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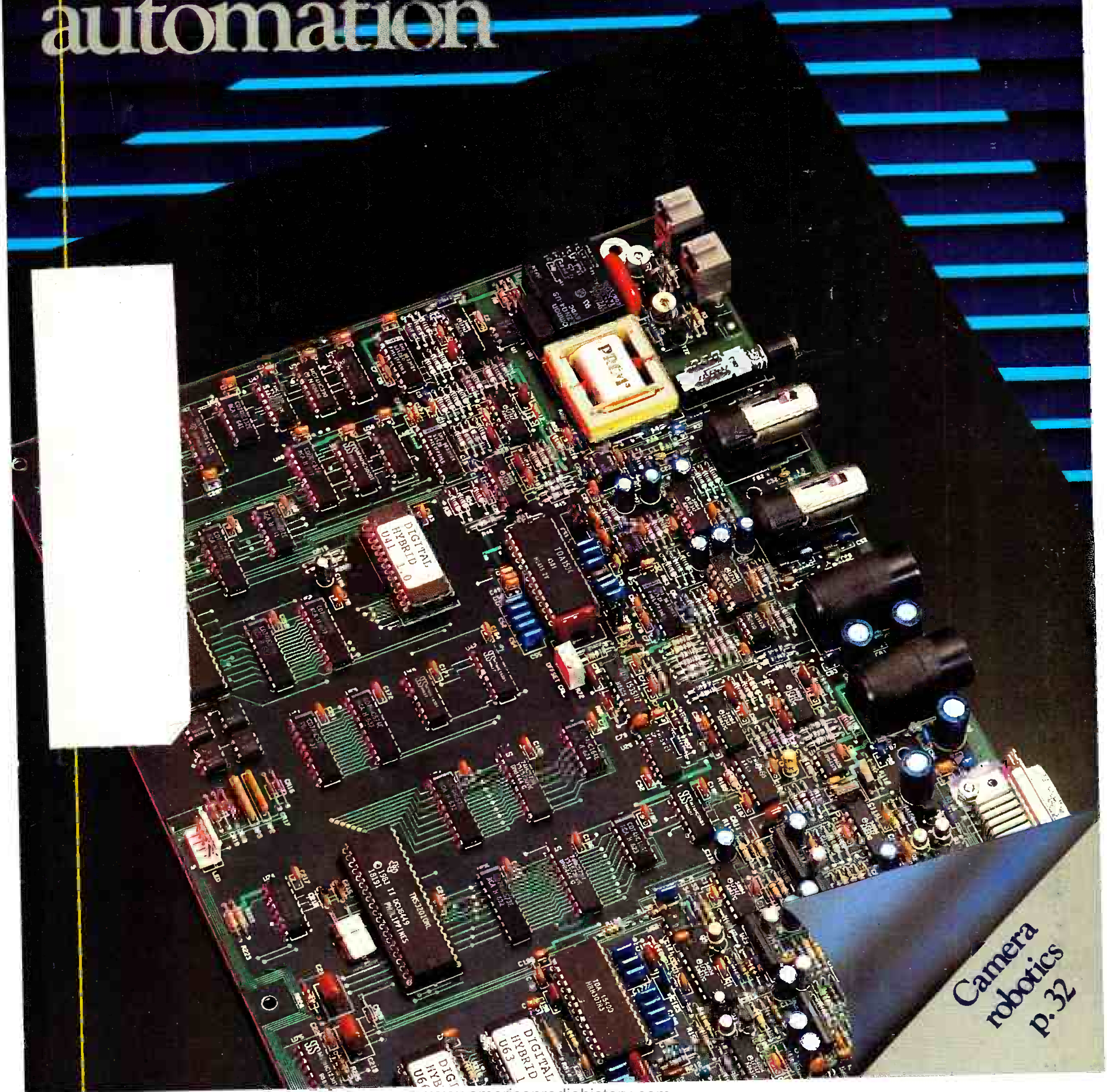
April 1988/$3

Radio/Television automation



Camera robotics
p. 32

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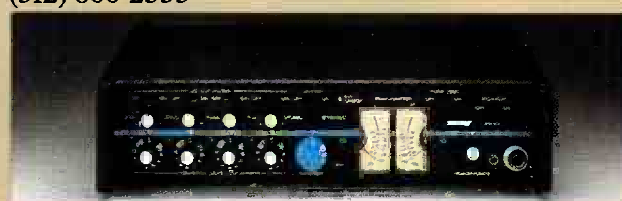

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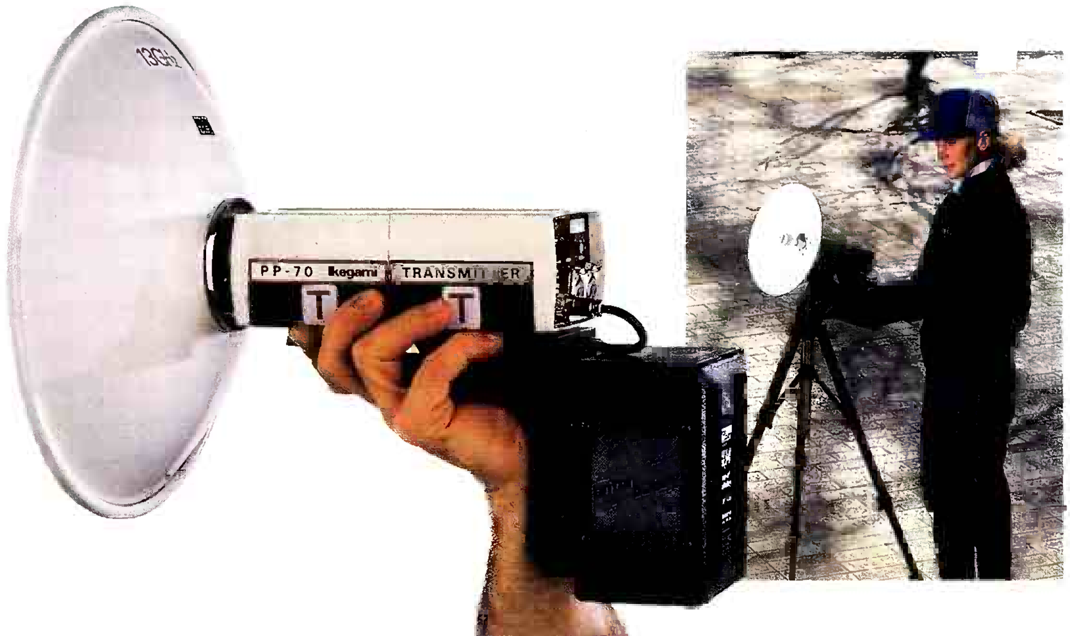

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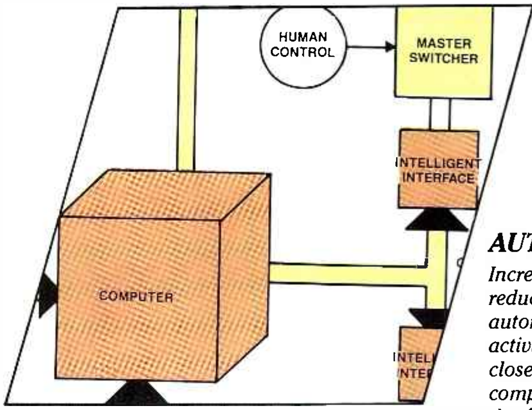

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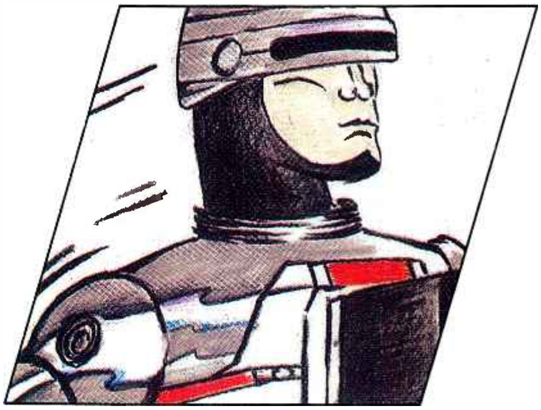

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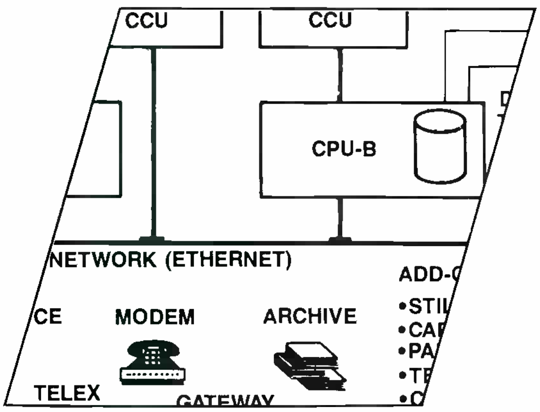

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BROADCAST ENGINEERING

AUTOMATION IN BROADCASTING:

Increased pressure on stations to improve efficiency and reduce on-air errors has led to a greater interest in automation. Using computers to manage the day-to-day activities of a facility is a complicated process that requires close coordination among all departments that will use the computer. This month we examine radio-TV automation in the following articles:

ON THE COVER

Computer control of studio and transmission equipment has reshaped the face of broadcasting and post-production. Automation systems and "smart" machines have given users new capabilities and greater efficiency. At the heart of all this development are advanced integrated circuits. (Photo by Doug Schwartz. Printed circuit board supplied by Gentner Engineering.)

DEPARTMENTS

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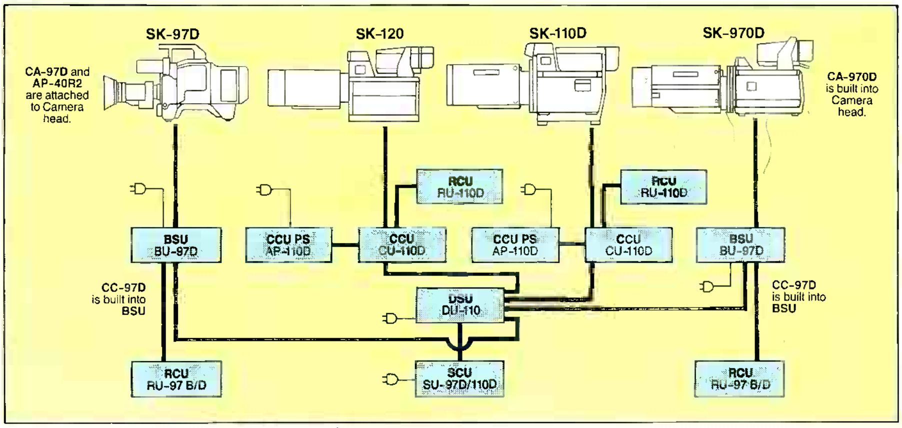
Stop sweating over G-reference setup. With Hitachi Zero Method automatic setup, no adjustments are required. Just fire up, press the auto setup button and within minutes you're ready to shoot. It's that simple.



How Hitachi's SU-97D Auto Setup Control achieves simultaneous setups on four different camera models. System can expand to set up and control 42 cameras.

Rear panel on Hitachi's SK-970D camera. Complete controls for automatic setup and camera operation.

Even better, Hitachi's SU-97D Auto Setup Control Panel can simultaneously and automatically set up as many as 42 cameras. Not only does the SU-97D achieve identical perfect setups on SK-970D and SK-97D cameras, it can also control auto setup of Hitachi SK-110D and SK-120 cameras (see chart).

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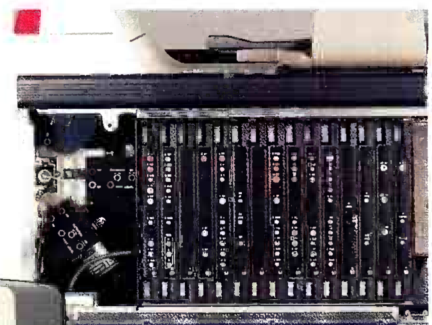

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Klystrode transmitters to begin on-air service

Construction is under way on two separate UHF-TV transmitting plants incorporating Klystrode-equipped transmitters. The 120kW units are being constructed for the Georgia Public Telecommunications Commission (GPTC), an affiliate of PBS, by Comark Communications. The work is the culmination of years of research and product development by Comark and Varian-Eimac.

GPTC operates nine TV stations, six of which are UHF stations. The organization's decision to buy the Klystrode-equipped units was based on the efficiency advantages of the new design. Klystrode technology offers substantial power consumption economies over existing pulsed-klystron UHF-TV transmitters. Power savings was a critical factor and the major incentive for developing the Klystrode tube and its supporting system technology.

The first 120kW Klystrode transmitter for GPTC will go on the air in June at the commission's station in Wrans, GA. The second transmitter is scheduled to go on-line by Aug. 31, in Pelham, GA.

The improvement in efficiency achieved by the Klystrode over a conventional klystron results from the operating class possible from the device. The Klystrode, which draws from both tetrode and klystron technology, operates in a Class B mode. The amount of power taken from the power supply is a function of the applied RF signal's video modulation level.

Conventional klystrons operate in Class A, requiring constant dc input power regardless of RF drive. Beam pulsing provides improved efficiency for a klystron, but the most successful applications of pulsing have yielded a figure of merit of about 77%.

In Class B operation, the RF drive automatically controls the beam current. When the video is at white level, the beam current is low. Power consumption increases toward the black level.

For 64kW peak-of-sync power output, the peak instantaneous beam current is approximately 3.9A when using a Klystrode. At black level, it is 2.7A and at middle gray levels, the beam current drops to just 1.4A. Under these conditions, a figure of merit of 123% is achieved for the Klystrode.

It has been estimated that use of a Klystrode device in high-power UHF transmitters will reduce utility power bills by half.

West German DBS program set back

By Howard Head

West Germany's direct broadcast satellite (DBS) TV SAT-1, which would have been Europe's first "true" (high-power) DBS service (see February 1988 **BE**), has failed. The satellite couldn't develop the power needed to drive the five 200W TWT power amplifier tubes for high-power broadcast service. The fault was with the solar pan-

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BROADCAST ENGINEERING

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For Product Information Circle (6) on Reply Card

Engineering for utility

Marketing people embrace a concept that boils down the reasons people buy things. It is called "utility," and it has four faces:

- *Place utility*—having what you want, where you want it;
- *Function utility*—accomplishing what you need to;
- *Need utility*—satisfying a desire; and
- *Time utility*—having what you want, when you want it.

Look at anything people purchase, from pet rocks to space shuttles, and you'll see they buy to achieve one or more of these utilities.

Once, television was king, hitting each utility squarely. Television brought the pictures and sounds of the movies into the home (place). Television informed and entertained its audience and provided an advertising vehicle (function). The audience found that it was enviable to own a TV set, then a color one, then a portable one for the kitchen, and finally an MTS-equipped big-screen unit with a cherry-wood cabinet (need). Television immersed homemakers in the midday "soaps," played cartoons for the kids after school and dished up the evening news at suppertime (time). Broadcast television was the only source for this in-home video wonder.

But nobody ever leaves a good thing alone. Instead, buzzardlike competitors swarmed about, stealing bites from the TV plate. First it was cable. It offered all the advantages of off-air television and, in earlier incarnations, CATV brought broadcast signals into many homes that had previously been geographically unreachable. But then cable mutated and began offering services that regular broadcasters couldn't (need). And, finally, cable betrayed its host by attempting to derail must-carry regulations.

Along came VCRs, a slick way to archive favorite TV shows for later viewing (time). VCRs have since gone on to compete with broadcasters by way of the neighborhood video store. After all, the viewer who is watching a videotape isn't watching the evening news. VCRs also made it possible to attack telecasting at the jugular, via "commercial zapping" with the fast-forward button.

Now, broadcast television is facing issues of quality. S-VHS, ED Beta, hi-fi VHS, surround-sound encoding, IDTV and HDTV all threaten to offer the viewer a better-looking, better-sounding product than broadcasters can provide. The only unique facets of broadcast television would be its immediacy—reporting live, from the scene (time)—and its ability to send a signal without wires or a monthly fee (place). It would be quite a dethroning for the king.

But it doesn't have to be that way. TV stations can embrace new technologies to hold their audiences. New encoding systems can increase greatly the quality of the broadcast signal. Multichannel TV sound can present high-quality audio through the same speakers used by the viewer's hi-fi decks. Closed captioning and second-language (SAP channel) programming can be an incentive for sizable chunks of audience to choose broadcast television over competing services. (Some experts say that 5% to 15% of Americans could benefit from closed captioning. The popularity of second-language programming depends on the local marketplace.)

Stations also can use new technologies to capitalize on television's immediacy. Teletext, for instance, is a companion service to existing television for which ads can be sold. One teletext-equipped station, KSL-TV in Salt Lake City, transmits updated election returns as soon as the state counts the votes. At other times, the teletext sends a stocks and commodities wire, in addition to a news magazine.

Television needn't sink to a demeaning secondary status, as some cynics predict. But it won't remain king just by commanding it to be so. If we want to hold our share of the market, we must provide our customers with what they want, and what they can't find elsewhere. It may take effort, and it will certainly take investment, but we must do it to keep ourselves bright in the eyes of the viewer. To keep the viewers watching, we've got to give them utility.

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Minority preference system reactivated

By Harry C. Martin

In three separate adjudicative cases, the FCC has reactivated its minority and female preference system by reaffirming decisions applying the preferences. These cases had been held in abeyance pending completion of an inquiry proceeding into the constitutionality and efficacy of the race and gender preference system. The commission terminated its inquiry because of a congressional directive in December. Following are summaries of the three decisions affirmed as a result of reinstatement of the preference system.

• *St. Simons Island, GA*: The commission review board granted an application based on an award of a "female" preference. Subsequently, the U.S. Court of Appeals for the District of Columbia Circuit ruled that the female preference policy was invalid but later granted a petition for rehearing *en banc*. The case then was remanded to the commission pending resolution of its general inquiry into the race and gender preference system.

Because the inquiry was terminated, the case has been sent back to the court for final disposition. If the court affirms its prior ruling, the gender preference (but not the minority preference, which is not at issue in this case) could again be invalidated in comparative hearings.

• *Orlando/Winter Park, FL*: The winning applicant received a slight gender preference and a substantial minority preference on the basis of proposed participation of females and blacks in station management. This case also was remanded to the commission pending outcome of its general inquiry proceeding. It will go back to the Court of Appeals for final disposition. One of the issues that will be heard is the constitutionality of the minority preference system.

• *Hartford, CT*: The commission granted the request of a TV licensee to assign its facility to a minority-controlled group under the "distress sale" policy. That policy permits a licensee facing a hearing on character issues to sell its station prior to hearing if the sale is to a minority-controlled entity and the sale price is at least 25% below the appraised value of the property.

The Hartford distress sale was attacked by a group that was prevented by the sale from prosecuting an application in competition with the seller's renewal. With the reaffirmation of the commission's decision approving the distress sale, it will be up to the court to decide whether the underlying policy is constitutional.

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

Problems/programs listing conformed

The commission is proposing to conform the public file rule for commercial and non-commercial licensees to require both to prepare quarterly lists of five to 10 issues of importance in their communities and programs which, in their judgment, represent their stations' *most significant treatment* of those issues.

Commercial licensees already are expected to list programs that represent their most significant treatment of local issues, whereas non-commercial licensees are required to list "typical and illustrative" programs directed to community problems. By changing the standard for non-commercial licensees, the commission hopes to promote uniformity in its regulatory program and to eliminate confusion regarding broadcasters' public interest obligations.

All broadcast stations are required to place listings of issues and responsive programming in their public files on or before Jan. 10, April 10, July 10 and Oct. 10 of each year. The lists must cover issues of concern and responsive programming during the previous quarter.

Carroll Doctrine and "UHF impact" policy rescinded

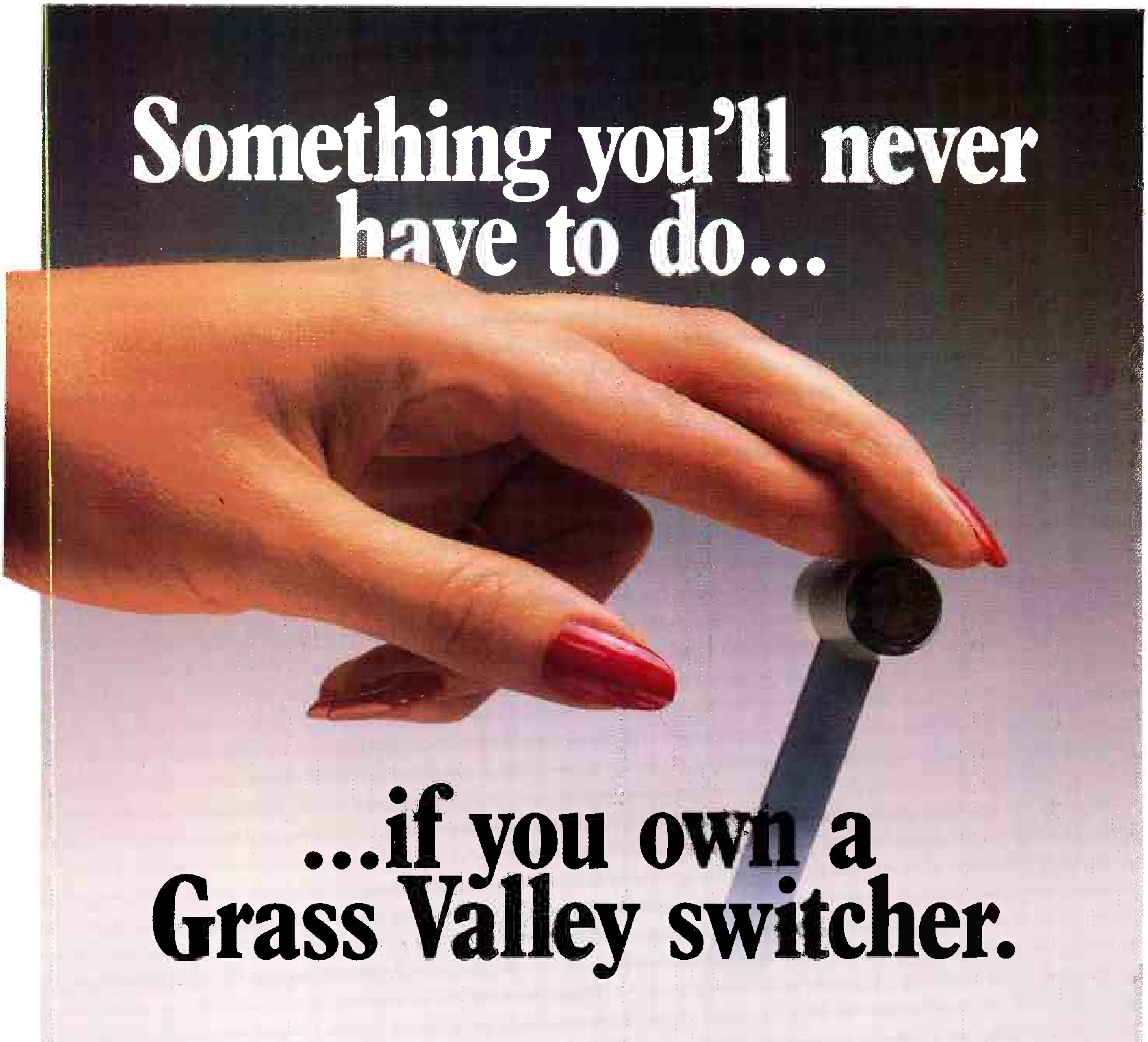
In an order released in February, the commission eliminated its Carroll Doctrine and UHF impact policy. Under these policies, applications for new stations or upgraded facilities could be opposed by local broadcasters on the basis that the new competition would destroy the existing station's ability to survive and to serve the public interest.

The commission said it had found no instance in the 30-year history of the Carroll Doctrine in which a new service had been denied on the grounds of harmful competition to existing stations. In more than 80 cases involving claims of Carroll injury, no petitioner had been able to demonstrate sufficient evidence to warrant a finding of harm. Also, the commission found that the doctrine conflicts with its general policy of relying, whenever possible, on market forces rather than on government rules to regulate mass media industries. The agency also said repeal of the doctrine will eliminate a vehicle that has delayed service to the public through time-consuming litigation.

Under the UHF impact policy, the commission scrutinized the effect on existing UHF services of proposed new or improved VHF services. The policy was adopted to further the development of UHF service at a time when UHF stations were at a significant disadvantage, both economically and technically, to VHF stations.

However, the commission has concluded that the economic condition and environment of the UHF service have improved dramatically since the UHF impact policy was adopted. This improvement is seen to be a result of the overall growth of the TV market as well as commission requirements for changes in TV receiver designs.

In 1962, the commission adopted rules requiring that all TV receivers be capable of receiving UHF as well as VHF signals. In the early 1970s, the commission required TV receivers to have UHF tuners with capabilities more comparable to those of VHF tuners. By 1976, the commission was requiring that TV receivers be equipped with a UHF antenna. In addition, the commission noted, UHF stations now have the same opportunity for cable carriage as VHF stations. With the disparities largely eliminated, there is no longer a need for special protection policies applying to UHF.



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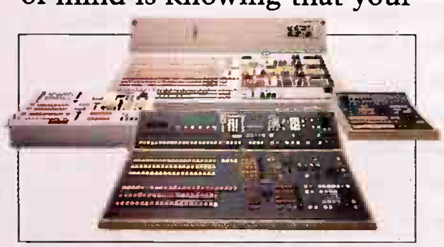

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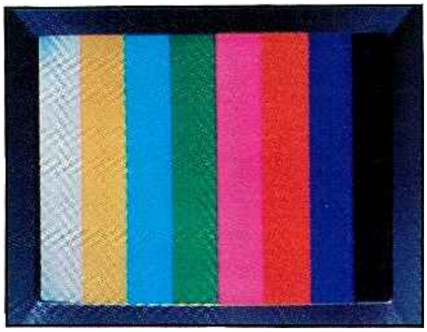


Y/C systems require new test signals

By Dietrich "Rick" Seaman

The new S-VHS and ED Beta formats have promised "better-than-broadcast" recordings, partly through improved bandwidth and partly through separation of luminance and chrominance. If used throughout the system, from camera to monitor, separate Y and C yield good pictures. However, Y/C equipment can have problems that conventional NTSC test signals do not reveal.

Consider the modulated ramp used in NTSC for checking differential phase and differential gain. Normally, differential gain means the gain change of a constant amplitude chrominance signal as the luminance on which it is riding is ramped from 0IRE to 100IRE. Differential gain in a Y/C system means that luminance and chrominance never meet (except indirectly on the video track). Therefore, an S-VHS recorder could show nearly perfect differential phase and gain response but still have non-linearities. A modulated ramp is simply the wrong signal for displaying them.

The butterfly signal

A new signal, called the *butterfly*, measures video non-linearities in S-VHS and ED Beta recorders. The signal has three elements: a 0-to-100IRE luminance ramp, two shallow luminance ramps and two saturation ramps. See Figure 1(a).

