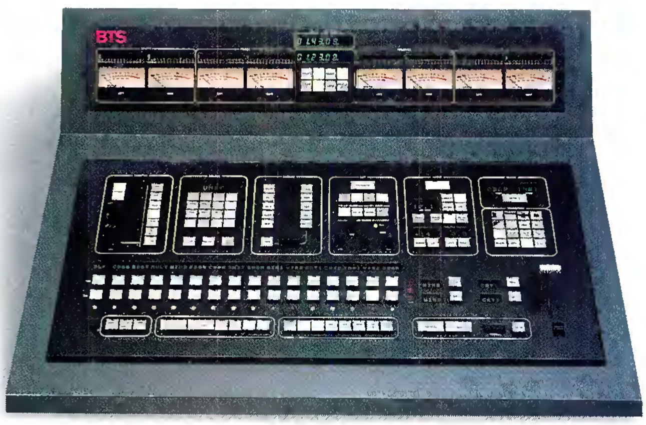
As he pondered the various systems, Roizen became incensed that so many standards could have developed. Each system had its champion, who extolled some virtue of his system that "obviously" made it the color system of choice. Worse, nationalistic and political influences had hopelessly muddied the water. Although Roizen personally favored a worldwide standard, the hope seemed remote. He vented his feelings in the form of a comic document in which he proposed an all-encompassing system that captured the most famous feature from each contending system. In the process, acronyms sprang forth. National Television Standards Committee (NTSC) became "Never Twice Same Color." The French line memory system, SECAM, which would be adopted later by the Soviets, became "Something Essentially Contrary to American Methods." Phase alternative line (PAL), a reasonable compromise at the time, became "Peace at Last." Few proposed systems escaped Roizen's barbs. His own system, NUTSEQAMIR (which defies description), became "Never Underestimate the Stubbornness Engineers Quite Adamantly Manifest at International Referendums."

A NUTSEQAMIR receiver would have required two picture tubes, a special mirror and a whirling glass disk. Unwieldy, to say the least, it was a clear parody of what was happening as politics muddled technical judgment.

Roizen requested a few extra moments in front of the audience and, after his serious paper, he launched deadpan into his roast. Ampex artists had prepared some humorous placards to illustrate the presentation. The audience roared.

Although the paper was effective — the acronyms popularized in NUTSEQAMIR linger to this day — neither it nor the fond hopes of all concerned could save the day for a world color standard. Three principal systems, with several variations of each, are currently in use. And history seems destined to repeat itself. It appears that recent events may upset the dreams of those who had hoped to see a universal HDTV system. A new generation of standards conversion equipment undoubtedly will evolve.

How to take control of a broadcast station.



MCS-2000 Master Control Switcher

Go ahead, be ambitious. Controlling a broadcast station is no small potatoes, but these advanced products from BTS make it easy by giving you total control of all on-air programming from two workstations.

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BTA-2300 Automation System

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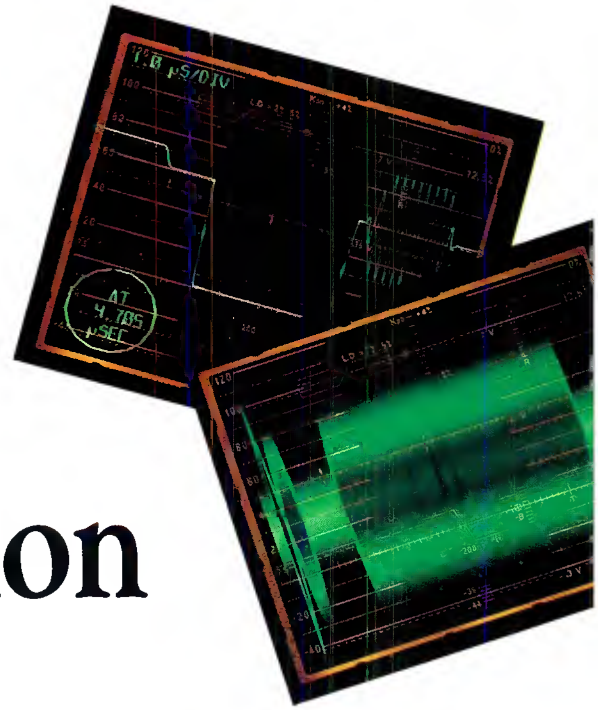
Advances in analog instrumentation



By Margaret Craig

Analog waveform monitors and vectorscopes are better than ever.

Analog waveform monitors and vectorscopes are not a thing of the past. In fact, they're better than ever. Computer-based test and measurement equipment, which digitizes and automatically analyzes the video signal, is becoming increasingly available to TV stations. These instruments offer significant advantages in repeatability of results and ease of use.

Does this mean that analog monitors and vectorscopes soon will be replaced by digital instruments? Maybe eventually, but today's digital technology cannot yet meet every analog measurement requirement. Digital equipment can perform automatic measurements and reduce operator error. Even so, numeric readouts and displays of digitized signals cannot provide a complete picture of some signals. Today's analog and digital TV test equipment complements each other. Well-equipped facilities will rely on both types of equipment.

The demand for analog test equipment continues, and new analog products are being developed for TV applications. These new waveform monitors and vectorscopes perform the same basic functions of their predecessors, but they also benefit from modern digital technology. Recently introduced models have new features, enhanced capabilities and better performance.

Analog oscilloscopes

The design and implementation of analog oscilloscopes is by no means trivial, but the concept is straightforward. A waveform monitor, like a general-purpose oscilloscope, presents a display of voltage vs. time. In the vertical direction, the CRT beam is deflected in proportion to the video signal itself. In the horizontal direction, the beam is swept across the screen by a ramp locked to horizontal or vertical sync. A vectorscope demodulates the incoming video and drives the display vertically with the R–Y signal and horizontally with the B–Y signal.

In both cases, the signal is processed only in the analog domain. Signal-processing techniques such as amplification, demodulation, filtering, phase lock and sync separation are used to condition the signal and to extract synchronization information. In contrast to computer-based instruments, however, the baseband signal never is digitized and manipulated as digital data.

Why analog?

The analog method of displaying signals has some inherent benefits. An analog display is *real-time* in that the waveform is displayed at the same rate it occurs, virtually every time it occurs. In a line-rate video display, every line in the frame is displayed, one on top of the other. Aberrations that appear on only one line, therefore, do not escape the notice of the operator. This ability to display all of the lines overlaid is one of the principal advantages of an analog scope.

Waveform displays of one or two video fields, which are useful for evaluating hum

Craig is an engineer with the technology development group of Tektronix, Beaverton, OR.

This switcher handles standard bandwidth like it's going out of style

TVS/TAS-3000 Distribution Switcher

The new TVS/TAS-3000 video/audio distribution switcher from BTS handles standard bandwidth switching in stride. But the fact is, standard bandwidth may not be the standard much longer. And that's why the TVS/TAS-3000 is not your standard switcher.

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And if high bandwidth capacity isn't a requirement, BTS still has you covered with our best-selling switcher, the TVS/TAS-2000. The 2000 represents the same advanced technology and quality as the 3000 in a standard bandwidth switcher. BTS also offers a full-range of control panels and distribution amplifiers for a complete system designed, tested and guaranteed by one supplier.

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Tube Dinner

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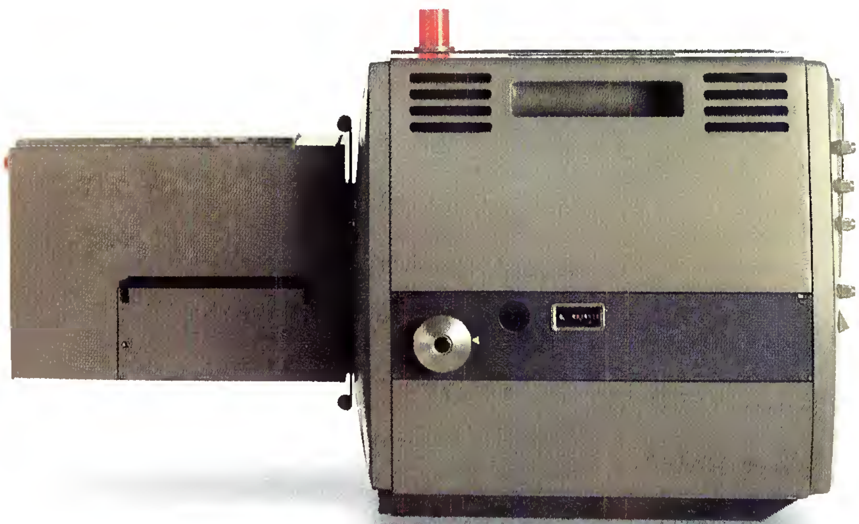

Plumbicon Tube Camera

...nary changes in the way ...as not invented by BTS.

switchers, videotape recorders and graphics equipment are among the best-engineered, highest quality and most reliable in the world. Our work in High Definition and CCD products is pacing an industry which faces the most sweeping technological advances since its beginning.

And we're as dedicated to better product service and support as we are to better products.

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Including the Swanson Company.

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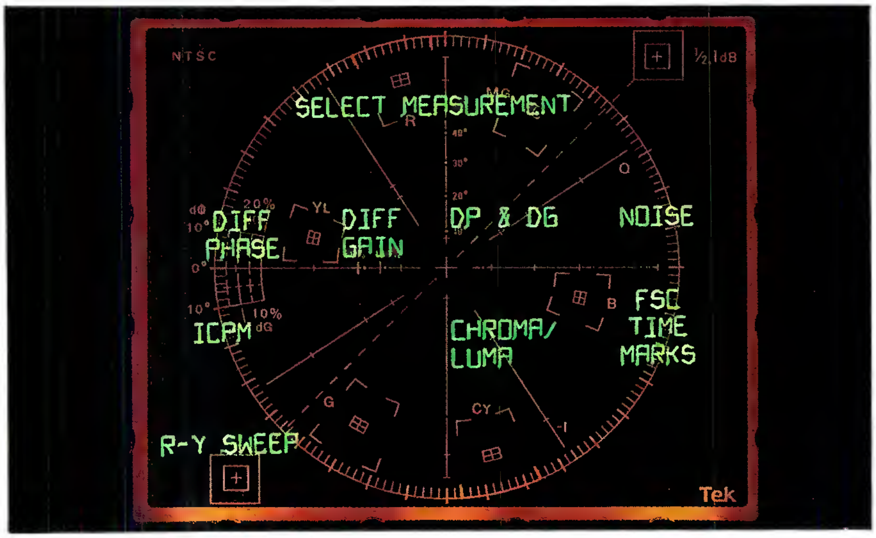

Figure 1. *Alphanumeric readouts provide important information to the user and help eliminate mistakes.*

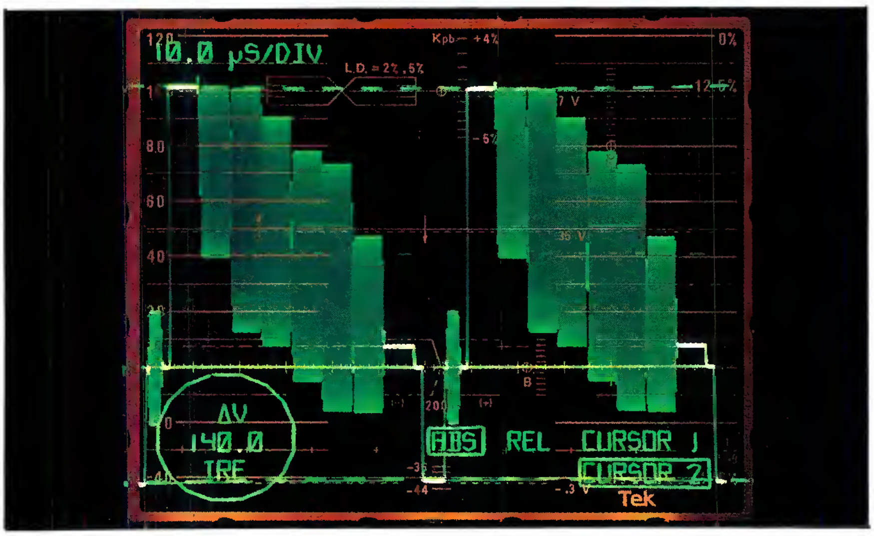

Figure 2. *The amplitude cursors are positioned to measure white bar. The amplitude is displayed automatically on the CRT.*

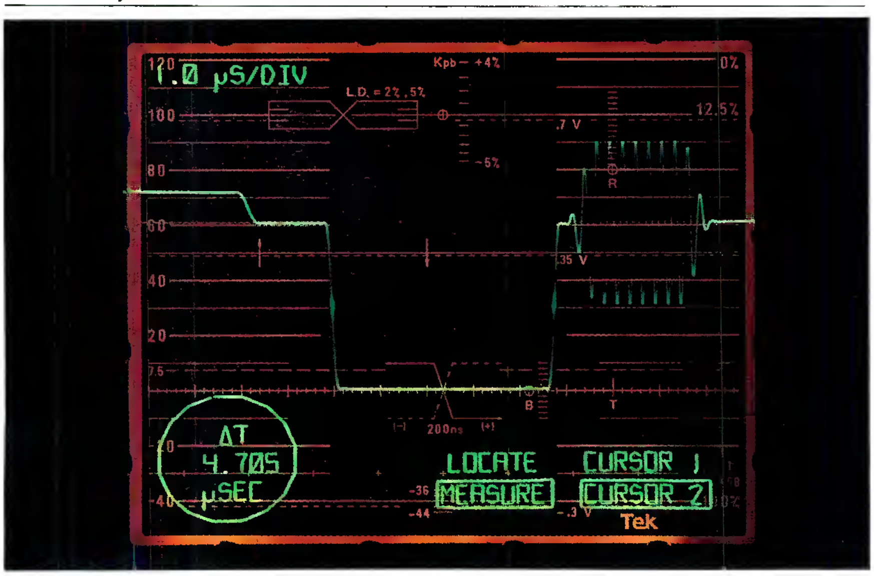

Figure 3. *Time cursors, shown here as dots, allow timing intervals to be measured.*

Continued from page 58

and they may be either synchronous or asynchronous with the video waveform.

In general, this is not a problem, but in some cases the multiplexing can produce visible artifacts. If something suspicious appears on the waveform, turn the readout off to be sure that the aberration is really part of the incoming signal.

Conversely, there is also a chance that the signal itself may have a problem that cannot be seen because the beam is busy with the readout when it occurs. Again, you can make a quick check simply by turning off the readout.

Amplitude and time cursors

Traditional waveform monitors, and indeed oscilloscopes of all kinds, require the operator to quantify signal amplitude and timing by comparing the waveform with a graticule screened on the face of the CRT. Internal graticules work well, but they have some limitations where high precision is required. Inaccurate readings can be caused by amplifier non-linearities or in the CRT itself. Although careful design and high-quality CRTs can minimize these effects, the opportunity for error is not eliminated. External graticules, which are mounted in front of the CRT, further compromise accuracy because both viewing angle and distance affect the reading.

Electronic cursors are one solution to graticule problems. Because the cursor voltage passes through the same signal path as the waveform, distortions manifest themselves equally in the two signals and do not affect the results. An important advantage is that electronic cursors can simplify and speed the measurement process.

Amplitude cursors typically appear as independently positionable horizontal lines. An on-screen readout indicates the voltage separation in millivolts, IRE or as a percentage. Figure 2 shows how voltage cursors can be positioned to measure white bar amplitude.

Timing cursors can be displayed either as vertical lines or as bright-up dots on the waveform. Figure 3 shows the dot method being used to position the cursor accurately on the 50% point of a pulse edge.

Measurement accuracy is highly dependent upon the method by which cursors are implemented. Voltage can be quantified in a fairly straightforward manner using a D/A converter. The digital input to this device is varied in proportion to the desired cursor separation and the corresponding voltage number on-screen. From this digital data, the D/A converter produces analog cursor signals at known voltage levels that are switched into the signal path for comparison with the waveform. The quality of the D/A con-

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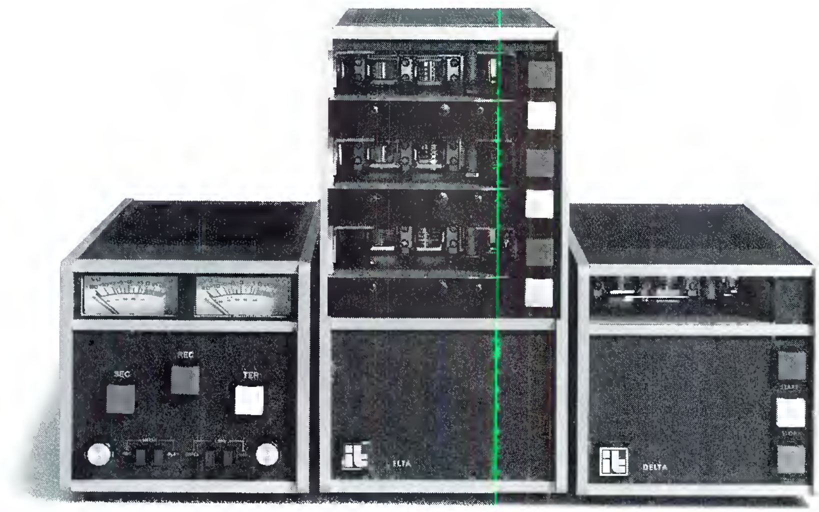

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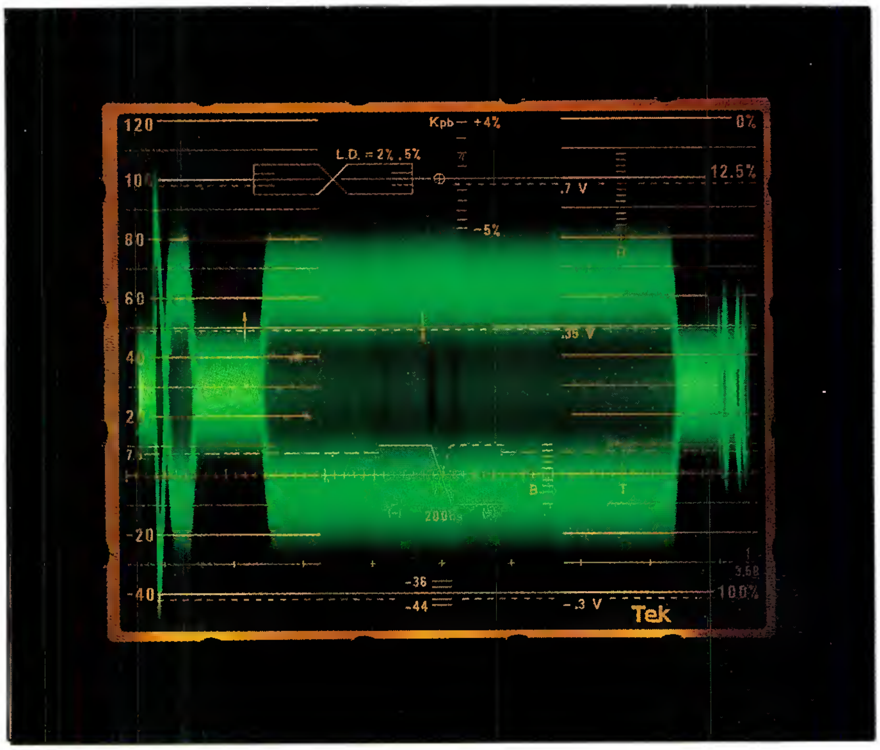

Figure 4. *Digital noise filters make it possible to measure signals formerly hidden in noise. Shown here is a differential phase display with the noise filter switched off.*

verter and the number of bits are the key determinants of accuracy and resolution.

Timing cursors present a somewhat more difficult problem. The most obvious implementation involves dividing the horizontal ramp voltage (which represents a known time interval) into voltage increments that represent smaller time intervals. The accuracy of this method depends on both ramp linearity and horizontal calibration, neither of which are perfect.

A more complex method involves the generation of a crystal oscillator reference for the timing cursor separation. Because this reference actually exists in the time dimension, the voltage-to-time conversion is not required, and greater precision can be achieved.

Cursors are particularly useful if they expand with the waveform when it is magnified horizontally or vertically. This implementation removes the constraint that both cursors be on the screen at the same time. With the instrument in a high-gain mode, the user can more accurately position a cursor on the waveform.

More digital technology

In addition to providing new features, digital technology can improve the ac-

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curacy of analog oscilloscopes. The phase control of a vectorscope is one function that benefits from a digital implementation.

Traditionally, phase shifting has been accomplished by inductively or capacitively delaying the subcarrier signal. However, this is difficult to do in a linear fashion, even over a small range. A digital implementation of this phase-shifting function allows the user to shift phase in precise 0.05° increments over the entire 360° range.

Another problem is measurement of differential phase and gain in the presence of noise. One solution to this problem is to use a recursive filter to remove the noise without significant bandwidth reduction or loss of horizontal resolution.

The 1-line delay required for this filter is implemented by digitizing and storing the demodulated video signal, something that would not have been a cost-effective solution just a few years ago. Figures 4 and 5 illustrate the noise-reduction capabilities of such a filter.

New standards and measurement needs

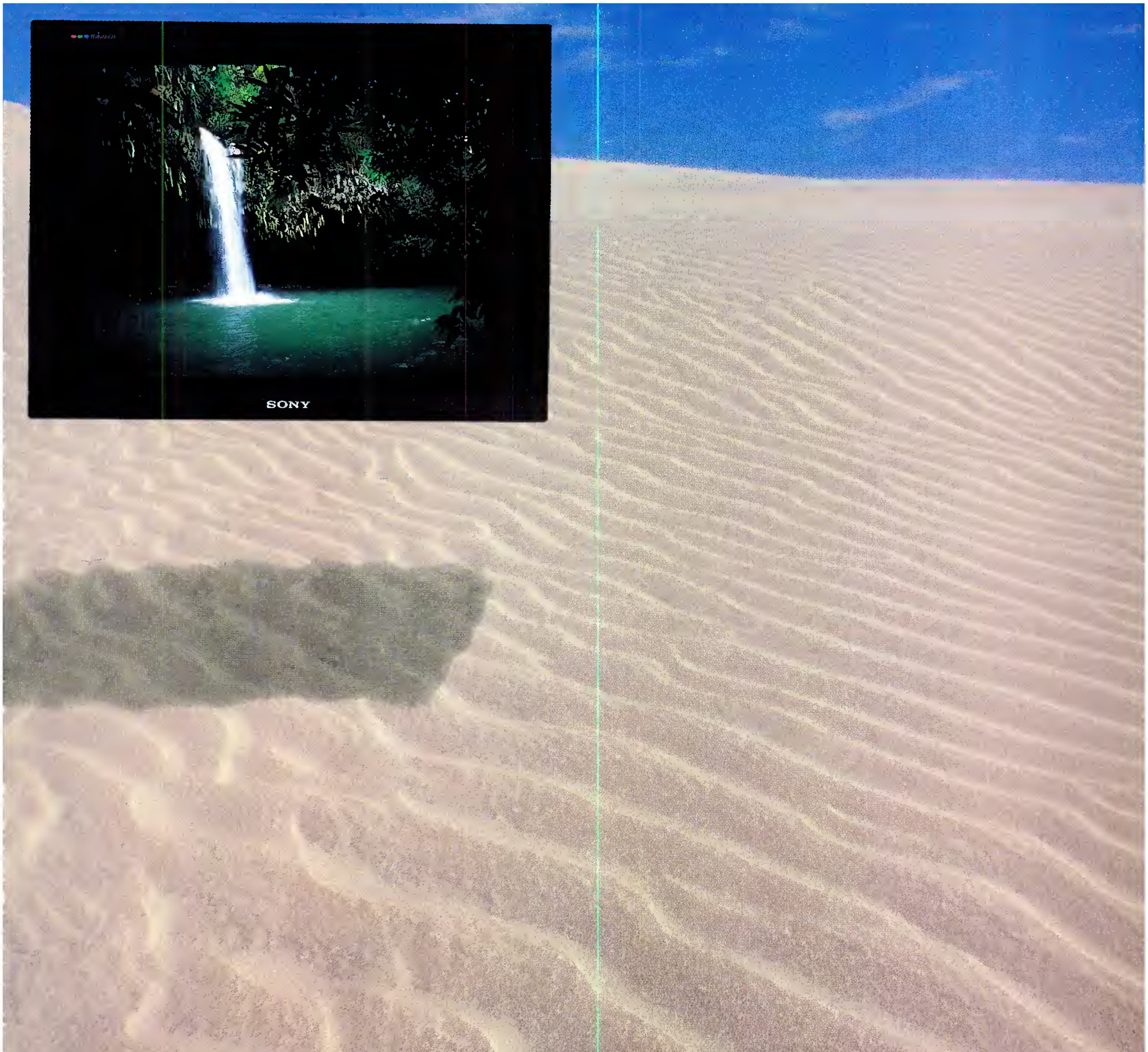
Basic analog oscilloscope designs can be adapted readily as industry requirements change. For example, X–Y inputs for checking channel-to-channel audio phase and amplitude were added to vectorscopes when stereo audio came into use for TV applications. Although some additional processing and switching are required for the audio, the deflection amplifiers, power supplies and CRT can be shared with a vectorscope. Eliminating the need to purchase and maintain another specialized piece of test gear is clearly an advantage to equipment users.

As new analog video standards appear, new variations on the basic waveform monitor/vectorscope theme often are required. Analog component standards, for example, require the addition of input clamping and switching so the three signals can be displayed side by side or overlaid. Test equipment for such signals also may include new displays such as *lightning* and *bowtie*, which facilitate measurements unique to those standards. The new HDTV standards require yet another configuration, including wide bandwidths and special sweep rates.

The future is digital...and analog

In today's environment, analog waveform monitors and vectorscopes continue to play an important role in verifying the quality of video signals. New models provide the real-time displays needed for making accurate measurements while incorporating the advantages of digital technology.

Despite an overlap in functionality between these products and the digital in-



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struments, the obsolescence of analog scopes is by no means imminent. Computer-based instruments offer distinctly different features that complement the real-time displays. Together, digital and analog test equipment provide a comprehensive set of measurement capabilities. Broadcast engineers can expect both digital and analog instruments to be useful tools for years to come.

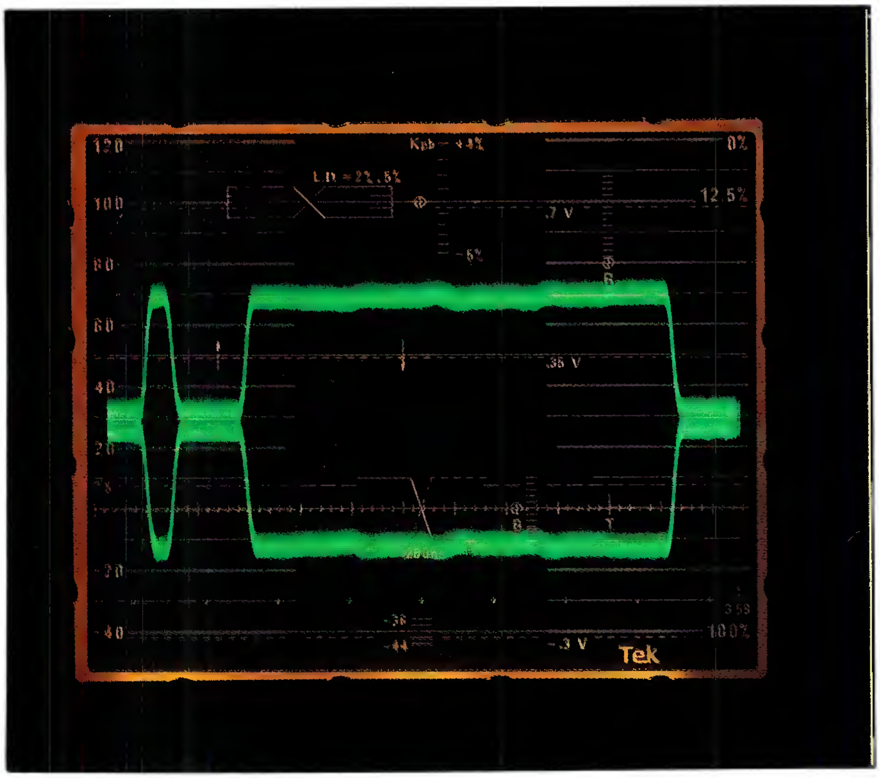

Figure 5. *The same signal shown in Figure 4, with the digital filter switched on.*

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The ins and outs of microphones

By Brad Dick, radio technical editor

The applications for microphones run the gamut, from the radio remote to the TV panel discussion. The right mic is a must.

Using a microphone is easy. The hard part is selecting the best one for your particular application. As stations strive for better, higher-quality audio, choosing the proper microphone becomes even more important.

Ideally, there would be a single type of microphone best-suited for all applications. Unfortunately, that's not the case. Each application has its own set of requirements. Providing PA for a bluegrass band on a stage in the hot August sun is quite different from recording the same band in a studio. Likewise, the microphone used by a sportscaster inside a basketball arena must provide a different type of performance than the microphone used in your air studio.

Transducer types

Microphones are classified in several ways. The first is by type of transducer, or how the acoustical energy is converted into electrical energy. Three general types of transducers are used in broadcast-type microphones: moving coil (dynamic), condenser and ribbon. Each has unique characteristics that translate into advantages and disadvantages, depending on the particular application.

The construction of the moving coil or dynamic microphone resembles a speaker. (See Figure 1.) A coil of wire attached to a flexible diaphragm is suspended in a magnetic field. As sound pressure vibrates the diaphragm, the coil moves inside the magnetic field. The movement generates a small current in the coil, which represents the sound.

A condenser-type transducer is shown in Figure 2. A diaphragm, plated with gold or another metal, is mounted above a conductive backplate. Sound waves strike the diaphragm, forcing it to move back and forth with respect to the backplate. If a voltage is applied to these two surfaces, the plates form a capacitor. As the spacing between the plates changes, so does the capacitance. The varying voltage developed on the backplate represents the sound.

Condenser microphones typically rely on a polarizing voltage between 9Vdc and 48Vdc. The voltage must be obtained from either an external power supply or internal batteries. Some condenser microphones rely on a permanently charged element to form the capacitor. They are called *electret* condenser microphones.

Because the condenser microphone elements represent an extremely high impedance, amplifiers are needed to drive the mic cable. The amplifier's function is twofold: Boost the signal level, and isolate the element from the lower impedance of the cable and termination load.

The ribbon microphone, shown in Figure 3, is similar to the dynamic

Illustration courtesy of Audio-Technica U.S.

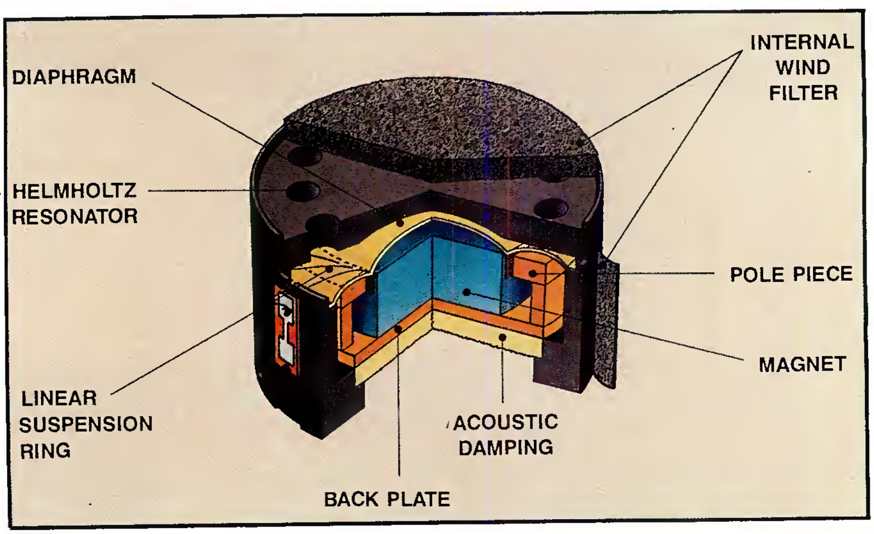
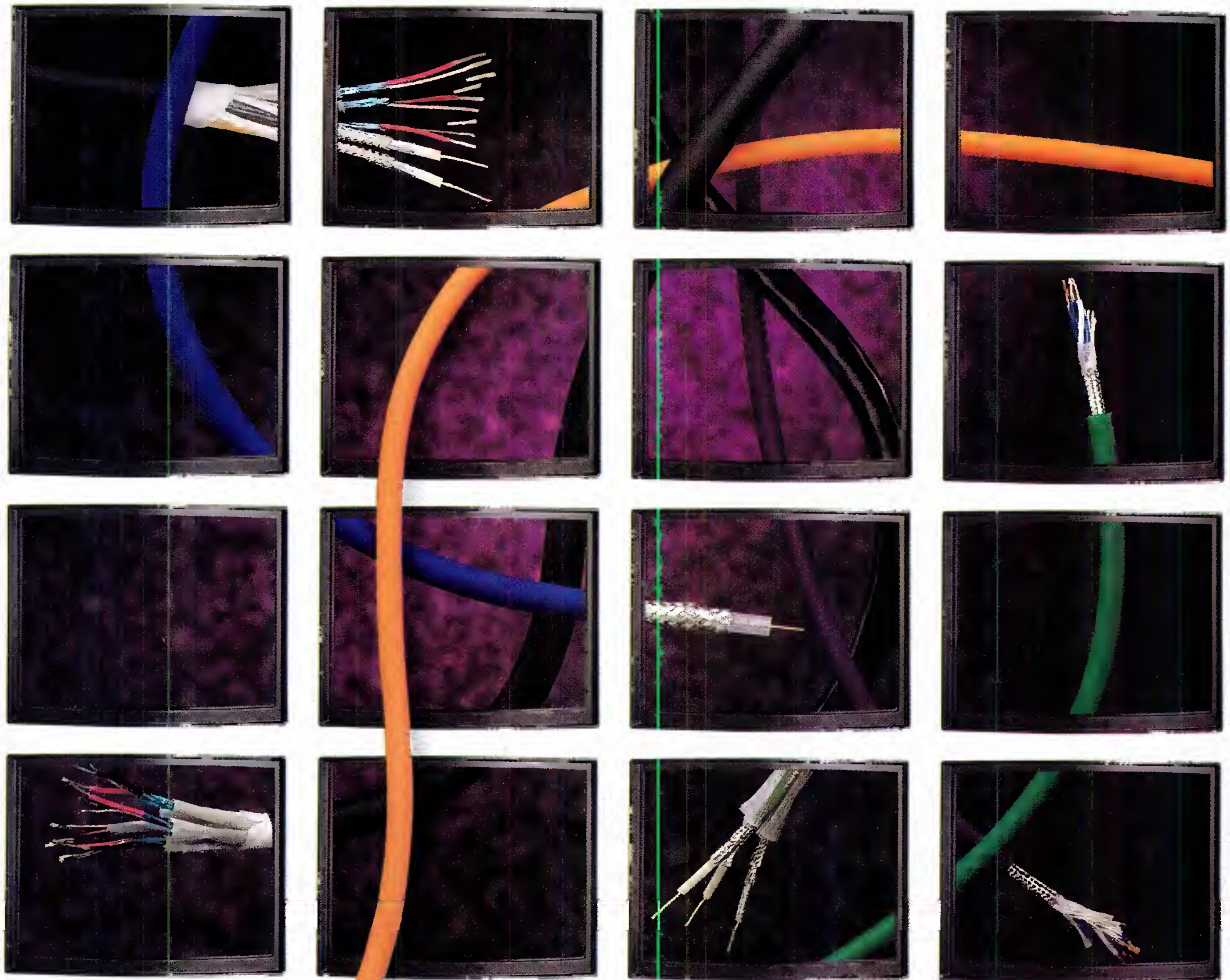


Figure 1. The dynamic or moving coil transducer resembles the construction of a speaker. The simplicity of dynamic transducers makes them highly reliable and rugged.



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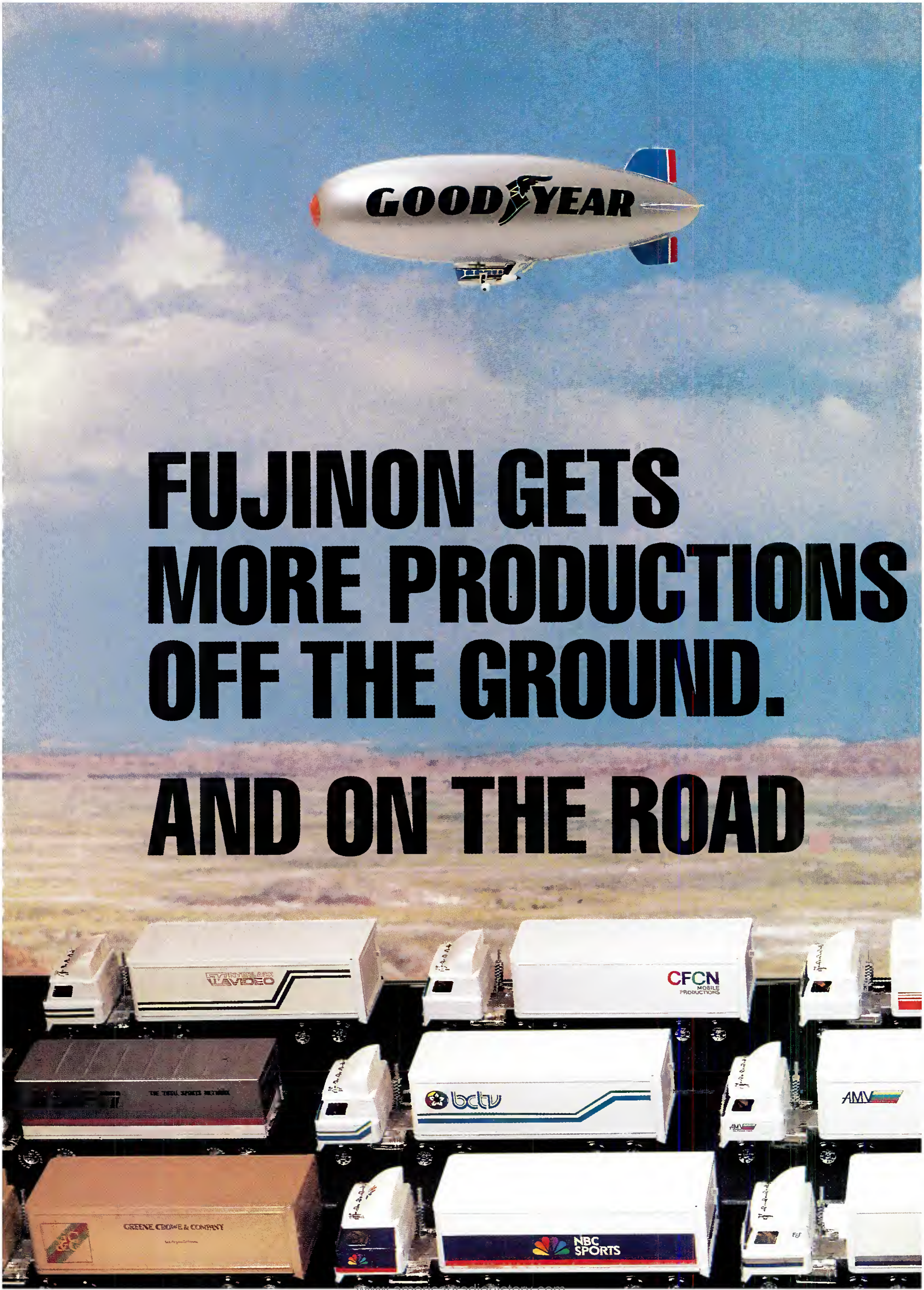
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microphone because of the moving element in a magnetic field. A thin metal foil or ribbon is suspended within the air gap of a powerful magnet. The ribbon is clamped on each end, but the middle is free to respond to acoustical pressure.

When sound strikes the ribbon, it vibrates, cutting the magnetic lines of force in the air gap. This induces a low voltage in the ribbon. The extremely low impedance of this type of microphone requires a transformer, which boosts the voltage and isolates the ribbon impedance from the load impedance.

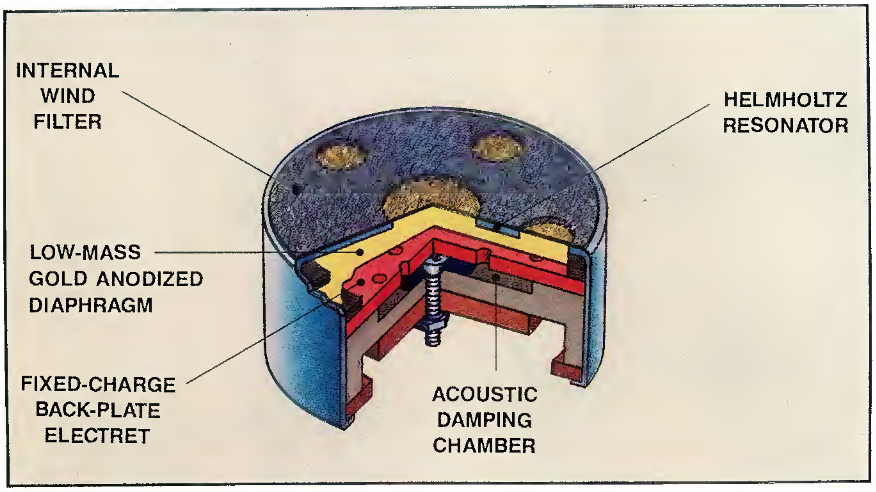


Illustration courtesy of Audio-Technica U.S.

Figure 2. The condenser transducer forms a capacitor by applying a low voltage between the front and rear surfaces of the diaphragm. The electret transducer, shown here, relies on a polarizing voltage applied in the manufacturing process. This simplifies the requirements for remote powering. Such mics can often operate on phantom power-supply voltages ranging from 9Vdc to 52Vdc.

Although there are other types of transducers, they seldom are used in professional applications. Examples include carbon and piezo-electric elements. This article will discuss only the three types of transducers mentioned.

Transducer performance characteristics

Microphone performance depends greatly upon the type of transducer. It's not that one transducer is better than another. It's just that some transducers are more appropriate for particular applications.

Dynamic microphones are well-suited for high sound-pressure-level applications. They have low self-noise levels and often are extremely rugged. Dynamics tend to be less susceptible to high humidity problems. An important advantage is that they don't require power. This helps make them highly reliable and often less expensive than other designs.

Dynamic microphones come in a wide variety of types and models ranging from hand-helds to headset microphones. These microphones have a slower transient response, which makes them ideal for applications that do not require excessive detail. Typical sensitivity of a dynamic mic might be −54dBV to −57dBV.

Condenser microphones often are considered high-performance devices. The transducer's low diaphragm mass and high damping allow it excellent transient response, which is important for micing percussion instruments, cymbals and large ensembles. Any application requiring a clear, detailed sound may benefit from a condenser mic.

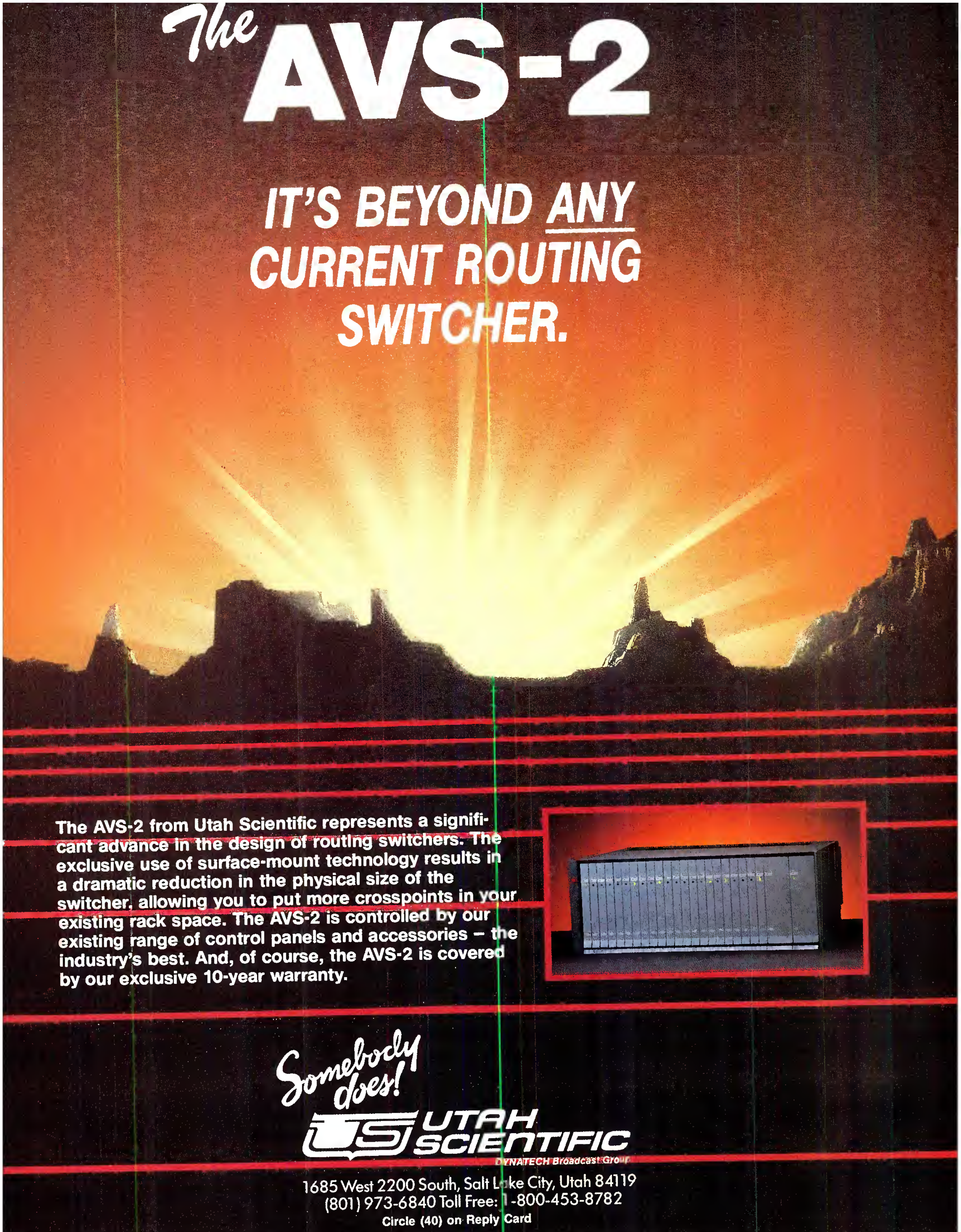
The high sensitivity of condenser microphones makes them perfect for distant micing. A typical output level might be −46dBV to −52dBV. This high output level sometimes is useful with long cable runs to capture sound sources from a distance. Condenser mics are available in many configurations. Because the transducer can be made quite small, most tie-tac microphones are condensers.

Ribbon microphones are not used widely today, but in addition to a warm, smooth sound, they offer excellent transient response and low self-noise. Ribbons often are used in the studio as voice microphones. Of the three major types, this microphone offers the lowest output level. Sensitivity might be −57dBV to −60dBV.

Despite the low mass of the ribbon microphone, high frequencies tend to be canceled by the acoustic phase interference between the front and rear of the ribbon. Ribbon microphones are, unfortunately, more fragile than dynamics.