With a 0-to-100IRE luminance ramp, luminance non-linearity can be checked using a differentiating network. These networks are built into some high-end waveform monitors, or they can be fabricated locally. Because a linearly increasing voltage differentiates to a constant amplitude line, a non-linearity will bow the line and is expressed as a percentage of the maximum amplitude. Alternatively, measure luminance non-linearities with an oscilloscope or waveform monitor with an A–B mode. Subtract the original ramp from the tested device's output. If the amplitudes are correct, any difference between inputs is system non-linearity.

In addition, two shallow luminance ramps centered at 50IRE display non-linearities in analog-to-digital and digital-to-analog converters such as those used in TBCs. The slowly changing ramps step through 10% of the generator's full 180IRE output range and reveal converter errors as steps or glitches in the ramps.

To test for gain and phase non-linearities in the chrominance channel, the signal has two saturation ramps that appear as a straight line on the vector display from 75% red (87.7IRE), through zero, to 75% cyan. See Figure 1(b). These chrominance levels should pass through the system undistorted.

Phase distortion shows up as crookedness in the vector display. Measure by rotating the phase control until the ramp vector lies horizontal, and reducing the gain until the ramp's end lies at 40IRE. Then, in differential phase or R–Y mode (many waveform/vector monitors have this display), measure differential phase at one end of the ramp and read the phase error in degrees from the graticule.

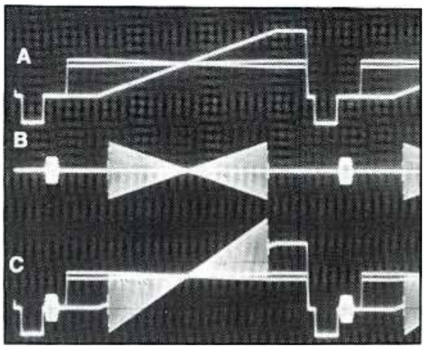


Figure 1. The butterfly signal for checking non-linearity in Y/C recorders, consisting of (a) the luminance channel and (b) the chrominance channel, yielding (c) the A–B combination of luminance and chrominance. The crossed ramps are markers for ±10% amplitude distortion.

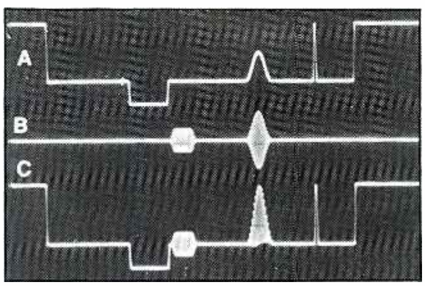


Figure 2. Interchannel timing is measured by combining the (a) luminance and (b) chrominance outputs to form a (c) 12.5T modulated chrominance pulse. In this case, the chrominance signal is advanced by 170ns.

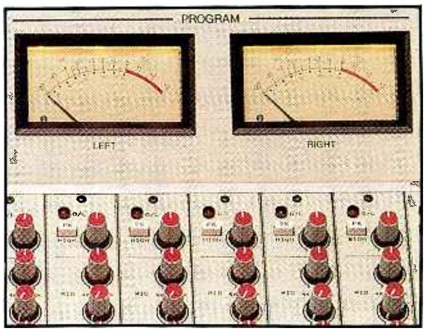
Amplitude non-linearity in the chrominance channel is seen as crookedness in the saturation ramp envelopes and can be caused by a too-high chrominance record drive current. To measure this distortion, combine the chrominance signal with the luminance signal, either with the A–B input mode on a waveform monitor or oscilloscope or, although it is less accurate, by using the VTR's NTSC output. (If possible, combine the luminance signal directly from the generator with the chrominance playback from a gen-locked VTR.) The luminance and chrominance ramp slopes were chosen so that, when they are added, one edge of the chrominance envelope makes a horizontal line, as shown in Figure 1(c), with any non-linearity showing up as a tilt. The two intersecting luminance ramps denote ±10% amplitude distortion.

Measuring interchannel timing

Interchannel timing measurements also require new test signals. Use the Y/C version of the NTSC 12.5T pulse by combining the Y and C outputs. See Figures 2(a) and 2(b). If all is correct, the pulse baseline will be straight; if it is not correct, an amplitude or timing difference will occur between the two channels. Too little chrominance will make the baseline bow up, and too much chrominance will make it bow down. A timing difference causes a single cycle of ripple in the baseline, as shown in Figure 2(c), thickening the pulse's leading or trailing edge, depending on whether the chrominance is advanced or delayed. One IRE unit of peak-to-peak ripple in the baseline indicates 10ns of timing difference.

Other special Y/C test signals have been created to align the Y/C comb filters at the VTR's NTSC input, to measure the chrominance channel frequency response, to adjust video noise-reduction circuitry and to view the interaction (moire patterns) between the FM luminance signal and the color-under subcarrier.

Seaman is a sales engineer with Magni Systems, Beaverton, OR.



Reducing AM band skywave interference

By John Battison, P.E.

Because so much information about directional systems has been published in recent years, many broadcast engineers have become familiar with the design theory for directional antennas. It is well-known that the actual field produced at any given point *P* in space is the sum of two or more signals differing in phase and magnitude arriving at this point.

This signal determines the field strength measured at point *P.* One aspect that is sometimes overlooked is that close-in to a directional antenna, at distances of less than 10 times the operating wavelength or tower spacing, the pattern has not developed. Measurements within these distances will not provide much indication of the pattern's shape or size. For this reason, most DA measurements start at this point. Some research is under way on nearfield values.

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

Measurement of vertical radiation on DAs seldom is performed because of the difficulty in determining the measurement point and the distance. Even helicopters are not well-suited to checking radiation around TV antennas. It would be nice if there were an effective, repeatable way to check the high-angle radiation from tall and short towers.

Some engineers forget that the intermingling of ground and reflected waves produces what is often called the *fading wall.* This is the area where the skywave begins to arrive with a higher field strength than the groundwave. Generally, usable reception is obtained if one signal is at least twice as strong as the other. In the fading wall area, the varying skywave interferes with the essentially steady groundwave. The varying skywave arrives with rapidly changing phase and amplitude and often is several times stronger than the groundwave. See Figure 1.

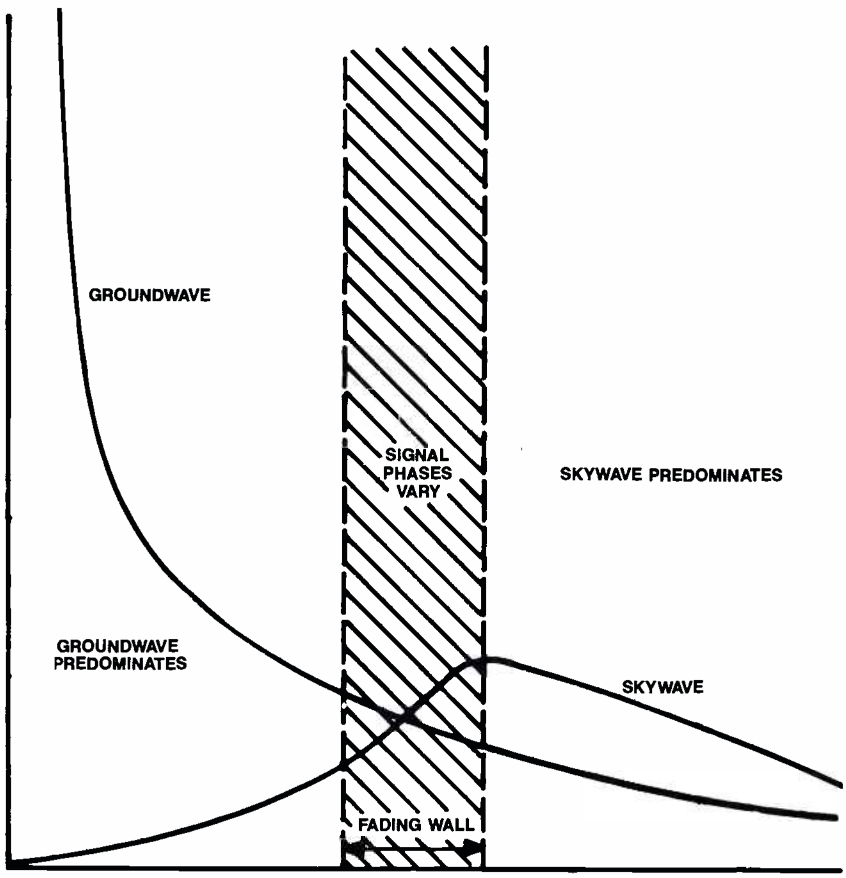


Figure 1. *Effect of skywave on groundwave service. As the skywave is reduced, the groundwave service area often can be extended. The shaded area represents the fading wall, where signals from at least two sources are received. In this area, the ratio of ionospheric wave to groundwave changes continuously.*

As the field intensity and phase of the skywave varies, it reinforces and diminishes the groundwave, producing signal variation. Selective frequency fading, in which the actual bandwidth of the received skywave signal varies, also occurs. This results in uneven reception of frequencies across the receiver band. This phenomenon emphasizes some audio frequencies and reduces others, with the subsequent *screeching sound* typical of skywave reception. The farther out the fading wall can be maintained, the greater the groundwave interference-free area.

New designs

Various means of reducing high-angle radiation are now under examination. Two test antenna designs, one by Richard Biby and one by Ogden Prestholdt, are the latest attempts to reduce skywave interference by controlling high-angle radiation. The NAB hoped to build and begin testing at least one of these antenna designs in 1987. Unfortunately, various land-use zoning restrictions delayed these plans.

Another promising line of attack against high-angle radiation is vertical stacking of antennas with multi-elements in the vertical, rather than horizontal, plane. A lot of work on this type of antenna has been done by Carl E. Smith, P.E.

Although AM antenna designs have remained unchanged for many years, there is great hope that new techniques can be developed to reduce skywave interference. This technology could be a great boon to the entire AM band.

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IMPEDENCE: 100 ohms (designed to drive 600 ohm load)
LEVEL: (adjustable): < - 20 TO + 20 dBm

FREQUENCY RESPONSE: 50 HZ TO 15 kHz: +/- 1 db

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OPERATE MODE: < 0.15%. 50 Hz - 15 kHz typical

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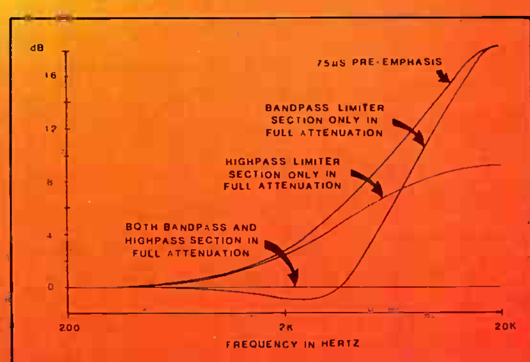

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Basic operations of modern satellites

By Elmer Smalling III

Early satellites, such as the ECHO balloons and Explorer series, orbited the earth at about 300 miles. Expensive computer-guided hardware tracked them as they rose on one horizon and set on the other. In contrast, today's geostationary satellites are placed 22,300 miles above the equator, moving at a speed in step (or synchronous) with the earth's rotation. Elaborate tracking hardware is not necessary because from earth, these satellites appear stationary.

Types of satellites

There are two types of modern communications satellites. One is the *spin-stabilized* satellite, which gets its orbital stability from the on-axis spinning mass of the spacecraft. An object that weighs almost a ton and spins rapidly has a tendency to remain stable, like a top or gyro. Some of this spin is imparted to the satel-

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

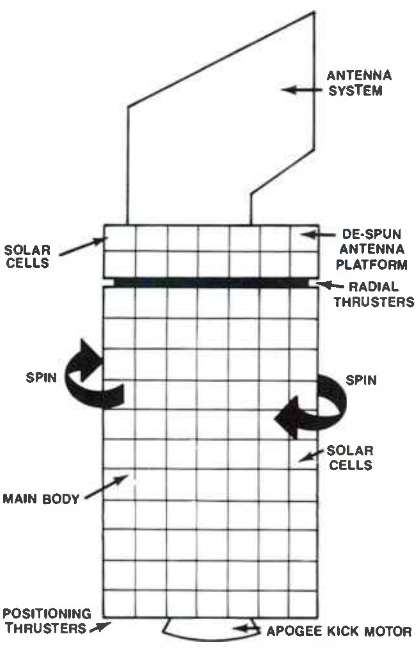

Figure 1. *The spin-stabilized satellite has a rotating-drum, stabilized antenna platform. The mass of the drum provides orbital stability. The drum surface is covered with photocells for satellite power.*

lite as it leaves the launch vehicle. After it gets into its orbital parking place, or *box*, the satellite fires radial thrusters mounted on its side to achieve and hold a velocity of 50rpm to 60rpm. A *despinning* system, basically an electric motor that counter-rotates the platform to negate the spin, keeps the satellite's antenna platform pointed toward the earth.

The second type of satellite is the *3-axis*

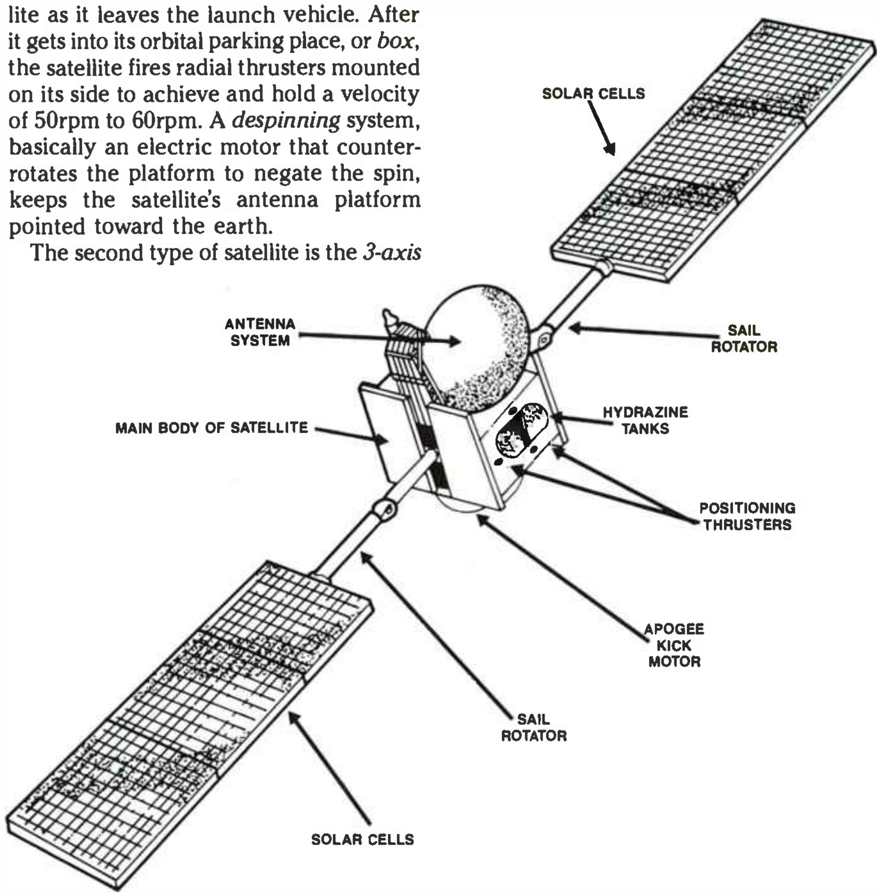

Figure 2. *The 3-axis stabilized satellite uses an internal inertial wheel for stability. Solar cells are mounted in large panels or "sails."*

stabilized unit. The stability of this satellite is a function of an inertial wheel, a large gyro buried inside the ship. This wheel, along with *magnetic torquers*, which are coils of wire in the spacecraft that react with the earth's magnetic field, controls the craft's attitude.

Orbital corrections and spacecraft power

Forces such as the gravitational pulls of the earth and moon and the collisions of solar wind particles, may perturb the attitude and orbital position of the satellite. Attitude adjustments by the inertial devices often are performed automatically by the on-board electronics. Grosser adjustments require the use of hydrazine thrusters located on the periphery of the spacecraft. These generally are ground-controlled. For the precise alignment of earth stations, satellite operators provide *center-of-box bulletins* that state times at which the satellite will be centered in its orbital slot.

Solar cells are mounted around the spinning hull of a spin-stabilized satellite so that sunlight always is present to provide power. The solar cells are mounted on panels or *sails* on a 3-axis stabilized unit. These can be turned, by electric motors, to provide the best angle with respect to the sun. Twice a year the satellite is eclipsed by the earth, and on-board batteries are used to power the craft.

Next month, we'll look into the on-board electronics used for communications and control.

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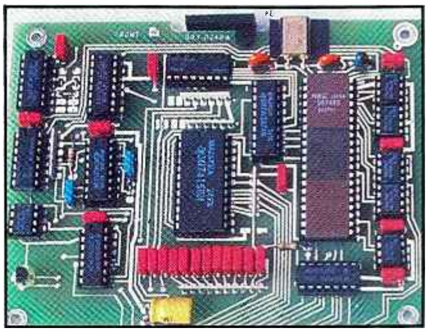
Part 19

Circuits



Inside digital technology

By Gerry Kaufhold II

In digital circuits, integers and fractions are expressed as powers of two. Powers of two are used as multipliers to the left of the binary point, and as divisors to the right of it. Sixteen binary bits can express integers as large as 65,535 or fractions as small as 1/65,535. This seems to be a wide range of numbers, but it is inadequate for most engineering work. Many frequency measurements are made above 1MHz, which is 10 times the highest integer 16 bits can express. The group delay of modulated microwave signals is measured in nanoseconds, orders of magnitude smaller than 16 bits can express.

Expressing large or small numbers

To save space and time and to prevent errors, large or small numbers can be expressed in *scientific notation*. This system breaks each number into two parts: the number itself and an exponent.

First, write the letter *E* to the right of the number. This E represents the number 10. Write a zero after the E. Now, move the decimal point one digit to the left, and add one to the zero after the E. Move the decimal point one more place to the left, and increase by one the number after the E. Continue until either a one remains to the left of the decimal point or all the digits are used up.

The number to the right of the E is called the *exponent*. The exponent indicates how many times the number to the left of the E must be multiplied by 10 to recreate the original number.

For example, 10,536,500 = 1.05365 E +7, and 7,536,612 = 0.7536612 E +7. (Note that a leading zero is inserted in numbers that do not have a leading one. Also note the plus sign in front of each exponent.)

Sometimes numbers written in scientific notation are referred to as *floating-point* numbers because the decimal point has been "floated" to a new location during the conversion process.

Small numbers are dealt with in a similar manner. The letter E is placed to the right of the number. Move the decimal point to the right, past each of the leading zeros, decrementing (subtracting one from) the number to the right of the E as each zero is passed.

Because the exponent's value begins as zero, decrementing makes the resulting exponent a *negative integer.* Stop when either a one is the only digit remaining to the left of the decimal point or no other digits remain to shift. For example: $1\mu F = 0.000001\mu F = 1.0\ E\ -6\mu F$, or $10\mu H = 0.000010\mu H = 1.0\ E\ -5\mu H$.

Advantages

One advantage of scientific notation is that all numbers will be in the same format. All will be comprised of either a one or a zero followed by a decimal point, then the digits of the number, followed by the letter E and the value of the exponent. Scientific notation also simplifies multiplying and dividing. To multiply two very large numbers in scientific notation, multiply the two decimal numbers, then add the exponents:

$$1.05365\ E\ +7 \times 0.7536612\ E\ +6 = 0.79409512\ E\ +13.$$

To multiply two very small numbers in scientific notation, multiply the two decimal numbers, then add the two negative exponents:

$$1.0\ E\ -6 \times 1.0\ E\ -5 = 1.0\ E\ -11$$

To divide two very large numbers, divide the decimal portion and subtract the exponents:

$$1.05365\ E\ +7 \div 0.7536612\ E\ +6 = 1.398041\ E\ +1.$$

Subtracting two negative integers is the same as adding one negative integer with one positive integer:

$$1.0\ E\ -6 \div 1.0\ E\ -5 = 1.0\ E\ -1.$$

Disadvantages

Scientific notation makes it easier to perform arithmetic with large or small numbers, but there are some drawbacks, primarily loss of precision. If the numbers involved suffer from round-off errors (discussed in last month's column), then scientific notation is a trade-off between accuracy and simplicity. If the exponents of the numbers are widely dissimilar, the round-off error could be significant. The other obvious drawback of using this system is the complexity of changing all the numbers from regular notation into scientific notation.

Digital circuits and scientific notation

Decimal numbers are first converted into binary equivalents. To minimize bits required in arithmetic circuits, some conversion programs first convert the input decimal numbers into floating-point decimal numbers. Subsequent software programs translate each floating-point decimal number into its equivalent binary floating-point number.

Errors in this process can be minimized by using more than 16 bits to represent the floating-point numbers. Most computers use 32 bits for each of them. The left-most bit is the *sign bit* of the number. A positive number's sign bit is zero. A negative number's sign bit is one. The following 23 bits express the decimal number, and the 25th bit is the sign bit of the exponent. If the number represented is greater than or equal to one, the sign bit of the exponent is zero. If the number represented is less than one (a fraction), the sign bit of the exponent is one. The remaining bits are the absolute value of the exponent.

For most computer work, if the left-most bit of any number is zero, that number is assumed to be positive. If the left-most bit is one, that number is assumed to be negative.

Two error sources exist for circuits using floating-point numbers: conversion errors that result from using too few bits to represent the decimal number, and round-off errors occurring during arithmetic operation.

Occasionally, computers extend the number of bits used to represent floating-point numbers. If more than 60 bits are used, the system is said to be operating in *double precision*.

The number of floating-point arithmetic operations that can be completed in 1s often is used to measure computer performance. One *megaFLOP* is one million *floating-point operations per second.* Modern digital circuits are capable of five to 10 megaFLOPs. Powerful NASA computers perform hundreds of megaFLOPs.

Kaufhold is an independent consultant based in Tempe, AZ.

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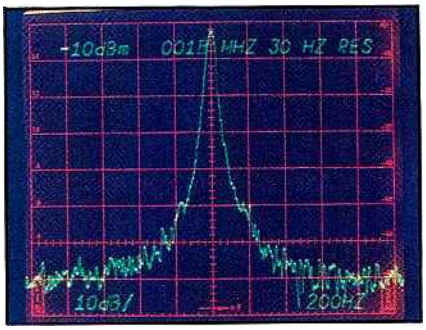
Part 1

Troubleshooting



CD player repair requires skill

By Brad Dick, radio technical editor

One of the newest pieces of equipment in the radio station is the compact disc (CD) player. CD players provide superior audio performance and can be quite cost-effective. In fact, some players are so moderately priced that they are not worth repairing.

If you can't afford to replace a failed player, however, or you want to attempt repairs, there is hope. Armed with a service manual and a good oscilloscope, you can revive a broken CD player, but be forewarned that it may be a strong test of your troubleshooting skills.

System overview

From a servicing standpoint, the CD player can be broken down into five types of circuits:

- Servos
- Optical system
- Audio system
- Control system
- Power supplies

More differences than similarities exist between compact discs and phonograph records. The CD has a diameter of 4.75 inches and is played from the underside with a laser beam. The beginning of the CD is near the center, and the laser scans outward to the disc edge as the program plays. An hour or more of audio can be recorded on a single disc.

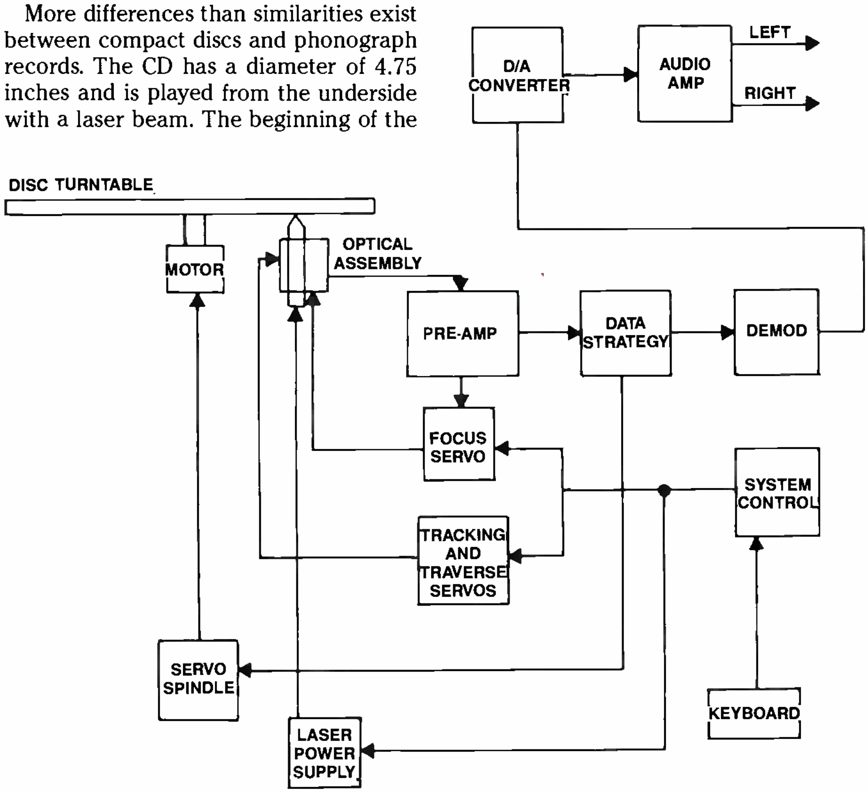


Figure 1. *Block diagram of a typical CD player.*

Servos

TV engineers may recognize some similarities between the servo systems in CD players and those in modern video recorders. Four different servo systems typically are used in a CD player. The servos control the mechanical positioning of the CD and laser optical assembly.

The *spindle servo* motor drives the turntable holding the CD. Recovery of the digital data requires that the information be read at a constant rate. The CD is scanned by the servo-controlled optical pickup at a rate of 1.3m/s. To maintain this linear rate, the rotational speed of the CD must continuously change from 500rpm at start-up to 200rpm as the scanner reaches the outside edge of the disc.

The servo cannot maintain precisely the 1.3m/s speed necessary to properly reproduce the sound. Therefore, the recovered digital information first is stored in RAM, then stepped out at a constant rate. As the RAM becomes full, the disc speed is reduced. As the memory begins to empty, the disc speed is increased to maintain a half-full condition.

The proper speed is maintained through synchronizing pulses recorded at the beginning of each digital frame. When the spindle servo motor is rotating at the proper speed, the synchronizing pulse produces a 7.5kHz signal. The sync pulse is read by the laser and compared with an internal reference. Any difference produces an error signal, which is used to correct the servo motor speed.