Directional patterns

Every microphone has a unique direc-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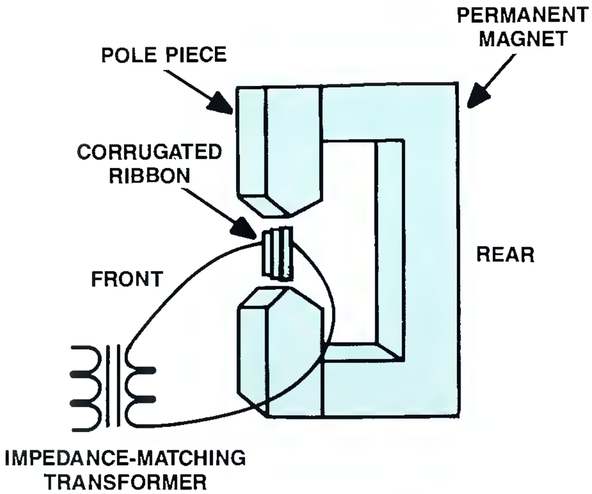

Figure 3. *The ribbon microphone uses a corrugated ribbon suspended in a powerful magnetic field to generate voltage in response to the sound. A transformer is required to match the low impedance of the cable to the high impedance of the ribbon. The transformer also must boost the extremely low-voltage ribbon voltage prior to sending it down the cable.*

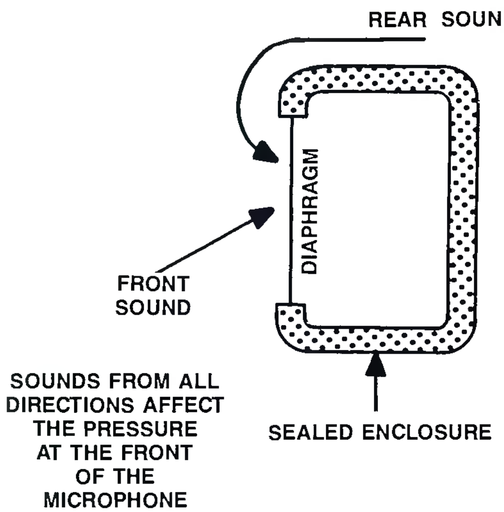

Figure 4. *Omnidirectional microphones rely on a sealed enclosure for the diaphragm. This forces all sounds to affect only the front of the diaphragm.*

tional or polar pattern. As with transducers, no single type of polar pattern is best. Each type of pattern has advantages and disadvantages and is primarily application dependent.

An *omnidirectional* microphone is equally sensitive to sound from all directions. A *unidirectional* microphone is more sensitive to sound arriving from the front than to sound arriving from the rear. A *bidirectional* microphone responds equally well to sound from the front and rear but responds less to sound from the sides. Bidirectional microphones often are called "figure 8" microphones.

Omnidirectional microphones sometimes are called pressure microphones. They can be either condenser or moving coil, but are open to sound only on the front of the diaphragm. (See Figure 4.) Sound waves from any direction create the same pressure at the front of the diaphragm, making the pickup pattern omnidirectional.

The omnidirectional microphone comes close to approximating the directional characteristics of the human ear. The head represents an acoustical obstruction to high frequencies, which results in a directional pickup pattern for these frequencies. Likewise, because of its size, a large omnidirectional microphone will become more directional at higher frequencies.

Unidirectional microphone patterns are subdivided into three categories, each progressively more directional. A cardioid (heart-shaped) microphone is sensitive to sounds arriving from the front and, to a much lesser extent, from the rear. The polar pattern for a cardioid microphone is shown in Figure 5.

Directional microphones develop their pickup patterns through phase shifting. Unlike the omnidirectional microphone, the unidirectional microphone diaphragm is open to sound from both the front and rear. The diaphragm, therefore, responds to the difference in pressure between its front and rear surfaces.

The sound from the front strikes the front of the diaphragm (path a). The front sound also travels around to the rear of the diaphragm along a greater distance and through the phase-shift network, path b. The diaphragm is, therefore, exposed to direct sound from the front and phase-shifted (delayed) sound on the back. The resulting difference in pressure drives the diaphragm. The audio flow path is shown in Figure 6.

Sound from the rear reaches the front of the diaphragm by going around the case (path c) and through the rear-entry ports or vents to the rear of the diaphragm (path d). Like the front sound, this rear sound passes through the phase-shifting (delay) network. The acoustical network is designed to match the delay experienced by the sound traveling around to the front of the mic. The result is that, for rear sound, the pressure on the front and rear of the diaphragm is the same, hence no output voltage. This makes the microphone less sensitive to sounds from the rear than the front.

This points out something that is often overlooked: The microphone's directional pattern is highly dependent on the rear and side ports or vents. Cardioid microphones have holes running along the entire case. If you tape or otherwise obstruct those holes, the microphone's directionality will be affected.

Two other types of unidirectional patterns should be mentioned. They are supercardioid and hypercardioid. These types of patterns are especially useful in applications in which acoustic feedback or noise is a problem. However, such characteristics don't come free.

In general, as the microphone becomes more directional, it also becomes more susceptible to handling noise. Polar patterns of supercardioid and hypercardioid microphones are shown in Figure 7.

A special type of cardioid microphone is the shotgun. It offers an extremely tight polar response pattern and often is used for distant micing of dialogue and sound effects in film, television, ENG/EFP work and news and sports coverage.

Frequency response

A microphone's frequency response is a measure of its sensitivity vs. frequency. Unlike many other electronic devices, microphones do not exhibit extremely flat response across wide ranges of frequency. All microphones deviate to some degree from what is known as flat response.

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frequency-response variations often are used as advantages in certain applications. Many microphones exhibit a peak in the upper frequencies. This gives them a characteristically bright sound, which often is useful in vocal applications. The same characteristic also might result in feedback in PA applications.

Another factor compounds the issue of frequency response. The frequency response of a microphone often is directionally dependent. This means that the response changes depending upon the direction from which the sound originates.

Figure 8 shows the frequency response of an omnidirectional microphone at 2kHz, 4kHz and 10kHz. Note that as the frequency increases, the microphone becomes more directional.

Cardioid microphones have a more difficult time controlling frequency response throughout the pickup pattern. One measure of a directional microphone's performance is how flat the response is off-axis. This is extremely important if the sound source, person or instrument might move during the recording or broadcast. Any frequency-response variation is called *coloration*. Uniform off-axis frequency response is a characteristic of high-quality directional microphones.

The polar response of a cardioid microphone measured at 1kHz, 6kHz and 10kHz is shown in Figure 9. At 1kHz, the microphone has excellent rear rejection. However, at 6kHz and 10kHz the rear response is about 15dB higher than at 1kHz. Compare this to the 10kHz rear response of the omnidirectional mic.

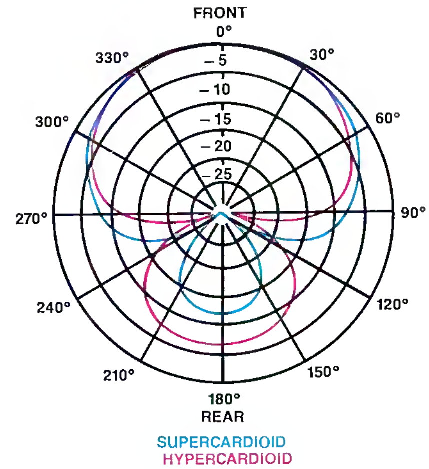

Figure 7. *The primary difference between supercardioid and hypercardioid patterns is the amount of rear pickup.*

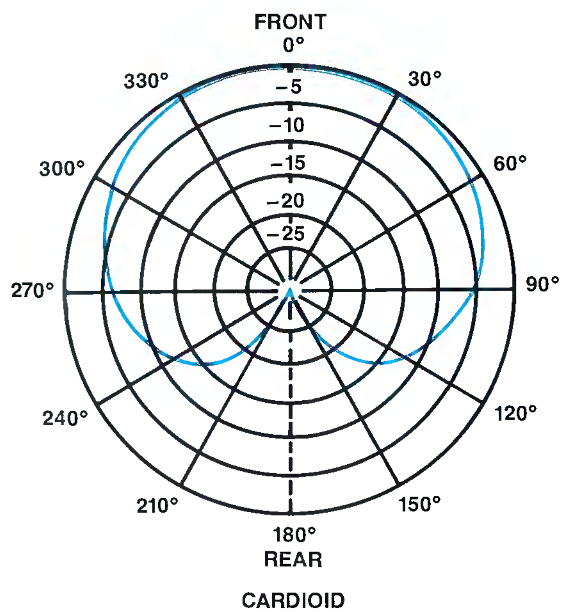

Figure 5. *A cardioid microphone polar pattern. This pattern provides rejection of sound from the rear of the mic.*

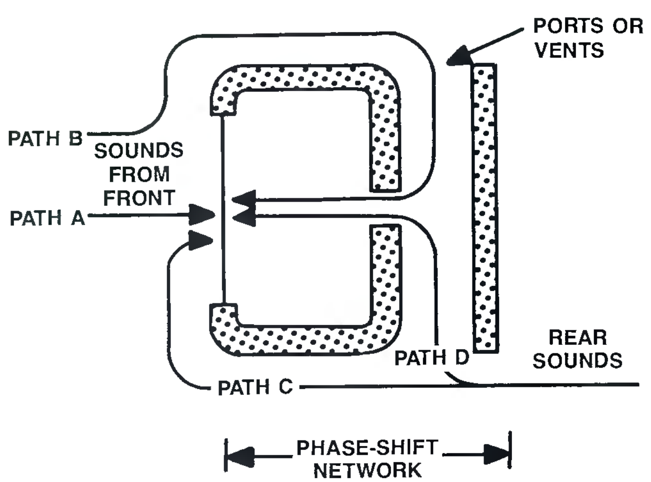

Figure 6. *Directional microphones rely on transducers that are open on both the front and back. Acoustic networks provide delay that either reinforces or cancels the sound pressure exerted on the diaphragm.*

The issue of frequency response also is related to *proximity effect*, an increase in a microphone's low-end response as the sound source becomes extremely close. As an example, some performers begin their shows holding the microphone six inches away from their mouths. As the show progresses or during certain passages, they may move the microphone right up to their lips. The result is a change in the microphone's frequency response.

Figure 10 illustrates what happens to the frequency response as the sound source moves from three feet to one inch from the microphone. The lower frequencies are boosted. Proximity effect is a common characteristic of *single-D* directional microphones. (Single D means that the microphone element is the same distance from the front and rear entry points.)

Proximity effect can be either useful or problematic in vocal applications. Many microphones rely on a switchable bass rolloff filter to reduce the effect. Variable-D microphones reduce the problem by providing multiple rear ports along the mic for the entry of sound.

The low-frequency boost can be extremely useful in live vocal applications. Bill Cosby is an example of an entertainer who uses the proximity effect to good advantage in his performances.

Basic applications

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tern. Do you want an omnidirectional or directional microphone? Consider the following suggestions.

If the broadcast involves talent holding the microphone, try to use an omnidirectional mic. These mics are less susceptible to handling and cable noise than most cardioid mics. They also won't change frequency response as performers change the way they grip the microphone or move toward it. Hand-held applications demand a microphone with an internal shock mount.

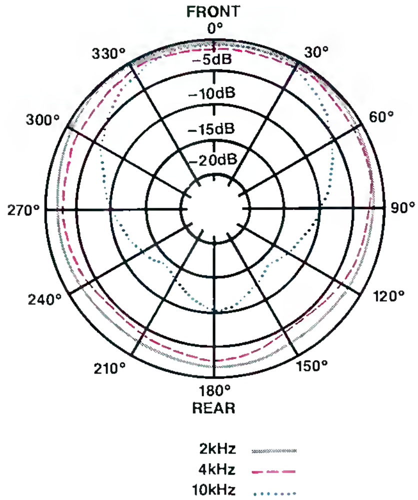


Figure 8. This polar pattern shows how even omnidirectional microphones become more directional at high frequencies.

Unless you expect extremely loud ambient noise, an omnidirectional mic still should be able to balance the ratio of talent to background noise. Most live shots sound better with omnis because the background noise is included. A cardioid or supercardioid pattern may be so tight or the talent positioned in such a way that the audio sounds flat, almost studiolike. Be careful when using a cardioid mic with moving talent. If the talent moves with respect to a particularly loud background sound, the level of that sound may change up and down as the microphone's null swings past the sound.

Remote broadcasts demand that the mics be rugged. Quality means nothing if the microphone won't take a fall from a table and continue to work. Today's dynamic and some condenser microphones are extremely rugged and reliable.

Consider the environment in which the microphone needs to work. Some condenser microphones may fail in extremely humid conditions. Ribbon microphones are not well-suited to outside use, especially in windy conditions.

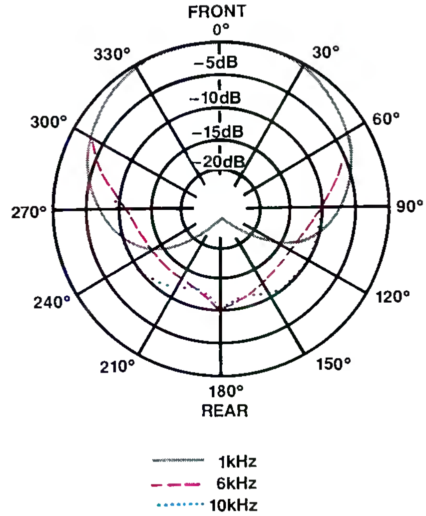
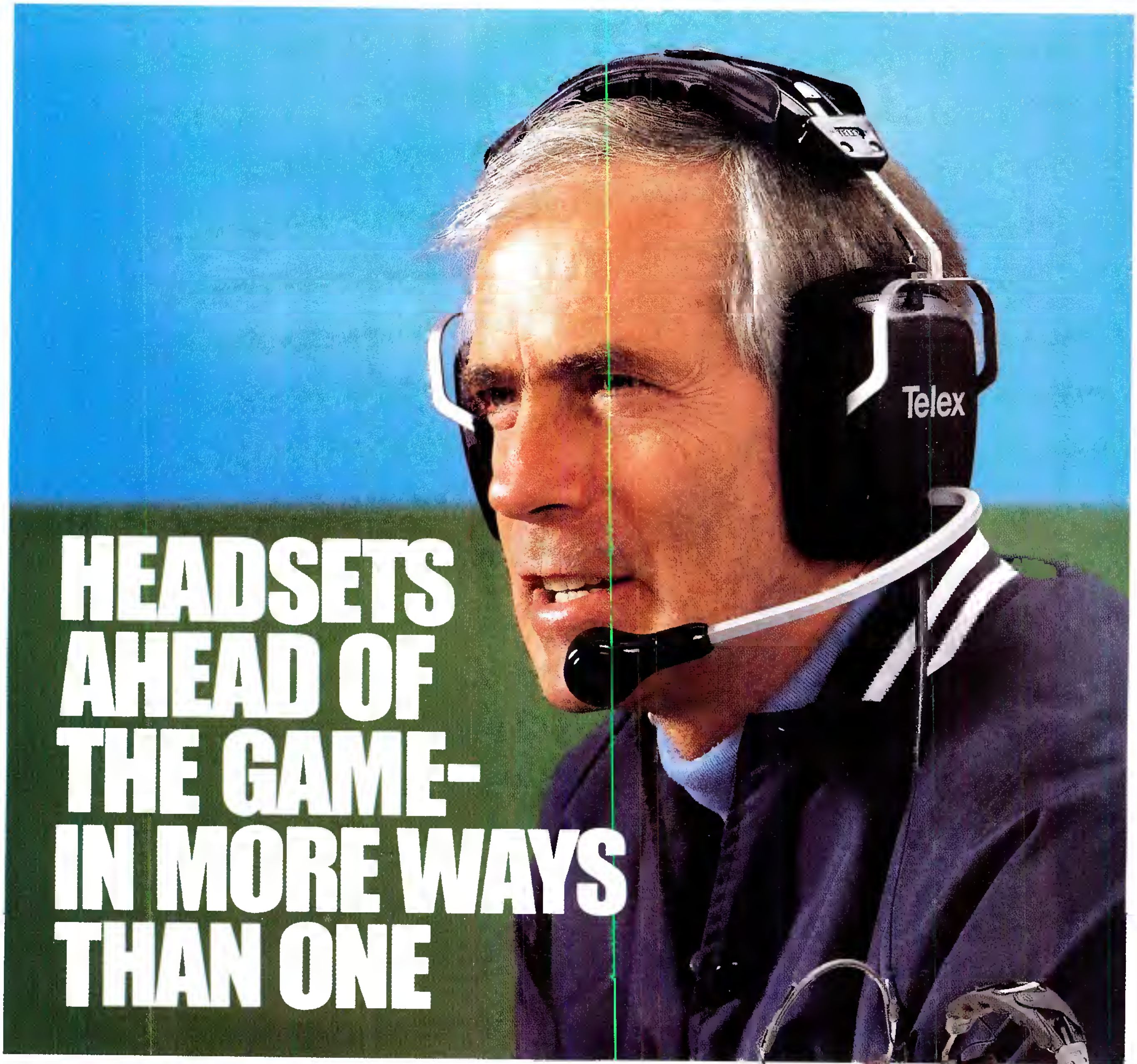


Figure 9. Cardioid microphones often suffer from coloration because their pattern changes with respect to frequency. Here the microphone's rear pickup increases greatly at high frequencies.

Condenser microphones require power. If you use them, be sure the batteries are fresh. If you are going to rely on phantom power, be sure the snake or splitter will handle it. If you are on the wrong side of



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the split, your condenser microphones will have to rely on batteries.

TV applications demand a non-reflective microphone surface. Many quality microphones are available with both reflective and non-reflective surfaces.

Be especially careful about changing microphones between shots. Try to rely on the same microphone for the entire recording or shot sequence. This is especially important when using shotgun microphones. The sound produced by a shotgun microphone often is difficult to match. If you have to rely on a shotgun microphone for some camera shots, try to use the same one even for the standups. If you don't, the sound may be noticeably different.

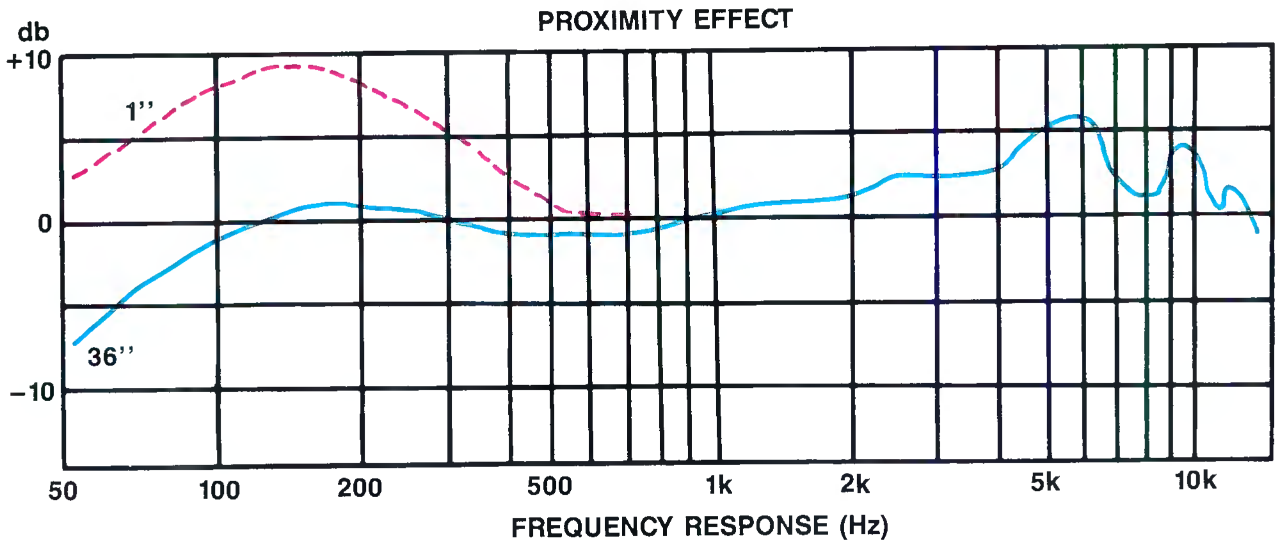

Figure 10. Proximity effect is common with directional microphones. Microphones often provide bass rolloff filters to help compensate for this phenomenon.

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Multiple-mic setups

Most commercial radio and TV broadcasts can be handled with one or two microphones. Primarily, non-commercial stations that broadcast music need to use the more complex multi-microphone setups.

Adding a second microphone makes things more than twice as complex. The chance for error probably goes up by a power of two. Multiple microphone setups often seem easy at first. It's only after you consider the opportunity for problems that you realize how difficult the tasks may be.

For most applications, relying on the 3:1

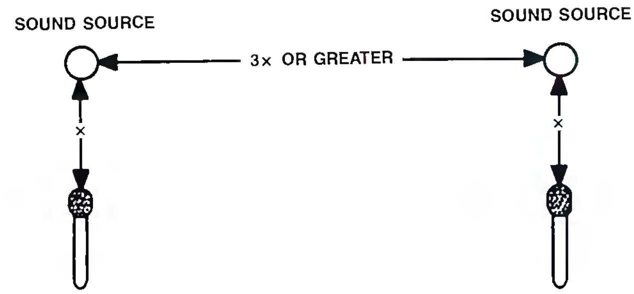

Figure 11. Observe the basic 3:1 rule when using more than one microphone. Remember that the rule applies for each microphone and sound source. Maintaining these distances can become a problem with more than a couple of microphones.

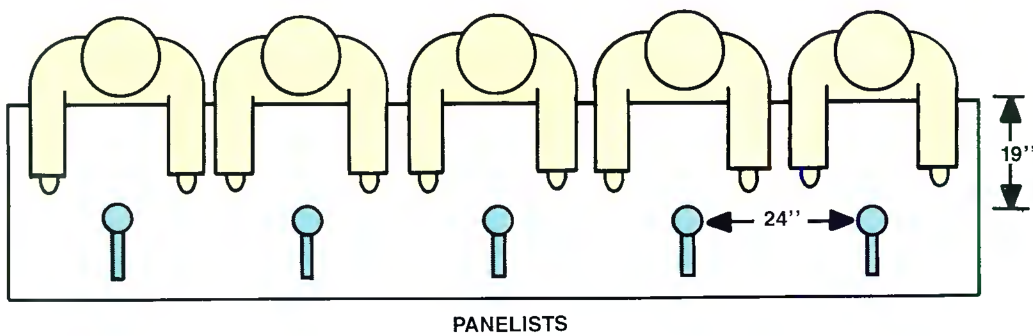

Figure 12. Panel discussions are often miced improperly. Note that the 3:1 rule is violated by the mic placement shown here.

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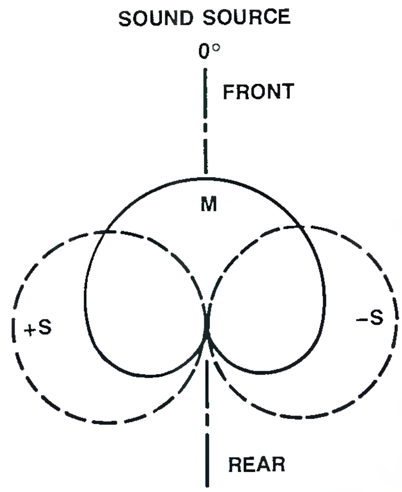
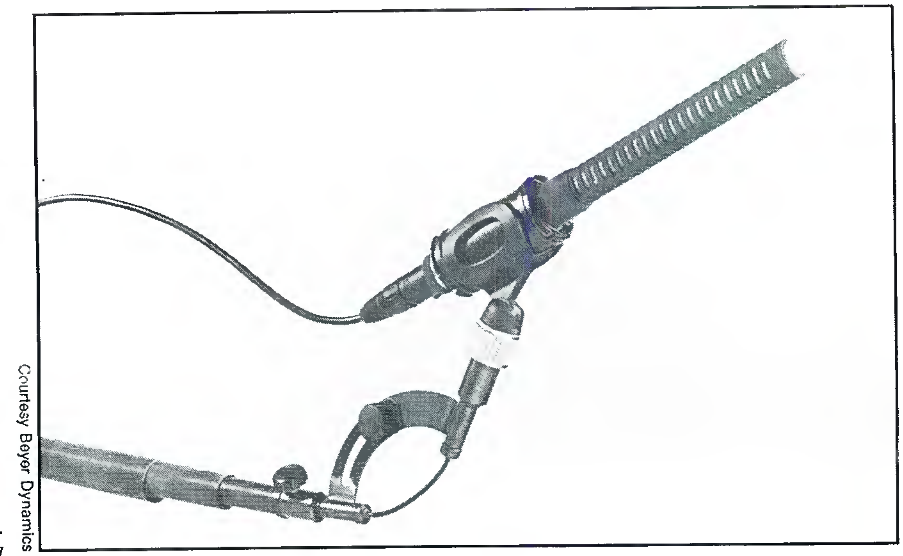


Figure 13. The M-S stereo micing pattern provides excellent stereo localization and good mono compatibility. The main drawback is that it requires a figure-8 microphone.