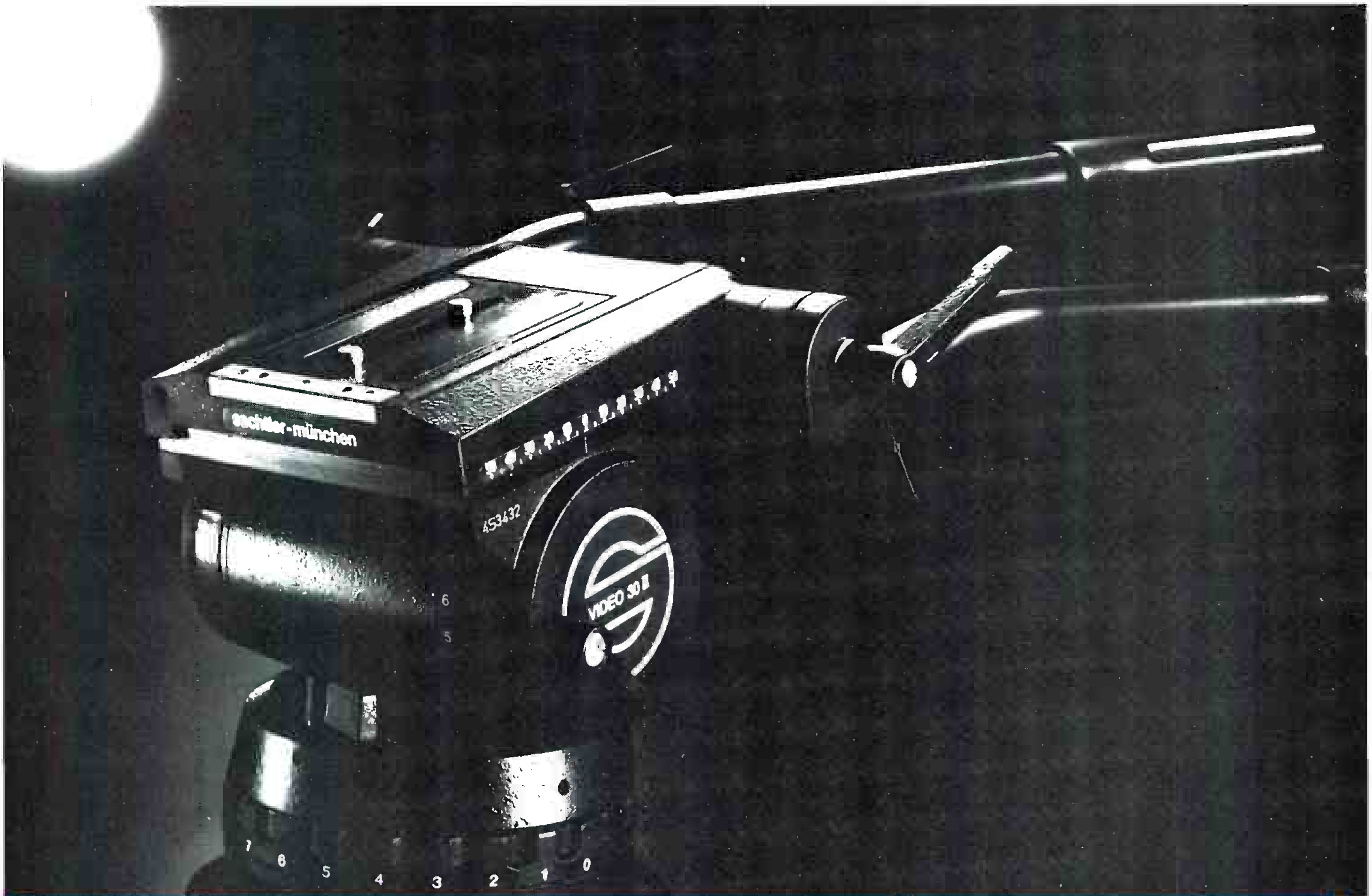
With each disc revolution, the pickup must move outward 1.6μm. To move the laser pickup assembly across the entire disc requires two tracking servos: one to perform the fine-tracking control and one to move the entire optical assembly in groups of tracks.

The *tracking servo* system keeps the laser optics correctly positioned above each track. The tracking is changed by shifting the position of the pickup system (or rotary mirror) in 1-track increments.

The *radial* or *traverse servo* performs the large-scale positioning of the entire pickup assembly. This servo is activated only when the tracks needed are beyond the reach of the tracking servo.

The *focus servo* guides the laser optics so that the CD pits are read accurately by compensating for vertical movement of the disc. As the laser beam is reflected from the data tracks, a circle should be produced on the detecting diodes. Any warping of the disc produces minor distortions in the tracks, and the circle becomes elliptical. A photodiode array detects this shape change and produces a correction voltage.

Many other aspects should be considered by anyone planning to repair a CD player. Until you are confident of the proper servicing methods, do not remove the access covers to the laser assembly. Direct exposure to a laser beam can result in permanent eye injury.



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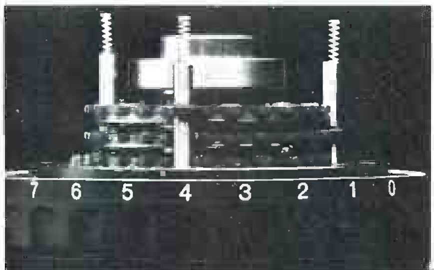

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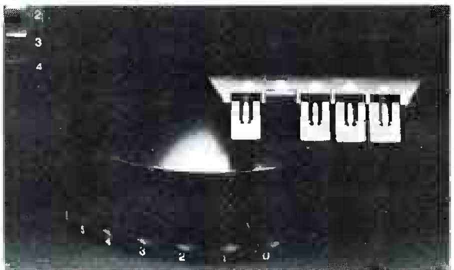

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☐ Most advanced dynamic counterbalancing system.	Yes	____
☐ Multi-step adjustment, even for latest CCD cameras.	Yes	____
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☐ Fast, accurate remounting, an ENG time saver.	Yes	____
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Part 2

Management for engineers

When your style cramps leadership

By Brad Dick, radio technical editor

Frank left the manager's office more shocked than angry. Although he'd had his share of "chewing outs" in his career, never before had he felt so disillusioned. Up until now, he had thought he knew how to manage people, but he'd just been given a month to "straighten things out or else." He didn't need to have the "or else" explained.

In last month's column, we learned of Frank's promotion to chief engineer of a major-market TV station. He was a knowledgeable engineer, well-liked by his previous staff. Yet, in this new position, it seemed that trouble was coming out of the woodwork. His crews were unhappy. The union was unhappy. The problems had reached the boiling point. The meeting with the general manager had made it clear. If he couldn't fix the problem, someone else would be given the chance.

External factors

The leadership style appropriate for a manager depends upon more than personal preference. Outside influences, such as the company philosophy and the past experiences of your staff, also affect the style to be used. Effective managers recognize these external criteria and take advantage of them.

Recall the four basic leadership styles discussed in last month's column: *tell, sell, consult* and *join*. Knowing the various styles is only the first step. The next step is recognizing that the appropriate style depends on seven external factors, which are summarized in Table 1.

One of the most critical elements affecting management style concerns *your authority*. Can you, without consulting anyone else, hire, fire and promote your staff? Having this authority gives you great flexibility and leaves all four leadership styles available to you. If you have less than full authority to hire and fire, then the tell method may not work. You might find it more effective to use the consult method with your staff.

Another factor sometimes overlooked by managers is the *previous experience of the group*. If your staff has never encountered a tell style of management, be careful about using it. Rebellion might result. Likewise, if a staff is used to being told what to do, a hands-off, join or consult approach is likely to be ineffective. A staff used to direct supervision may view as suspicious any attempt you make to consult with or join the group.

Find out about the previous manager's technique. Was the staff happy under the previous administration? If so, don't expect them to adapt quickly to a different leadership style.

Consider the *company environment*. What leadership styles do the other managers use? Are one or two approaches generally followed? If the join approach seems common, be careful about using the tell approach. This is one way to immediately disassociate yourself from the other managers. Companies often have a leadership or management philosophy. Promotions may be more likely to go to those who effectively use management techniques that are similar to the company's approach.

New managers often get into trouble by assuming that the position qualifies them to enforce decisions. Suppose you have *less experience* than your crew members? In this situation, the last thing you want to do is tell them how to complete a job. If you do and you're wrong, the crew will be the first to discover your lack of knowledge or experience. Your boss may be the second.

- YOUR OWN AUTHORITY
- THE GROUP'S PREVIOUS EXPERIENCE
- COMPANY ENVIRONMENT
- YOUR OWN EXPERIENCE
- TIME AVAILABLE
- THE STAFF'S ATTITUDE
- YOUR COMFORTABLE STYLE

Table 1. *You can determine the appropriate leadership style for yourself by examining these external factors.*

You needn't be afraid of managing a staff that has more experience than you do. In this situation, the consult or join approach probably is most effective. This allows an experienced staff to influence the outcome and helps you learn the ropes.

Even the amount of *time available* to reach decisions can influence the leadership style used. If decisions must be reached quickly, the tell or sell approach is often effective. There is no time to hold a staff meeting when the remote van is rolling down the hill by itself.

Analyze the *staff's attitude* toward you. Hostile or immature staff members usually are best handled in a straightforward manner—tell them what to do. An eager, committed and mature staff, on the other hand, often responds well to a consult or join approach.

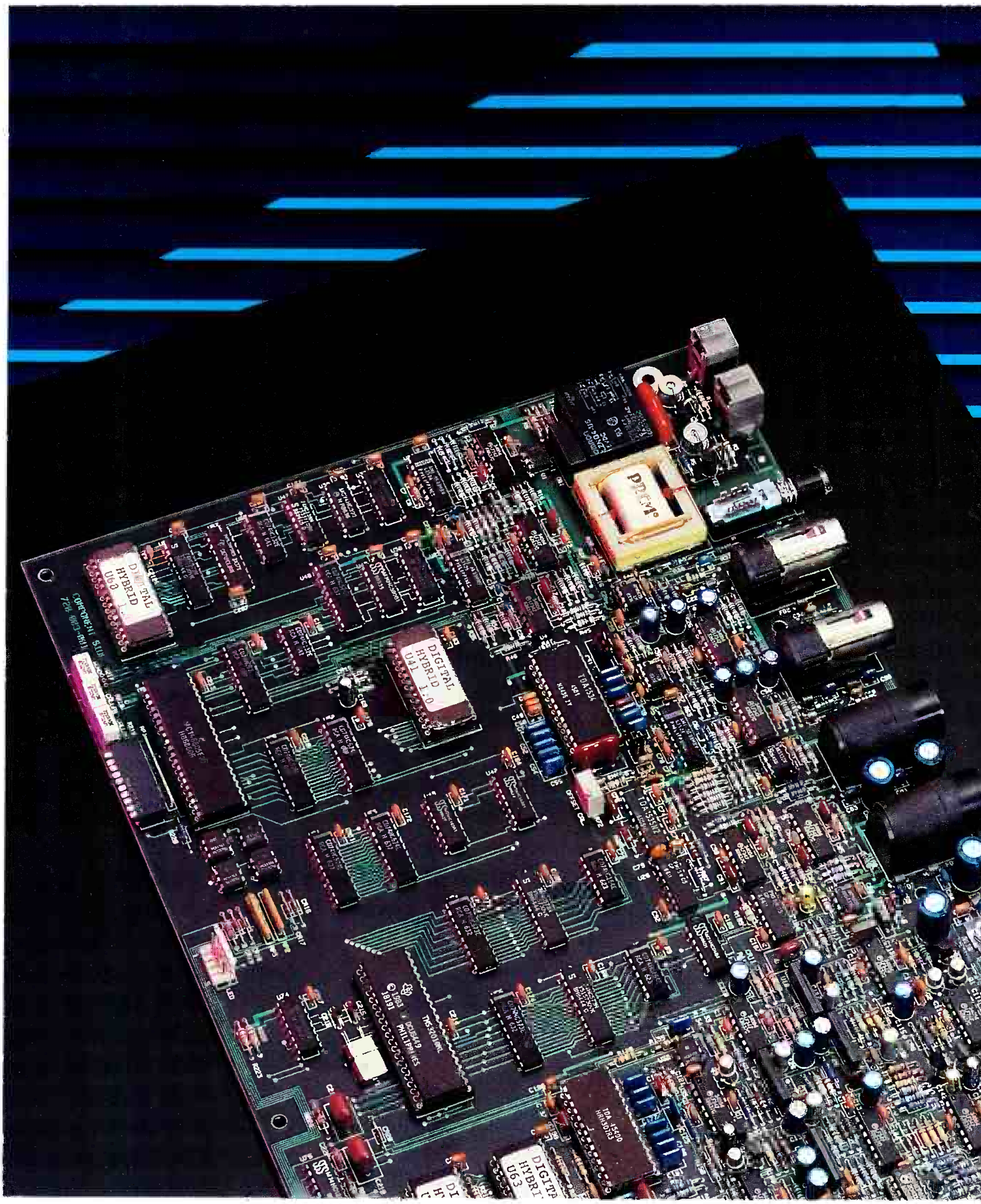
Finally, consider the management style with which you feel *most comfortable*. Examine how you manage people. The style with which you are most at ease will be obvious. There is nothing wrong with having a preference. If you've always been the hard-driving task master, you may find it uncomfortable to adopt a join or consulting approach. However, you must be able to shift gears to meet varying situations. Fortunately, the more often you adopt a different style, the easier it becomes.

Frank's mistake

Returning to our scenario, what was Frank's mistake? He did not adapt his approach to more closely match what his staff was accustomed to.

Frank's previous staff was used to his open, hands-off style, and he assumed that the new crew would respond the same way. Unfortunately, this didn't happen. The different management style only confused and worried his new staff.

Management decisions cannot be made in a vacuum. Consider carefully the external factors that can help you determine how to best lead your people.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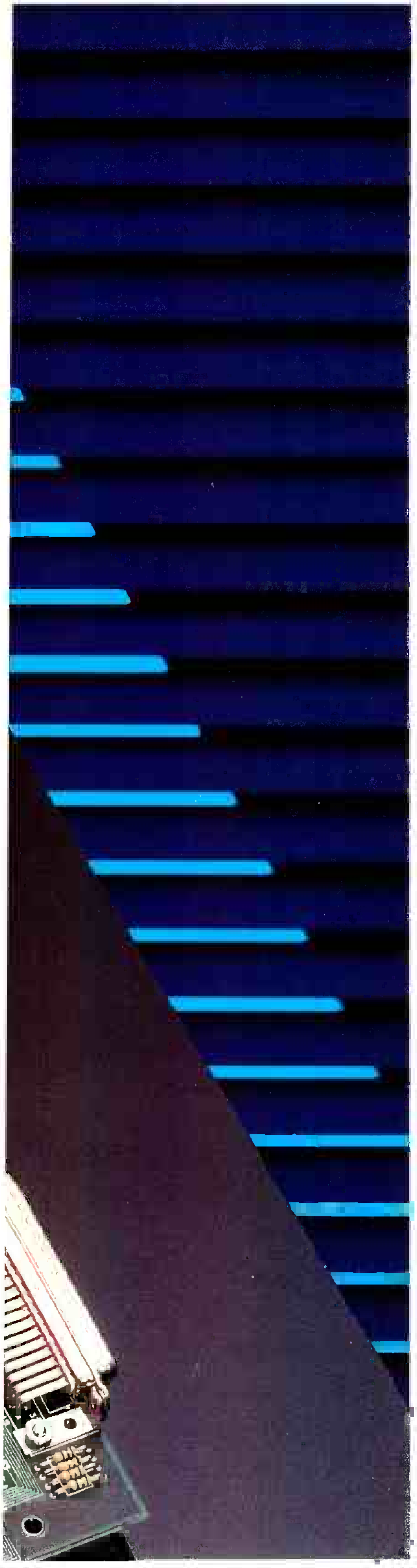

Radio/Television automation

special report

By Brad Dick, issue editor

For broadcast automation, the revolution has begun.

Today's radio and TV stations often use automated equipment to produce on-air programming. Automated camera-control systems, automatic transmitter monitors and even automated switchers are becoming commonplace. Perhaps the most visible automated device in a broadcast station is the intelligent audio or video source. Audio "juke boxes" and video library cart machines bring reliability, flexibility and convenience to the day-to-day tasks involved in creating the air product. These systems offer stations the capability to automate programming sequences, thereby reducing the chance of operator error and, perhaps, lost revenue.

The broadcast engineer's task is to plan effectively for this new equipment so that it can perform to its potential. This month's issue is devoted to helping you understand better the important criteria involved in preparing for successful broadcast automation. In the following articles, you'll see how automation can be accomplished in various areas of the broadcast domain.

Automation requires the careful integration of human needs, hardware limitations and programming constraints into an understandable and workable system. Properly implemented, automation brings a consistent, high-quality product to the consumer. And, perhaps best of all, it relieves the broadcaster from the time-consuming details of switching programming sources. The revolution is under way. Are you ready for it?

The sho
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Perspective on broadcast automation

By Peter Granet

Broadcast automation requires "intelligence."

Various forms of automation have been used in broadcasting for many years. One of the earliest audio-based systems was developed in the late 1960s. This primitive automation system consisted of coupled juke boxes using single-play records. When the tracking arm reached the run-out groove, this signaled the *end of message*, (EOM) cue. The play order was set manually for each magazine of records. Provided that the loading and scheduling was correctly set, the system worked as well as might be expected. This almost "stone-age" system lacked the sophistication and features broadcasters now expect.

Broadcast equipment

The standardization of the audiotape cartridge machine format, with its separate cue track, stop and EOM cues, provided the key to more complex and intelligent systems. At the same time, the use of 25Hz tones recorded on the left channel of reel-to-reel tapes allowed these machines to be integrated into automation systems. Within a short time, multicartridge machines capable of random access were developed, adding greatly to programming flexibility.

Unfortunately, no standards for the random access of reel-to-reel programming were ever developed. Also, stations often wanted to use their existing players, which had no provision for recording time code or pilot-tone cues. This shortcoming forced the system to rely on sequential programming for the songs or music. Early automation systems consisted of one or more random-access multicartridge machines and four or more reel players. The programming was varied by alternating between the reel players.

The first automation systems relied on mechanical memories. The running order and source machines were preselected, usually in 15-minute segments, by thumbwheels. Random-access cartridge machines also were manually programmed.

Most of these systems were hardwired, with the operating program in *firmware*.

1. Carefully define the operational goals for your automation system.
2. Select a consultant.
3. With the consultant's assistance, redefine your operational goals.
4. Develop an equipment list, and order the equipment.
5. Order and install the main computer. Run simulations and finally bring the system on-line by stages.

Table 1. *Sequential planning is the key to successful implementation of any computer application.*

Granet is a free-lance technical writer based in Weybridge, UK.

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One Australian firm used a minicomputer that could be reprogrammed by punched tape. Although these systems were efficient and labor-saving, they concentrated solely on the mechanics of airing the program. Scheduling, invoicing and other business-related tasks still had to be completed manually or, in larger installations, by a mainframe computer.

Video systems

Early attempts to automate the transmission of TV programs also concentrated on the mechanics of playing back the program. In the early 1970s, a small station in Adelaide, Australia, ran its entire evening and overnight programming from a small mainframe computer using drum storage. The system relied on quad tapes and 16mm film video sources. Films were tagged with metal foil cue marks, and the tape machines relied on time-code readers. Scheduling and billing still had to be completed manually.

Later, a station in Perth, Australia, ran most of the day's programming from a minicomputer. The system's control interface and software were developed and constructed by the station staff. The system's success depended heavily upon the timing of events. Each program segment had to be timed carefully prior to air, and the data entered into the computer. This labor-intensive process required considerable operator training. This was especially the case for the film-handlers, who had to be more exact than they were accustomed to in timing the film.

The first fully automated station was built by NHK in Japan. The system was developed to completely automate an entire station. From the moment a program schedule was settled, the computer took over. It checked the availability of artists, booked facilities, highlighted special requirements, allocated rehearsal facilities and performed the actual on-air switching. All invoicing, logging and fault reporting also were handled by the automation system.

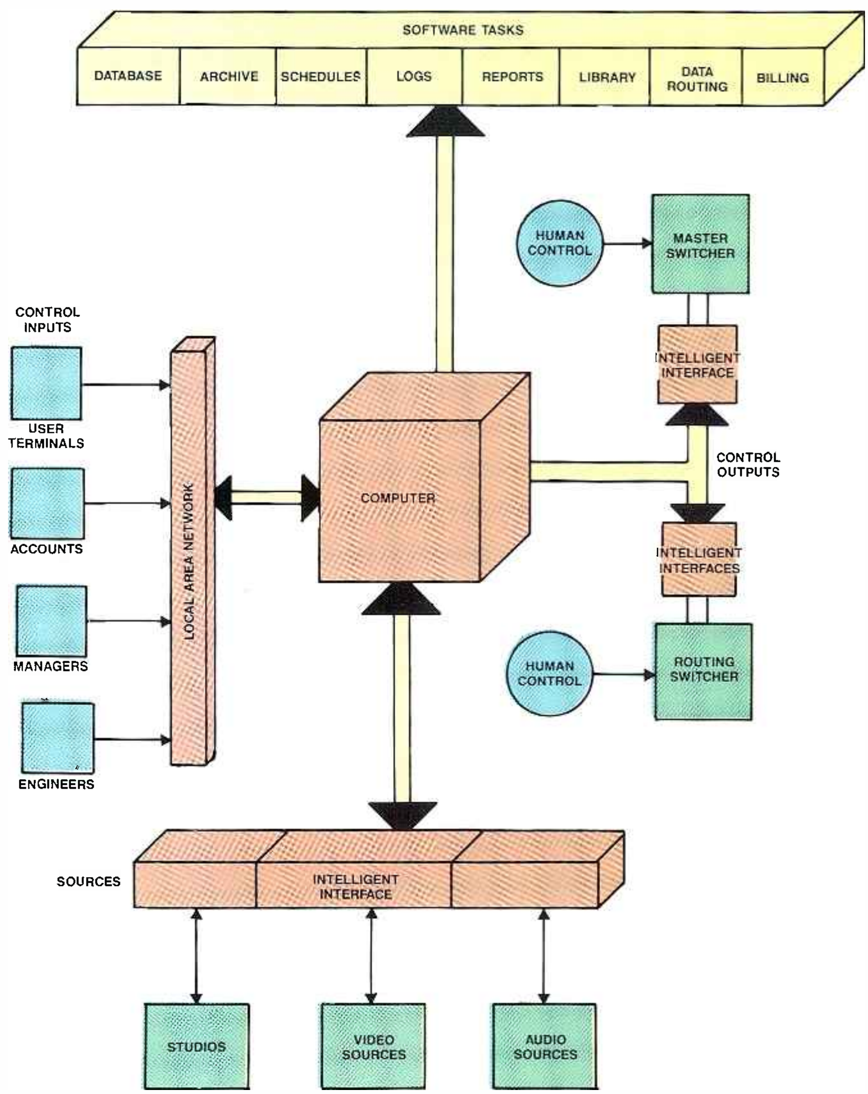

Figure 1. *Although the computer is the heart of any broadcast automation system, the various input controls, tasks and output interfaces make the system useful.*

Today's status

One of the most significant events in the history of computer development was the work of two young men in a back-yard garage. It was there that Steve Jobs and Steve Wozniak together produced the Apple computer. This "home" computer provided computing power at a price affordable to almost anyone.

Another noteworthy result of their work was the removal of the mystique that had previously surrounded the use of computers. No longer was the computer a tribal god to be tended by a data-processing manager, acting as high priest, and large staffs of software writers and operators. Suddenly, almost anyone with a minimum of training could begin to use computers.

The small computer also opened the way to data networks with distributed intelligence. A small, dedicated microcomputer could now perform specific tasks under the control of and reporting back to a larger computer. This design meant that virtually any piece of equipment that could be electrically, rather than mechanically, controlled was capable of being run by a properly programmed computer.

Sequential planning

The relatively short history of broadcast automation provides the basis for today's systems. As in the early days, the key to effective application of computer technology is defining precisely the task the computer is to complete. A mistake in this early stage will cause great delays in the successful implementation of any computer application. It makes no difference whether you're talking about designing a computer system to handle payroll or to automate the overnight spot playback. It's useful to use step-by-step (sequential) planning (see Table 1).

The first, and most important, task is to meet with everyone involved and define the operational goals for the station. Remember, the computer is your servant, not your master. Effective implementation requires that the computer change the station's operations as little as possible. Staff acceptance is predicated on keeping changes minimal.

There is one exception to this rule. During the course of planning, you may find some operational practices have developed over the years that are unnecessary or inefficient. Now is the time to change them. The installation of any computer automation system is the perfect excuse to rid yourself of outmoded or costly procedures that hamper your staff.

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Case history: the Children's Channel

The integration of intelligent playback equipment and modern PC technology might best be represented by the Children's Channel, located in the United Kingdom. The custom-designed automation system provides a fully automatic playback sequence as well as logging, scheduling and traffic features. The design is based on a ½-inch professional tape format cartridge machine and an MS-DOS database program.

One-person operation

The entire transmission facility is run by one person, who loads the tapes and software and monitors the output. All programming is either originated in the ½-inch format or dubbed to the format by a separate staff. The selection of a ½-inch automated cartridge machine was based on two factors.

First, the tape format itself was a major element. The tapes are small, cost-effective and require little storage space. Second, the machine is equipped with a high degree of intelligence. This makes the interface with the PC much easier.

Software

Using a typical database program may seem odd, considering that the application is broadcast automation. However, the intelligence contained within the cartridge machine, in a sense, dictates the software requirements.

The program director develops a daily schedule using archive information from the traffic department. When the program schedule is completed, the operator loads it and the first 40 tapes into the cartridge machine. The program schedule is contained on a 3.5-inch disk. The cartridge machine then compares the loaded tapes with the schedule and reports any discrepancies.

After each segment is aired, the cartridge is rewound and returned to its original slot within the cartridge machine. If that segment is not needed again during that day, it can be removed. As each event takes place, an event log is maintained by the computer and recorded on disk. Last-minute changes can be accommodated through an attached keyboard.

The combination of an intelligent cartridge machine and a standard database program has been effective for this station. Although few stations may want to convert all material to the ½-inch format, the use of only one operator in such an operation is certainly cost-effective.

The obvious limitation of 30-minute program segments may hamper some applications. However, the same equipment could automate spot playback, which would provide tremendous benefits to a staff that already may be hard-pressed to keep up with the load.

Select a consultant

Unless you are lucky enough to have a person on staff with superior training in this area, you'll need a consultant. Many so-called consultants are, in fact, little more than sales agents for particular manufacturers. They often have limited general knowledge of computer-controlled systems.

Experience in broadcasting may not be the most important qualification to seek in a consultant. You and your staff can provide the expertise in that domain. Instead, look for someone with experience in such areas as *process control*. Above all, you must find someone who is a good listener, who can absorb what you say and can communicate well. It's in the planning stage that mistakes are most likely to occur, and it's here that the consultant is crucial.

Spend a lot of time with the consultant, making sure the station's plans and needs are completely understood. Do not hurry this planning phase. It takes time for you to describe and for the consultant to understand all you hope to accomplish with the new system.

During this planning stage, you will undoubtedly modify some of your original thinking. Cost estimates also may cause you to rethink some of your earlier plans. That's actually a good sign, because it shows that you really are beginning to define exactly what it is you want the system to do.

A station does not need to fully automate an operation; rather, it can be done in stages. It may be that you decide to begin with a hybrid system, reserving such tasks as master control and assignment switching for manual operation. If you elect to install only a partial automation system, be sure you allow for future expansion without wholesale replacement. Also be sure that any custom software is well-documented, so that it can be altered as needed by someone other than the original programmer. At this point, it's still not too late to back out. All you have contracted for so far is a person's time.

Hardware purchases

Now comes the moment of decision. Before you finally commit yourself to it, carefully think through the proposed system, discuss it with the entire staff again and modify the plan if necessary. Obtain cost estimates for the hardware and software. Be sure you understand what current hardware can be interfaced with the final system. Working with the consultant, develop a phased installation program.

Order the equipment. When it arrives, thoroughly check it out, using its own operating system. Test each operational mode and feature. As you become confident that the device is capable of running in a stand-alone mode, use it on the air. Do not, at this stage, hook it up to the main computer.

Select the computer

The selection of the main computer will depend upon the number of tasks you want it to perform. In addition, the computer must be compatible with existing intelligent hardware and slaved micros, which are used to control non-intelligent machines. See Figure 1.

Be sure there is sufficient RAM for all the day-to-day tasks and enough hard disk memory for schedules, programs and essential data. If possible, ensure that this equipment can be upgraded instead of replaced, so that future expansion can be implemented cost-effectively. Although you may not realize it now, tasks will appear later that will push the system to its limit. Prepare for this eventuality.

Be sure the air automation computer can talk to the station's business computer. Even if you don't plan on this application now, be sure it can be added later.

When the new computer system arrives, do not install it on-line immediately. Instead, verify that each of the programs and control functions operate properly. Have the system produce all of the hard-copy reports available. These may include error codes, schedules, logs and even the computer programs themselves.

Using typical schedules, run as much of the system as possible for several days. Take a machine off-line and see if the automation system properly detects the problem in time for it to be corrected. Verify that all of the hardware and software interfaces work correctly with each individual piece of equipment. Simulate as many error conditions and operational situations as possible.

This may seem complicated and time-consuming, but the procedure will pay dividends over and over again. You will never regret having allowed time to perform these types of tests.

The future

Some 15 years ago, my superior and I wrote a paper on the effect of computers and digital techniques on broadcasting. Taking an almost science fiction leap ahead, we suggested that a future station might consist of a number of individual machines, studios and switchers all connected by a digital interface (local area network, or LAN) that would carry not only control information, but also the audio and video signals.

The development of the distributed intelligence concept, the acceptance of the 4:2:2 digital video format and the increasing use of digital audio have confirmed our earlier projections. In fact, the only thing I would change in that paper would be to suggest that optical fiber, rather than copper, be used for the interconnect.


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RoboCam

By Rick Lehtinen,
TV technical editor

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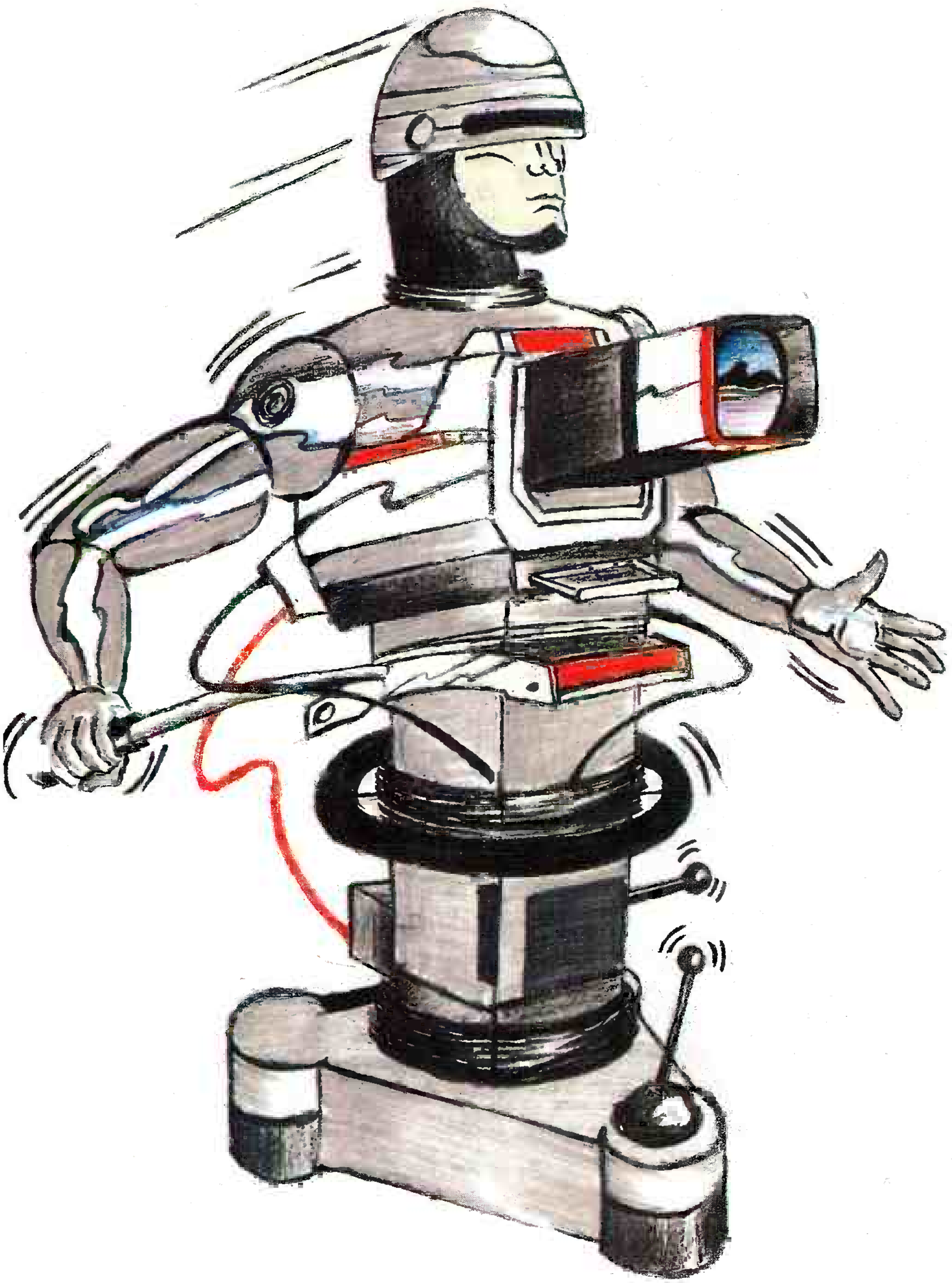

It's the mid break in the 6 o'clock news, time to slide the cameras apart and let No. 2 truck back for the chroma-key at the weatherboard. In the booth, the director nods to the technical director, who down arrows a computer terminal, then presses the "enter" button.

Back in the studio, after checking their tallies, cameras No. 1 and 3 whir softly and pull away from each other. Camera No. 2 accelerates between them, then slides over to the weather position. An errant floor monitor senses No. 2 approaching and skitters out of the way. No. 1 and 3 start to return to their places, but the floor director is standing too close. No. 3 freezes, honking at him, because no mics are open yet.

In the booth, the TD down arrows to the next item on the screen, waits for the commercial to end and hits enter. He yawns; the director nods in agreement. It has been a frantic news day, and both are very tired. On the control room wall, a quartz clock ticks loudly.

"Sure is quiet in here these days," the director says.

Interest in *camera robotics* has increased dramatically in the past year, perhaps spurred by NBC's recent automation of the "NBC Nightly News." Studio automation equipment is now sophisticated. It has grown from simple remote-control systems into intelligent robots capable of autonomous movement in several axes. The scenario described—robot pedestals and computer-controlled newscasts—is being played out to varying degrees as you read this. All the "RoboCam" technology mentioned will be in place within about two years.

In the beginning

The hardware roots of camera robotics systems can be traced easily. You'll find them in surveillance pan and tilt mounts,

Continued on page 36

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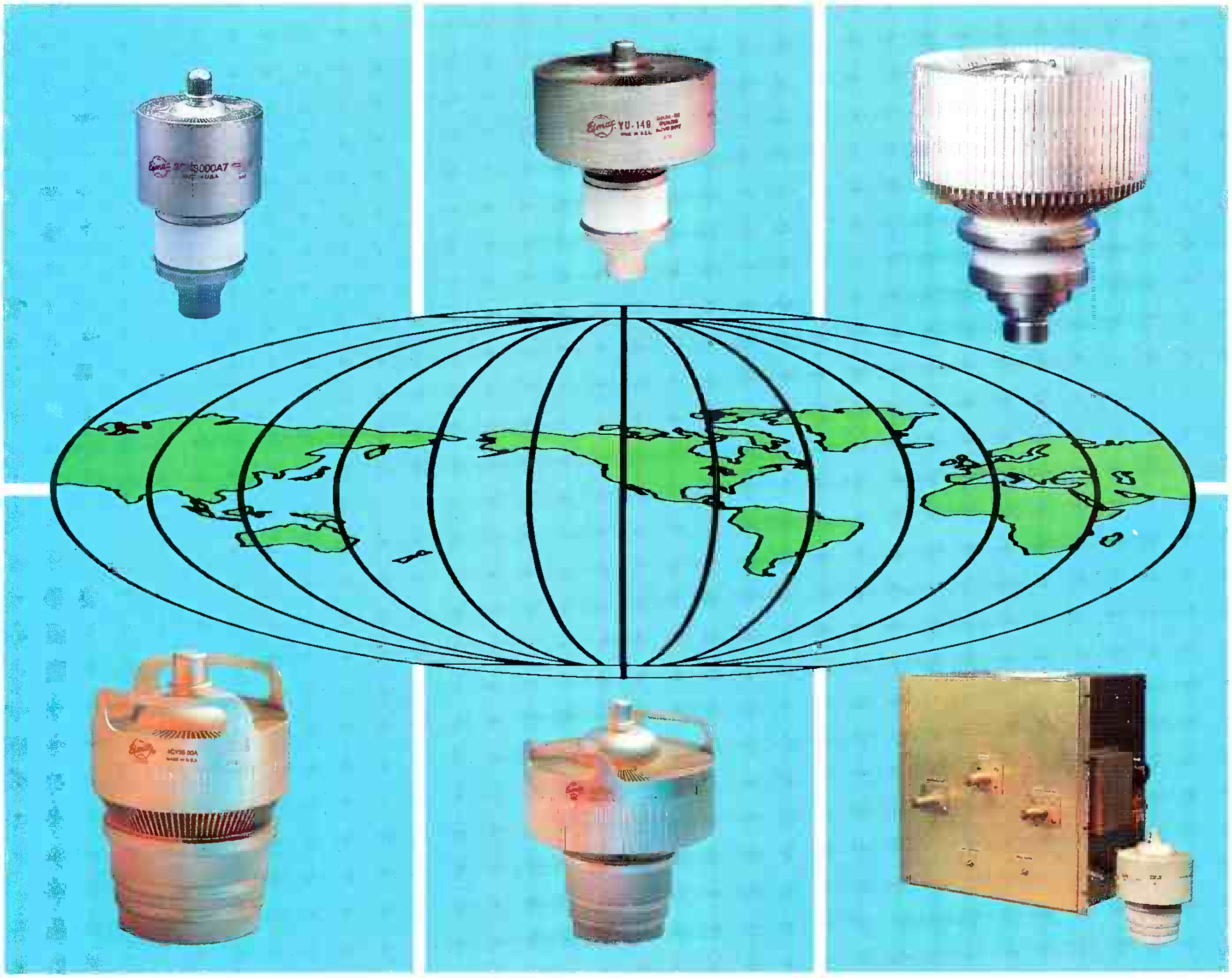

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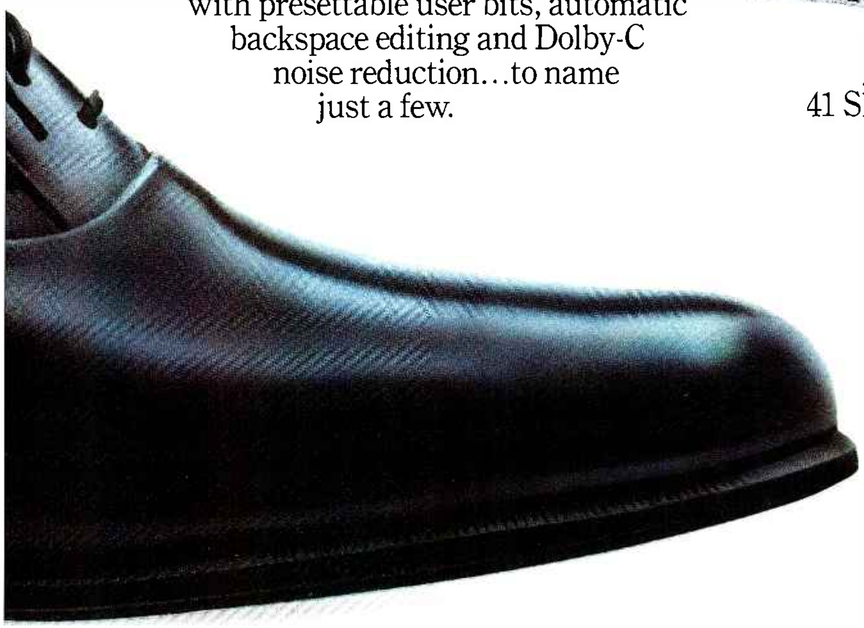

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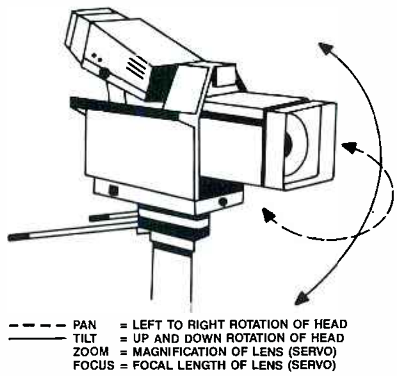


Figure 1. *Pan, tilt, zoom and focus follow their traditional TV definitions. Pan and tilt are accomplished with a robotic pan-tilt head. Zoom and focus use lens servos, modified in some cases to provide greater precision.*

Continued from page 32

in mechanisms that keep telescopes pointed correctly in spite of the earth's rotation, and in weapons systems. Actually, whirling a heavy tracking dish to follow an approaching missile is mechanically similar to panning a heavy studio camera and Teleprompter.

The "why" of these robots is harder to pin down. Do visual robots embody the creative person's wish to escape drudgery? Is it this same urge that leads aspiring engineers to figure ways of self-propelling the family's lawn mower? Do you want the cameras to do the mindless back-and-forth stuff while you do the tricky parts around the edges? Or is robotics just good engineering, something that should be implemented simply because it's right?

More likely, the current interest in robotics comes from a change in broadcast management. The old guys, the ones who built the first stations, are retiring. Their replacements are much more profit-oriented. Having little room to raise rates and facing stiff competition from cable television and other services, these "bottom-line guys" may see robotics as a way to increase productivity, and they are starting to open their billfolds for it.

Systems to remotely control the attitude and direction of cameras have been around for a long time. Strictly speaking, these weren't true robots, but rather, remote controls. Nevertheless, they provided shots from above the boxing ring, from behind the backboard, suspended in the air over the 50-yard line, and from the seat beside the race car driver. If it was difficult or unsafe to send a human operator, a remote controller was dispatched.

Much work has gone into increasing the intelligence of camera-control systems. Today's systems don't just move as you tell them; they move as you *teach* them. They learn an instruction sequence for a camera move, then execute it on command. This means that instead of a camera operator standing near a dangerous turn at a racetrack or crouching out of the way and manipulating a joystick (in both cases repeating the same maneuvers each time the cars come around the bend), the robotic gear now can be programmed precisely. ("Start right full wide...tighten up as you pan left...pause at the deep part of the curve...then move right a bit, down slightly and hold while the cars go out of frame to the left.") With a press of a button, you can start the move, then repeat as desired. It can even be triggered remotely, with some sort of "car approaching" sensor.

Manufacturers see robotic cameras eventually taking cues directly from scripts stored in newsroom computers. The human operator would be nearby to monitor, jumping in if an emergency came up. The operator's job would be similar to that of a modern airline pilot's, in that the pilot doesn't really need to *fly* the plane as much as *supervise* while the aircraft goes through automatic take-off, course correction and landing.

Of pan and zoom, X and Y

Robotic pan-tilt heads must not only be smooth; ideally, they should look as if humans were moving them. It is a fairly simple matter to twist a pan-tilt head around. But doing it smoothly and with repeatability is more complex. To emulate the human touch is sublimely difficult.

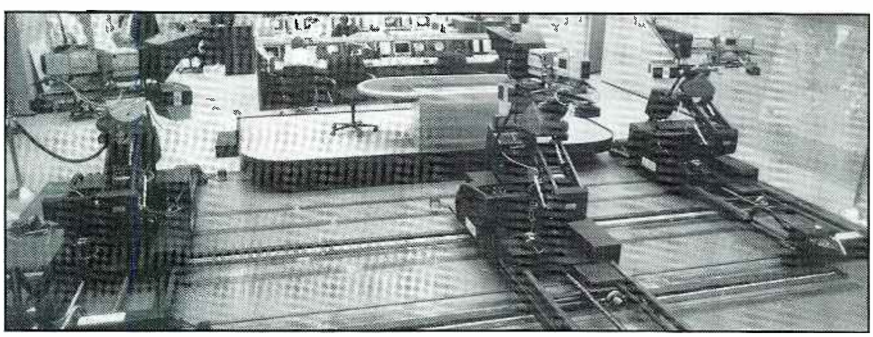
A human operator can tell where a camera must point, and can gauge easily the velocity with which to move it there. However, a robot has no visual reference to the scene being photographed, so it must calculate these details on its own. Also, the human operator is a somewhat elastic system, capable of coupling the camera to the floor and damping mechanical oscillation. Any stray momentum in a robotic camera head must somehow be dissipated without a human operator to absorb it.

A discussion of camera automation requires precise definition of terms and clear description of the movements assigned to robots. Most of today's robots are capable of at least four types of motion: pan, tilt, zoom and focus. These terms follow their standard TV definitions (see Figure 1).

Advanced systems can pedestal up or down (raise or lower the camera head on its pedestal) and move around on the floor. When you move left and right with respect to the set, you are moving along the X-axis. Movement forward and backward with respect to the set is along the Y-axis (see Figure 2).

The motors in robotic heads are small, quiet and, typically, dc-powered. Some systems couple to the motor with a low-friction, low-backlash gear chain. Any backlash (mechanical looseness of the gear mechanism) would throw off the head's positioning system, causing jerkiness. Other systems use cogged pulleys and strong, titanium-reinforced drive belts. Elaborate servo systems control the head's speed and position. Sensor systems, which provide feedback to the servo loop, vary by manufacturer, but most place some kind of encoder at the motor end, then use proprietary means to compensate for inaccuracies in the linkage.

Different manufacturers use different operator interfaces. Some use a system resembling "key frames" that allows the camera operator to specify a beginning and an end point and lets the computer interpolate. Other manufacturers' robots memorize a motion path and recreate it on cue. Camera operators use tools such as keyboards, tablets and menus to program the systems.



The robotic camera system used for the "NBC Nightly News." Note the drive wheels for X-axis (left-to-right) positioning. The camera dolly slides on Y-axis rails. Spring-steel cable sheath manages cables. The pedestal system uses a scissor jack for elevation.

Servo control

Manufacturers approach zoom and focus control in various ways. Some drive the existing lens servos, and others modify the servos to improve response. At least one company removes the native servos altogether, substituting precise servos of its own design. All of this is necessary because a human can compensate for some of the "personality" of a given zoom or focus servo.

After you point and focus the camera, you need to control its elevation. Robots do this in two ways. One system uses a scissor jack that lifts the camera head by pulling together the base of a pivot assem-

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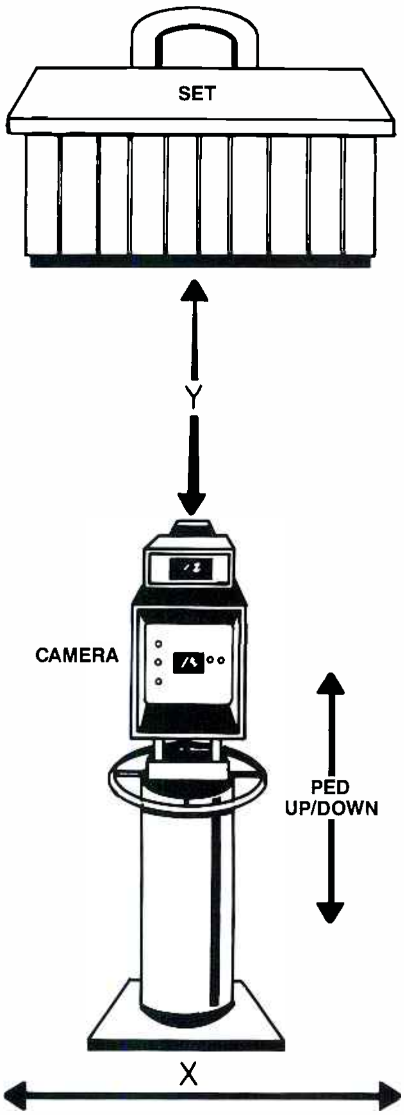

Figure 2. In robotics studios, X refers to motion left and right with respect to the set, and Y is motion forward and backward. The height is set by the pedestal moving up and down.

bly. Other systems use existing pedestal technology, modified to cope with the mechanical stress of servo control.

X–Y stuff

The most complex movements involve X–Y positioning. Three systems currently are used for X–Y motion.

One manufacturer's system is track-based. Guide rails running left and right across the studio form the X-axis. Another set of rails rides perpendicularly atop the first. This set of rails, the Y-axis, has drive and idler wheels that allow it to move back and forth over the length of the X-axis. A dolly cart travels up and down the Y-axis, closer to the set for tight shots, further back for wide ones. The scissor pedestal system sits on this dolly, and the pan-tilt head sits on top of that.

Track-based systems are stable and quiet, but some critics point out that anchoring down the rails ruins the studio floor, necessitating an expensive refinishing job if the rails are ever retired. Also, the rails themselves take up a lot of floor space. This type of system just about requires a studio dedicated solely to robotics.

These drawbacks didn't deter Ray Lowe, NBC engineering project manager for the robotic "Nightly News" studio. Lowe installed NBC's track-based system in a studio originally built for radio, so studio flatness was not a given. In fact, Lowe created flatness by perching the entire X–Y grid on a network of carefully leveled steel beams.

A second X–Y positioning system operates like a baby Hovercraft. A large platform that looks like an inverted cake pan is levitated on a cushion of air. A proprietary wheel-less propulsion system, resembling an octopus's tentacles, pulls the platform at a controlled rate along a magnetic guide tape stuck to the floor. Optional control systems can steer the platform electronically or guide it by laser beams.

An advantage of this system is that it can go anywhere. Four grips can carry it, and a flat floor isn't a necessity, as long as the grippers and air curtain can seal against it. A disadvantage of this system, however, is that the wide pedestal bases, built big enough to hold camera dollies, do not allow two cameras to get closer than four feet to each other. They also create a certain amount of noise. Proponents of the system say the large bases are actually an advantage because they guarantee that a run-amuck robot will not pan two cameras into each other.

The hardware of a third X–Y system resembles a conventional studio pedestal, except that special robotics hidden inside allow it to roam about the floor. Many people have speculated how this type of system might navigate. Some engineers have proposed radio positioning schemes similar to LORAN, and others have suggested a laser-based system. The guidance scheme for this pedestal system, however, is a lot like a sailor's system of dead reckoning. The computer keeps track of how far and in which direction the pedestal has traveled. It periodically reaches landmarks that it uses to update its counters.

Cable management and auto tracking

In addition to controlling the camera and damping mechanical oscillations, human operators do a fine job of keeping the camera's cables out of the way. Robots may find this a vexing chore. For the NBC project, engineers ran the cables through spring-steel sheaths, then laid these into trenches. As the robots travel, they pull out as much of the cable as needed, and the rest folds back into the trench. Free-roaming pedestals, however, make cable management much harder. One approach is to emulate the techniques used by humans: thinking ahead, choreographing each camera setup and, when necessary, using servo-controlled reels to imitate "cable kickers."

The auto-tracking facets of camera robotics seem like spin-offs from "Star Wars." Imagine a camera mounted high up in a football stadium. It moves back and forth, following the ball with perfect accuracy. There is no operator.

This "seek-and-find" function of robotics, loosely referred to as "target acquisition," is based on weapons systems technology for tracking incoming missiles. If the missile goes behind a cloud, computers figure out where it probably is and wait for it to reappear. When the football is obscured, the computer figures out where it would be if someone weren't sitting on it and points there. Although true target acquisition is not in the immediate future for camera robotics, its studio version—auto-tracking—is available now.

Auto-tracking circuits are designed to keep the talent framed in the shot. The incoming video is digitized and, after some proprietary filtering, target information is fed back into the robotics computer, where it is used to correct the servos. If the talent moves, the camera does too. (See Figure 3.)

Designers face two dilemmas in the auto-tracking field. The first problem is a busy background. This is especially challenging when people are moving behind the talent, as on a newsroom set. The answer lies in carefully identifying the target. Chroma filtering, for instance, might let the robot lock in on the newscaster's clothing or some color that is different from the background, so it is easier to pick out the target from the surroundings.

The second problem is one of intelligence. If the talent changes position, the camera should follow. But if the newscaster merely leans for a moment, or coughs, the camera should remain stationary. This is one area in which human operators definitely have the advantage compared with computers.

Robot safety

The technology of robotics is fairly well-established in other areas of electronics and manufacturing. Although camera robotics is a new field, manufacturers have adopted technology from other areas, adapting and refining it for television. One area in which broadcasters will benefit richly from others' experiences is that of robot safety.