Shotgun microphones are especially useful where you can't get close to the sound source or the microphone must be out of camera view.

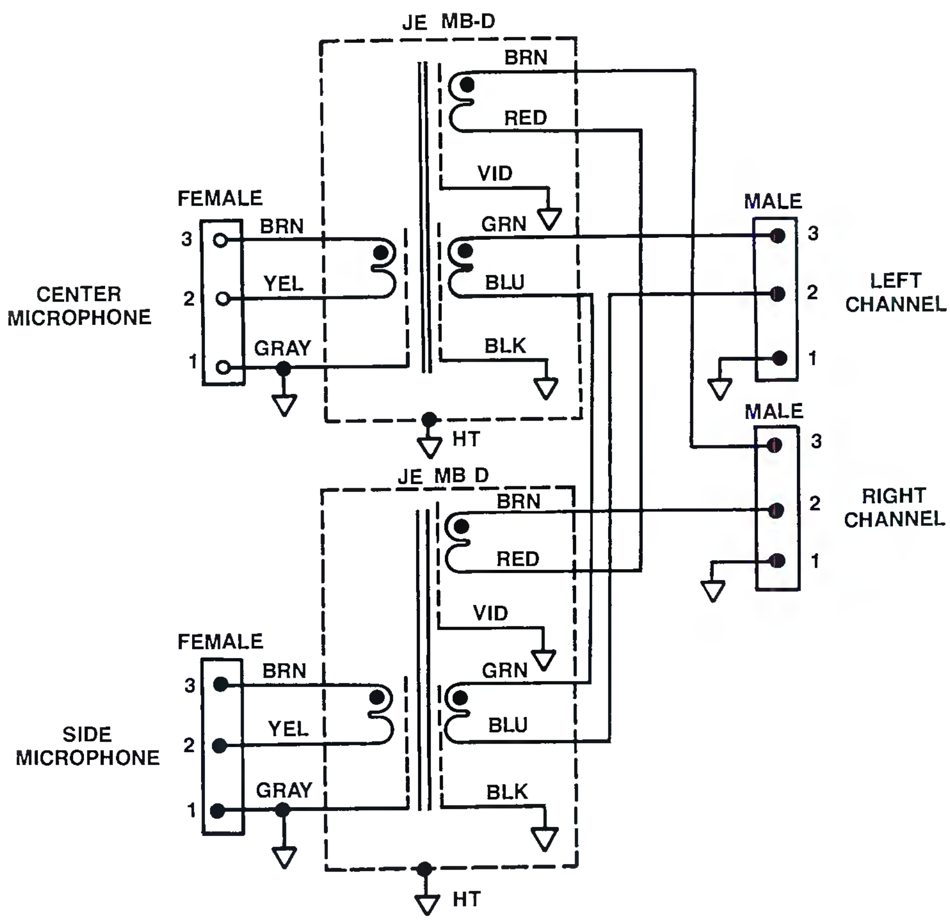


Figure 14. The M-S recording technique requires a matrix and can be implemented with a pair of matched transformers. The wiring scheme is described in the text.

Continued on page 90

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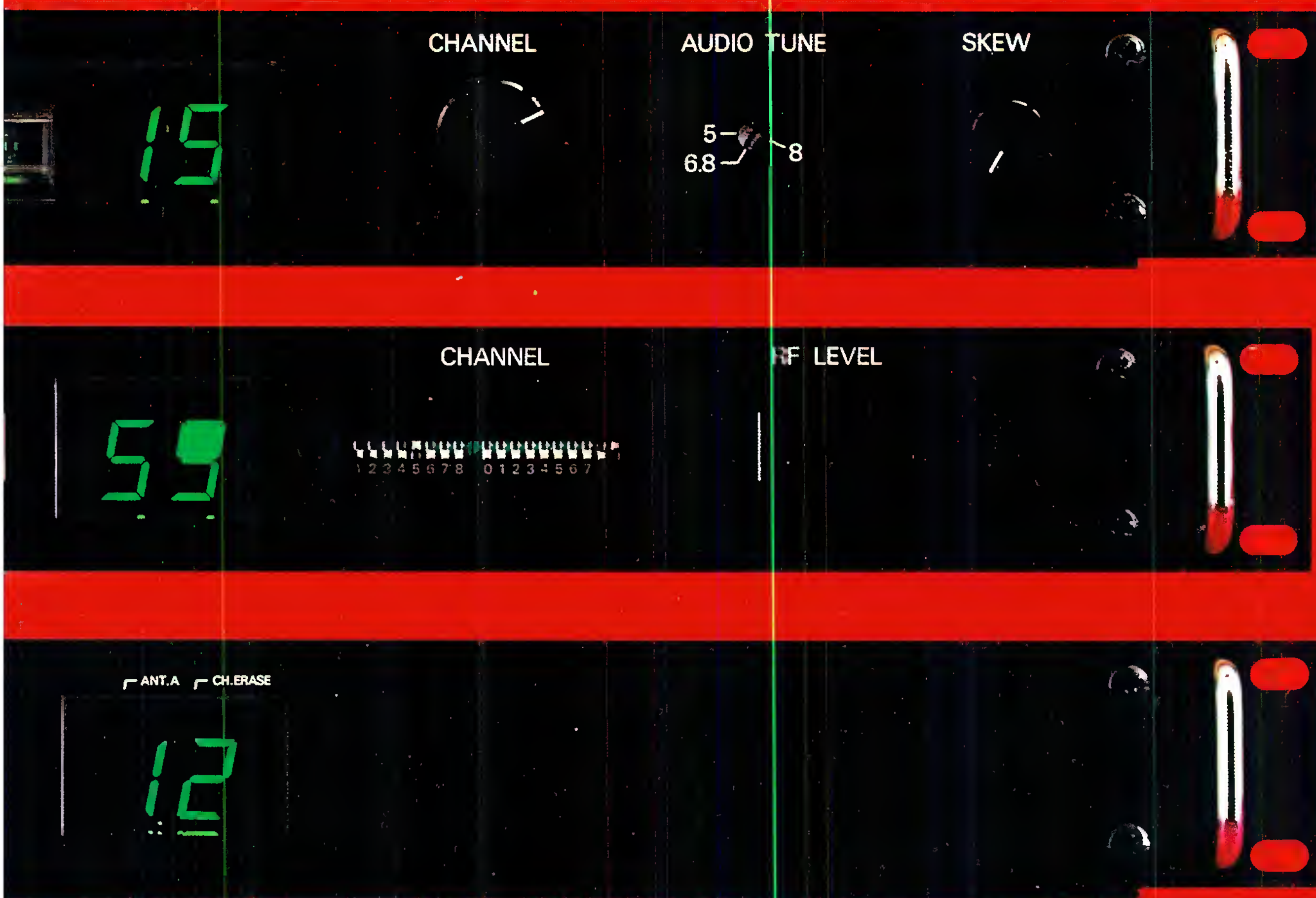

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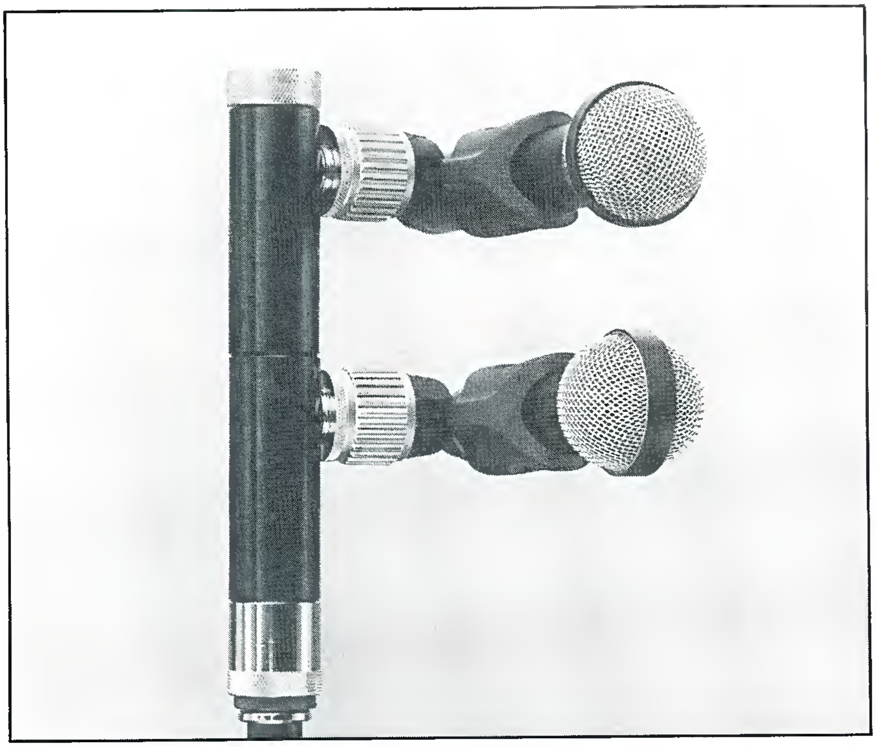


Courtesy Beyer Dynamics

The two microphones are mounted on a single vertical stand to produce the M-S signal. The top microphone produces the M (mid) sound and the bottom the S (side) sound.

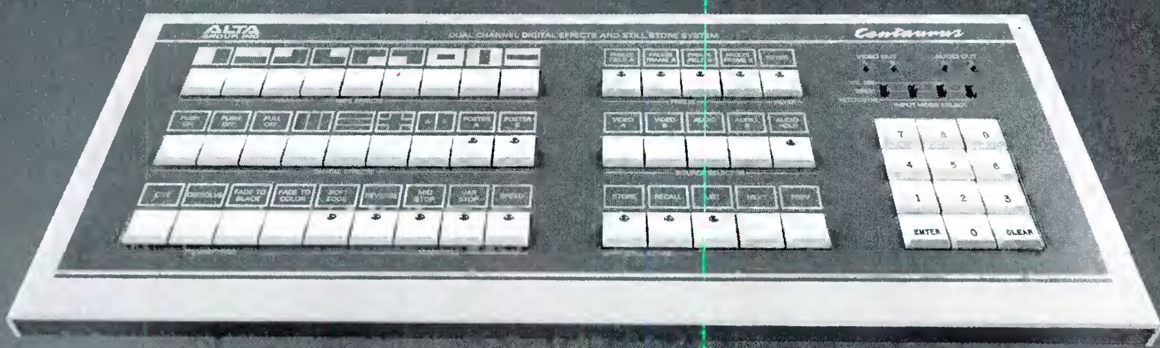
Continued from page 86

rule will keep you out of major trouble. The basic principle is illustrated in Figure 11. The 3:1 rule states, for example, that if the distance between the sound source and microphone is one foot, then the nearest microphone should be spaced at least three feet away.

Note that this rule applies to each combination of sound source and microphone. If you mic one source at a distance of two feet, then all microphones should be separated by at least six feet. It's usually easier to move the microphones closer to the sound source than to try for widely spaced microphones.

This principle often is violated in setups for panel discussions, as shown in Figure 12. Note that the distance between each panel member and the microphone is 18 inches. Yet, the distance between microphones is only 24 inches. This violates the 3:1 rule, and comb filtering may result. This might be a good application for the boundary microphone. Other options are to use fewer, wider-spaced microphones or move the mics much closer to the panelists.

Continued on page 93



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Continued from page 90

Simple stereo setups

If you happen to find yourself facing the prospect of recording or broadcasting a large group, don't panic. A couple of simple techniques may save the day.

One of the most popular stereo micing techniques used today is the mid-side (M-S). The M-S technique relies on a pair of coincident microphones. One microphone produces the mid (M) sound. Although this microphone can be of any polar pattern, a cardioid often is used. The side (S) microphone must be a figure 8 and be aimed perpendicular to the primary sound source. The stereo sound is determined by the difference in the intensity of sound as it arrives in phase at the pair of microphones. The polar pattern of an M-S setup is shown in Figure 13.

The technique offers two important advantages to the broadcaster. First, only one microphone stand is required. This greatly simplifies setup. Second, the resulting sound is highly mono-compatible, which is critical to both radio and TV broadcasters.

The following equation shows how the monaural signal is developed from the M-S pair of microphones. Because the S outputs cancel, the resulting 2M output is identical to that from a monaural microphone, but it is increased by 6dB.

$$
\begin{aligned}
M + S &= \text{left} \\
M - S &= M + (-S) = \text{right} \\
L + R &= (M + S) + (M - S) \\
&= M + M + S - S \\
&= 2M
\end{aligned}
$$

The M-S technique requires that the two microphone outputs be combined properly. Figure 14 shows a method that uses a pair of transformers. Each transformer has a single primary and dual secondaries. One secondary winding of each transformer is connected in series and in polarity for the sum output. The other set

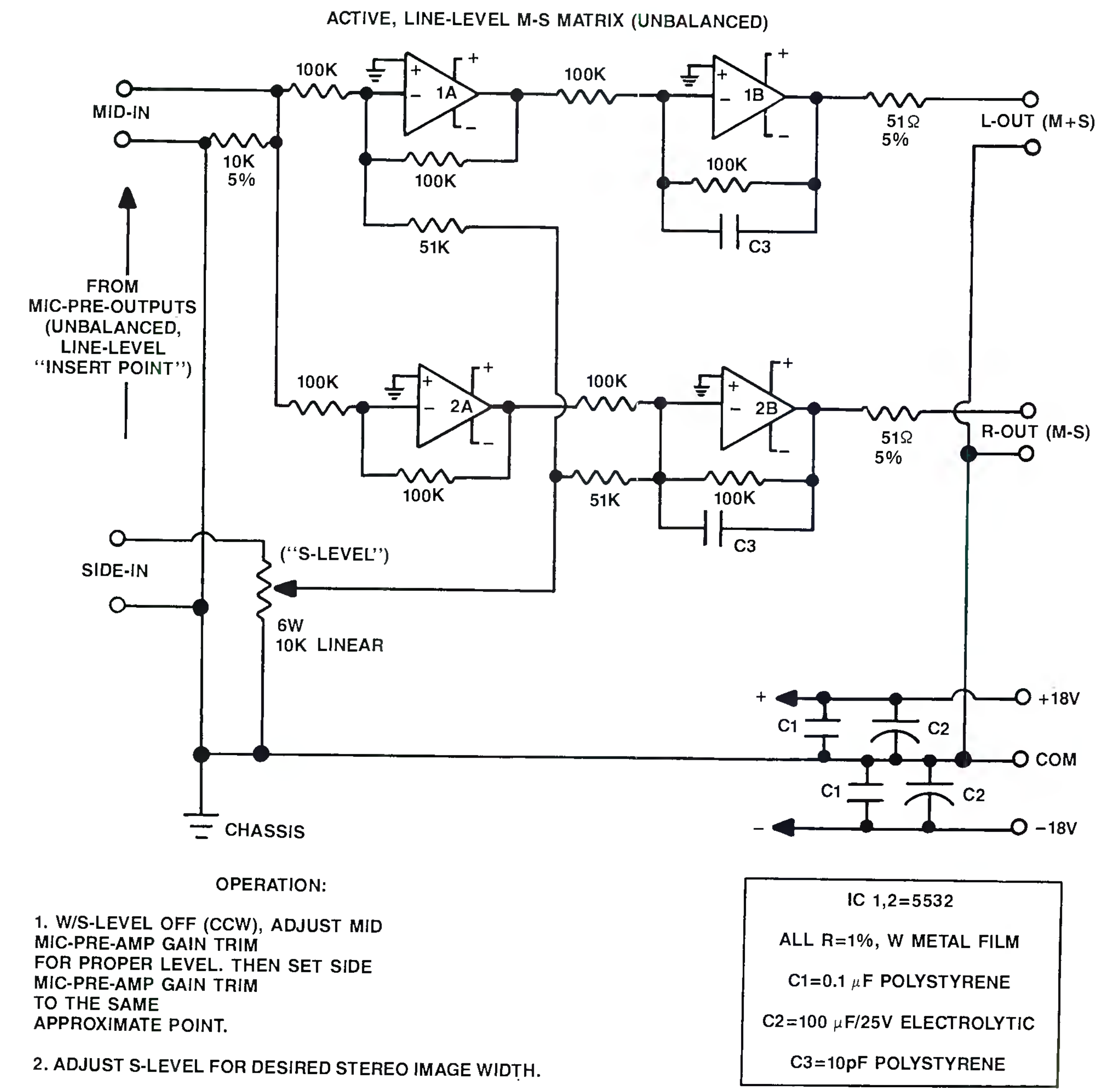

Figure 15. *This M-S matrix can be installed in the console, just after the microphone pre-amps. This avoids the problem of phantom powering the mics.*

of secondary windings is connected in series, but out of polarity, creating the difference output. Adding attenuators before the transformers allows the ratio between the M and S signals (overall stereo image) to be adjusted. The disadvantage of this setup is that phantom powering becomes difficult.

An active M-S matrix is shown in Figure 15. The matrix is designed to be inserted in line after the microphone pre-amps. This solves the phantom powering problem. This design also offers a convenient adjustment for the S signal level.

Other versions of the circuit permit the matrix to be installed before the console or recorder inputs. Several manufacturers offer stereo microphones equipped with built-in M-S capability. Simply connect the microphone outputs to your stereo tape recorder or console.

The coincident pair (X–Y) microphone method uses two directional mics mounted close together. The mics are placed one on top of another so their diaphragms are centered vertically and aimed toward the left and right sides of the sound source. The amount of included angle determines the apparent stereo width. The microphones should be aimed properly, matched closely, and they should have good off-axis response to avoid coloration.

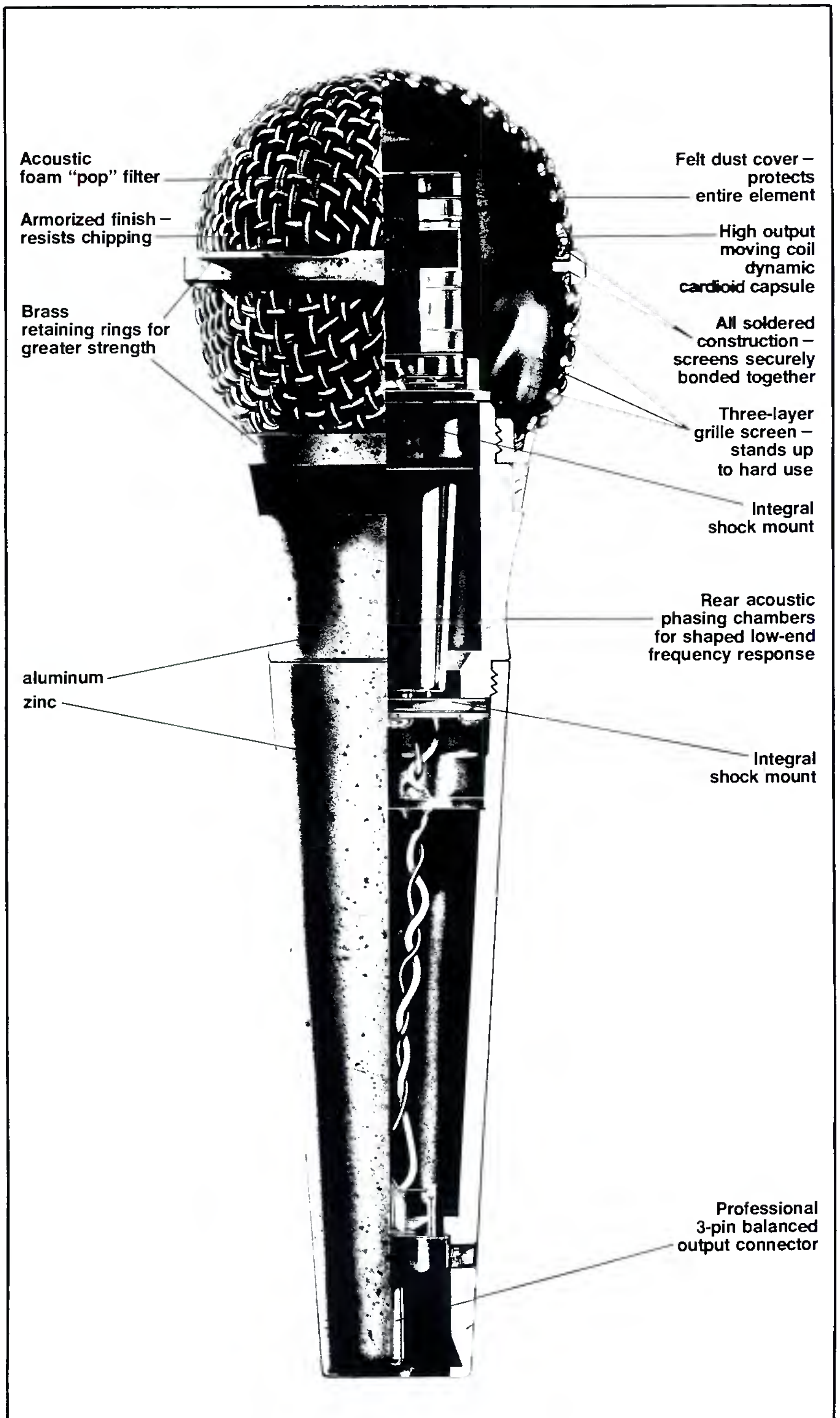

Illustration courtesy of Audio-Technica U.S.

Modern unidirectional microphones can provide excellent performance. The construction of this mic shows some of the features that help make dynamic microphones so popular and useful.

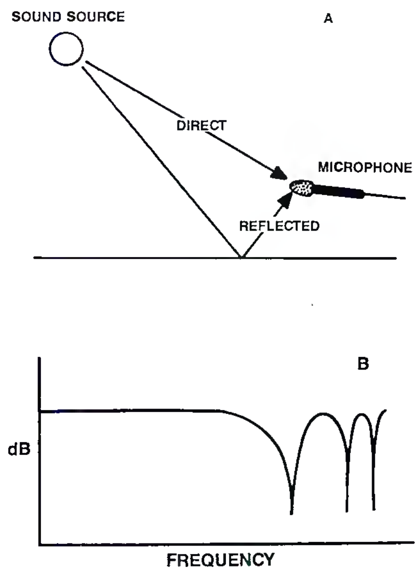

Figure 16. *In (a), the sound is received at the microphone from two paths. Because the reflection is longer, comb filtering occurs. The resulting frequency response is shown in (b).*

This recording technique allows good stereo imaging and is extremely easy to set up. When used with cardioid microphones, the technique narrows the stereo image more than M-S does.

The same setup can be used with bidirectional (figure 8) microphones in what is called the *Blumleinn* configuration. Tests show this provides better stereo localization and a natural sound. The disadvantage is that not every station has a pair of figure 8 microphones.

Special microphones

Two other types of microphones deserve consideration: the boundary microphone and the Soundfield microphone. The boundary microphone uses a miniature electret condenser pickup mounted extremely close to a reflecting plate. This configuration prevents the comb filtering that results in many situations.