In some courses for automobile assembly workers, trainees are warned that robots are insensitive and stupid because they can't always sense when they run in-

Continued on page 42

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Chief Engineer
WATL, Atlanta

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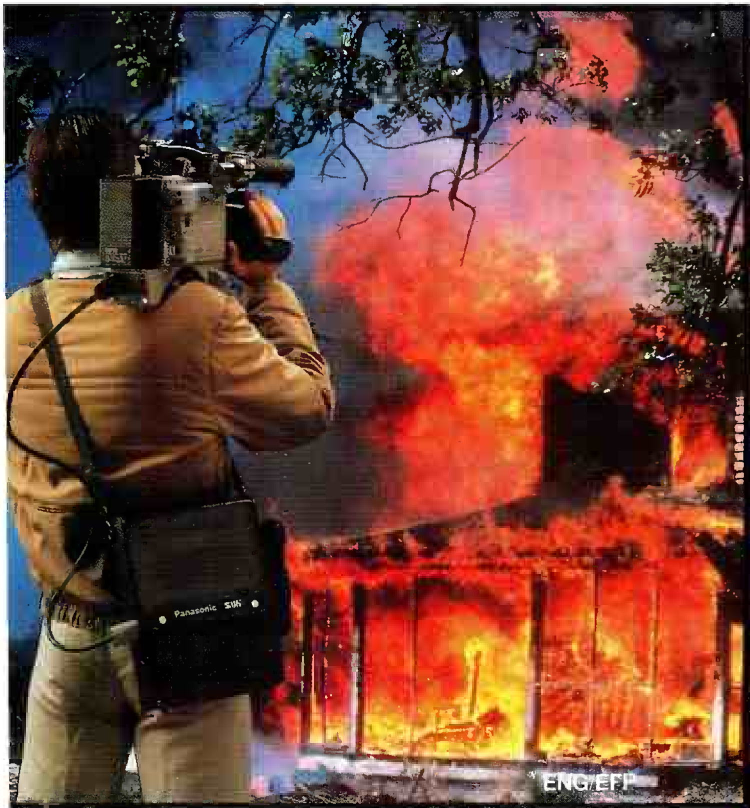
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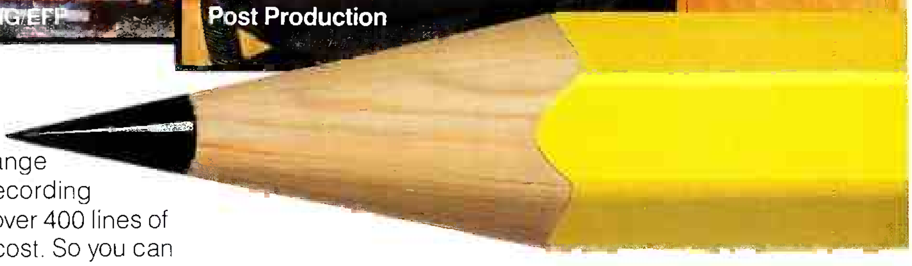

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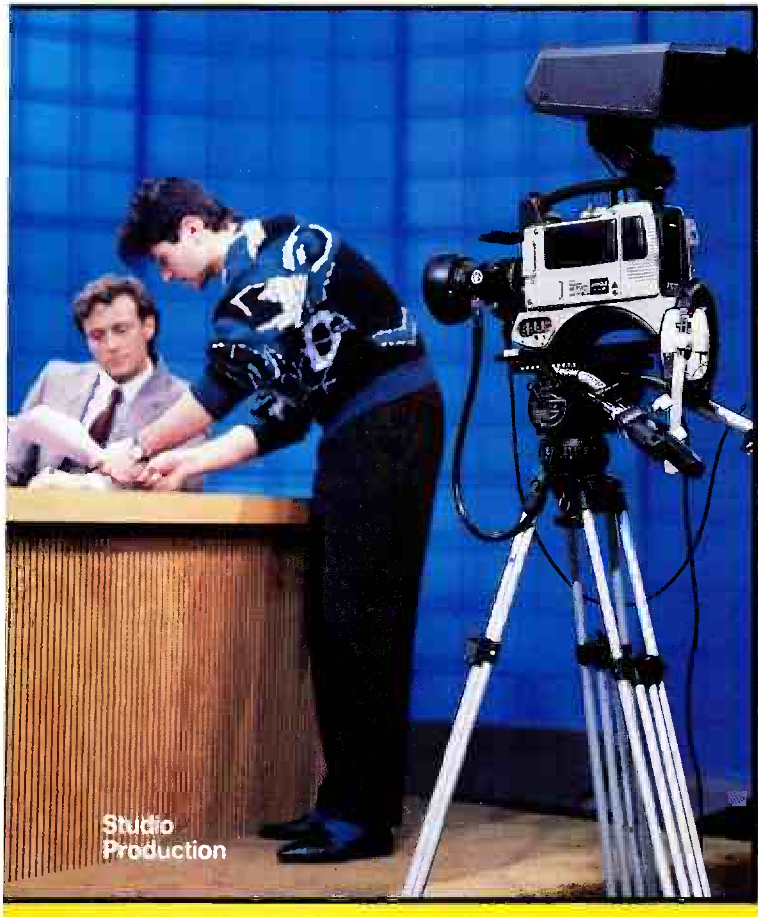

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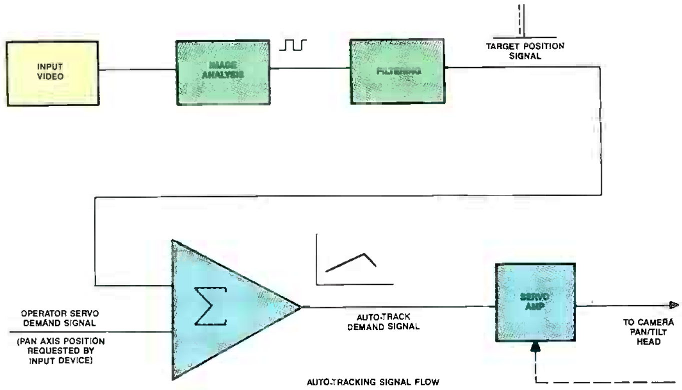


Figure 3. *Diagram of the auto-tracking signal flow. Input video from the camera is digitized, processed, then filtered to yield a target position signal. This is summed with the pan position requested by the operator's input device and presented as an offset signal to the pan-tilt head servo.*

Continued from page 38

to obstructions. The force put against a robotic arm by grappling an engine block may be similar to the force required to knock a man across the room. For this reason, all robotics systems come with elaborate safety features.

Robot safety is implemented, in part, through software design. Limits are calculated, and the robot tells itself it can't go to a certain place or perform a certain task. Other safety features are imposed by proximity sensors. Some systems inhibit motion when someone is standing nearby; others allow only reduced-speed movement. The air-glide system mentioned previously has a tolerance sensor on its magnetic ribbon detector and a proximity detector around its circumference. If it falls off track or bumps into something, it shuts itself down and requests further instruction from its operator.

In the case of the NBC studio, designers included several overlapping safeguards. The first is that the robotic dolly is encircled by an infrared beam. If something crosses the beam, robotic activity stops. When people must be within the envelope, reduced speed is enforced. Finally, robots cannot pass beyond a proximity-based dead zone.

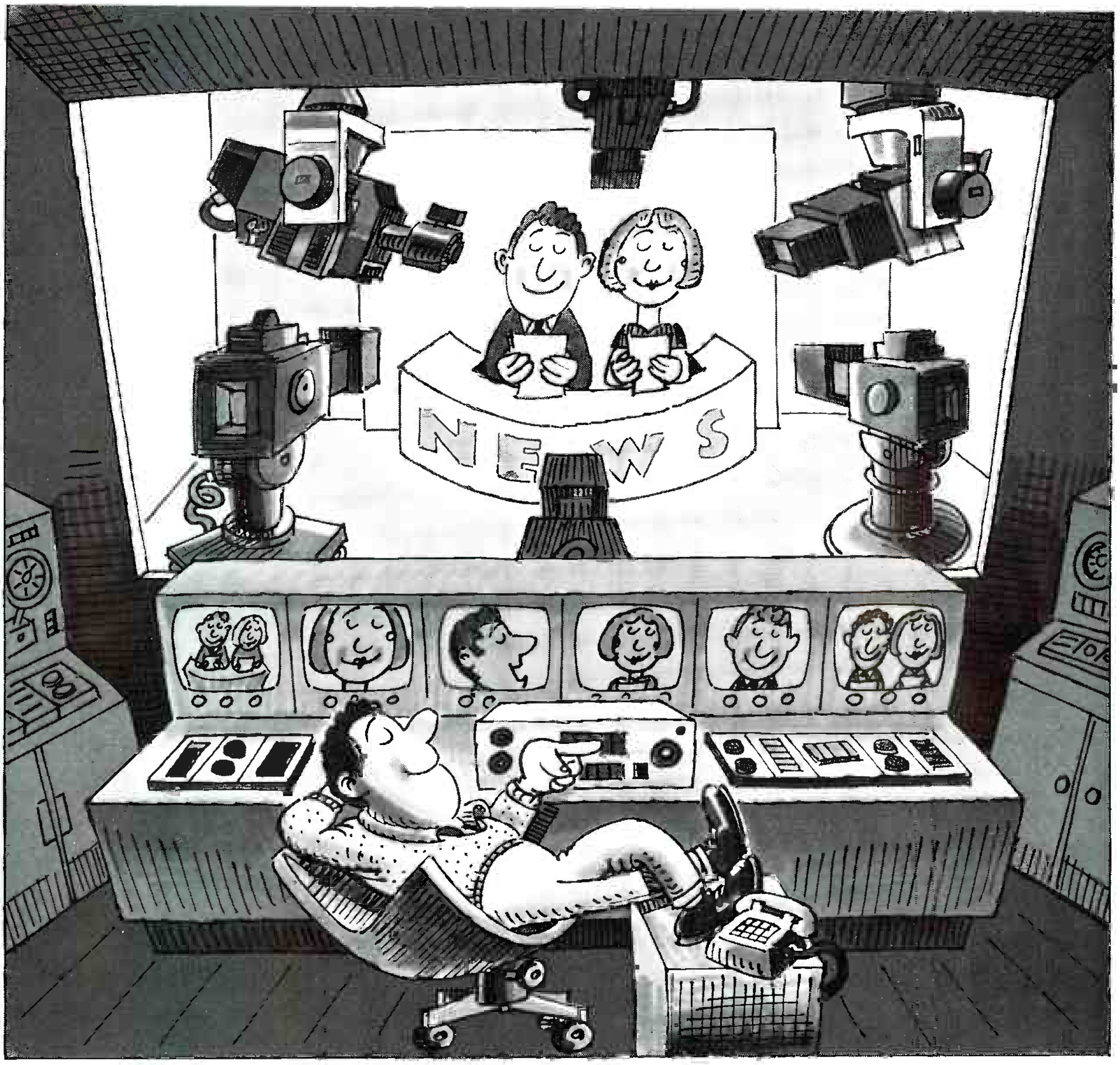
Current to the drive motors is limited to just enough to do the job. The pan-tilt head, for instance, rotates no faster than 45° per second and can move the camera head, but not much more. You can stop its motion by holding out your hand or even by pushing it with your head.

Finally, the camera operator observes the robotic pit with a surveillance camera. A stop box is incorporated on each camera, on the whole system and at the operator's position.

The subject of money makes it easy to appreciate the need for robot safety. Although you might laugh at the idea of two robotic cameras "having it out" with each other, the thought of replacing a prompter mirror, let alone repairing a lens, is sobering. And no one wants accidents involving people. There was a time when TV technicians had a healthy respect for the then-lethal voltages they dealt with. Those who labor in robotics are likely to develop a similar level of reverence for safety.

The integrated station—who's the boss?

The power of robotics isn't in trading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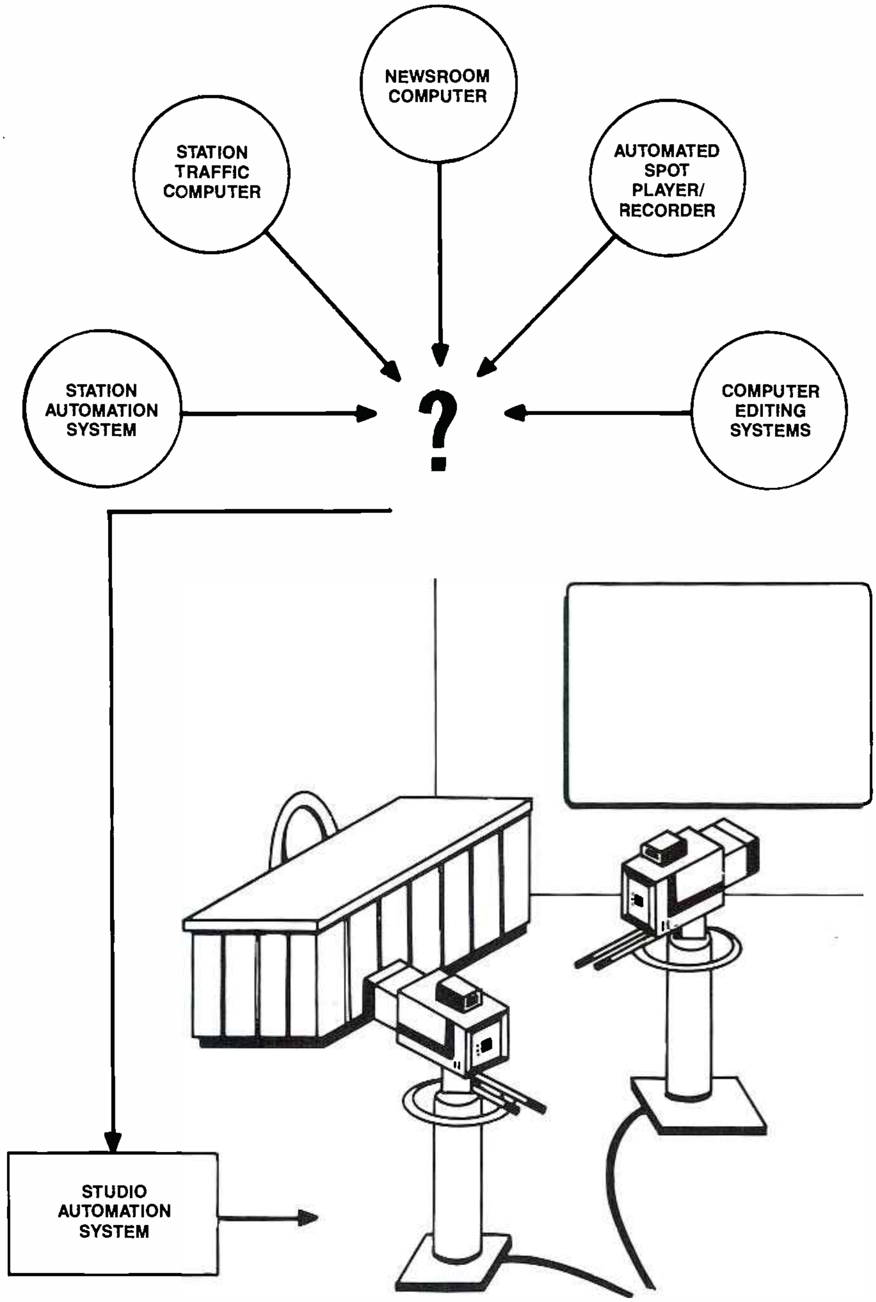


Figure 4. *Until equipment manufacturers determine which station computer system has dominance and work out communication protocols, totally automated studios will remain just out of reach.*

three operators on the studio floor for one in the booth. The true power of robotics lies in its repeatability. Complex camera moves can be designed and scripted to come off identically, time after time. This means that the whole operation can be choreographed in advance, then triggered step by step with cue points from a script or playlist. This has staggering implications for the way programs are created and produced.

Assume that it is a few years in the future. The producer knows that the format calls for a given shot right after a break. The shot is scripted, and the name supers for the following story are transferred to the character generator, where they are created and stored. Story graphics are crafted by the art department and stored in the still store. Appropriate page numbers from both devices are written into the script and, as the show rolls down, the computer directs each device to preset the correct page. At the instant a certain element is needed, the computer directs the control room switcher to put the desired element into place. Camera moves are scripted along with everything else.

Presumably, this level of computer integration could do for production what word processing has done for writing. The creative freedom is preserved, and the drudgery, such as the retyping of revisions, is passed on to the computer.

It is not equipment that is holding back this dream. Most of the technology is readily available and, in some cases, lies dormant in current hardware. There are some missing links, to be sure, but another roadblock seems to be a power struggle among station computers. Before the integrated studio can be fully realized, various station systems have to do a better job of talking to each other.

Manufacturers seem more intent on expanding the capability, rather than the connectability, of their systems. Instead of working to freely interchange information, computers are trying to steal each others' turf. From the traffic system, which already controls what plays when, to the automation and editing systems, which already are interfaced to everything, there are many good candidates for the position of dominant computer. Like a pack of ambitious sons-in-law, each wants to be the company's next CEO. (See Figure 4.) Until broadcast manufacturers can work out which computer will be in charge, the needed communications links won't be forged, and the fully integrated studio will remain just out of reach.

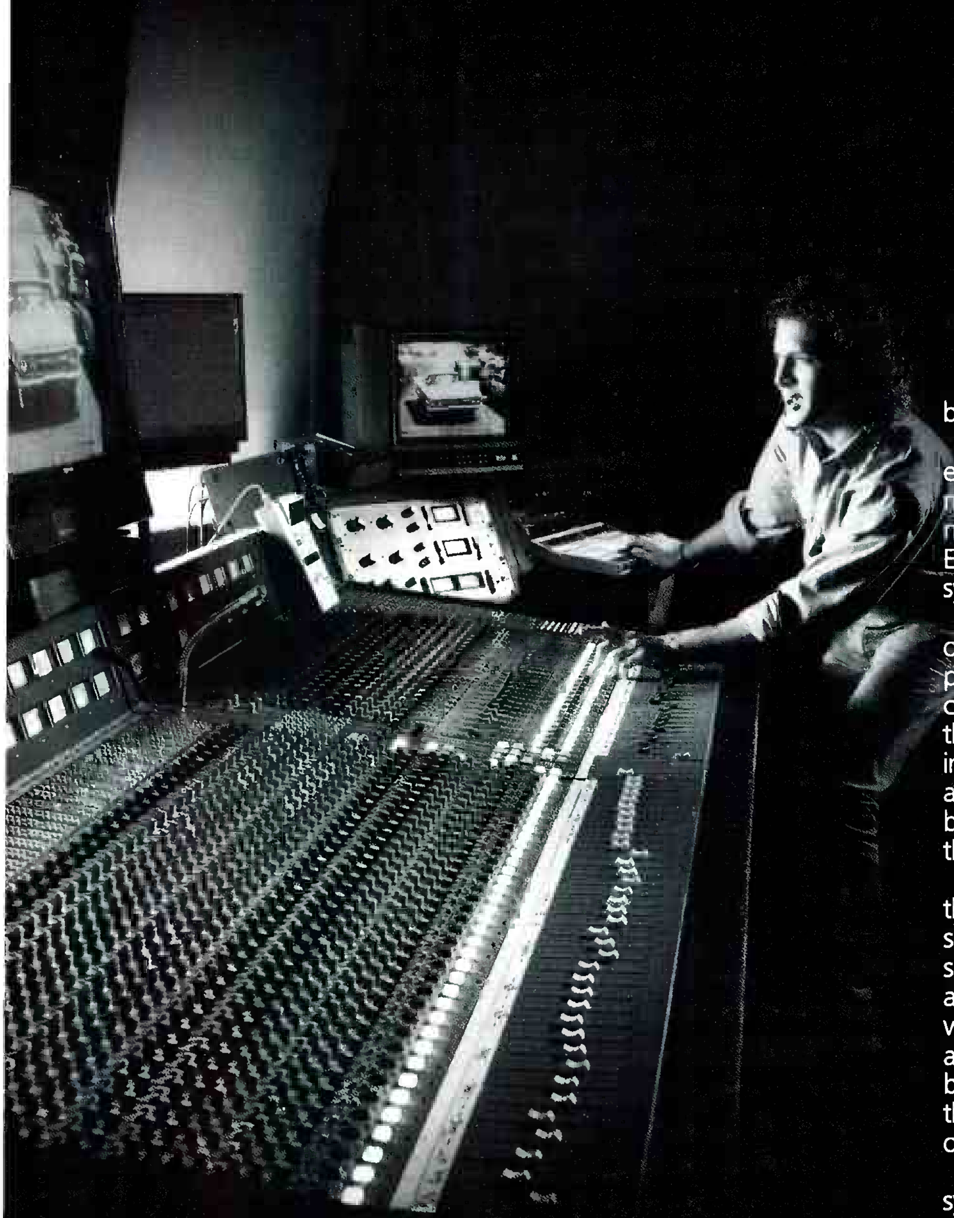
Even robotics manufacturers disagree among themselves about where to draw the lines of authority. Some systems have knobs for color correction and video levels. The idea is that if a scene takes place in a dark part of the studio, then the robotics should raise the iris. Other manufacturers say that the camera and prompter are strictly payload, and that if the iris needs to go up or down, that's the camera's problem. The charter of camera robotics, they say, is to point the camera in exactly the right place, at just the right time, and nothing more.

All quiet on the set

Perhaps one result of robotics will be a quieter studio. As computers do more of the talking, the people will do less. Headset chatter may at last reach tolerable levels. Producing a news program may become much like programming a station cart machine. Updates and changes still will have to be typed in, often just under the wire, but there might not be a great deal to say, save expletives, during the course of the show.

So when will RoboCam come crashing through the walls of your studios? Probably never. After all, if a technology can sneak up on you that completely, you are sleeping at your post as the technical guardian of your facility. When will you start taking advantage of advanced technology studio automation systems? That's up to you. RoboCam is waiting outside your door. He will come in just as soon as you invite him.

Acknowledgment: Assistance in the preparation of this article was provided by Bob Gonnelli, TSM; Peter Regla, Elicon; Marc Bressack, AF Associates; and Ray Lowe, NBC.



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Transmitter remote control

By Harold Hallikainen

Remote-control systems are more flexible than ever.

Even with deregulation, broadcast transmitter sites must be carefully monitored and controlled. Many transmitters provide automatic functions that make the remote-control interface easy to accomplish. Older transmitters require more supervision. Fortunately, modern remote-control systems can be customized to perform any manual, semi-automatic or automatic functions. Although few stations elect to implement full automatic transmission systems (ATS), most want to automate as many monitoring and control features as possible.

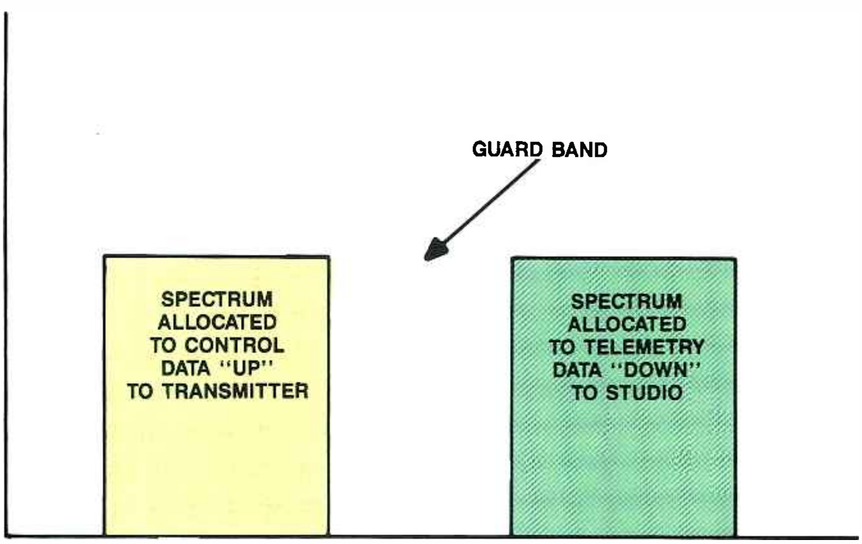

Figure 1. *Frequency-division multiplex spectrum allocation on a 2-wire, full-duplex circuit carrying 300b/s data in each direction.*

Remote-control building blocks

A single-site broadcast transmitter remote-control system generally consists of two devices: a transmitter-site unit and a studio unit. The transmitter-site unit sends sample voltages (or a representation of the sample voltages) to the studio unit for display or logging, and the studio unit sends control information to the transmitter-site unit. This control information is used to select the proper sample voltage and to activate devices or circuits at the transmitter site. The interconnecting links between the studio and transmitter control units, which will be discussed at another point in this article, are summarized in Table 1.

Typical functions performed by the transmitter-site portion of the remote control include sample voltage selection, processing and control and status monitoring. The transmitter-site portion may be intelligent, performing monitoring functions

Hallikainen is president of Hallikainen & Friends, San Luis Obispo, CA.

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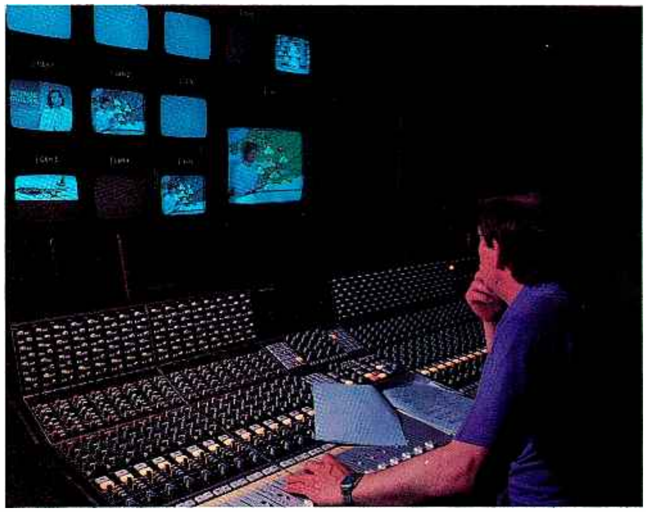

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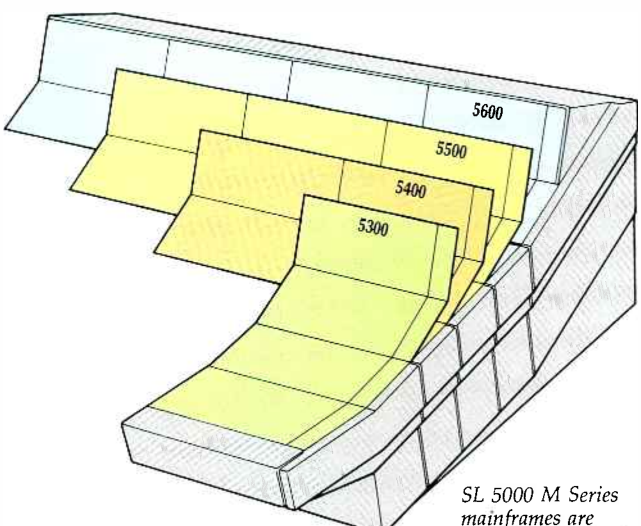

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Table 1. *A combination of these links usually is required to implement a remote-control system.*

on its own, or it may act entirely under the direction of the studio unit.

Communication methods

The early remote-control systems used *metallic pairs*, dedicated phone lines with dc continuity. Control signals consisted of dc pulses on one phone line, with metering signals returned to the studio on another line. Although the design worked effectively, the high cost of phone lines encouraged remote-control manufacturers to seek alternative methods.

Modems reduced the required number of telephone lines from two pairs to one. Audio tones for control were sent from the studio to the transmitter, and the metering voltages were sent back to the studio over the same phone line. This design represented a *full duplex* (data continuously going both directions), *2-wire* (requiring only a single phone line), frequency-division multiplex circuit. The phone-line bandwidth was divided, with the spectrum above 100Hz being used to carry control information from the studio to the transmitter, and the spectrum below 100Hz (including 0Hz dc) being used to return metering information to the studio.

As metallic pairs became difficult to acquire, systems that used audio tones for the metering return were introduced. This design permitted full-duplex operation on a 2-wire line using frequency-division multiplexing. (See Figure 1.) One popular remote-control system used 300Hz to 400Hz for the control signal and 800Hz to 1,200Hz for the metering signal. The control signal was transmitted using *frequency shift keying* (FSK) methods. FSK is the same as FM except that the modulating signal is a square wave. The metering circuit used a linear FM scheme to transmit an analog representation of the sample voltage back to the studio.

Under this design, 800Hz represented a sample voltage of zero, and 1,200Hz represented a sample voltage of full scale. This new technique (audio up, audio down) allowed any full-duplex voice-grade circuit to link the studio and the transmitter.

Subcarriers

Subcarriers often are used to carry control and metering information above the program (either video or audio) channel. This subcarrier generally is frequency-modulated, although any type of modulation can be used as long as no program channel interference is created. Some systems use a single-sideband suppressed-carrier AM technique, resulting in excellent spectrum efficiency.

Subcarriers usually can be modulated with a voice-grade signal without causing interference. Use of subcarriers that accept voice-grade signals allows the previously described audible metering and control circuitry to be used without modification. Because voice-grade circuits are readily available, most remote-control equipment is designed for use with these circuits.

AM stations can use subcarriers too, but the subcarriers must be located below the program frequencies to avoid creating adjacent-channel interference. Analog metering systems generally use 20Hz for zero sample voltage and 30Hz for full scale. Digital metering systems often use 20Hz to 25Hz FSK with low data rates (typically 9.4b/s) or low-frequency, low-speed differential phase shift keying. One system transmits data at 37.5b/s on a 37.5Hz carrier. Because of the low data speeds and the need for low-frequency AM stereo pilot signals, subaudible metering may not be practical in all cases. FM and TV stations may use subaudible metering on a subcarrier, leaving the remainder of the subcarrier free for background music or other audible programming.

Half-duplex systems

All of the communications methods examined so far are full duplex, with data being transmitted in both directions simultaneously. An alternative communications scheme is called *half duplex*. In such a system, the single channel is used to carry data in both directions, but in only one direction at a time.

A dedicated 2-wire phone line can carry data half duplex. Instead of using frequency-division multiplexing to break the circuit into two communications channels (one in each direction), a half-duplex system uses time-division multiplex techniques to provide the two circuits. An example of half-duplex communication is human speech. You spend a certain portion of time talking and a different portion of time listening. Ideally, you do not talk and listen at the same time.

Half-duplex communications allow the data bandwidth in each direction to be varied as system requirements vary. This contrasts with a full-duplex, 2-wire system, in which the data bandwidth allocated to each direction is defined in the system design. A speaker who has little to say cannot release some of the audio bandwidth to another speaker who has a lot to say. This wastes spectrum space.

An example of wasted space shows up in the 1,200b/s full-duplex (Bell 212 standard modems commonly used over dial-up lines. A 1,200b/s path is provided in each direction, typically allowing 120 characters per second in each direction. An operator may type at five characters per second, vastly underusing the channel. The computer may send a screen of data to the operator, but is restricted to the 120-character-per-second rate.

At other times, the operator may be uploading a file to a computer at 120 characters per second while the computer sends back an occasional acknowledgment, perhaps five characters per second. Although the roles are reversed, there is still a lot of wasted bandwidth.

If the same Bell 212 modulation technique (quadrature phase shift keying) is used, but with the entire available bandwidth, 240 characters per second can be passed in one direction. A half-duplex system divides up the available time to meet the data-transmission requirements at each end of the system.

If only five characters per second are sent, the remaining data bandwidth (measured in bits per second) is allocated to the other end. This allows the computer screen to be updated at perhaps 235 characters per second. Because the full-duplex frequency-division multiplex system requires signal guard bands, using the channel in one direction at a time further improves the total data throughput.

A comparison of the Bell standards for FSK full-duplex and half-duplex modems shows the throughput advantage gained by lack of guard bands. The Bell 103 standard allows 300b/s communications in both directions simultaneously, for a total capacity of 600b/s. The Bell 202 standard

Continued on page 49

on twenty transparent generations. Which makes post-production, especially compositing, significantly faster—while tying up fewer machines.

Superb sound: Four digital audio channels.

The 48KHz digital audio sampling frequency used by the VPR-300 is actually higher than the digital sampling rate

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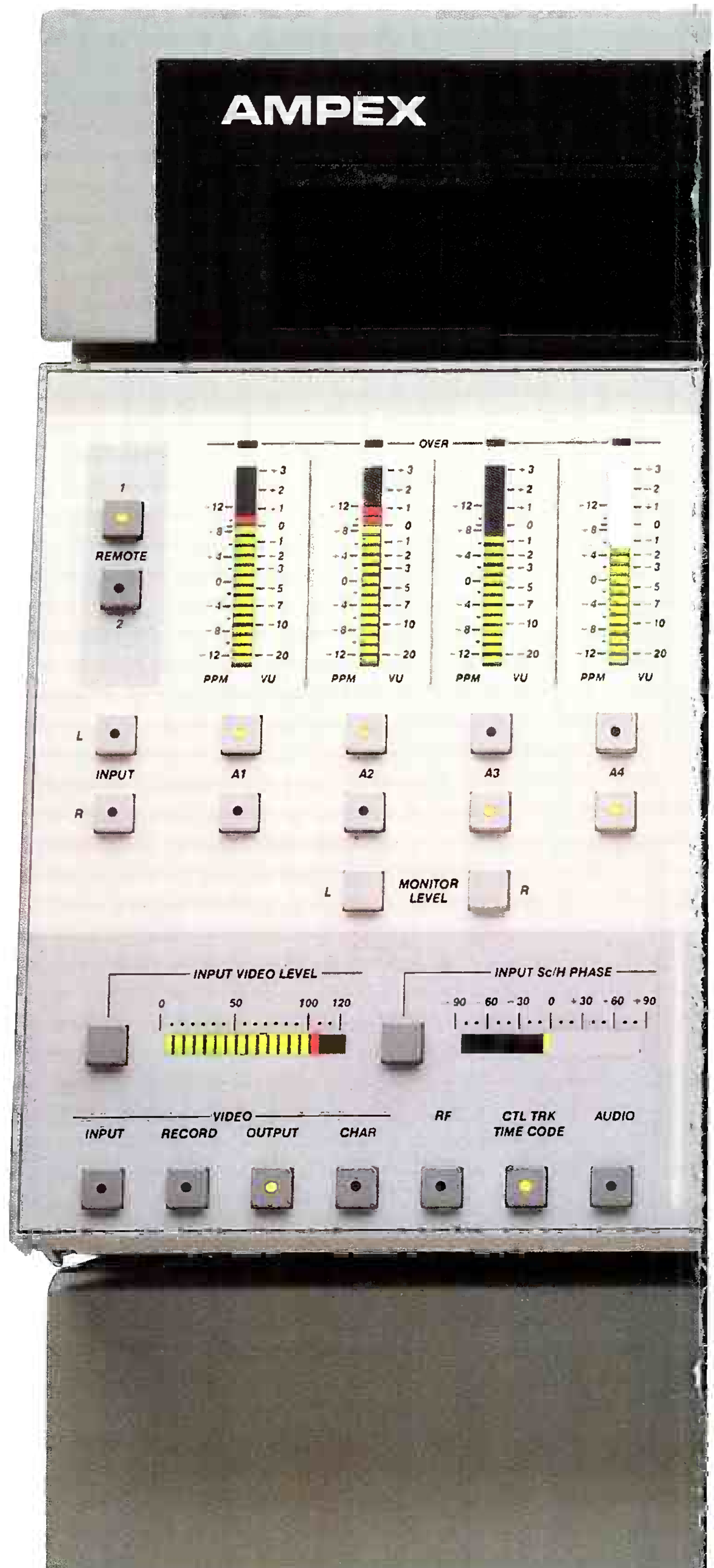

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used for compact disc mastering. There are *four* 16-bit digital audio channels with totally independent editing on each track. So you'll be able to do more of your audio work right on the VPR-300, instead of going off-line.

How good is the audio? Better than your CD player!

And when you layback sound using the digital interface, the integrity of your work is perfectly preserved.

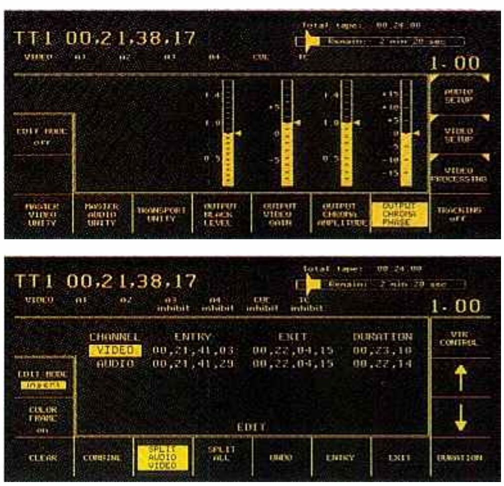
Digital technology makes the VPR-300 inherently easier to operate.

Compatibility and performance aren't the only benefits. The VPR-300 is also easier to operate. Since it's a cassette machine, tape is automatically threaded. And since the digital electronics are drift-free, no time-consuming set-up is required.

Controls on the VPR-300 are simple and straightforward, and they afford you the uncompromising flexibility your kind of work demands.

And to make operation easy, a large status display provides comprehensive operational information, in plain English.

This remarkable display helps eliminate human error by leading you step-by-step through operational procedures.



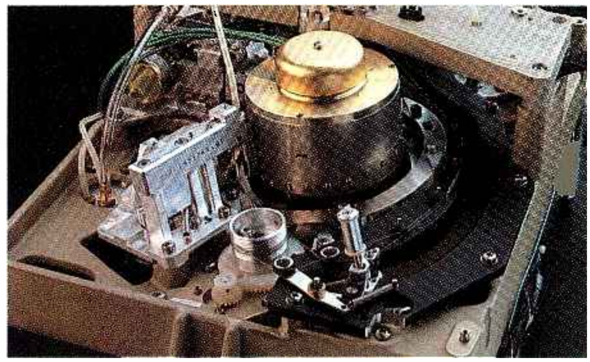
A large, interactive display makes operation easy.

But more importantly, it allows you to take full advantage of all the machine's capabilities.

If time is money, spend a moment with these specifications.

The VPR-300 will load and thread a cassette, ready for record or playback, in under four seconds.

It will recue a thirty-second spot in under 3.5 seconds. And playback lock-up time with scanner up to speed is under 20 milliseconds.



Computer-aided design techniques resulted in a pinch-rollerless transport with optimized tape path geometry, and a superior threading mechanism.

Incredible? Not when you consider its heritage. The machine's high speed pinch-rollerless transport is a descendant of our Emmy Award winning VPR-3. It uses air guide technology to deliver unmatched speeds, gentle tape handling, and durability that's measured in years, rather than in hours.

Full featured editing, and flexible machine interface.

As an editing tool, the VPR-300 is a pleasure to work with. It interfaces with major professional editing systems, as well as other analog and composite digital VTRs.

The VPR-300 will search to a field, jog field by field, and run at 60× play speed with viewable color pictures.

And the automatic and manual *assemble, insert, and animate* editing modes are engineered to ease your most complex editing tasks.

If your work involves time-compression/expansion or fit/fill, an AST™ automatic tracking system lets you vary play speed continuously from −1 to +3× normal.

Picture bounce and blur are precluded by digital signal processing.

And a computer monitors the machine's operation and reports on status and trends. So you can optimize performance, schedule maintenance, and eliminate costly downtime.

We've made no compromises.

And we've cut no corners. The VPR-300 is an exquisitely crafted, high end, no nonsense machine. And it's backed by the most professional service and support organizations in the industry.

If you create exquisitely crafted, high end, no nonsense video, you'll want one.

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Ampex Digital Tape:

The VPR-300 will record and play back on 32, 94 or 227 minute cassettes.

Get all the performance the format has to offer.

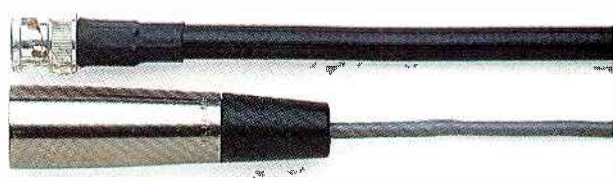
The D2 Composite Digital format was developed by Ampex. So we had a head start when it came to developing a digital video tape that could consistently deliver outstanding video quality and reliable performance.

Designed specially for D2, our new cassettes use metal particle tape. So you get higher signal output, better SNR, and shorter wavelength response.

To help prevent dropouts, the cassette shells are molded in special anti-static plastics that reduce the attraction of dust. We combined state-of-the-art plastics technology with our patented low friction hub design to create debris-free precision hub-bearing surfaces. And a newly designed clamshell door completely protects the tape outside the machine.

Cassettes are available in all popular lengths, the largest providing over three hours of play time. Ampex cassettes are designed to play in all D2 machines. And each size cassette features a unique *insertion slot* that prevents you from inserting it incorrectly.

Best of all, our new digital video tape has that single great feature you've come to expect from Ampex tape: *Consistency.*



BNC and XLR cables are all it takes to put the D2 Composite Digital VPR-300 on line in your facility.

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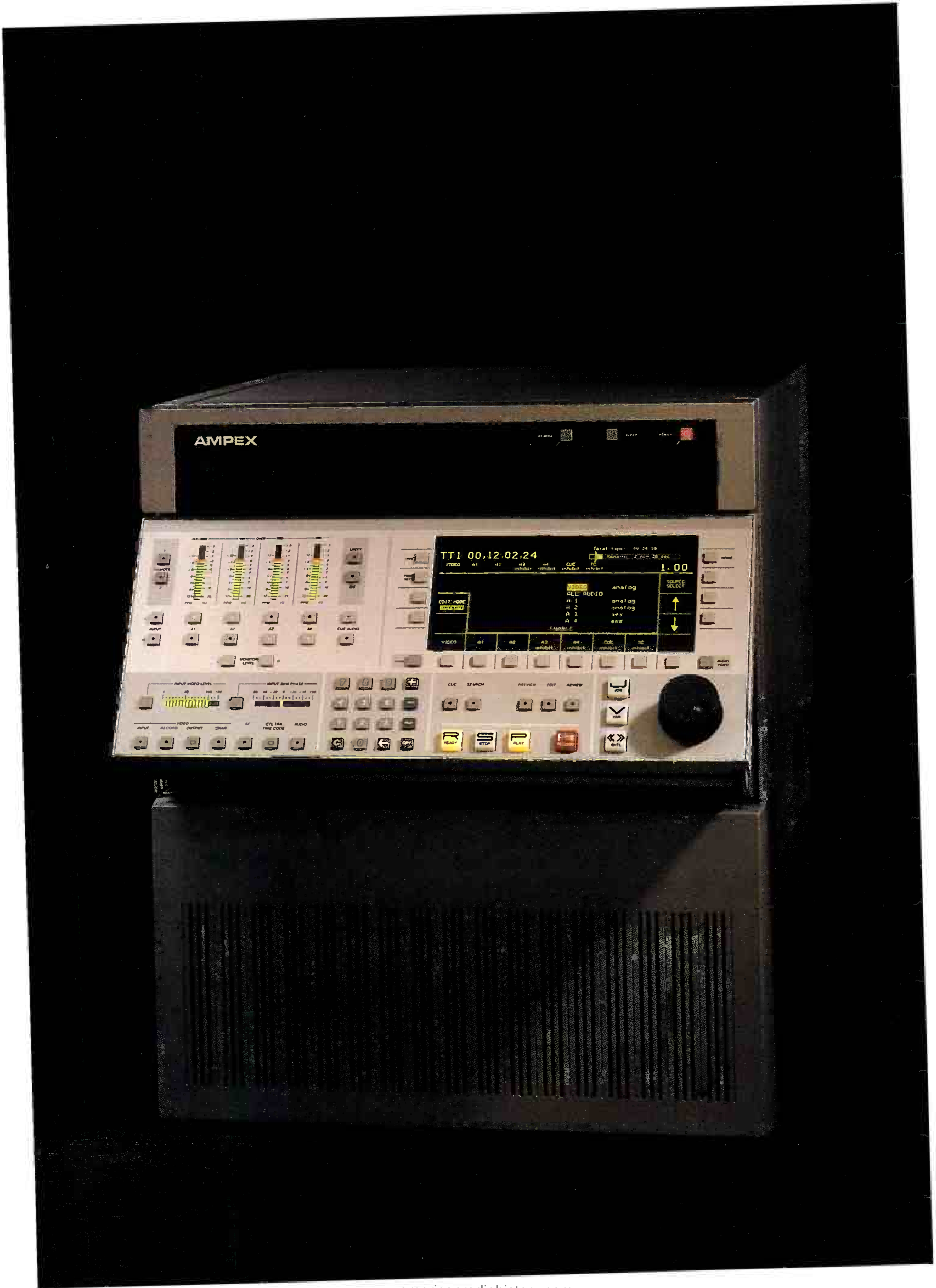
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Continued from page 48
permits 1,200b/s communications in one direction at a time, for a total capacity of 1,200b/s. A major portion of the gain is due to the use of spectrum that was previously allocated to guard bands. See Figures 1 and 2.

Turnaround delay

In a half-duplex communications system, it is necessary to turn around the system to allow transmission in both directions sequentially (instead of simultaneously, as in full duplex). These systems suffer from turnaround delay caused by the transmit carrier squelch time, channel propagation delays and carrier sense time. See Figure 3.

The turnaround delay reduces the total communications time available, or decreases throughput, because the channel is carrying no information during turnaround. This throughput loss can be reduced by minimizing the number of channel turnarounds and transmitting large blocks of data.

Multisite communications

Many times it is necessary for a single remote-control system to simultaneously, or at least sequentially, communicate with several sites. It's not uncommon for a licensee to need to control AM, FM and TV transmitters at different sites. Usually, such facilities also require the control and monitoring of intercity relay microwave sites. Half-duplex communications techniques allow any site to communicate with any other site over a single 2-wire channel. See Figure 4.

Each site places its data on the 2-wire channel, and all other sites hear it. The site to which the data is addressed picks up the data and processes it. Each site ignores any data not addressed to that location. This scheme is similar to the tristate computer bus, in that only the appropriately enabled ICs read or write data to the bus.

Four-wire systems

Long 2-wire circuits experience large losses because it is difficult to amplify signals passing in both directions over the same pair of wires. Long-distance circuits usually are constructed as 4-wire circuits. An analogy is the telephone system. Local circuits, from the central office to your home, are 2-wire circuits. Long-distance circuits use 4-wire design.

Figure 5 shows a 3-site, 2-direction, intercity microwave relay system. Each microwave link provides subcarriers for a 1-way voice-grade data channel. A radio station might use the combination of an STL and UHF P channel return link.

The system requires that each remote-control modem have two inputs, which are combined using an inverting summing amplifier. Such a design theoretically produces no crosstalk between inputs. Each remote-control modem also has two outputs that carry the same audio data (typically FSK coming from a zero source, which also reduces the crosstalk between the paths).

When a site needs to transmit data, it places the information on both the "northbound" and "southbound" circuits. Although all other sites in the system hear the data, only the one to which it is addressed responds. This allows any site to communicate with any other site.

UHF P channel links

Half-duplex communications can be implemented with a single UHF P channel for control and metering data communications in both directions. Each site in the system activates the RF carrier along with its modem carrier when it has data to transmit. The use of UHF P channel links for control and monitoring frees up subcarrier space on an STL or broadcast carrier for other uses. It also results in a communications system that is separate from the broadcast link in the event of an STL or broadcast transmitter failure. Loss of the STL does not mean loss of control, and the loss of the broadcast transmitter (and its subcarriers) does not mean loss of telemetry.

With proper coordination, multiple broadcast stations may use the same P channel for control and telemetry. The half-duplex communications scheme allocates variable portions of the total channel time among the different sites in the system. The FCC has allocated only eight P channels. Sharing of these communication channels in a half-duplex configuration allows a large number of stations to use a small number of channels.

DTMF and voice

Any data communications system must present the data in a form understandable by a human operator. The translation of remote digital data to human-readable form generally is done at the studio. The human-readable output may consist of 7-segment numeric or alphanumeric displays, a CRT terminal or a printer.

Operator input usually comes in the form of keystrokes, which are converted to digital data, sent to the modem and relayed to the transmitter site. Unfortunately, the terminal equipment that makes the data readable for operators can be expensive. A relatively new approach to solving this human interface problem is the use of DTMF (Touch-Tone) and voice synthesis.

If the transmitter site sends its data using a voice, no translation is required for the operator. Connecting an earphone across the telephone line may be sufficient. It still is necessary, however, to transmit control commands to the transmitter site. An inexpensive solution to this need is the DTMF generator, or keypad.

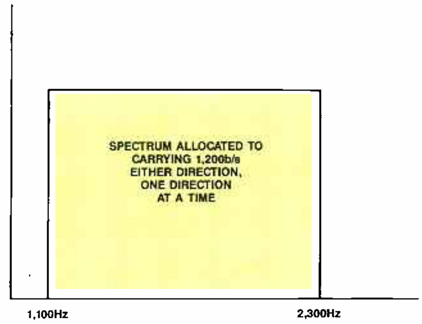


Figure 2. *Time-division multiplex spectrum allocation on a 2-wire, half-duplex circuit carrying 1,200b/s data. The information is carried only one way at a time.*

A keypad with 16 keys (four rows and four columns) generates an audible signal unique to the key that has been pressed. The signal consists of a single frequency tone below 1,067Hz to indicate which row the key is in, and a single frequency tone above 1,067Hz to indicate which column the key is in.

The DTMF/voice system is a half-duplex system. Each site in the system uses a major portion of the channel bandwidth when it sends data. Only one end sends data at a time. The operator selects the data the transmitter site is to send, and the transmitter site responds with the data in voice form. DTMF/voice systems typically use standard 2-wire circuits, although they also will work over 4-wire circuits. On a 4-wire circuit, only one direction is used at a time, unless it is a multisite system.

DTMF/voice systems are slow compared with FSK systems operating over channels of the same bandwidth. DTMF generally can operate at up to 10 digits per second where each digit has 16 possibilities, which can be represented with four bits. Therefore, DTMF throughput is about 160b/s compared with 1,200b/s for an FSK half-duplex system.

These systems still have enough speed to satisfy many, if not most, transmitter-control requirements. Their primary advantage over other systems is cost. Multiple control and monitoring points can be set up at minimal cost.

Intelligent systems

All the control and telemetry methods mentioned so far rely on a dedicated circuit to carry the data between the transmitter and the control point. Recent deregulation has permitted other techniques to be used.

The FCC eliminated the fail-safe requirements, such as FCC 73.67(a)(2), in 1984.

This rule required a remote-control system to immediately drop the transmitter carrier upon loss of the continuous circuit between the studio and the transmitter. Removal of this requirement allows the use of part-time circuits, which are less expensive than full-time circuits.

Part-time circuits are useful if the circuit duty cycle is low. The duty cycle depends on how frequently the studio needs to send data to the transmitter and how frequently the transmitter needs to send data to the studio. With increased stability of transmitter equipment, reduced logging requirements and intelligent transmitter-control systems, the duty cycle of today's control/monitoring circuits can be quite low.

The duty cycle can be reduced even further if *remote intelligence* is provided. If the transmitter-site unit initiates a call when an alarm condition occurs, routine polling of the remote site by the studio is not required. The circuit duty cycle is, therefore, reduced to zero, except when an alarm condition occurs. The result is substantially lower communications costs than with dedicated circuits.

The widespread availability of dial-up circuits is another advantage. It is easier and much less expensive to get multiple control/monitoring points through the use of dial-up lines than it is with dedicated lines. Note that *control points* other than the studio require FCC notification and may call for special attention to various FCC rules. *Monitor points* other than the studio require no FCC notification. You can call and monitor the transmitter from anywhere; however, you can control it only from an FCC-notified control point.

Sampling requirements

Broadcast remote-control equipment accepts sample voltages as representations for the parameter being measured. This is in contrast to the industrial control market, in which a sample current represents the monitored parameter (with 4mA representing zero and 20mA representing full scale).

Most sample voltages are linearly proportional to the measured parameter. For example, a 0Vdc sample might represent 0Vdc plate voltage and 1Vdc sample represents 5kV, and 1.5Vdc represents 7.5kV. Similar linear relationships exist between the sample voltage and the measured plate current, other transmitter voltages and currents, antenna base and common point currents, directional array relative loop currents and loop current phases.

These sample voltages are represented by the equation $Y = mX + b$, where Y is the sample voltage, and X is the measured parameter. Value b is the Y-intercept, which is the sample voltage when the measured parameter (X) is zero. In most broadcast applications, *b* is zero and *m* represents a scaling factor determined by the sampling device. A similar scaling factor is used in the remote control to convert the sample voltage back to a representation of the measured parameter in engineering units. After all, it's not important what the plate sample voltage is; you want to know the plate voltage.

The scaling factor in a remote-control system is adjusted with calibration pots. Computer-based remote-control systems rely on a floating point number stored in non-volatile memory. When the remote control measures the particular sample voltage, it is multiplied by the scaling factor, either by routing the actual sample voltage through the calibration pot or by software multiplication of the measured sample voltage and the scaling factor. The result is a display of the measured parameter in the correct engineering units.

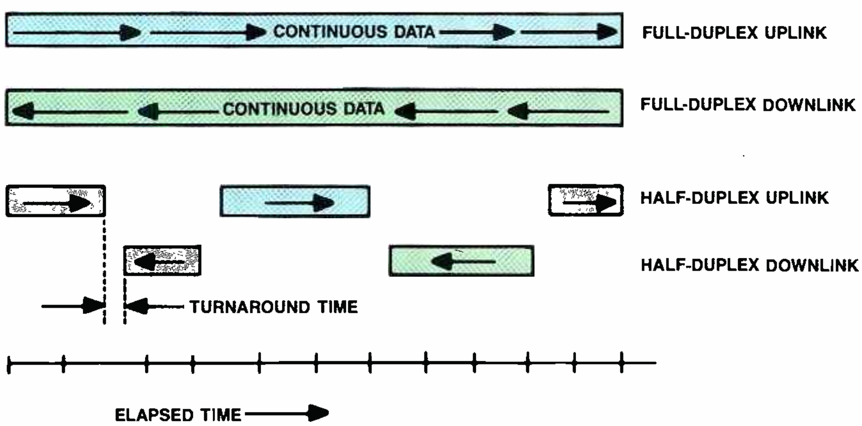


Figure 3. *Time comparison of full- and half-duplex communications systems. Note the turnaround time and variable packet sizes for half duplex.*

Sample voltage linearity

The sample voltage must be proportional to the measured parameter or proportional to the square root of the measured parameter. Many times, the remote-control reading agrees with the transmitter on high power, but not on low power. The question then becomes, "Which device is correct?"