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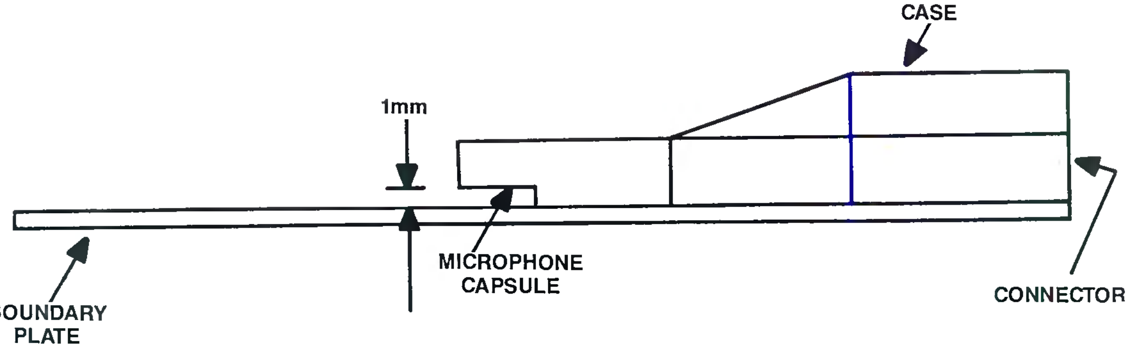

Figure 17. Boundary microphones avoid audible comb filtering by placing the microphone capsule close to a plate. Because the distance between the boundary and capsule is extremely small, the fundamental comb frequency is shifted into the inaudible range.

Figure 16(a) shows a microphone mounted on a stand about two feet above the stage. Sound will arrive at the microphone from at least two locations: direct and reflected. As the reflected sound combines with the direct sound at the microphone, a comb filter effect is created. The resulting frequency response is shown in Figure 16(b).

The boundary microphone avoids this problem by mounting an electret capsule extremely close, approximately 1mm, to a boundary. (See Figure 17.) In this example, the microphone would be placed on the stage. The close spacing of the mic to the boundary moves the fundamental frequency of the comb filter effect up into the inaudible range. The microphone's shape and size also make it useful in applications in which the microphone must be inconspicuous.

An unusual microphone design is the Soundfield microphone. (Editor's note: The Soundfield microphone is a registered trademark of Calrec by AMS.) It can simulate two coincident microphones with polar patterns adjustable from 0° (mono) to 180°. Polar patterns for the resulting two microphones are adjustable between omnidirectional, figure 8 and cardioid. Even the azimuth, elevation and dominance (zoom) can be adjusted from the control unit.

The microphone, shown in Figure 18, uses four separate capsules, mounted in a tetrahedral configuration. These capsule outputs feed four amplifiers that drive a special control unit. The control head is used to adjust the Soundfield azimuth, elevation and dominance. The stereo microphone controls permit adjustment of polar patterns and angle.

The design also helps solve the phase problems suffered by some microphone arrays because of capsule spacing. Some microphones, even when closely located, produce phase errors approaching 90° at frequencies below 1.5kHz. The microphone addresses this problem by creating a stereo output whose signals appear to have originated at the same point in space.

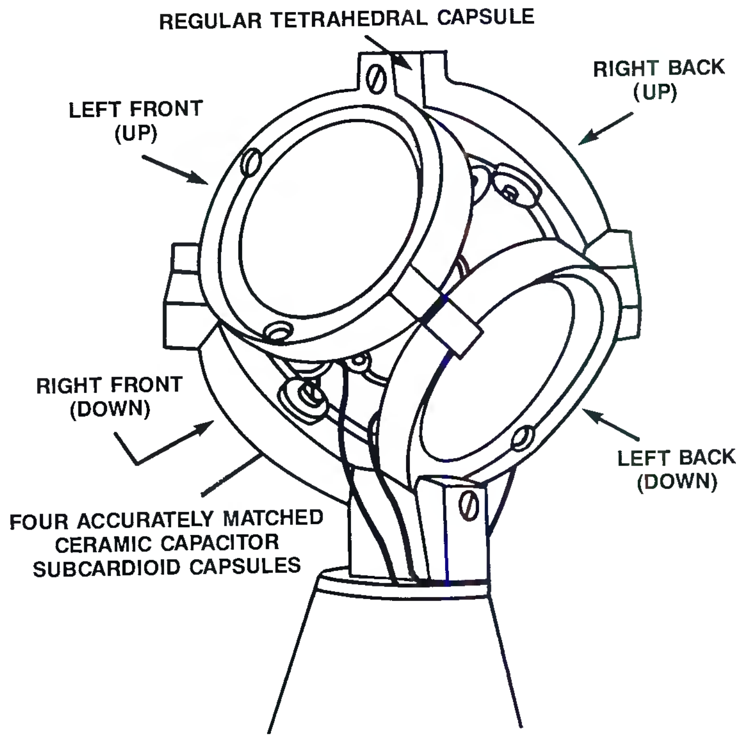

Figure 18. The Soundfield microphone uses four separate capsules to develop almost any type of polar pattern. If the four capsule outputs are recorded, the polar pattern can be varied in post-production work.

Although the microphone offers a good deal of freedom to the on-site recording engineer, what makes it unique is its post-production options. If the four separate capsule outputs are recorded during the original session, each of the pickup parameters can be adjusted later in a post-session.

There are many other microphone setups, but the ones listed are simple, easy to implement and (almost) foolproof. The suggestions also meet the guideline of *the fewer microphones, the better.* It may seem easy to add microphones, but unless you're fully aware of the potential pitfalls, stick with one or two microphones.

Next time you're faced with selecting a microphone, begin by looking first at the application. The requirements will help narrow your selection to those types of microphones most appropriate for the task.

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Acknowledgment: Appreciation is expressed to Nigel Branwell of Calrec by AMS, and Mike Solomon of Beyer Dynamic.

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"30 Years of Service"

The role of film in television

By Jerry Whitaker, editorial director

Although the motion-picture industry first sought to "take over" television, the marriage of the two has worked quite well.

George Eastman finally met Thomas Edison in person during a visit to Edison's New Jersey laboratory in 1907. Eastman asked Edison how wide he wanted the film for his new cameras. Edison held his thumb and forefinger about 1³/₈-inches (35mm) apart and said, "About so wide." With that, a standard was developed that has endured for 82 years.

The TV and motion-picture industries have been closely tied since the 1930s. As **Broadcast Engineering** magazine observes its 30th anniversary this year, the motion-picture industry celebrates its centennial. Two people share credit for the invention of film: Thomas Edison and George Eastman.

In 1877, the Civil War was still a recent memory. Rutherford B. Hayes was in the White House. Thomas Edison was a year away from inventing the incandescent bulb. And the primary means of transportation was by horse and buggy.

George Eastman was a 23-year-old bank clerk working in Rochester, NY. Legend has it that young Eastman was planning a vacation to the Caribbean, his first vacation since he went to work as a teenager to help support his family. Another employee at the bank suggested he take a camera with him. Eastman soon discovered that it was easier said than done.

Cameras were heavy and cumbersome. They were as big as soapboxes. They required sturdy tripods because it took so long to expose each image, and any movement would spoil the picture. And taking the picture was the easy part. Photographs in those days were recorded on glass plates that had to be coated with a wet chemical emulsion in total darkness just prior to exposure. The picture had to be taken before the emulsion dried, and the plate had to be processed immediately, again in total darkness.

Eastman never went to the Caribbean, but he did buy a camera outfit. He also paid one of the few photographers in Rochester the princely sum of $5 a lesson to teach him how to take, and make, pictures.

Eastman goes to work

From the start, Eastman searched for ways to simplify photography. An article he read in a photographic journal published in England mentioned a new kind of dry photographic plate. Eastman was intrigued. There would be no more need for lugging along bottles of chemicals on photo expeditions. He started experimenting, searching for a way to manufacture dry plates of consistent and uniform quality. Eastman's laboratory was the kitchen table of his mother's boarding house, where he spent most of his evenings and weekends.

In 1879, two years after he began experimenting, Eastman invented a machine to manufacture dry plates of sufficient and consistent quality. He traveled to London, then the capital of the photographic world, to patent his invention. One year later he and an associate named Henry Strong, a local businessman who boarded with the Eastman family, rented a third-floor loft in Rochester and started manufacturing dry plates for sale. In 1881 they formed a partnership called the Eastman Dry Plate Company.

Eastman, however, had a much grander vision. He wanted to further simplify picture taking. He set out to invent a flexible, transparent base for film to replace the rigid glass plate. Eastman soon discovered that owners of glass plate cameras had little interest in film. But, by then, he had a new inspiration — to popularize photography by inventing an affordable, easy-to-use camera that took good pictures. In 1888 he brought to the marketplace the world's first snapshot camera, which used rolled film. The *Kodak* camera was born.

Eastman's film, Edison's camera

In 1889, Eastman's company invented a way to manufacture a transparent film base that was flexible and sturdy enough to be used in a camera. The base was manufactured on 200-foot-long, 42-inch-wide glass tables. After the base dried, it was coated with a light-sensitive gelatin emulsion. Word of the development reached W.K.L. Dickson, an assistant to Thomas Edison. Dickson ordered a Kodak camera on May 30, 1889. What he really wanted was the film.

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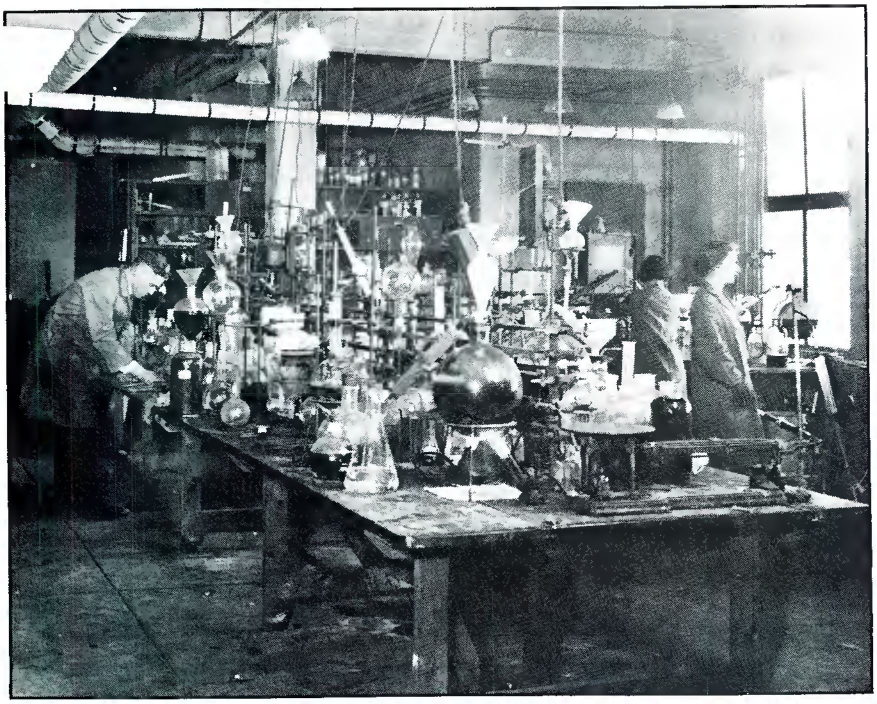

In 1912 George Eastman was one of the first American industrialists to organize a research laboratory. This picture was taken at Eastman's Kodak lab in Rochester, NY, in 1920. (Courtesy of Kodak.)

Using the film, Edison was able to invent the first motion-picture camera and projector used in the United States. Edison also built the first movie studio, in Orange, NJ. He subsequently showed his film viewer, the *Kinetoscope*, at the Chicago Exposition, where hundreds of thousands of people saw moving images for the first time. In the beginning, movies were a novelty. Most films were recordings of real or staged events, ranging from parades and foot races to vaudeville acts.

In 1896, Kodak manufactured the first print film designed for projection. This film eliminated the necessity of viewing motion pictures one at a time on the Kinetoscope, a "peep show" type of contraption, and opened the way for the introduction of movie theaters. In 1899, Frank Lovejoy, a young chemist employed by Eastman, developed a way to manufacture film in 1,000-foot lengths. This breakthrough made it possible to photograph longer and more complex scenes.

Just about the time cinematography was peaking as an art form, its biggest crisis occurred. The year was 1928. "Talkies" came into vogue overnight. With the overwhelming public acceptance of "The Jazz Singer," the silent film died. The transition was immediate. Studios stopped production of silent movies that were in the making so that sound could be added to some scenes.

The change caused enormous technical problems. After some experimentation with recording sound on disks that could be mechanically synchronized with the film in theaters, the industry decided such an approach would be impractical. It was decided, instead, to record sound directly on the film. There was an immediate need to solve a myriad of technical problems that threatened to compromise both the art of cinematography and the quality of the images and sound recorded on film. The scientists of the day, however, met the challenge. As they say, the rest is history.

With the overwhelming public acceptance of "The Jazz Singer," the silent film died. The transition was immediate.

Theater television

On July 30, 1930, a large TV screen was installed and demonstrated at an RKO theater in Schenectady, NY. After a successful test, a reporter for a leading entertainment magazine wrote: "With this successful experiment, the technical arrangements are virtually complete for projecting (television) on normal-sized motion-picture screens. Television will be a regular feature in large theaters before the new year." The writer had considerably underestimated the difficulties that lay ahead.

"With this successful experiment, the technical arrangements are virtually complete for projecting (television) on normal-sized motion-picture screens. . . ."

RKO had hopes of supplementing the motion pictures it regularly featured in theaters with televised vaudeville acts. The "large-sized" TV screen was just five feet high. Nevertheless, *theater television* had been launched.

From these humble beginnings, the major motion-picture studios began to develop plans on how to deal with the new medium of television. Only one week before the RKO demonstration, David Sarnoff wrote on the science pages of the "New York Times" that television soon would serve as a theater in every household. He foresaw great cultural benefits, with educational programs for children and an electronic art gallery for the family. The motion-picture industry didn't care much for Sarnoff's "theater-in-every-household" concept.

From the start, the motion-picture industry viewed television with suspicion. It is interesting, then, that in 1928, under Sarnoff's direction, RCA became heavily involved in movies through the *Photophone* sound recording system, and in the purchase of two theater chains to form RKO.

Nevertheless, the Academy of Motion Picture Arts and Sciences was sufficiently concerned about television to appoint a research council in 1938 to study the issue. The committee suggested that motion-picture companies install TV systems in their theaters. Members of the panel reasoned that the major movie corporations could "take over" television through their ownership of first-run theaters offering theater television.

During 1938, Paramount took the lead by purchasing a significant interest in DuMont Laboratories. Paramount put the first TV station in Chicago on the air in 1940 and established another in Los Angeles in 1943. With DuMont's stations in New York and Washington, Paramount had an interest in four of the nine first TV stations in the United States.

At the end of World War II, the other major movie corporations sought to get into the TV business. There was even talk of alliances with NBC and CBS. None of these plans ever came to fruition, however, because of the movie industry's mounting record of antitrust convictions. The FCC ruled that it would not grant a TV license to a corporation convicted of any monopolistic practices. In 1948, the U.S. Supreme Court affirmed the FCC action, effectively stopping the movie industry's efforts to "take over" television.

At the end of World War II ... major movie corporations sought to get into the TV business.

Disappointed but undaunted, the movie corporations returned to the idea of theater television that had been proposed a decade earlier. Led again by Paramount, they added TV rooms to existing selected theaters, which would continue to run feature films. The TV portion of the operation was intended to provide newsreels and sporting events, which could be covered better and faster with television than with film. Theater television offered a way to deliver news and sports on the screen with a speed formerly associated only with radio.

There was no shortage of promising theater TV projection systems in the late 1940s. Many were exotic, and many never made it out of the laboratory. The most intriguing idea came from Paramount. Called the *Paramount intermediate film system*, the concept was to distribute audio and video signals to theaters via electronic means and, upon reception, inscribe the video images and sound onto motion-picture film. The benefits were that both standard TV receiving systems and standard motion-picture projectors could be used. The conversion process from video and audio to film took 66 seconds.

The equipment to accomplish this task, however, was elaborate and expensive. The film had to be recorded, developed and projected in one continuous process. The system worked, but the quality of the reproduced image was considered only "fair." Other systems were tried, but the quality of the reproduced image never compared favorably with 35mm film.

Still, numerous theater TV systems were installed across the country with some degree of commercial success. By May

Theater television offered a way to deliver news and sports on the screen with a speed formerly associated only with radio.

1952, more than 300 different events had been presented. Networks were formed, using phone company facilities, to offer special attractions to the local theaters. Perhaps best remembered was the Joe Walcott vs. Rocky Marciano heavyweight championship fight in September 1952. Fifty movie houses in 30 cities were wired together for the event.

As home TV receivers became affordable, the interest in theater television began to diminish. It was no longer necessary to travel to the nearest movie house to view a news broadcast or sporting event. As television grew and matured, entertainment programming appeared as well, marking the end of theater television.

As home TV receivers became affordable, the interest in theater television began to diminish.

If the theater owners were suspicious of television, they couldn't stand the idea of pay cable television. Pay cable was a major bone of contention during the 1950s and '60s. Theater owners had failed to sidetrack over-the-air television, but they did their best to squash pay cable. The effort included a 1964 campaign by theater owners in California to flatly ban pay cable television. Following much promotion, the measure (Proposition 15) passed. It later was declared unconstitutional. The fight, not surprisingly, revolved around money. TV advertising revenues were up, and movie receipts were down.

Film production for TV

Failing to either kill off or take over television, the motion-picture industry in the late '40s and early '50s decided it was better to jump on the bandwagon than try

The fights, not surprisingly, revolved around money. TV advertising revenues were up, and movie receipts were down.

to derail it. Among the first TV programs from Hollywood was a 3-camera show called "Public Prosecutor," produced by Jerry Fairbanks in 1947-48. Independent film producers provided a number of programs for the fledgling networks at that time.

By 1952, television was taking a deep bite out of theatrical audiences. However, Hollywood film producers were discovering that television had the welcome mat out for their services. At first, the mainline studios avoided direct contact with television. They set up separate TV production wings, which operated under different names and even out of different facilities. During the early 1950s, an average of 16 prime-time network programs were originated on film every week.

A significant contribution that film made to the TV industry at that time could be summed up in one word: *residuals*. To appreciate just how significant that word was, consider this: Only 39 episodes of the famous Jackie Gleason "Honeymooners" series are available for distribution. (Recently, some additional "lost episodes" have been uncovered.)

Lucille Ball and Desi Arnez insisted on producing "I Love Lucy" on film in front of a live audience. The network didn't like the idea, but Lucy and Desi prevailed. The decision paid enormous dividends. Episodes of the original "I Love Lucy" series are still being aired today. In fact, it may have been the best deal any TV program

Hollywood film producers were discovering that television had the welcome mat out for their services.

producer ever made.

By the time **Broadcast Engineering** was founded in 1959, many (if not most) prime-time entertainment programs seen on the networks were originated in Hollywood by the same studios making movies for theaters. This was reflected in the quality and entertainment value of the programs. Some people still talk of the "good old days" when dramas were seen live. However, the reality was that Hollywood — the film production industry — won the battle for ratings and critical approval hands-down.

("I Love Lucy") may have been the best deal any TV program producer ever made.

By the early 1960s, the switch to color programming was gaining steady momentum. NBC had an obvious vested interest: Its parent company, RCA, manufactured color TV receivers. "Bonanza" was the showcase for color on NBC for many years. About that time, Eastman Kodak introduced a new, faster color negative film. It was a boon to TV producers because they could originate programs with less light and setup time and work with script situations that previously would have been prohibitive. By the fall of 1965, almost all of NBC's prime-time schedule was produced on color film. CBS was a year behind in reaching that plateau, and ABC

George Eastman (left) and Thomas Edison had a lot to talk about at their first meeting, in the late 1920s. By then, the motion-picture industry, which they helped to create, had blossomed into an important art form. (Courtesy of Kodak.)

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followed the next season.

News film

News was becoming increasingly important to local stations during the mid-1960s, and film was used for nearly all of it. The sound cameras were bulky by today's standards and had to be used with tripods. Most news photographers carried an additional small, hand-held, silent camera to film segments not requiring sound and to shoot cutaways. The photographic soundtrack of the cameras of the day did not have the quality or flexibility of the magnetic soundtracks used on later news cameras.

Like most local entertainment programming, news was black and white until the mid-1960s. *Reversal* films were used, so the film shot in the camera could be edited easily and projected at the station. Processing machines for reversal were, however, bulky and expensive, and the work was time-consuming compared with processing film as a negative. This prompted the introduction of a small, table-top machine in which the reversal film could be processed to a negative. The negative film was aired by reversing the polarity of the telecine chain. This simplified procedure permitted many more stations to install their own film-processing equipment.

With the increasing trend toward color in entertainment programming, local stations were anxious to add that capability to their news menus. As soon as one TV station in town was running and promoting news in color, the others had to quickly follow or lose a portion of their news audience. By 1969, 70% to 80% of the TV stations programming local news had converted to color. Most stations installed color-processing equipment rather than rely on an outside lab. Many were able to get into the business of producing color film commercials as a by-product.

As soon as one TV station in town was running and promoting news in color, the others had to quickly follow. . . .

In 1971, the introduction of the Cinema Products CP-16 camera hit the newsgathering industry like a bombshell. It was small and lightweight with innovative features designed to make news coverage easier and more reliable. Subsequent models featured a built-in sound amplifier and reflex viewing. Other news camera manufacturers followed suit and brought out improved, lightweight cameras of their own.

The introduction a few years later of portable videotape recorders and lightweight video cameras marked the beginning of the end for the use of film in local news. With the introduction of the first camera/recorder ENG system in 1981, the fate of film for news purposes was sealed. It should be noted, however, that film still is used to produce documentaries for the commercial networks and PBS.

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Continued from page 4

Elliott named to new NAB post

Janet H. Elliott has been named director, operations, of the NAB's Science and Technology Department. She will manage the department's non-technical operations, such as convention and seminar organization, member and committee services, department publications and information resources. Elliott's former position in the department was manager, special projects.

News from Europe

By John Blau, European correspondent

TV production in advance of 1992

The magic year 1992 is drawing near, and the European broadcasting industry is getting serious about it. There's lots of money at stake.

According to a study by the European management consultants Booz Allen & Hamilton International, the U.S. TV broadcasting industry, serving about 88 million households, earned about 22 billion pounds ($38.28 billion) in 1988 from advertising and subscription revenues. The United States continues to be a major exporter of programs to the rest of the world, with export revenues totaling 0.8 billion pounds in 1988.

By contrast, the European broadcasting industry, which serves approximately 112 million households, recorded revenues last year of only 10 billion pounds. TV exports (135 million pounds) represented just 1% of this total, compared with 4% in the United States.

The U.S. TV production industry, according to the study, long ago established an international approach to both producing and marketing programs. Europe's industry remains highly fragmented, linguistically divided and dependent on only two principal sources of funding — the license fee and advertising.

Nevertheless, Europe, still regulated and dominated by the national public terrestrial networks, has maintained reasonable levels of spending on program production. Large public service broadcasters such as Britain's BBC, West Germany's ZDF and Italy's Rai claim to do somewhere between 50% and 65% of their production in-house.

New media channels, on the other hand, are almost exclusively dependent on U.S. products. The dilemma now facing these broadcasters is how to respond to the imbalance between programming and funding that is emerging in the new era of deregulation broadcasting. Total transmission hours are set to double to more than 500,000 across Europe over the next five years as a result of new terrestrial and DBS channels as well as extended broadcast hours.

The race to capture market share is a hot one, especially for the public service broadcasters, who will have to identify and develop new sources of funding, according to the Booz Allen & Hamilton study. They will need strong financing to keep pace with the imminent escalation in acquired programs and the quantum leap in capital expenditure as HDTV and digital transmission are introduced across Europe.

International TV Symposium at Montreux

By Jerry Whitaker, editorial director

To say that the 16th International TV Symposium at Montreux, held June 17-23, was the PAL version of NAB is probably an oversimplification, but it's not far off the mark. Insofar as new equipment was concerned, there were a few landmark products introduced. Most, however, we saw six weeks earlier in Las Vegas, albeit in their NTSC versions.

What sets Montreux apart from any professional video trade show in the United States is its international flavor. Attendees from the world over converge on the city every other year to look at new products and discuss new technologies. Unquestionably the most frequent topic of discussion was high-definition television. Although talk of HDTV is nothing new to this industry, shows such as Montreux and the International Broadcasting Convention (IBC) in Brighton, England, offer distinctly different perspectives on those big questions looming on the horizon.