Most transmitters use mechanical, analog meters while remote controls often rely on dual-slope A/D converters. The A/D is much more linear than the transmitter meter. Therefore, if you are experiencing

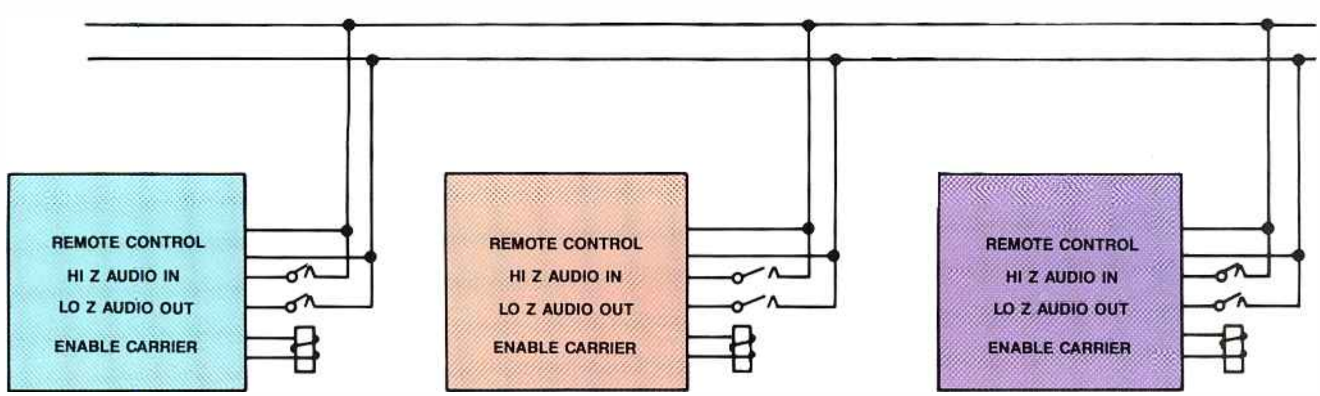
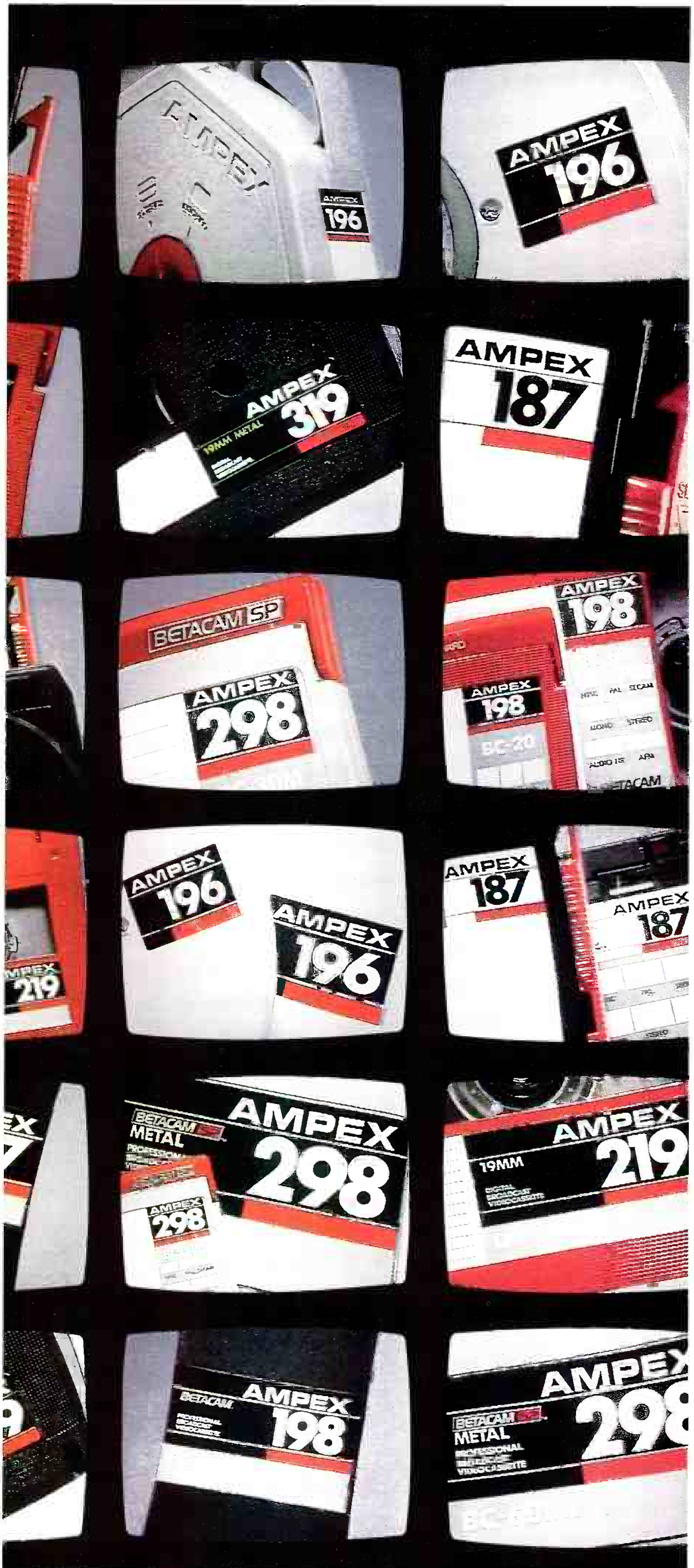


Figure 4. *Multisite communications on a 2-wire, half-duplex circuit using audio tristate drivers.*



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the problem of a reading that isn't matching the transmitter on low power, it might not be that the remote control does not track the transmitter meter, but rather, the transmitter meter is not tracking the remote control.

Square law sampling

Some sample voltages do not linearly track the measured parameters. This is the case with the indicated power output from a transmitter reflectometer. In this case, the sample voltage follows the square root of the indicated output power (or reflected power). The remote control or external signal-conditioning equipment must square this sample voltage before applying the scaling factor. This function generally is handled in the remote-control software or a power-to-linear converter.

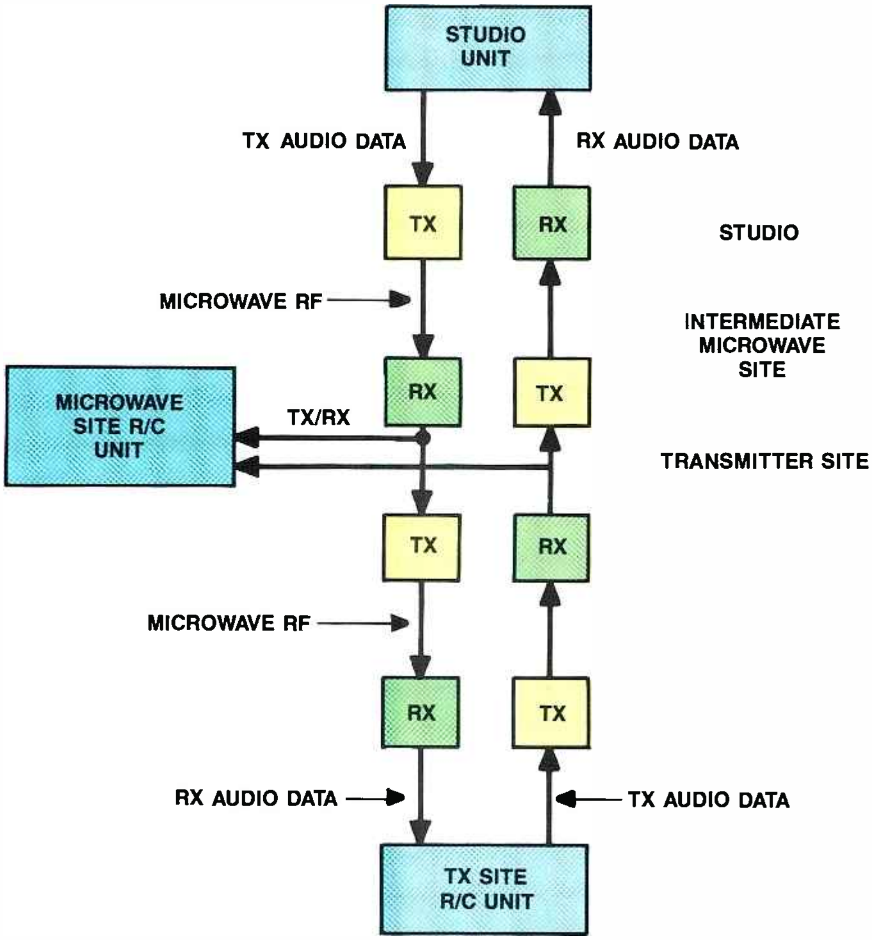

Figure 5. *Multisite communications on a 4-wire, half-duplex circuit using audio tristate drivers.*

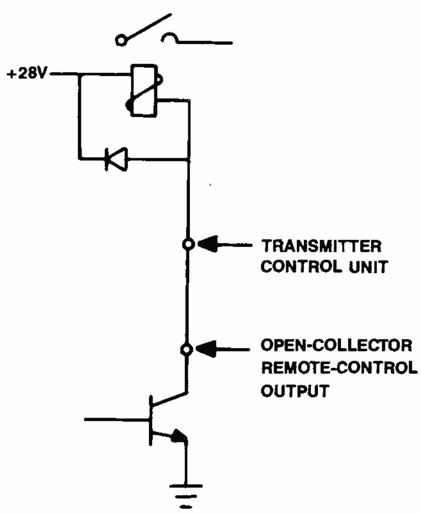

Figure 6. *Open-collector control output switches to ground, turning on the relay.*

Calculated parameters

Not all desired parameters can be measured directly. Some parameters must be calculated (derived) from measured parameters and known constants. Examples of derived parameters include indirect power, transmitter efficiency, DA loop current ratios and DA loop current ratio deviation from licensed value.

These derived parameters can be calculated by software in the remote control, which provides the operator with more useful data. For instance, instead of displaying the reference tower loop current and the tower No. 1 loop current, the system might indicate that the tower No. 1 loop current ratio deviation is −2%. Such information is not only more meaningful, but also is easier for less knowledgeable operators to understand.

Sample voltage range

There is some disagreement between transmitter manufacturers and remote-control equipment manufacturers as to the ideal sample voltage. Remote-control manufacturers prefer low sample voltages (2V full scale to 5V full scale), which can be applied directly to the A/D converter. This avoids the use of voltage dividers, which are not temperature-stable. Transmitter manufacturers, on the other hand, often provide high sample voltages (10V or more) so that the sample voltage is considerably above any ambient noise.

The sample voltages usually are dc, and noise is ac. The problem with low sample voltages, such as from a reflectometer, is in the available resolution of the remote-control A/D converter. It may not be possible to calibrate the monitoring channel if the sample voltage is so low that one LSB (least significant bit) change of the A/D converter represents more than 0.5% of the sample voltage. To ensure sufficient resolution, the sample voltage must be high enough to overcome this problem.

Common-mode voltage

A few remote-control systems measure the sample voltage as a voltage difference between two wires, while allowing the two wires to have as much as ±100V or more in common, with respect to ground. This is the *common-mode voltage range*. Other remote-control systems assume that all sample voltages will be measured with respect to ground.

Lack of common-mode voltage range, hence common-mode voltage rejection, may cause sampling errors due to ground loops. Usually the sampling currents are quite low, and the crosstalk between sampling circuits due to a shared ground will be small. Additional crosstalk may be introduced by the ground loop between ac power signals and the sample voltages. Fortunately, the sample voltages generally are dc, and the A/D conversion rate typically is designed for optimum 60Hz rejection.

The decision as to whether you need a remote-control system that accepts common-mode sample voltages depends on the transmitter. Most current transmitter designs provide unbalanced plate voltage and current samples. However, one older transmitter design places the power-trim pot in the cathode circuit of the final RF amplifier. This requires the plate voltage to be measured between the top of that pot and the plate. The design creates a

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Tower light sampling

When a remote control displays apparently random numbers, how can you tell if your tower lights are working properly? One solution to this problem is to pass the output of the tower light-sampling system (current sense transformer and rectifier) through a low-pass filter with a cutoff frequency of 0.01Hz. This filter might be a 100kΩ resistor and a 1,000μF capacitor.

The filter output will be a dc voltage proportional to the current drawn by the flashing beacon times the duty cycle of the beacon, plus the current drawn by the side lights. The result will be a stable indication on the remote control. A higher-than-normal reading indicates the beacon flasher is stuck on. A lower-than-normal reading indicates one of the lamps has failed or the flasher is stuck off.

T1 is the current sense transformer. It typically has a 1-turn primary in series with the power supply to the tower lights. The current transformer converts a low-voltage drop with a high current in the primary to a high voltage with a small current in the secondary. The secondary of T1 appears as an "almost ideal" current source, so R1 is added to convert this to a voltage source with a source resistance of 10kΩ (the Thevenin resistance).

D1 converts the 60Hz ac to dc (with a high 60Hz ripple component). The voltage at the output of the diode is shown in the "scope sketch." The envelope of this signal has a rectangular wave shape. The lowest voltage of a rectangle wave envelope corresponds to the current drawn by the steady burning side lights. The highest voltage of the rectangle wave envelope corresponds to the current drawn when the side lights and the flashing beacon are on. The rectangle wave has a duty cycle of about 67% (see FCC 17.25(a)(1)) and a frequency of between 0.2Hz and 0.67Hz.

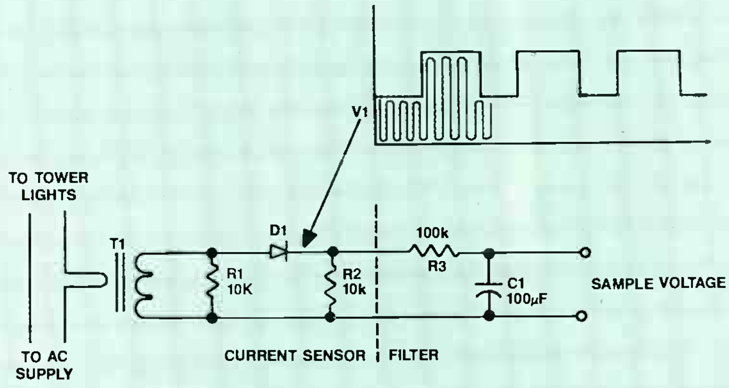
The low-pass filter (formed by R3 and C1) attenuates any component of V1 that is above the cutoff frequency (0.016Hz in the sample circuit). The output of the filter is a dc voltage (with very low ac components) that is proportional to the current drawn by the side lights plus the product of the current drawn by the beacon and the duty cycle of the beacon. Should any of these factors (side light current, beacon current or beacon duty cycle) vary, the output voltage of the filter changes. Note, however, that the output voltage does not change with flash rate, but flash rate variation (other than the rate going to 0, which results in a duty cycle change) is a very rare failure in tower lighting systems.

The overall effect of all this is that a failure of any lamp will cause a low reading. Failure of the flasher will cause either a low (beacon off) or high (beacon on) reading. The failure that will have the least effect on the sampler output is the loss of one side light (116W to 125W each).

Simulating a failure to determine acceptable sample voltage limits might involve climbing the tower. However, once this circuit is installed, you should be able to see the change in sample voltage caused by adding one 116W lamp to the lighting system. This can usually be accomplished in the transmitter building or at the tower base. The change in sample voltage will be the same magnitude (but opposite direction) as the change in sample voltage caused by a loss of one lamp (assuming D1 is an ideal diode).

Tower light limit charts or alarms should be set to somewhat above the sample corresponding to the loss of one lamp, so that the loss of one lamp reliably results in the operator being notified. If the alarm limit is set too close to the normal voltage, line-voltage variations may result in false alarms, although incandescent lamps tend to draw a constant current over a range of supply voltages, minimizing this effect.

Note that the cutoff frequency of the low-pass filter will be affected by the resistance of the load (the input resistance of the remote control). If this resistance is above 1MΩ, the effect can be ignored. Otherwise, the cutoff frequency can be approximated by using the resistance of a parallel combination of the filter resistor and the load resistor. Excessive loading will increase the cutoff frequency, introducing ripple in the output. To drive remote controls with low-input resistances, the filter resistor can be decreased while increasing the capacitor, the filter could be replaced with an active filter, or the filter could be followed by an isolation amplifier (such as an op-amp voltage follower).



T1: CURRENT SENSE TRANSFORMER
R1: CURRENT SENSE RESISTOR, DETERMINES OUTPUT VOLTAGE
R2: PROVIDES A RELATIVELY LOW RESISTANCE TO FILTER
R3 AND C1: FORM A SINGLE POLE LOW-PASS FILTER WITH A CUTOFF FREQUENCY OF $\frac{1}{2\pi RC}$ = 0.016Hz

Accurate tower light monitoring can be accomplished through the use of simple current sensor and low-pass filter circuits.

plate voltage sample with up to 100V of common-mode voltage, because of the voltage drop across the power-trim pot.

Antenna monitors

Directional array antenna monitors require special consideration. These monitors typically display the current and phase of only one tower at a time. They must be told which tower to monitor, usually with *tower-select* inputs. Furthermore, once the tower-select input is driven, there is a settling time before the sample voltage is valid. These constraints mean that the remote control must provide a method of driving the tower-select lines (often done with raise or lower control lines) and allow time for the sample voltage to settle (typically 1s).

Status inputs

Remote controls often allow the status of on/off devices to be relayed to the control point. Such on/off status indications might include the transmitter filament and plate contactors, day/night power switch, transmitter overload relay and RF switch status (antenna or transmitter changeover switches), DA pattern switches or burglar-alarm switches.

These status inputs generally are TTL compatible, using a TTL or CMOS chip with pull-up resistors to +5V. One state is represented by +5V, the other by 0V. These inputs can be driven by TTL or CMOS devices, switch or relay contact closures to ground or open-collector closures to ground.

Unfortunately, some transmitter manufacturers don't provide compatible logic levels on the status outputs. Some use

Continued on page 58

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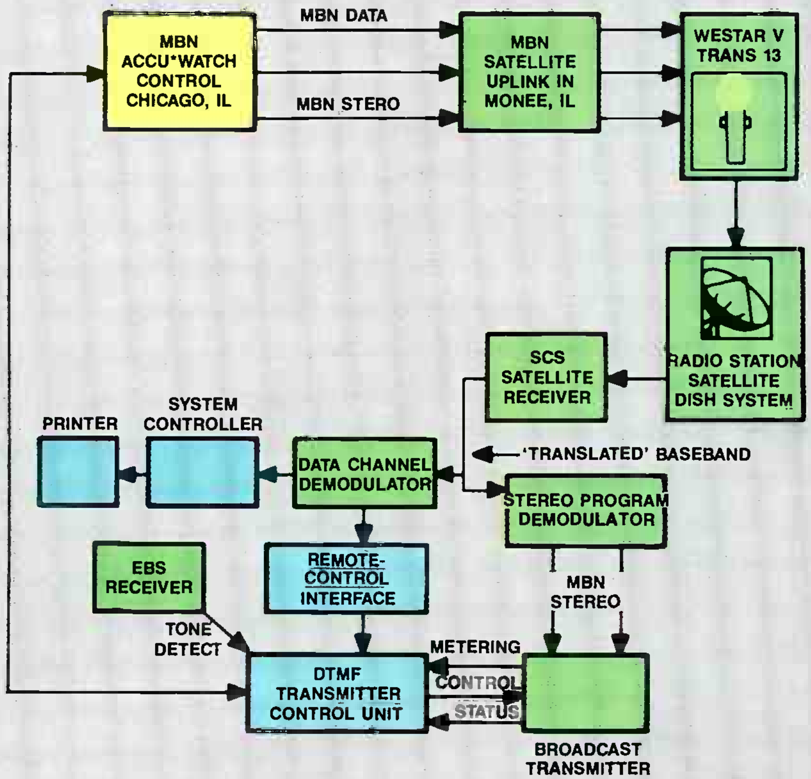
Circle (30) on Reply Card

Network operates affiliate transmitters

By Jim Goodrich

"Walk-away," part-time and overnight staffing has long been a concern for managers and chief engineers. Stations often find that although the programming is available, the cost of staffing the studio and training the operators is prohibitive, particularly at small or marginal operations.

Controlling the programming is relatively easy with today's satellite-delivered audio, but what stumped broadcasters for years were the technical considerations of automatic transmitter system (ATS) implementation. Even if a station purchased an ATS-capable remote control, the EBS requirements were another stumbling block. Now, computers, voice-synthesis remote-control systems and satellites have teamed up to solve the dilemma.



*The Accu*Watch system allows stations to remain on the air without an operator on duty.*

Network control

The Moody Broadcasting Network (MBN) distributes programming via satellite to more than 100 affiliates across the United States. Because the audio link was already in place, it seemed a natural progression to provide staffed transmitter control along with the programming.

Using the facilities of United Video's Satellite Control System (SCS), MBN is part of a group of religious networks sharing the same distribution channel. Through the addition of a data channel to the satellite network, many data and control options became possible.

Smart remote control

Addition of the data channel provided the network with a way to send hard-copy information to affiliates instantly, along with transmitter-control signals. MBN uses two 15kHz program channels with the data channel for data and transmitter control. A custom-designed satellite demodulator/controller allows the network to pass data and commands to any transmitter site.

Because it is not convenient for each station to pass telemetry back to the network on a full-time basis, an intelligent remote control was needed at each site. Therefore, each affiliate uses a computer-based, voice-synthesis remote-control system to perform the required monitoring and adjustments "on site." Transmitter power, current and voltage are monitored and adjusted as required by the local remote-control system. The unit also provides monitoring of tower lights, antenna icing, fire and security. If any parameter exceeds preset conditions, the remote control calls the network as well as station personnel.

When alarmed, the remote control calls the *designated control point* (DCP) by telephone. A synthesized voice then reports the situation to the operator. Control security is provided through identification numbers. This prevents an unauthorized user from making changes in the transmitter or other transmitter equipment. The FCC provides local EBS waivers with the requirement that monitoring be handled locally and at the DCP via the remote control. Now, through the control system, called Accu*Watch, the site is capable of operating by itself.

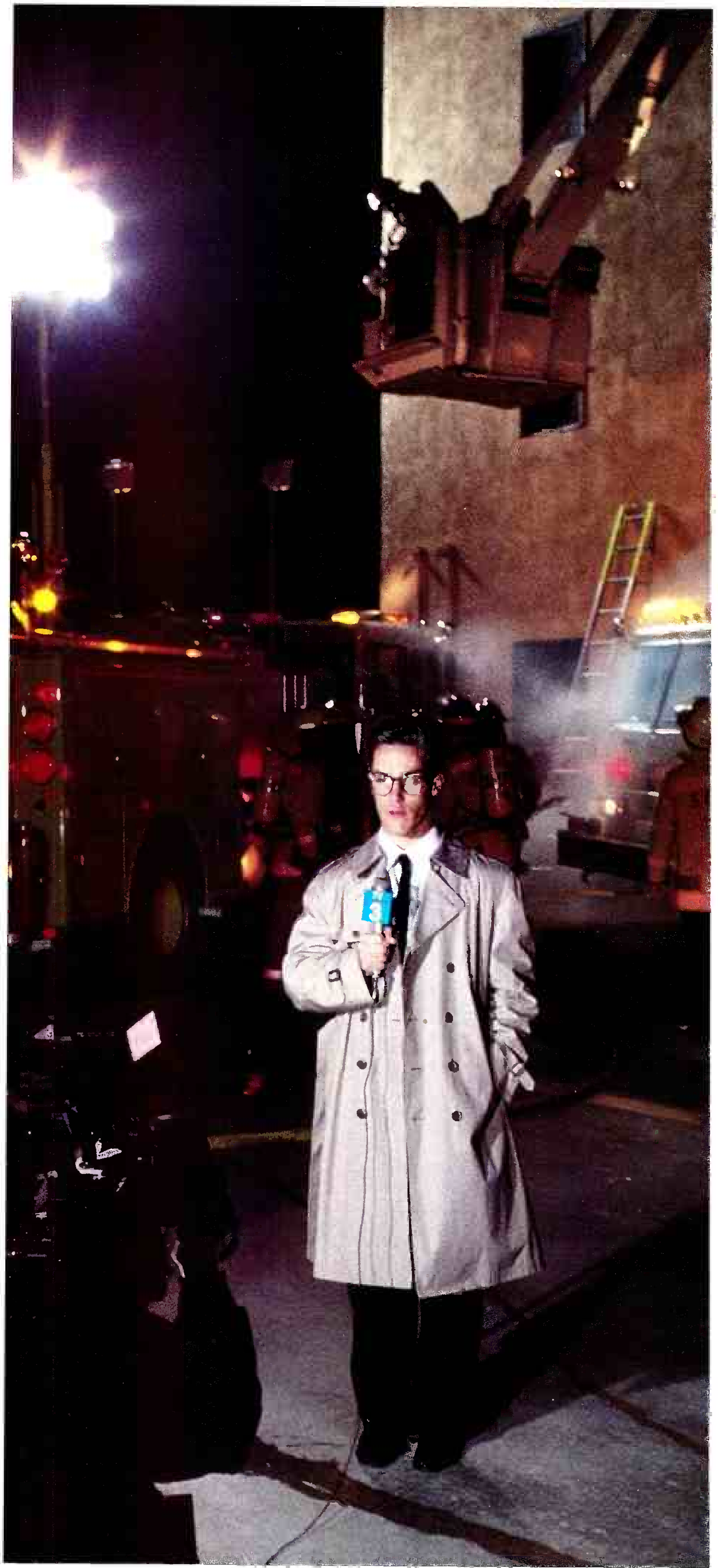
The FCC has approved four methods of controlling the transmitter:

1. Automatic transmitter control by the synthesized-voice remote-control system;
2. Telephone access from either the DCP or station personnel by telephone;
3. Data channel control by the DCP; and
4. Pulses and silence-sensing via the program channels.

Each affiliate's transmitter, then, can be controlled by four different methods. There is little likelihood of a transmitter being left on the air if a problem develops. The computer-based satellite demodulator will control the transmitters using any ATS remote-control system that complies operationally with the DCP procedures and the FCC requirements.

The Accu*Watch system cost for WESTAR V users is less than $900 for the demodulator/controller equipment and data service, provided the station is equipped. Initially, the service is being provided only to affiliates and to other WESTAR V users. The network may provide the service to non-affiliated stations in the near future.

Goodrich is assistant to the vice president for the Moody Broadcasting Network, Chicago.