Eureka EU95

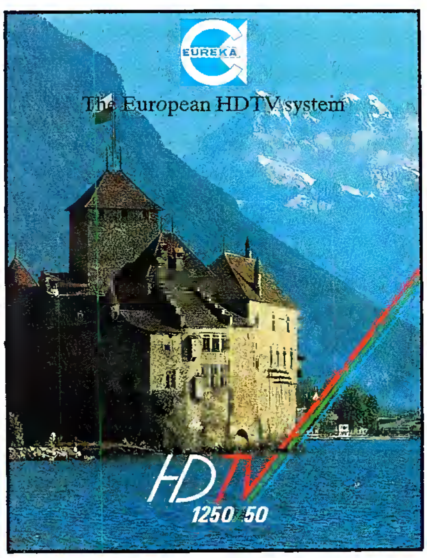
Everybody went to Montreux expecting the Eureka forces to come out slugging. Nobody was disappointed. On the opening day of the convention, leaders of the Eureka 95 directorate held a press conference to outline the progress made since IBC last September. The press package handed out to everybody in attendance included a news release that identified Eureka as the "Single World Production Standard" (their emphasis). During a question-and-answer session that followed the formal presentations, Peter Bogles, president of the directorate, admitted that perhaps the pronouncement was a bit premature.

The Eureka group is a case study in cooperation and division of labor. The directorate consists of representatives from Bosch, Philips and Thomson. Partners include Angenieux, AVS, Barco Industries, the BBC, Quantel, Rank Cintel, Captain Video and other major players in European manufacturing and media circles. Since the launch of the project in June 1986, the group has developed and produced a complete 1250-line/50Hz HDTV system that is tailor-made to the current and future European TV distribution system.

Bogles admitted that there was a good deal of cynicism when the project began. After all, some of the companies involved are fierce competitors (or have been in the recent past). Reasonable questions were raised as to whether the Europeans could get their act together and produce a system that worked. Bogles said, "Well, today you have your answers. Not only have the Europeans done it, it has been done very convincingly."

The Eureka group makes a convincing argument for its system in the European market. There is no doubt that Eureka will go on the air and will succeed in Europe, to one extent or another. Key government and industry leaders in all the major European countries are behind the effort — increased commercialization of broadcasting notwithstanding — and governmental bodies still hold sway over most activities on "the continent."

1992 is the magic date for Europe, marking the start of HDTV broadcasting. Still, a few producers will be using the Eureka 1250 system in the field in the meantime, for shoots including the upcoming Moscow Jazz Festival, the World Cup Football games in Italy, the Port Pop Festival in Rotterdam and the Summer Olympics in Spain.



Montreux 1989 was the big show of the year for the Eureka EU95 high-definition TV group. Supporters made the most of the event.

To back up their ambitious plans, the Eureka member companies brought new and improved versions of their 1,250-line hardware to Montreux. The images were, predictably, good; in fact, they were better, for the most part, than those demonstrated in Brighton nine months earlier. Essentially all the hardware needed to build a complete HDTV system was on display.

The Eureka news conference included one particularly intriguing aspect — the reported interest by Hollywood producers in the 1250 system. Although this may be the case, it's the first this observer has heard of it. In point of fact, Hollywood does not appear to be busting down the doors to buy high-definition gear from anybody right now. The more confusion and controversy that swirls around video of any definition, the more certain Hollywood is that 35mm film is the real high-definition medium, or at least the safe one for the time being.

1125/60

Not to be outdone, the 1,250-line/60Hz proponents put on an impressive demonstration of the full line of products available today based on their standard. Twenty-five major players from Japan, the United States and Europe demonstrated products that included everything from cameras to monitors. With Montreux being literally in the back yard of the Eureka 95 group, 1125 boosters did everything possible to demonstrate that they were backing the better system, and that they were ready to deliver products.

The 1125 demonstration was a smaller version of the show put on in Las Vegas during NAB. The wide range of equipment available demonstrated clearly the leading position of the Japanese-led contingent.

With increasing numbers of 1125-based hardware now in the field, and planned deliveries of 1250-based gear, it is clear that any hope for securing a single worldwide production standard for HDTV is remote. Some hopeful remarks were made at various sessions on the topic, but the chances for compromise dwindle with each piece of hardware shipped by the

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proponents. If the industry can't manage to work out agreement on a set of standards before users have invested hundreds of thousands, or even millions, of dollars in hardware, it is doubtful that it ever will.

Fibercasting

Aside from HDTV, the second hottest topic of discussion on the shores of Lake Geneva was fiber-optic technology and what it could do for, or to, broadcasting. Fiber-optic distribution within a broadcast plant offers many potential benefits. It is not, however, without its problems. Both were discussed in engineering sessions and on the floor of the convention center.

Fiber to the home, although long-range, made for more exciting discussion. The installed base of fiber-optic broadband networks is increasing. Cable TV operators are looking at fiber as an efficient means of distributing their signals.

The promise of video via fiber is viewed much differently in Europe than in the United States. Many Americans see fibercasting as a significant threat to over-the-air television, but most Europeans view it as just another way to get a picture from here to there. The obvious difference is the traditional non-commercial structure of broadcasting in Europe. You can expect this view to change as commercialization sweeps across the continent.

The show, overall

No show wrap-up would be complete without statistics. So, here goes. Montreux organizers put attendance for both the symposium sessions and equipment exhibitions at about 40,000. That's about 3,000 more than attended the 1987 show. Registered delegates and other officials numbered about 2,300.

The 1989 Montreux Achievement Medal was awarded to M. D. Windram, head of engineering research and development for the Independent Broadcasting Authority (IBA) in England. Dr. Windram was recognized for his "outstanding role" in the development of the MAC (multiplexed analog component) TV transmission system.

Dr. Windram joined the IBA in 1971 and, 10 years later (together with Dr. K. Lucas), published the paper that launched the MAC system for TV broadcasting via satellite. He is currently head of the IBA experimental and development department, responsible for all engineering research and development.

Overall, Montreux 1989 was a good show. There were problems (discussed in some detail in "Postcard From Montreux," page 6), but it was, nonetheless, *the* world-class event for 1989. NAB is important because it is big and overpowering. Montreux is important because it is the meeting place for the world's key players in the video business. BE

Register early for Ennes workshops

By Bob Van Buhler

A new feature of the 1989 SBE Convention and Broadcast Engineering Conference will be the Ennes Engineering Workshops, which will precede the official convention opening by one day. The workshops are designed to give attendees valuable factory training at no cost.

Because the sessions are designed in a hands-on format, attendance will be limited to 25 persons per session. Registration for the sessions will be on a first-come, first-served basis.

Ennes workshops

The Grass Valley Group, Dubner Graphics Factory will conduct two separate workshops. The first will provide an overview of the Graphics Factory and how it is used in a broadcast environment. The second workshop will introduce Graphics Factory operators to software design features and provide training on the use of K Programming software.

The Harris Corporation will provide a workshop to explore how semiconductor devices are being used in radio and TV equipment. The course will examine how the devices are applied and how to maintain them. Instructors will be Darryl Buechting and Dick Fry.

Sony Professional Video will provide a look at the applications for D-2, the composite digital format. The formats D-2, type C and D-1 (the component digital format) also have unique and interrelated applications. This session will compare the operational features and applications of all three formats. Hands-on machine operation will be provided to demonstrate the capabilities of D-2.

Broadcast Electronics will offer an inside look at its new advanced-technology FM exciter, the FX-50. The exciter provides audio specifications that rival CD performance. RF design engineer Ed Anthony will take all the covers off the FX-50 so that 25 fortunate engineers may get an inside look at this product.

Mitchell Vocational Technical School will present a comprehensive workshop on the key aspects of satellite communications. The following topics will be covered: satellite launch and operation, SCPC communications, TV applications, signal analysis and uplink operation. GTE Spacenet, Midwest Communications, Tektronix and MTVS will provide instructors and equipment for this hands-on practical training for both mobile and fixed uplinks. This is a must-attend workshop for uplink operators.

AM and FM radio antennas will be the subject of a workshop featuring consulting engineer Ralph Evans, John Sadler of the FCC, and Gaeza DiEnes of Andrew Corporation. Don't miss this chance to upgrade your skills in the critical area of AM and FM radio antenna systems.

Engineering management techniques will be the subject of a daylong seminar coordinated by the Cupka Corporation. The session will teach engineers how to grow and survive in the rapidly changing field of broadcast engineering. Topics to be covered include management style, communication techniques and dealing with difficult people. Instructors will be Sim Kolliner and Brad Dick.

Ampex Corporation also will provide a workshop. The details of this session have not been specified.

To attend any of these workshops, you must register for the **Broadcast Engineering** conference. Sign up early for these valuable programs to ensure successful registration. You must select a first and second choice for workshops. The successful registrants will be notified of their selection before the convention. Paid registration to the **BE** conference is required for admission. Ennes workshop attendees may want to adjust their hotel and airline reservations accordingly.

The Ennes workshops were arranged by Don Borchert, WHA-TV, for the Ennes Foundation. The foundation is responsible for education, training and certification programs of the SBE.

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Joseph Snelson, Kansas City, MO
*Tom Weems, Los Angeles
*Larry White, Tulsa, OK

* *Incumbents seeking re-election*

Table 1. *The 1990 proposed slate of SBE officers and board members submitted by the nominating committee.*

Bring the family, celebrate

This year's convention is especially well-suited to spouse and family entertainment. The convention will feature daily spouse programs, ranging from the culinary secrets of Kansas City to museum tours and a seminar on stress in the family. The wives of Chapter 59 will host many of the local events for spouses. There are plenty of fun things to do in Kansas City. Don't miss this chance to share the fun with your family.

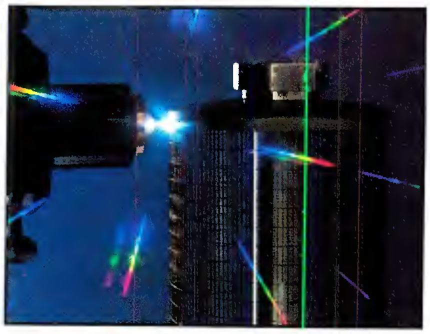
The Kansas City convention marks the SBE's 25th anniversary. The crowning event of the convention is a matter of special pride to both the SBE and **Broadcast Engineering** magazine. Early organizational efforts 25 years ago by John Battison while he was editor of **BE** resulted in the birth of the society and Chapter 1 in Binghamton, NY.

A special 25th anniversary observance will be held at the Allis Hotel featuring a reception and banquet, followed by a special member and attendee party. There will be gifts and prizes for all. Among the prizes will be a laptop computer. Don't miss the celebration.

Officers and board nominees

The nominating committee presented president Jack McKain with an official slate of directors and officers for the 1989 election. The nominating committee's slate of officers and directors is shown in Table 1. Write-in candidates will be announced next month after their certification by the national office.

Van Buhler is manager of engineering at KNIX-AM/FM, Phoenix.



Film-to-tape transfer systems

By Peter R. Swinson

For nearly half a century, flying-spot telecines have been the cornerstone of post-production and film-to-video transfer facilities. Indeed, until the advent of video recorders in the 1960s, the only true prerecorded and editable program source for broadcasting was film. Even today, film remains the only internationally compatible medium for moving images. Major post-production facilities around the world rely on advanced technology telecines and highly skilled operators, or colorists, to obtain the best-quality video from film.

Some telecines minimize the amount of operator input needed to achieve satisfactory results. However, experts who work on high-profile, quality-sensitive jobs often demand telecines that can perform creative image-positioning moves, and more important, that allow them absolute control of primary and secondary color correction.

Some operators complain that although CCD telecines require minimal day-to-day alignment and adjustment, they are limited by their inability to provide a "live" (as opposed to frame-stored) image of the film frame in the gate when the transport isn't moving. Such a feature is desirable for making color and positioning decisions when transferring film to video. Conversely, until recently, flying-spot telecines have required the loving care of engineers to ensure that they remain at peak performance.

Swinson is telecine products manager for Rank Cintel Ltd., Ware, Hertfordshire, England.

A new generation of CRT-based flying-spot telecines (such as the Rank Cintel Ursa) have reduced greatly the need for engineering adjustments and added new capabilities to the film-to-video transfer process. Three new technologies can be considered responsible for this new generation of flying-spot telecines:

- advances in cathode ray tube (CRT) design.
- new digital methods of CRT scan control.
- digital video channel processing.

The cathode ray scanning tube

A new CRT design is at the heart of the new system. (Laser scanning also is flying-spot, but a successful system has been elusive so far because of the difficulty in controlling its scanning systems.)

The latest CRT for telecine usage employs novel principles to:

- remove flare from its scanning surface.
- reduce the effect of dust on the faceplate.
- prevent external magnetic fields from influencing spot position.
- ensure quick and easy replacement.
- allow precise spot location.

Flare removal, dust-effect reduction

Colorists have to face the unpleasant effects of CRT flare and surface dust, two problems that have been traditional sticklers in the transfer suite, on a daily basis.

To address these concerns, the new CRT assembly includes a thick faceplate — more than three inches of precision optical glass — that prevents all total internal reflections from reappearing on the phosphor surface. (See Figure 1.) The thickness of the faceplate also ensures that any dust on its surface is defocused and will not interfere with the scanned image.

Removing the flare from the CRT makes a great difference in the quality of the final video image. On print film transfers, highly contrasting picture portions retain their depth of image without halos of diffused light around the brighter objects. On negative transfers, where some early CRTs gave an unnatural look, flare showed up as dark halos appearing on lighter parts of the object. Therefore, although the degree of flare is less on the negative transfers, its removal can be more dramatic than with print film.

Previous thin-faceplate CRTs attempted to reduce flare by including neutral density filters to reduce the level of secondary illumination reflected back onto the

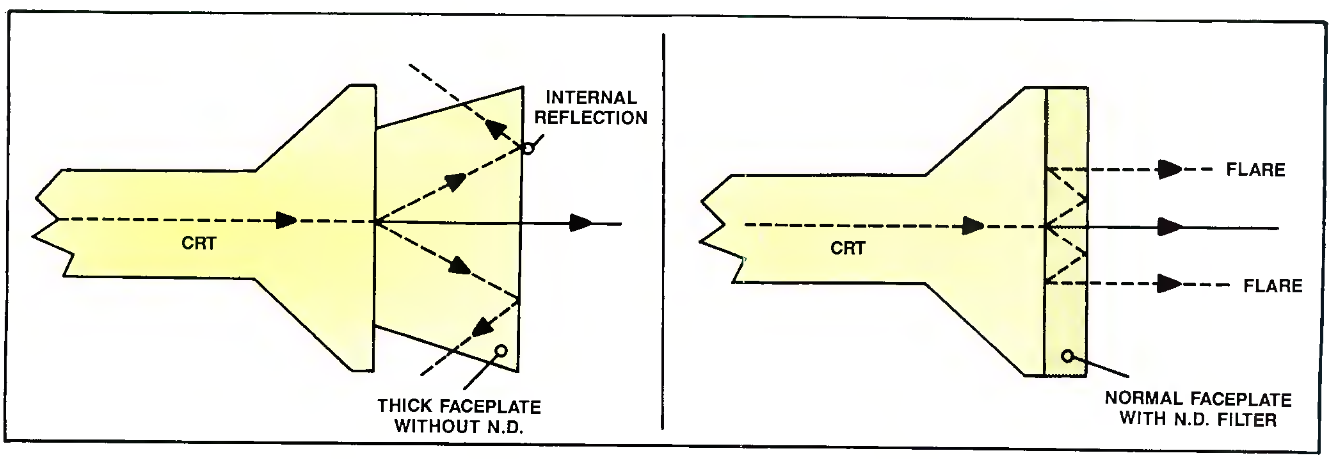


Figure 1. A new, thick-faceplate CRT eliminates flares and internal reflections, resulting in better images. Neutral density filters, used on thin-faced CRTs, are no longer required.

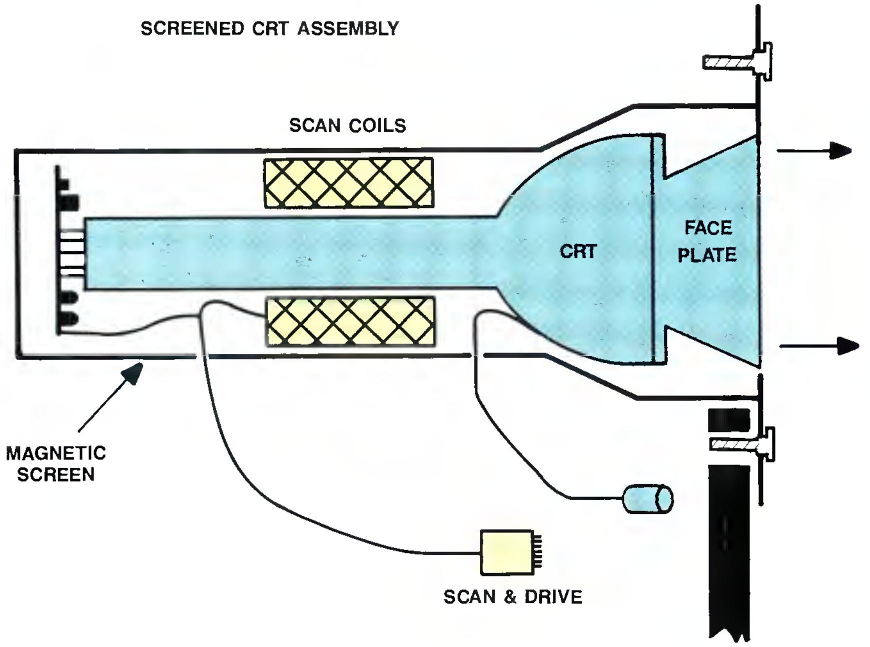


Figure 2. A magnetic shield around the CRT attenuates "positional hum" caused by stray magnetic fields affecting scan.

phosphor. But this naturally also reduced the main light beam. The new, thick faceplate requires no such filter. This gives the extra advantage of additional available scanning light, with resulting improvements in signal-to-noise ratios.

Other advantages of the thick-faceplate CRT are extended dynamic range and removal of "clamped-in defects."

Preventing external magnetic influences

Telecine artists rely upon pinpoint accuracy of the scanning beam. Again, great strides have been made in ensuring that the beam does not waver from its appointed rounds.

The latest CRT package forms a single assembly completely encased in a magnetic screen, which prevents external magnetic fields from influencing the electron beam's position. (See Figure 2.) Slight positional movements of the beam, caused by external fields, cause equivalent movements of the final video image. These have a progressively greater effect as the size of the scanned raster becomes smaller, as is the case when zooming. In the past, this effect has been described as "positional hum." An effective magnetic shield wrapped around the CRT attenuates positional hum, thereby ensuring that the final video image is extremely stable, regardless of the amount of zoom applied.

CRT replacement

In addition to technological improvements that afford quality upgrades to colorists, ergonomic issues also must be taken into consideration. With earlier flying-spot telecines, CRT replacement, pre-aging and alignment could take up to 48 hours. This was a fact of life all colorists learned to accept and live with.

The redesigned CRT addresses this issue. It comprises a complete assembly that can be pre-aligned and pre-aged by the manufacturer as a single system. In addition, the CRT assembly also is designed to be loaded and unloaded from the front of the telecine. Also, today's telecine requires only minor electrical alignments. The total replacement exercise takes less than 30 minutes. This is expected to greatly improve film-to-tape transfer suite productivity.

Precise spot location

The experienced and creative colorist needs absolute control of every aspect of the image. This need can be addressed with CRT innovation. The scan coils in the new CRT assembly are special, low-inductance devices, with negligible back-EMF properties. In conjunction with special linear drive amplifiers, precise and instantaneous spot positioning is possible. This technology has come about from development with the military and civil avionics display industries, which require fast, vector-scanned displays.

Linear scan amplifiers

Producers seek out highly skilled flying-spot colorists for their ability to manipulate and modify the filmed image in the delicate process of transferring it to the extremely different video medium. So that colorists can have even greater power to change and manipulate film images before the first generation of tape, the new telecine also incorporates special scan amplifiers, which are controlled via digitally generated signals. With digital precision, the flying spot can be directed instantaneously to any part of the CRT face. Such precision CRT control is something entirely new for the colorist, and it opens up tremendous creative capabilities. The following functions are added to the repertoire of the CRT-based flying-spot telecine:

- pan and zoom cuts.
- extended zoom ranges.
- rotation and positional effects.

The instantaneous nature of the scan allows completely different positions of scanning from one film frame to the next. Therefore, pan and zoom cuts are possible in situations in which, previously, colorists could cut image positions only by editing several transfer sequences. What's more, precise scan control, in conjunction with the lack of positional hum, allows an extended range of zooms both in and out. In fact, through variation of the raster size, the zoom range is at least double what was available previously.

Various methods have been attempted to provide image rotation in real time. Historically, rotation has been applied after transfer using digital video effects units. However, quality degradation often occurred because of aliasing of the reprocessed video image. In comparison, rotating the flying-spot scan causes no video image degradation, because the effect is identical to keeping the scan steady and rotating the film. (See Figure 3.)

The sophistication of the digital control of the latest CRT flying-spot telecine provides a wide range of special effects. Indeed, the resultant images may be indistinguishable from film optical effects produced with optical glass (except, of course, that it is unlikely that many could be achieved using even the cleverest glassware).

Linear effects include rhombic, trapezoid and multi-image, whereas non-linear effects include curved images and fish-eye distortions. Every effect is selectable for X- and/or Y-plane adjustment, all effects can be used dynamically in real time, and any combination of effects is available. Transition from any one combination to another is possible either dynamically or as a frame cut.

All these effects are made possible through the computerized control of linear scan amplifiers and use of special scan coils, which are an integral part of the CRT package design.

Digital video channel processing

So far, this has been a look at the latest developments in scanning the film image. Now, let's consider developments in proc-

Put Dolby SR before the cart

There's no doubt that compact discs and other digital audio sources have helped to raise broadcast audio quality to new heights. And to some degree, almost all broadcasters have embraced this new technology.

But you probably continue to use carts right along with these new formats. For on-air playback of your programming, as well as commercials, spots, and jingles, carts are still tough to beat for convenience, ruggedness, and familiarity.

Carts do have one limitation, though: sound quality that doesn't measure up to today's high expectations. Dolby SR (spectral recording) overcomes that limitation. With Dolby SR, your carts can capture the full range of dynamics present in all your source material, digital or analog. And using Dolby SR to produce spots and jingles ensures an outstanding finished product.

You've always had good reason to use carts. Now with Dolby SR there's a great one: sound quality updated for today's demanding broadcast environment.

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*Broadcast units incorporating up to 12 channels of Dolby SR for use with multiple cart machines or open-reel recorders are also manufactured by Pacific Recorders & Engineering Corp., Carlsbad, CA.

essing the image. Digital video processing is used extensively for both color and telecine alignment. Such processing offers better image accuracy and a reduced maintenance requirement for the entire video channel.

Once the film image has been scanned, the resultant illumination levels are beam split into red, green and blue (RGB). Photomultipliers detect the relative illumination levels and output a video signal proportional to the illumination. Analog afterglow correction is applied to each signal.

From this point on, the new telecine differs from its predecessors. The signal for each RGB channel is converted to a 14-bit digital signal. As no gamma or other nonlinear correction has yet been applied, the dynamic range of the digital signal must be capable of the entire density range of the film. For print film this range may well exceed 4,000:1, hence the requirement for a 14-bit signal, to ensure that no information is lost in digitization.

Automatic shading alignment

With earlier telecines, some form of shading correction always has been applied to overcome unevenness of the CRT illumination and optics. In the case of CCD telecines, this is done to overcome the different gain levels of each CCD photo site. With the latest-generation telecines and associated complex CRT scan patterns, simple manual or single-line automatic shading and pattern correction would be impractical. With a fully digital channel, however, a much more elegant approach is possible.

In each of the RGB channels, a large memory is used, not to store the video image, but to store a gain-correction signal for every X–Y location on the CRT faceplate. For each film format and gate change, or at power-up, an auto alignment sequence can be activated to scan every location on the tube face. The same scan signal is used to address the memory, where for each X–Y address, the illumination level is recorded. This data is used to modify and to balance the peak signal. The alignment procedure can be completed automatically in less than two minutes. Such a procedure eliminates any manual intervention and takes into account all illumination errors in the optical path.

Use of digital channels can reduce, by several hundred, the number of internal preset controls, compared with previous flying-spot scanners.

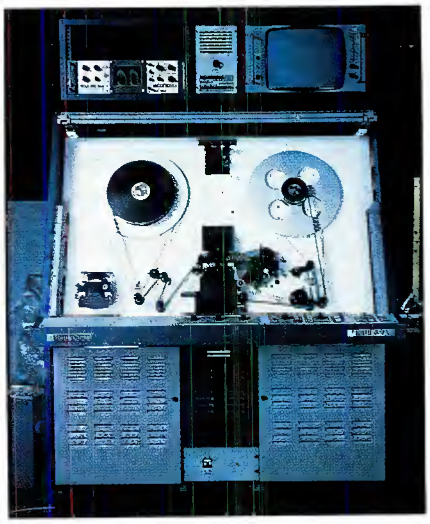
Color correction

Color correction is an integral part of any transfer. The eye of the creative colorist is a much-valued post-production asset. Colorists have grown in industry stature as the technology of color correction has advanced, and as the need for quality film-to-tape transfer has escalated.

To obtain the best dynamic range from any film material, both the digital channel gain and photomultiplier gain must be controlled continuously for each film scene, or even for every film frame. Until now, such a range of control has been difficult to achieve.

The digital channel maintains 14 bits RGB until gamma correction is applied to the signal. After this, 10-bit RGB gamma-corrected signals are processed by secondary color-correction IC chips. These chips allow not only hue and saturation control, but also include luminance control for each of the red, green, blue, cyan, magenta and yellow vectors. Digital and secondary color ranges far exceed those found in previous analog systems.

Following secondary corrections, the RGB 10-bit signals are digitally matrixed to obtain luminance and color-difference signals. Variable digital horizontal and vertical enhancement (aperture correction) signals are applied, and the resultant signal is routed to a conventional flying-spot framestore where sequential-to-interlace conversion is applied.



Rank Cintel's Ursa flying-spot scanner telecine uses advanced CRT design to provide special effects, zooms, pans and rotations. Effects are created by modifying the CRT beam's scanning patterns.

Cinema-quality video?

The overall effect of combining new CRT, CRT-scan and digital-channel technology in the latest-generation flying-spot telecine offers not only the benefits previously described, but also greater stability of video levels, considerable improvement in signal-to-noise ratio, reduced maintenance and increased operational flexibility.

With today's technological breakthroughs and highly skilled telecine artists, more quality can be extracted from film stock and recreated on tape than ever imagined in the past. Video now can take several steps toward matching the quality of the much-acclaimed cinema image.

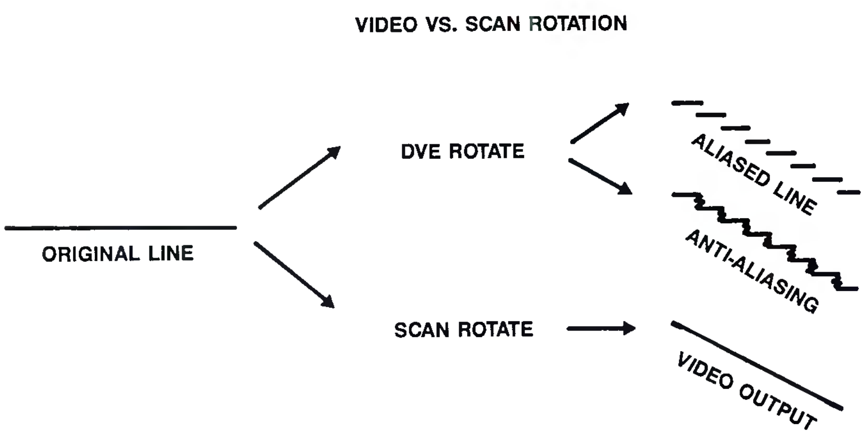
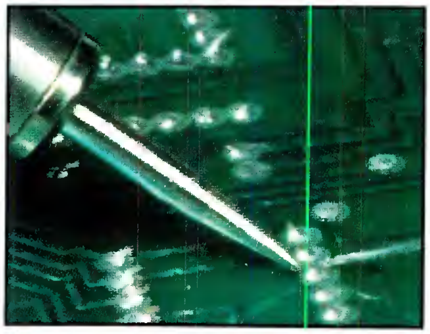


Figure 3. *Rotating video with scan rotation, as opposed to a digital effects device, eliminates aliasing artifacts.*

Station-to-station



Vertical interval AGC meter

By Eliot Case

Setting up a live microwave shot is easy in theory, but often difficult in practice. If you have a microwave site with no telemetry to help you call in a live shot, you need a circuit that will make it easier than just looking for the best picture. This article is about just such a circuit, which performs three basic tasks: First, it decodes the sync from incoming video. It then times out to a selected line in one field and inserts a 40IRE white line proportional in length to the receiver's AGC level. The line then can be viewed easily at the final receive site on any pulse-cross video monitor.

The circuit never breaks the path between the receiver baseband output and the transmitter baseband input. If the device fails, it will not disable the relay site.

The inserted line is additively mixed (voltage-summed) to the baseband signal passing through the device. Protection against interference into the audio subcarriers is provided by limiting the high-frequency content of the inserted line.

Circuit description

The circuit is placed in the video, or baseband path, between a microwave receiver and a microwave transmitter. (See Figure 1.) A representative dc AGC (signal-strength) voltage from the receiver is encoded onto the video signal being passed to the transmitter.

The circuit is shown in Figure 2. The baseband signal is passed from BNC 1 to BNC 2 without interruption. A sample of the video signal is tapped by R1 and fed to the high-impedance input of half of IC1 (a 5532 dual high-speed op-amp). The amplifier's gain is set to 2 by R2 and R3. The video level is doubled before it reaches the sync separator to optimize the locking range. This is important for tracking a wide range of video levels.

The amplified video passes through a dc blocker capacitor, C1, then through a low-pass filter to eliminate chroma and other subcarriers. The processed video then is coupled to IC2, an LM1881 sync separator chip. Resistor R5 and capacitor C3 determine the time constant of the sync separator.

The field-index pulse is taken from the sync separator, which identifies field one vertical. The pulse triggers half of IC3, a 4538 1-shot. The 1-shot is adjusted by R6 to the desired metering line. (Line 14 is nominal.) The resistor also sets the start point of the next stage. When adjusting the circuit, set the start of the pulse at pin 7 of IC3 to the middle of horizontal sync preceding the desired line.

The output from IC3 pin 7 triggers the second half of IC3, another 1-shot. This second 1-shot is the horizontal window generator. Adjusting R7 will determine the maximum length of the inserted line.

The horizontal window is sent to half of IC4, a 4073 dual 3-input AND gate, where the backporch and composite sync pulses are compared. The comparison guarantees that the IC's output pulse will not occur during any sync pulse or colorburst. This output is considered safe video and is sent to the other half of IC4, a dual AND gate.

The dc AGC voltage from the receiver is applied at terminal strip T1, which connects to the wiper of R11. Centering R11 nulls the gain of half of IC5. Adjusting R11 in either direction allows the circuit to accommodate either a positive- or negative-going AGC voltage. The output from this half of IC5 mixes with an adjustable bias from R9. The combined signal creates a default line length, which results in at least a small bar being displayed even when no AGC voltage is present. Under that condition, the video probably would be unusable. This also makes it possible to set up the device on the bench for testing to determine the amount of AGC level needed to get a lockable signal and maximum meter range.

The second half of IC5 compares the processed AGC voltage from the first half of IC5 with the ramp signal from C5, the horizontal window-timing capacitor. The op-amp produces a negative-going pulse when the dc is above the ramp. This meter pulse is dependent upon the dc level. The higher the voltage, the longer the pulses.

The meter pulse is passed to a Schmitt inverter, one-sixth of IC6, to half of IC4. The AND gate compares the pulse against the safe video pulse from the first half of IC4. This guarantees that no signal will occur to be inserted during sync or colorburst. The output of IC4 passes through two Schmitt inverters (IC6) and to C6. The

Case is an engineer at KUSA-TV, Denver.

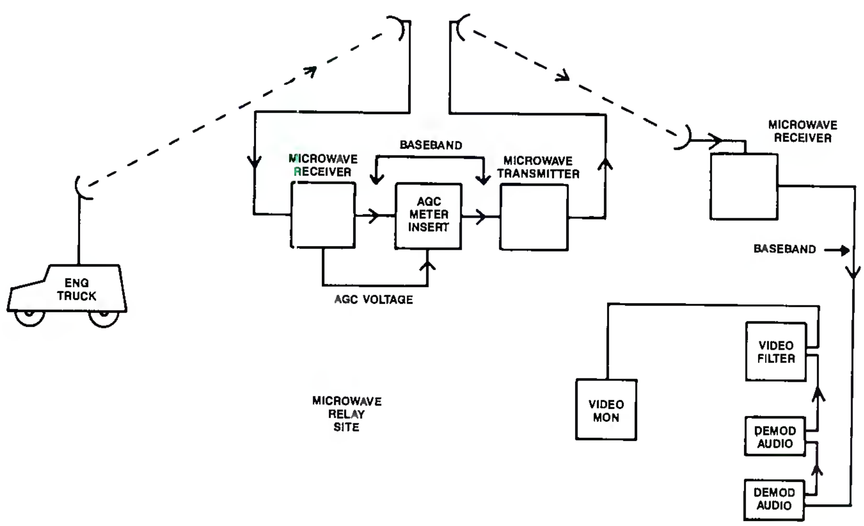


Figure 1. The AGC meter can be inserted between a microwave receiver and transmitter. If more than one hop is needed, use one metering circuit per site.

capacitor rolls off the higher frequencies that would interfere with audio subcarriers. Resistor R17 couples the signal back to the loop between BNC1 and BNC2.

The power supply is regulated at +5Vdc for stability in the timing circuits and dc voltage processors. The negative supply is unregulated and is used only to supply the op-amps with a negative rail. Transformer X1 is a 110V to 12V CT transformer. Diodes D1-4 form a 50piv bridge rectifier. Capacitors C7 and C8 are rated 1,000μF 50V. Be sure to bypass IC7 with a high-quality 0.01μF capacitor (C9). This will keep the regulator from oscillating at RF frequencies.

Capacitors C4 and C5 are high-quality polyester or other temperature-stable devices. Thermal stability in these capacitors is important because they affect the accuracy of the timing circuits. All resistors are ¼-watt. Mounting the circuit in a sealed metal box helps promote thermal stability. A complete parts list is shown in Table 1.

Other considerations

If more than one microwave relay station is in the same video path and multiple metering at several points in the system is required, multiple inserters can be set on different lines so they will not mask each other. If the inserter is not used for baseband insertion and is only used on video monitoring, C6 may be removed, which will produce a sharper line.

Inserting an AGC reading is only one of the uses of the meter. The circuit also can be used to meter any positive- or negative-going dc voltage. Even audio can be monitored if it is first rectified and filtered.

COMPONENT VALUES:

Resistors (W)

R1 = 100Ω
R2,3,8,10,14,15,16 = 10kΩ
R4 = 620Ω
R5 = 680kΩ
R12,13 = 1kΩ
R17 = 470Ω
R6,7,9 = 10kΩ trim pots

Capacitors (25V or greater)

C1,3 = 0.1μF disk
C2 = 510pF disk
C4 = 0.1μF polyester or other high-quality cap
C5 = 0.005μF polyester or other high-quality cap
C6 = 0.005μF disk
C7,8 = 1,000μF electrolytic
C9 = 0.01μF disk (a good high-frequency bypass cap)

Integrated circuits

IC1,5 = 5532 dual high-speed op-amp
IC2 = LM1881 video sync separator
IC3 = 4538 dual 1-shot
IC4 = 4073 dual 3-input AND gates (positive logic)
IC6 = 7414 hex Schmitt trigger inverter TTL output
IC7 = 7805 tab-mount +5Vdc regulator

D1-4 = 50piv 1W diodes (or a bridge rectifier)

Other supplies

X1 = 110V to 12V CT transformer, rated at 500mA
BNC1,2 = chassis-mount female BNC connectors
T1 = 2-conductor terminal strip

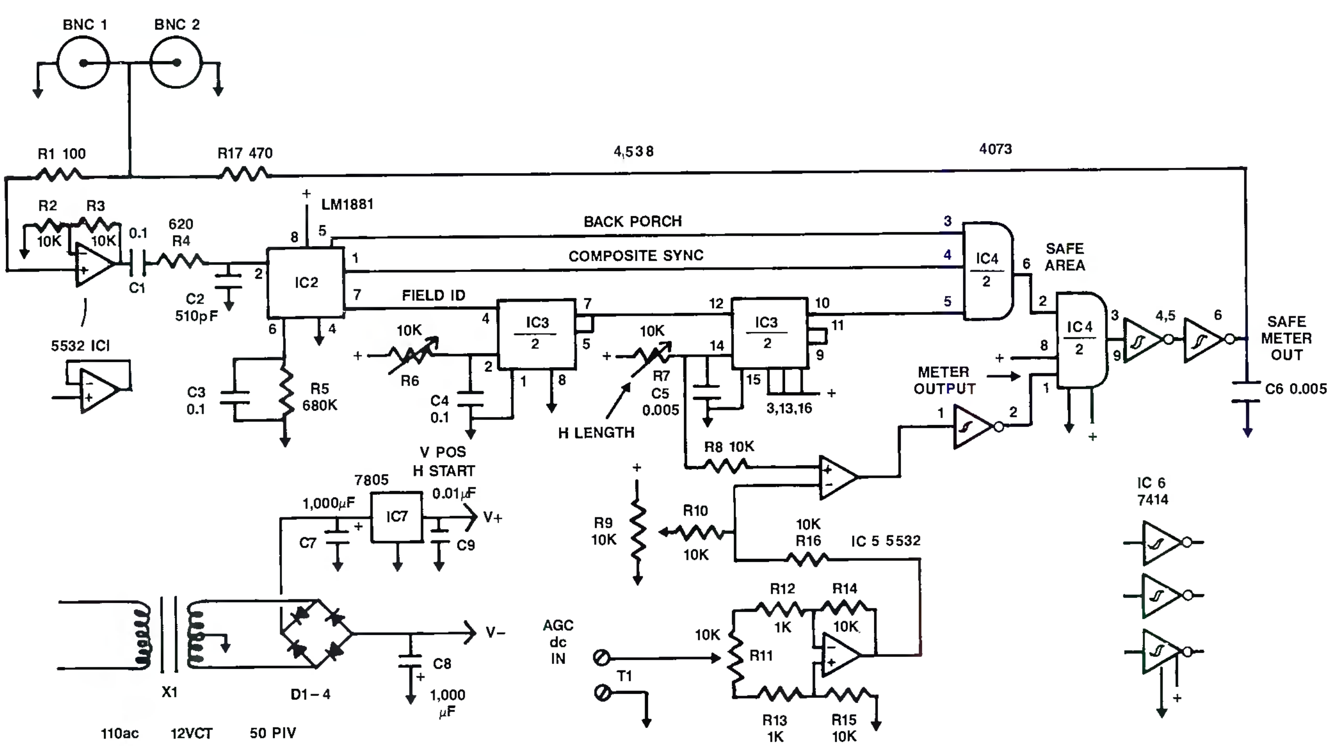


Figure 2. AGC metering circuit. Temperature stability is important, so use quality components.


ON AIR
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News Special Report

An ATTC progress report

By the *BE* staff

It has been two years since the Federal Communications Commission initiated its inquiry into advanced TV services. The 2-year charter for the blue-ribbon Advisory Committee is about to expire and is expected to be renewed by the FCC at the same time as another "tentative decision and further notice of inquiry" is issued. This article discusses the findings of the committee and expectations for the next two years or more.

Subcommittees

The Advisory Committee created the following three subcommittees to carry out its work.

- *Planning Subcommittee:* conducts initial studies of economics, spectrum and other factors; develops guidelines for analyses and tests of proposed systems.
- *Systems Subcommittee:* performs technical and economic analyses of proposed systems; conducts laboratory and field tests; recommends standards.
- *Implementation Subcommittee:* analyzes technical and regulatory implications of systems and develops implementation scenarios.

The Planning Subcommittee has completed much of its work. Its working parties have developed an extensive list of system attributes to be considered in testing and analysis. Technical guidelines have been established for testing the performance of proposed systems in the areas of terrestrial broadcasting, cable television, satellites, fiber optics, terrestrial microwave and recorded media. Spectrum studies have indicated the constraints on availability and use of spectrum. Subjective test plans have been developed.

The Systems Subcommittee is currently the most active. Anyone interested in its work should contact the chairman — Irwin Dorros, of Bellcore — or the individual working party chairmen, listed in the following updates:

- *SS/WP1, technical analysis* (Birney Dayton, Grass Valley Group).

Last year this group requested that proponents submit detailed technical proposals for ATV systems. In November, all who had submitted proposals were invited to make presentations during a weeklong "marathon" meeting, sometimes referred to as "Hell Week." A second meeting of this type was held in May of this year. SS/WP1 is responsible for certifying that a system is of sufficient technical merit and has reached a level of development at which it should be accepted for testing.

- *SS/WP2, evaluation and testing* (Ben Crutchfield, Advanced Television Test Center). This working party has taken the test guidelines developed by the Planning Subcommittee to prepare detailed test procedures. Because neither the commission nor its Advisory Committee have the resources to conduct laboratory or field tests, SS/WP2 also must identify laboratories that can do the work.
- *SS/WP3, economic factors* (Larry Thorpe, Sony). While the other groups are conducting technical studies, SS/WP3 is studying the costs of implementing proposed systems. Factors include the costs of equipping networks, broadcast stations and cable systems to produce and deliver the signals as well as the costs of consumer equipment.
- *SS/WP4, ATV standard* (Bob Hopkins, Advanced Television Systems Committee). The analyses and data from the other working parties will be assembled and used to prepare recommendations to the Advisory Committee on which system or systems should be recommended to the commission as a new standard for TV broadcasting in the United States.

Although the Advisory Committee considers other media, its primary responsibility is to recommend a terrestrial broadcast system. The commission has no jurisdiction over the choice of systems used by the other media.

Systems

Last year, 19 companies responded to the SS/WP1 call for proposals through letters indicating their interest. Of those, 14 submitted some sort of proposal or made a presentation during Hell Week. By the end of 1988, 23 ATV systems or technologies had been proposed. (If variations on the systems were counted, the number would be even higher.) Although only one of the original 19 has made a formal withdrawal, only eight were present at a recent meeting to which proponents had been invited.

The proposed systems may be divided into three general categories, according to how they use spectrum. These are:

1. The 6MHz systems compatible with existing receivers. Most systems in this category are improved- or enhanced-definition television (IDTV or EDTV), basically NTSC with "compatible" improvements. In theory, pictures will look the same or better on existing receivers and will look even better on new receivers designed to take advantage of the improvements.

Some go beyond EDTV. One proposal, the Del Rey HDNTSC, claims to be able to transmit HDTV with an NTSC signal. Another, Production Services, Inc. (PSI), claims to offer a transmission technology that can use an NTSC signal as a "pipeline" to carry augmentation information, a second NTSC signal or even a separate HDTV signal. Just how compatible these systems are and how they work remains to be seen.

2. The 9MHz-12MHz systems using a 6MHz NTSC signal and an augmentation signal (of 3MHz to 6MHz). The NTSC signal is broadcast on the station's current channel, VHF or UHF. An augmentation signal — carrying some combination of more detail, side panels for wide screen and digital audio — is broadcast on another channel, probably UHF. The NTSC signal also may be enhanced. Existing receivers receive the main channel as always. New receivers will receive both channels and combine the signals to produce an HDTV picture.

3. The 12MHz simulcast systems (through which the same program is broadcast over an NTSC channel, at NTSC quality, and over a 6MHz ATV channel). In this approach, the two channels are independent. The second channel, however, need not maintain any characteristics of NTSC except as needed to avoid interference with NTSC signals. Otherwise, the designer can use any available coding and modulations technologies to get the best picture and sound into 6MHz.

Although the term simulcast implies broadcasting the same signal on two channels, it is not clear exactly how much would have to be the same, nor is it clear how long simulcasting would continue. The answers will depend on implementation scenarios, yet to be developed.

Testing laboratories

The Advisory Committee and all its subsidiary groups are voluntary and have no resources other than the time donated by its members. A small budget has been created from contributions by members, but its purpose is only to cover certain expenses such as travel to committee meetings for individuals who lack company sponsorship.

The actual work of building laboratories and conducting tests is being done by member organizations. Broadcasters established the Advanced Television Test Center to conduct tests related to terrestrial broadcasting. Tests related to cable and fiber will be done by the Cable Television Laboratories, a research group established by cable system operators. The Jerrold Applied Media Lab also has offered to conduct system tests, and others have contributed or offered considerable support.

The Communications Research Centre of the Canadian Department of Communications has offered to conduct the subjective tests. This is an element of the testing program essential to the evaluation of system performance under conditions of interference and other transmission impairments, as well as testing the baseband quality of the system output.

Paul Fisher has been appointed manager of Microwave Radio's system integration and contract service group, Lowell, MA.

David Anglin and **David Webster** of Ampex Recording Media, Redwood City, CA, have been awarded the 1988 Alexander M. Poniatoff Award for Excellence in Engineering and Ampex's Excellence in Manufacturing Award, respectively.

Anglin, a senior chemist, received a silver Poniatoff Award. He is being recognized for his contributions in the development of polymer combinations and chemistries that have been incorporated into both the Ampex 298 Betacam SP and Ampex 319 D-2 videotapes.

Webster received Ampex's Excellence in Manufacturing Award for his work as production/inventory control manager of the Material Group at the Opelika, AL, manufacturing center. His contributions include the development and implementation of a planner/buyer program, an inventory control program, a microcomputer-based Manpower Requirement Planning System, as well as the fostering of teamwork and communications between his department, manufacturing, engineering and quality assurance.

Recipients of the 1988 Poniatoff Awards were determined by a committee of Ampex vice presidents for all operating units. Each silver and Excellence in Manufacturing Award carries a $3,000 cash stipend and a desk trophy.

Rick Berry has been named product manager for the ARRI grip line of lighting and grip equipment for Arriflex, Blauvelt, NY. He will assist in developing a line of equipment.

Joseph Germani has been appointed Eastern regional sales manager for Belden Wire and Cable, Richmond, IN. He is responsible for directing the sales activities in the sales office located in Shrewsbury, MA. Additional responsibilities include overseeing the field sales personnel and the customer service department.

Phillip Smith, Kenny Shewmake and **Greg Smith** have been appointed to positions with BTS, Salt Lake City. Smith is Southwestern regional sales manager. Shewmake is Southeast regional sales manager. Smith is Midwest regional sales manager.

Joseph R. Patton has been appointed Western regional sales representative for Canon U.S.A., Optics Division, Jericho, NY. He is responsible for servicing new and existing clients, in addition to handling trade shows and other assignments.

Manfred Klemme has been named marketing manager for Cinema Products, Los Angeles. He is responsible for new product introductions, including the CP KEYKODE Reader, as well as marketing the company's film and video products.

Lani Ridley has been appointed vice president of worldwide sales for Cubicomp, Hayward, CA. She directs all sales activities including the direct sales force for the Vertigo workstation-based 3-D animation systems, the video dealer network for PictureMaker graphics systems and all international sales.

Richard Salter has been appointed development director at Focusrite Audio Engineering, Bourne End, England. He is responsible for overseeing the mass production of the company's modules and consoles.

Gary Carter has been named marketing director for FOR-A, Newton, MA. He works with research and development groups in Japan and the United States in connection with new product development as well as cultivating new applications and enhancements for existing products.

Thomas Volpicella has been promoted to regional sales manager for the Northeast region for Fuji Photo Film U.S.A., Magnetic Products Division Professional Products, Elmsford, NY. He is responsible for managing sales efforts of professional videotape. He also oversees the region's sales force.

David Higgins has been named director of engineering/satellite systems for Hughes Television Network, New York, NY. He supervises all technical aspects of the encryption and related transmission facilities — both satellite and terrestrial for the company's scrambling network.

Steve Cunningham has been appointed vice president of sales and marketing for Hybrid Arts, Los Angeles.

He is responsible for the strategic planning and distribution of the company's hardware and software products.

Bob Palmer has been appointed Eastern regional sales manager for LDL Communications, Laurel, MD. He is responsible for the sale of TV transmitters, TV and FM antenna systems and LeBlanc & Royle towers.

Bob Strauss, Bill Warnke and **Hank Van Amburgh** have been appointed to positions with Landy Associates, Cherry Hill, NJ. Strauss is sales representative industrial accounts for Massachusetts and Rhode Island. Warnke is sales representative broadcast and production accounts for Massachusetts and Rhode Island. Amburgh is sales representative for Maine, New Hampshire and Vermont.

Greg Brown, Ertha Sims, Clayton C. Dore and **Karen A. Martinez** have been appointed to positions with Standard Communications, Los Angeles, CA. Brown is product support technician in the customer service department of the SatCom division. He is responsible for assisting customers in learning to operate new equipment, and to solve technical problems over the phone. Sims is customer service administrator in the customer service department of the SatCom division. She is responsible for maintaining customer records, customer repairs and loaner units distributed under the Lifetime Loaner Program. Dore is manager of technical services for the SatCom division. He is responsible for providing technical support and field service. He also oversees the Gold Standard and Lifetime Loaner Programs. Martinez is senior sales administrator for the SatCom division. She is responsible for receiving and processing orders, telemarketing and working with special network customers.

Joe Bean has been promoted to Eastern sales manager for professional dealer products for Studer Revox America, Nashville, TN.

David Tearle has been appointed Western regional sales manager for LEE Filters, a division of LEE Colortran, Burbank, CA. He is responsible for all sales activity in the motion picture and theatrical markets in the western United States. He also manages the filter product line manufacturing operations in Andover, England.

Salatore G. Coraccio has been appointed operations manager for Microwave Radio, Lowell, MA. He is responsible for manufacturing, purchasing and manufacturing services.

Rick Plushner has been promoted to national sales manager for PCM products for Neve, Bethel, CT.

Robert E. Lambdon has been appointed national sales manager for Microtime, Bloomfield, CT.

David W. Keller has been appointed president and chief executive officer for Quanta, Salt Lake City. He will continue in his position as director, new market development for the Dynatech Broadcast Group.

Varian TVT and Larcan reach distributorship agreement

Varian Associates TVT Division, Montreux, Switzerland, and *Larcan Communications Equipment*, Ontario, Canada, reached a distributorship agreement at the International TV Symposium. Larcan will serve as exclusive distributor for Varian TVT's TV and solid-state FM products in Canada. Varian TVT will be the exclusive European distributor of Larcan's solid-state VHF transmitters.

Each organization will provide total field sales and service support.

Aphex on the move

Aphex Systems, Sun Valley, CA, has moved its headquarters to a new facility, which more than doubles its space. The address is 11068 Randall Street, Sun Valley, CA 91352. The phone number is 818-767-2929; the fax number is 818-767-2641.

BTS enters sales agreement with BARCO

BTS Broadcast Television Systems GmbH, Darmstadt, Federal Republic of Germany, has decided to cooperate with *BARCO*, Kortrijk, Belgium, in the monitors sector. The BTS product range has been expanded to include the BARCO master-control color monitors CTVM 4, the CVS series control color monitors, the CVM color monitors as well as monitors from the HD series for HDTV.

In accordance with market demand, the product range will continue to include complimentary BTS monitors.

Microwave Radio creates contract service organization

Microwave Radio, Lowell, MA, has created a system integration and contract service group. The company has recently introduced a line of portable, short-haul and long-haul fixed-link microwave systems. With the systems, the company has moved from supplying portable systems as part of a contract to providing complete microwave systems for major installations.

New England Digital forms European distribution company

New England Digital, White River Junction, VT, has formed a London-based office, New England Digital (UK), to directly oversee sales of Synclavier, Direct-to-Disk, and PostPro, digital audio workstations throughout the United Kingdom and Europe.

In doing so, New England Digital and its European distributor, Harman International, have restructured their relationship. New England Digital will oversee all European sales and provide support for distributors, while assuming direct responsibility for sales of its workstations throughout the United Kingdom. Harman Deutschland has expanded its territory to include the Netherlands, Belgium and Luxembourg.

Solid State Logic opens Canadian office

Solid State Logic, Ontario, Canada, has announced the opening of a Canadian subsidiary. Based in Toronto, the office will provide sales and service support for SSL's increasing client base. The office is located at 36 Toronto Street, Suite 850, Toronto, Ontario, Canada; telephone 416-363-0101; facsimile 416-360-3838.

Circle (75) on Reply Card

Circle (76) on Reply Card

Circle (77) on Reply Card

Transportable uplink

Midwest Communications has introduced the S-2 transportable uplink system that uses a 2.4m collapsible antenna for increased gain. Driving the antenna are two phase-combined MCL 300W traveling-wave-tube amplifiers.

Circle (350) on Reply Card

CAD symbol libraries

Network Communications Consultants has expanded the CADalog symbol libraries with video product drawings to simplify facilities-design projects made with AutoSketch and AutoCAD. Symbols include wiring drawings and information regarding heat loads and rack layouts. Current CADalogs include products from Abekas, Ampex, BTS, Chyron, Grass Valley Group, Ikegami, Quantel, Sony and Tektronix.

Circle (351) on Reply Card

Loudspeaker system

Altec Lansing has introduced the A700 loudspeaker system that provides a building-block approach to loudspeaker clusters in sound systems. Included are subwoofer systems, electronic crossover and system protectors, power amplifiers and an accessory suspension kit. A single trapezoidal cabinet houses a vented bass horn, compression driver and Mantaray horn.

Circle (352) on Reply Card

Precision video cable

Belden Wire & Cable has introduced the Belden Brilliance 8281A precision 75Ω video cable with flame-retardant PVC jacketing. It is UL CL2 listed by NEC codes for installation in walls of commercial buildings without conduit. Electrical performance is equivalent to No. 8281 cable.

Belden also has announced the Kings BNC 75Ω coaxial and Tri-Loc triaxial connectors as well as Neutrik 3-prong audio connectors with internal strain relief, expanded boots for larger cable diameters and an O-ring design for improved fitting of connectors.

Circle (353) on Reply Card

Color comparator

Bourbon Street Associates has announced the Geisbrecht IRT MK II color monitor comparator. It is a battery-operated, portable unit to assist color-temperature adjustments and gray-scale balancing. Referenced to Illuminant-D (6,500°K), comparisons are made from 19-foot-L peak white to 0.96-foot-L low-light levels. The unit can be mounted on a tripod.

Circle (354) on Reply Card

Large lens adapter

BTS has introduced a large lens adapter accessory for the LDK 90/91 CCD cameras. Enabling a wider range of lens systems, the adapter configures for different local or remote power-supply arrangements for ENG and EFP applications.

Circle (355) on Reply Card

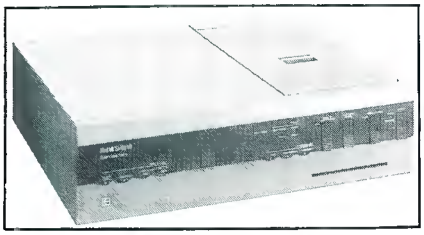
Computer power protection

Liebert Corporation has introduced a computer isolation transformer with integral spike suppression. A 3-phase system, available for 10kVA to 150kVA capacities, uses double-shielding to achieve 140dB common-mode noise rejection in addition to the suppression network to guard against high-speed, high-energy transients and high-frequency noise in normal mode.

Circle (356) on Reply Card

Video printer

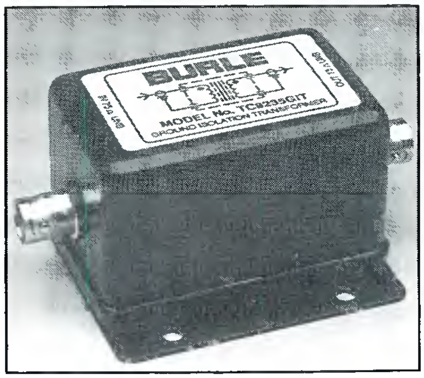
Eastman Kodak has introduced the Kodak SV6510 color video printer to document video material. It offers continuous-tone, thermal prints from NTSC or RGB with sync-on-green sources. Full color or black-and-white images in single or quad formats are produced by a 512-point thermal sublimation process. Single prints are 4″×5.2″ with ¼-inch borders, while the quad mode prints four 2″×2.6″ images of the same subject or two images each of two subjects.



Circle (357) on Reply Card

Ground isolation device

BURLE INDUSTRIES has introduced the TC8235GIT that solves common ground-loop conditions found in many video and data line installations. For 75Ω coax, the device has a bandwidth of 10Hz-7MHz.



Circle (358) on Reply Card

Digital multitrack recorder

Akai Digital and *International Music Company* have introduced A•DAM, a digital multitrack recording system using 8mm videotape. The 12-track recorder incorporates 16-bit linear resolution with 44.1kHz or 48kHz sampling for a 90dB dynamic range. With 12 digital tracks, two analog tracks serve synchronization requirements.

Circle (359) on Reply Card

Multipurpose audio mixer

Mackie Designs has introduced the CR-1604 multipurpose mixer. The 16-channel system features seven aux sends per channel, 3-band EQ, true stereo solo and constant power panning. In driving the 4-bus main output, six channels include −129dBm EIN mic pre-amplifiers. Faders feature sealed rotary design.

Circle (360) on Reply Card

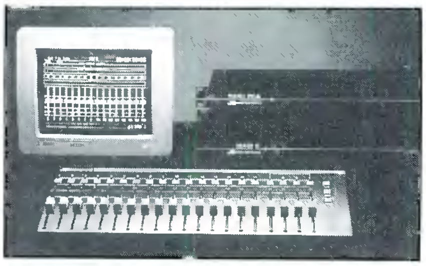
Client management software

Richmond Software has introduced the Maximizer client management database software package, which includes contact database, communications capabilities, appointment and planning calendar, personal expense records, mail merge and notepad. DOS 3.0 or above, 640k RAM and a hard drive or dual 3.5-inch floppy drives are recommended.

Circle (361) on Reply Card

Console automation

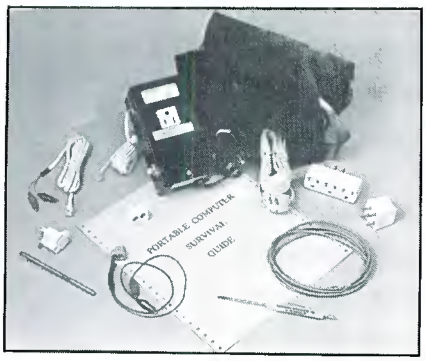
J.L. Cooper Electronics has introduced the MAGI II for Apple Macintosh or Atari ST PCs. It offers audio mixer automation with SMPTE time-code accuracy. The system consists of rack-mounted VCAs, a controller unit, remote fader unit and software for 16- to 64-channel configurations. An interface to existing VCAs also may be used.



Circle (362) on Reply Card

Computer accessories

Electronic Specialists has introduced the portable computer survival kit that contains adapters, tools and cables for use with traveling computers. The kit also features the RJ-11 Tee and 4-pin to RJ-11 adapters for telephone line use and 2-prong to 3-prong adapter plugs.



Circle (363) on Reply Card

Satellite equipment

IDB Systems has introduced the AMSET antenna-mount satellite earth terminal and MACS-50 control system. AMSET locates low- or high-power amplifiers, power supplies and RF upconversion equipment, as well as monitor and control interfaces, at the antenna, easily accessed from the ground or rooftop antenna-mounting location. Redundant and non-redundant packages have multiple transponder capability. MACS-50 includes an earth-station controller and command console with microprocessor-based automatic redundancy switching and interface to the earth-station equipment. The controller may be used in slave or stand-alone configurations.

Circle (364) on Reply Card

Circle (82) on Reply Card

Antiglare screen

Opto-Technics has introduced the Glare Eliminator kits. They provide an anti-reflective optical coating for computer terminal or video monitor screens. The coating applies directly to the faceplate of the CRT, and does not alter the appearance of the monitor or impair the field of view of the screen.

Circle (365) on Reply Card

Console software options

Orion Research has introduced three options for the NewsMaker software-based audio consoles. Fault Recover System (FRS) protects against power failures with redundant CPUs and power supplies, an automatic switchover module and "Last Image Recall" recovers the last system configuration. An MM-16 mix-minus matrix extends any NewsMaker console with an additional 16 mix-minus sends, while incorporating the status of all sends into the console ReMem memory files. A floor stand for the consoles provides space for a meter panel and external signal processors.

Circle (366) on Reply Card

SCA receivers

SCA Data Systems has introduced the Type II MUSIC 4 receivers. They are compatible with other MUSIC 4 system equipment but exhibit improved S/N ratios and flatter audio response at lower RF levels. The 50kHz incremental channel-frequency control adapts the equipment to different market requirements.

Circle (367) on Reply Card

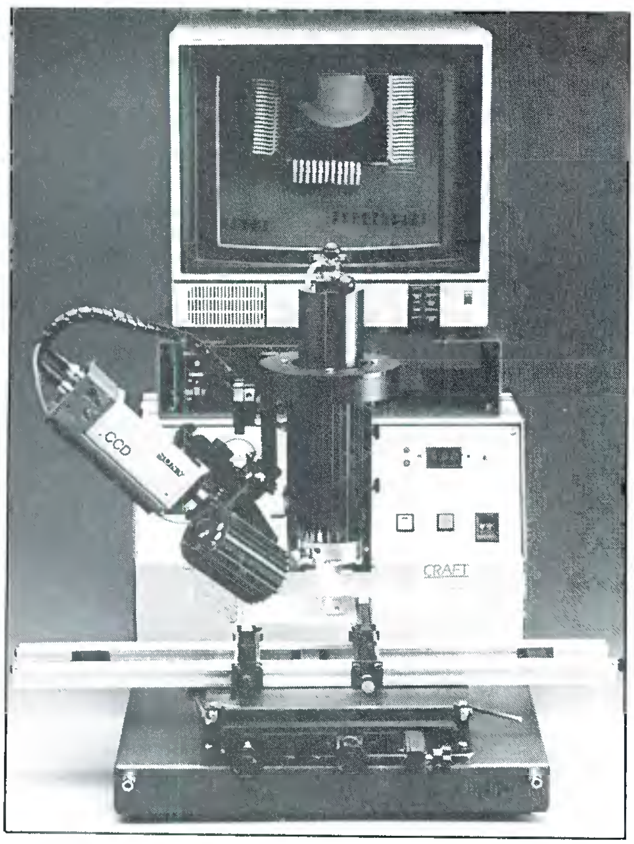
Color correction

Pandora's Other Box has introduced PRISM with POGLE, an RGB color-correction device with computer control. For film-to-tape transfer processing, the system can select from a wide range of shades of one color without affecting other shades, enabling the use of colors very close to video keying hues. The POGLE computer is needed to support the complexity of the corrector.

Circle (368) on Reply Card

SMD repair equipment

PACE has introduced the SMR-25 pulse-heat reflow system and CRAFT-15 workstation. The system provides controlled-temperature ramping to avoid thermal shock to components and substrates using SMD devices. Various handpieces and tips can be rapidly changed to meet space and component requirements. CRAFT-15 offers total thermal process control and accurate device alignment in a single-head station with temperature control between 500°F and 800°F and X–Y positioning control.



Circle (369) on Reply Card

Temporary communications service

ViaSat Technology has introduced PSAT, a Ku-band portable satellite terminal, which serves emergency or temporary communications when regular services are unavailable or interrupted. With ViaSat Dial Access Service, the PSAT unit enables private network voice, data and 1-way video communications with Hughes Network Systems' personal earth station to link the members of a remote crew with their headquarters location.

Circle (370) on Reply Card

Tape storage racks

RTI/Research Technology International has introduced a series of modular videotape storage racks with a capacity for 350 videocassettes. The double-sided, heavy-gauge steel 36-inch-width modules double the storage capacity per square foot of floor space.

Circle (371) on Reply Card

Instructional program

Reference Recordings has introduced a video standard instructional program that combines test signals with instructions for system calibration in an interactive laser videodisc presentation. Viewers learn techniques for producing high-quality NTSC video signals.

Circle (372) on Reply Card

Intercom equipment

Production Intercom has introduced three intercom products. The HS-1 headset station includes XLR connections for headset or handset units, volume controls and lighted signaling button. A wall-mount station connects to the wired intercom through a 4-pin edge connector. An LS-3 loudspeaker station supports 2-way communications automatically adjusting for press-to-talk, full-duplex with gooseneck mic or headset station operation. BLAZON adds signaling capability, using 5-second series of 70,000 candle-power strobe flashes or audio tones to command attention.

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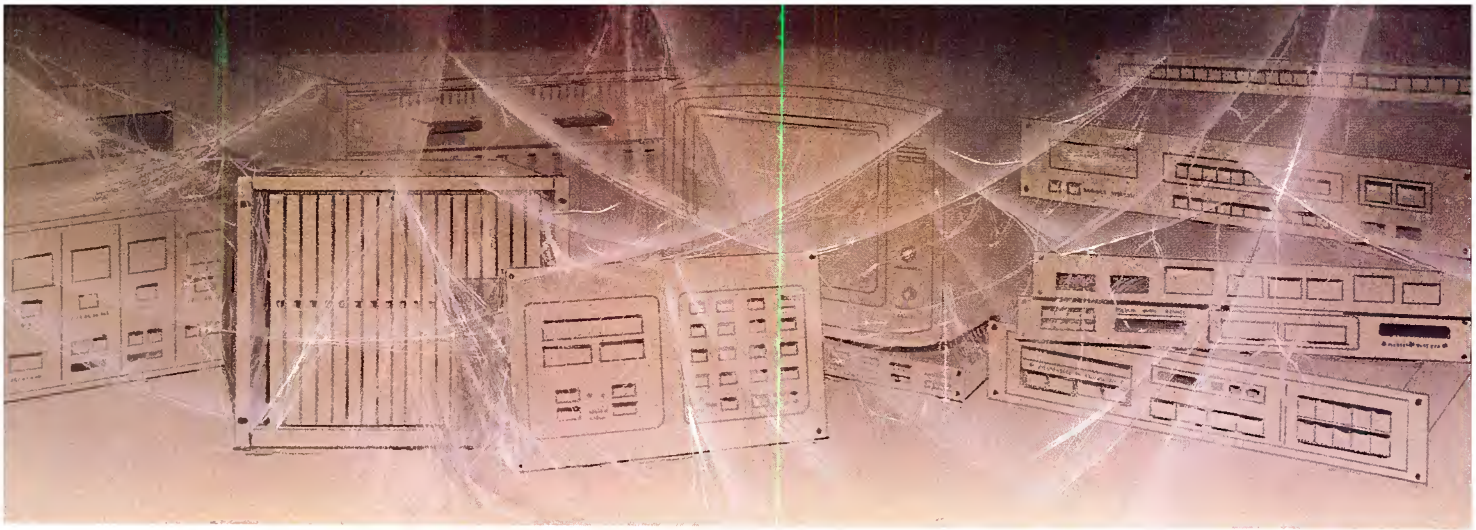

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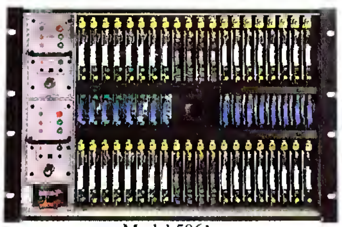

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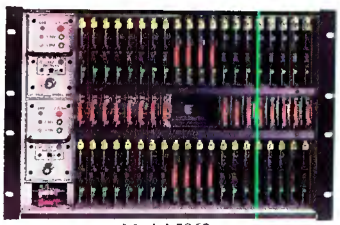

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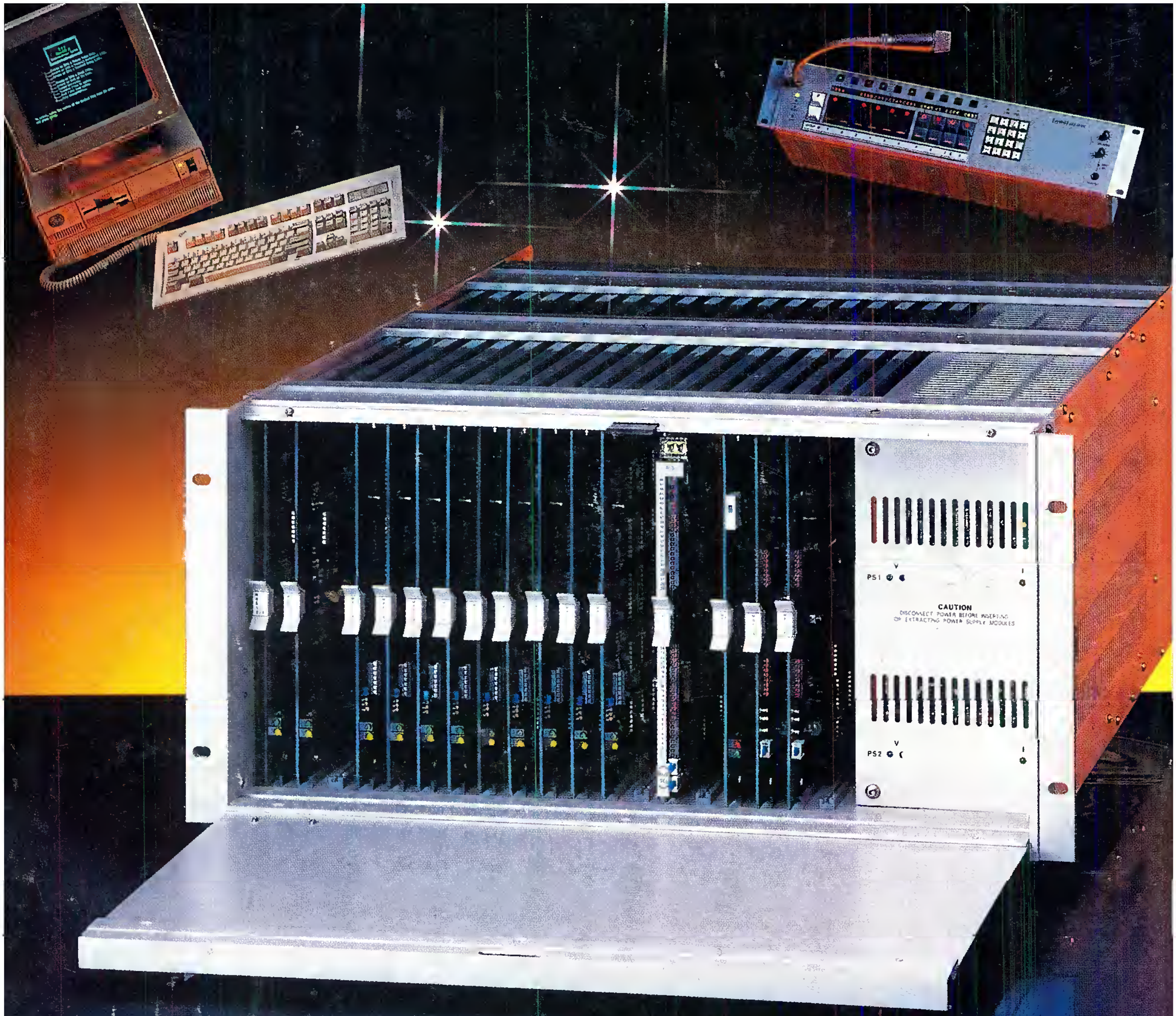

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