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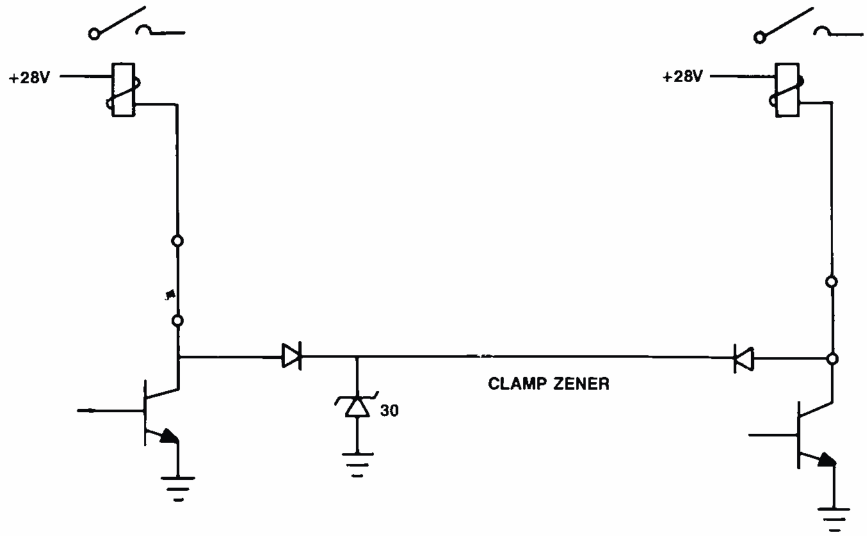

Figure 7. The zener diode clamps excessive voltages to ground, thereby protecting the transistors.

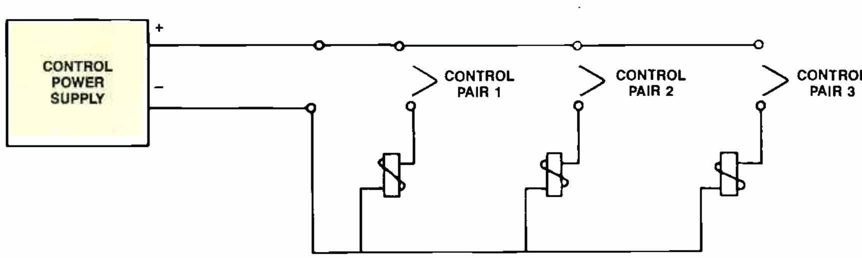

Figure 8. If the transmitter relies on positive switching, try reversing the power-supply leads to the control ladder.

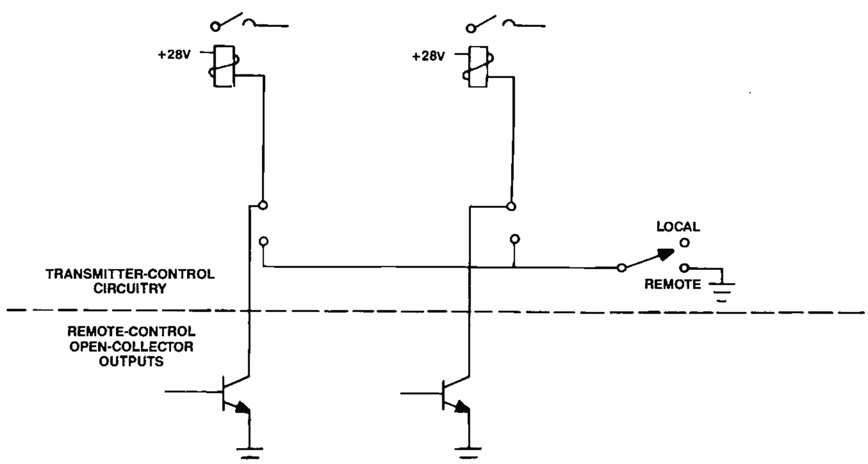

Figure 9. Be wary of open-collector outputs that may bypass the local/remote switch. This creates a safety hazard.

Continued from page 54
levels of +28Vdc and 0Vdc. Another manufacturer uses voltages of +28Vdc for false, +1.4Vdc for true, powered through a 10kΩ resistor. In this case, the station engineer is required to design a logic-conversion circuit to develop a compatible status input signal.

Control outputs

The remote control also must be able to control, as well as monitor, the equipment at the transmitter site. Let's look first at the hardware, then the software aspects of developing control outputs.

Most transmitters use low-voltage dc
Continued on page 62

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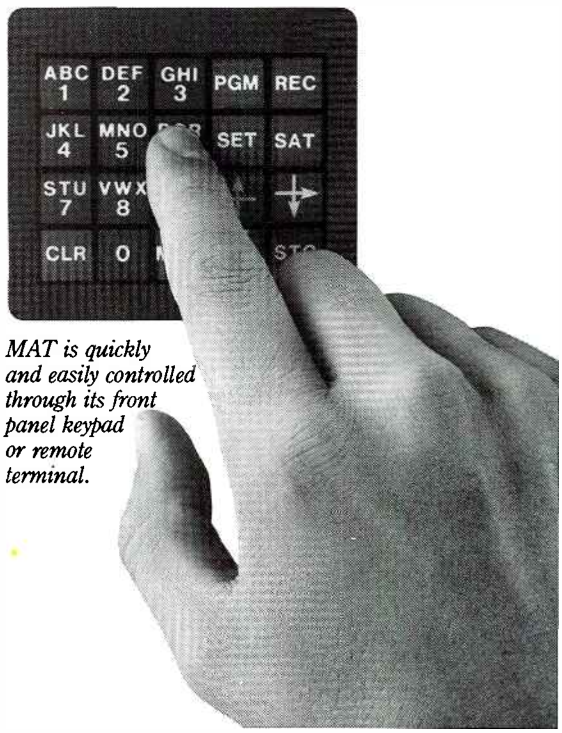

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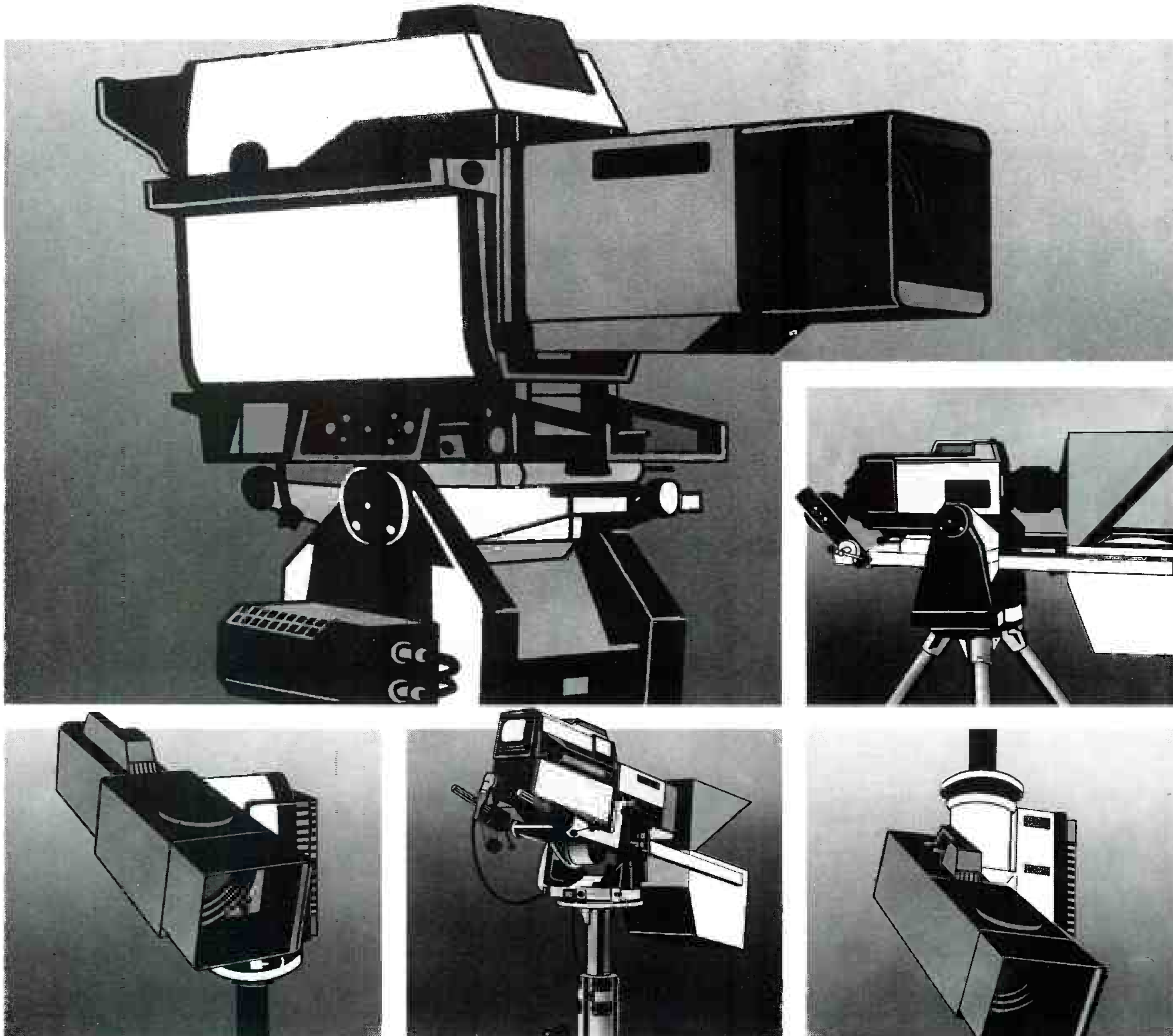
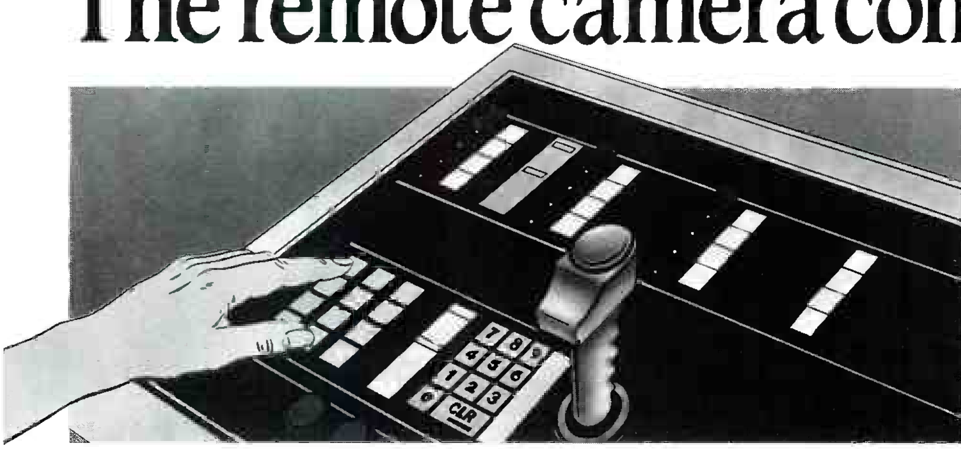


The remote camera control system.



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Continued from page 58
control voltages of 28V or less. These control voltages can be driven easily by small relays or by driver transistors in the remote control. Older transmitters may have 220Vac on the control ladder.

Although relays are rugged and provide floating control outputs, they also are expensive. Their cost is only one of the disadvantages. Relays also require extra printed circuit board space and extra back-panel connectors (two wires for each control output instead of one wire and a common ground). These costs encourage remote-control manufacturers to use open-collector outputs for control signals.

Open-collector outputs assume that the circuit to be controlled is providing a positive voltage to the control output. In many remote-control designs, when the control output is activated, a driver transistor is enabled, pulling the control output voltage to ground.

Figure 6 illustrates a typical open-collector driver connected to a control relay. This controlled device may be an electromagnetic, photo-coupled or solid-state relay. The diode across the relay coil prevents the collector voltage from exceeding the supply voltage by clamping the voltage to the supply.

If this diode is missing, the relay coil will try to maintain a constant current when the transistor is turned off, by increasing the collector voltage above the supply voltage. If this voltage goes high enough, it will break down the transistor. The relay-coil diode also increases the relay release time, but this is generally of no consequence.

Figure 7 shows another clamping circuit used to protect the driver transistors. This circuit is used commonly in remote controls because the clamp diodes are provided in the driver chip, and the control voltage generally is not available inside the remote control. As the collector voltage approaches breakdown, the steering diode carries the current to the zener diode. The zener is designed to break down before the transistor, thereby providing the required protection.

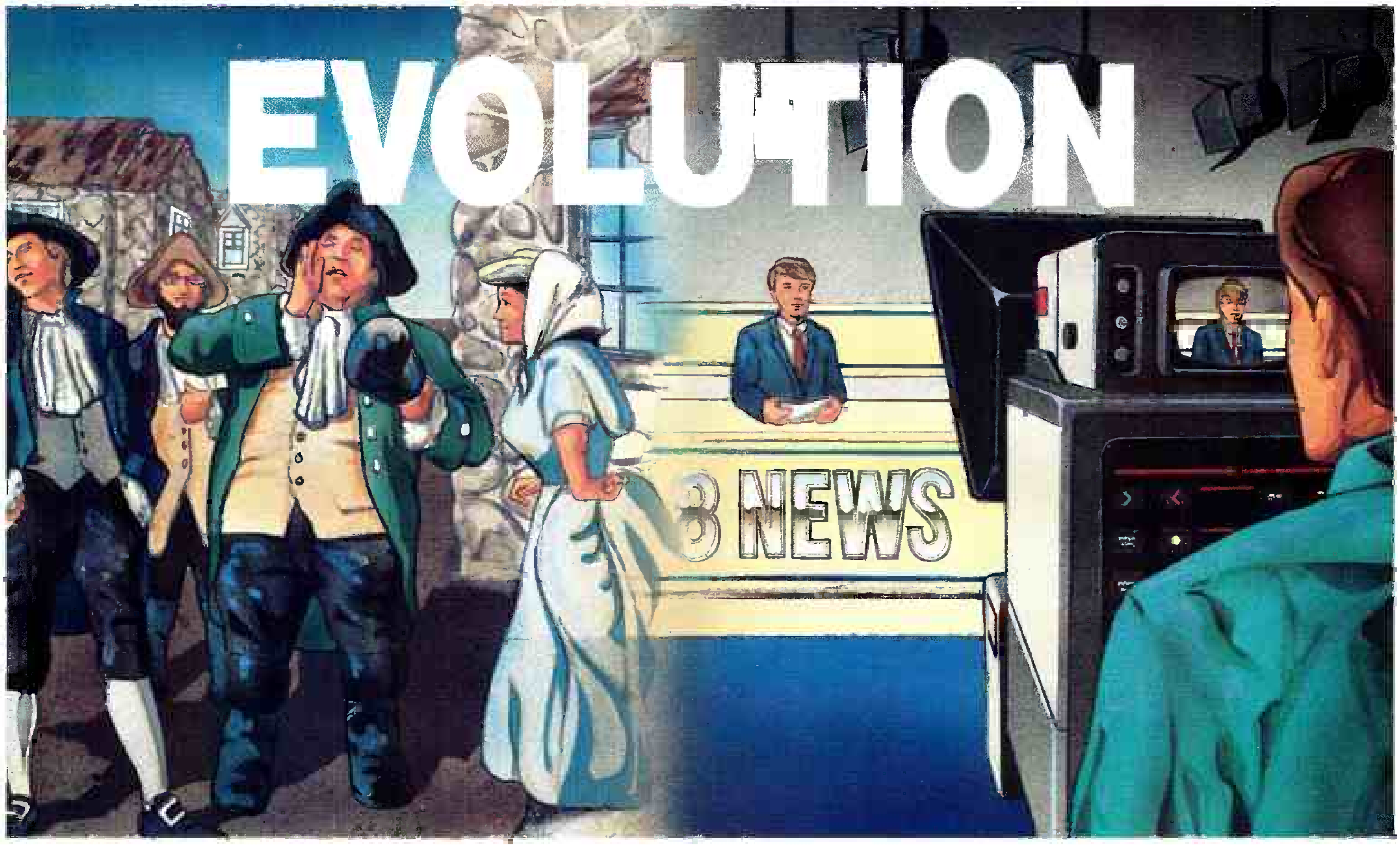
Figure 8 shows a common transmitter-control circuit that cannot be driven by an open-collector remote control. Note that the control inputs are switched to +28Vdc instead of to ground.

Fortunately, many transmitters using this circuit have a single pair of wires providing power to the remote interface assembly. Reversing this pair of wires places the negative side of the supply on the common side of the switch. The transmitter relays now can be driven by open-collector drivers. If there are transient-suppressing diodes across the relay coils, they also must be reversed.

Some transmitters use 2-coil magnetic latching relays to control various latching functions, such as mono/stereo. Don't forget that because the current through the relay coil is now flowing in the opposite direction, these functions are reversed.

The various transmitter designs, when interfaced with a remote control, also can affect operator safety. Figure 9 shows a common circuit for a transmitter remote/local switch. The switch merely breaks the ground circuit available to the remote control. Because the remote control's open-collector outputs always switch to ground, no matter how the remote/local switch is set, the remote control still works. This means that the studio could turn on the transmitter even though the remote/local switch is set to local.

Such an open-collector output can be converted to isolated relay contact by buying/building an interface assembly or redesigning the transmitter circuit. A better approach might be to disconnect the primary power whenever maintenance is performed. This is probably the safest approach, although the transmitter remote/local switch must be labeled to protect



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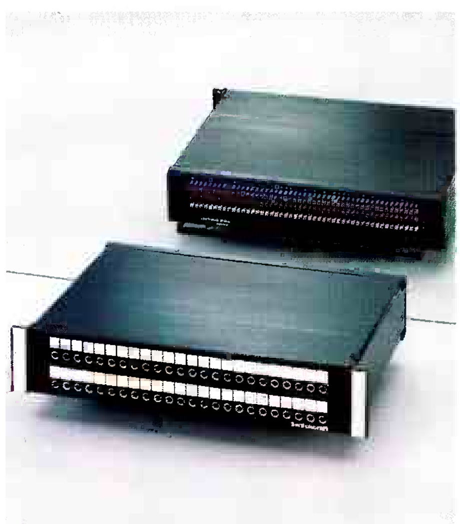

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Software options

Most earlier remote controls provided momentary control outputs, typically called *raise* and *lower*. Latched outputs seldom were available. Today, some remote controls provide latched outputs, usually as a software option.

A momentary output closes the relay or grounds the collector for a fixed or programmable period of time, then releases the output. A latched output typically closes the relay or grounds the collector in response to a raise command, then releases the output in response to a lower command.

Inside the transmitter, most control functions are latched, allowing momentary external controls to be connected in parallel. If the transmitter plates are on, a momentary lower pulse from the remote control or a momentary plate-off pulse from the transmitter front-panel switch can turn the plate off. Providing such features with latching outputs is much more difficult.

Not all internal transmitter-control functions are latching. The power adjust or trim is an example. Here, a raise or lower pulse typically activates a motor-driven pot to adjust the output power. A fast motor-driven pot coupled with a long control pulse can result in overshoot, making it difficult to adjust the power. Short- or programmable-duration pulses are useful in these situations.

Many options

Semiconductor devices have improved the accuracy, functionality and programmability of today's remote-control systems. Yet, the basic techniques used show a clear evolutionary path back to the original telephone dial and stepper switch remote controls built many years ago.

If you're considering a new remote-control system, first examine the transmitter requirements. What sample voltages are provided? Are they floating or single-ended? Is the control ladder positive or negative with respect to ground? Are balanced control outputs required?

Some modern transmitters provide most of their own internal control and monitoring circuits. In these units, the remote control may simply need to provide the positive on/off action required by the FCC. Older transmitters require more supervision, and the ability to monitor various parameters becomes important.

Consider other transmitter-site elements and functions that might be controlled: antenna heaters, building air-conditioning/heating systems, coax pressurization equipment, microwave relay switching/monitoring and auxiliary generator controls. The more information and control you have, the better you can deal with problems at a remote site.


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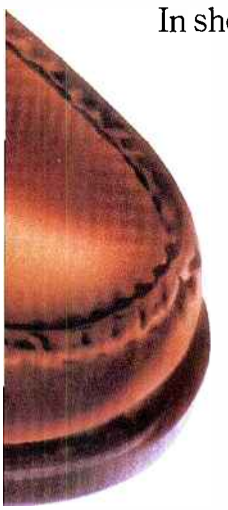

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Circle (40) on Reply Card

Installing computer hardware

By Brad Dick, radio technical editor

Installing computer hardware is much more than plug-and-go.

The proliferation of computers in broadcasting has probably had more effect on the industry than any other single technological development. Today, computers and microprocessor-based equipment comprise perhaps 80% of all TV equipment and 40% of all radio equipment. Intelligent control systems are used in everything from camera control units to switchers to complete automation systems. Even the radio station cartridge machine and CD player rely on microprocessors. As any engineering manager can tell you, the growth of computers in the financial realm of the station has been just as dramatic.

In most cases, the computer or microprocessor is invisible. It resides on some circuit board, buried deep within the equipment, performing its task automatically. In most hardware control applications, its invisibility is crucial to effective operation. The operator doesn't need to know anything about computers to use the equipment.

In other applications, such as computerized newsrooms and business systems, the computers are, by design, quite visible and require a great deal of operator training. With these systems, the operator must be specifically skilled in "talking" to a computer.

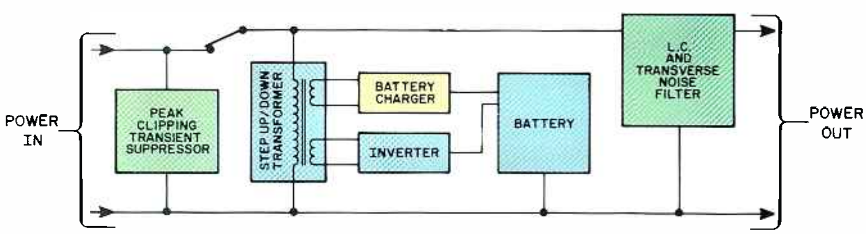

Figure 1. The typical standby power system protects only against blackouts. Also, the transition time between modes can create problems for some computers.

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From the engineering manager's perspective, the two computer applications require completely different approaches. The hardware-based computers are subcomponents to broadcast equipment that is selected, operated and maintained by the technical staff. Business and newsroom systems often are purchased by the engineering manager because the hardware must interface with the on-air equipment. However, these systems are seldom used, or maintained, by engineering staffs.

These factors make the installation and operation of computer systems unique to all other pieces of broadcast equipment. Special planning in frequently overlooked areas is important to their effective operation and long life. Four major areas must be addressed to ensure a successful installation: ac power, equipment environment, interconnection techniques and system supervision.

ac power

The single most critical factor in the reliable operation of a computer system is a clean, well-regulated power source. Don't automatically assume that the power within your station is adequate for a computer system. Research shows that unconditioned power from the local utility may run 5% above or below the stated levels of 120Vac and 240Vac. In addition, the typical power feed may be full of noise, voltage surges, glitches and other problems. Failure to consider the possible effects of such power-line problems on a computer system may be disastrous.

Before concluding that your power feed is clean enough for a new computer system, it's advisable to perform some tests. Measure the voltage between the station ground and the ac neutral. If there is more than 1Vac between the station ground and the ac neutral, you have a problem that must be eliminated. Repeat the test at all points where computer equipment may be located.

It's also advisable to monitor the line voltage over several weeks. You may be able to rent or borrow a recorder from the power company to provide a graphic display of power surges, outages and sags. Digital power-line monitors are capable of sophisticated monitoring and may be valuable in identifying glitches or spikes, which are too short to be detected by electromechanical recording mechanisms.

The two most common problems are improper ac neutral grounding and power-line noise. Do not rely on the ac conduit as the computer's primary ground point. Instead, run a heavy gauge strap or cable to the main station ground.

Be sure you also consider where the peripherals will be located. It is imperative that no ground loops exist between the main computer and the peripheral. Equipment has been destroyed when connected to a power feed with a high-voltage ground loop between the peripheral's safety ground and the computer's ac ground. Ground loops also produce noise, which can affect the reliability of data transmission.

Operator safety is the primary reason for ensuring the quality of the ac service to all locations, so don't take any chances. Thoroughly investigate the condition of the power system throughout the station before you begin hooking up equipment.

Power-line conditioning

Computer system vendors usually suggest that you at least install surge protectors on each device. Few stations have ac service so quiet and reliable that some form of protection or conditioning is not necessary. Power lines may not be the only devices that require surge protection. PBX systems will not fully protect your modem and computer from some telephone-line spikes.

Many computer applications also require sophisticated voltage regulators, standby or uninterruptible power supplies (UPS). If the computer system is intended to perform only financial functions, a backup power supply may not be needed. If, however, you plan on using the computer system in automation or electronic newsroom applications, some form of backup power is advisable.

UPS vs. standby

The specific type of backup power supply needed depends upon the application. A standby system, shown in Figure 1, consists of an inverter, battery, charger and a high-speed transfer switch. When not activated, the primary ac power passes straight through to the load. When the line voltage falls below a preset threshold, the load is transferred to the inverter, which switches on to supply ac power.

The standby system is sometimes called an *off-line UPS* because there is a brief lapse during the switching process from line to batteries. The switching time typically varies from 2ms to 10ms. Check with the computer manufacturer to see if this outage period will cause problems.

A UPS system, shown in Figure 2, is similar to the standby power system but doesn't switch between the ac and dc power sources. Instead, the load is continuously supplied with power developed by the batteries. A drop in the primary ac power causes the charger to shut off, but the power continues to be developed by the batteries. During normal operation, the line voltage is converted to dc and is used to charge the batteries. The length of time the system can power the computer depends on the battery capacity and the load.

A UPS has two advantages compared with other systems. The first is that all power developed is fully conditioned. Low voltages, spikes, surges and noise are eliminated and never reach the load. The second is that there is no switching time; the device is always on-line. Because some computers cannot tolerate even the brief outage produced in a standby power system, this may be an important factor.

If your station relies on a generator for emergency power, additional intelligence may be needed by the backup power supply. Some backup power supplies may begin to oscillate (switch on and off) as the generator comes on-line and stabilizes. It's important that the backup supply remain on-line until the generator is stable. Only after the generator is on-line and stable should the power supply switch back to ac power. Check with the power-supply manufacturer before installation.

Keep in mind that it may not be necessary to power the entire computer system and all peripherals. Remote terminals, non-critical printers and other devices may not be needed in emergency situations. If you cannot supply power to the entire system but still need modem access, be sure the modem is powered from the same supply as the computer. More than one station has discovered that when the power failed, so did remote access to the system.

Another significant factor with regard to the power feed to the computer is that of loading. Even though an entire computer system may draw only 20A, it may be advantageous to distribute that load across two or more 20A circuits. The benefit is that if one phase or circuit fails, the remainder of the system could continue to operate.

This technique also could reduce the

Continued on page 74

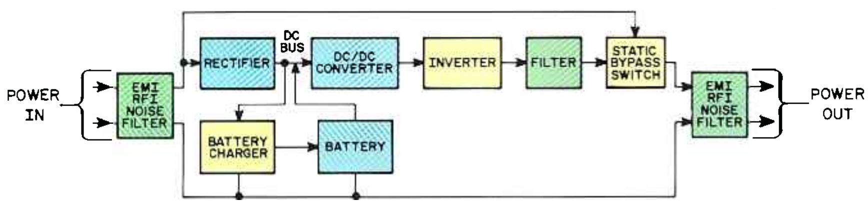

Figure 2. *The UPS system provides constant operation. There is no transition time outage between line and backup operation.*

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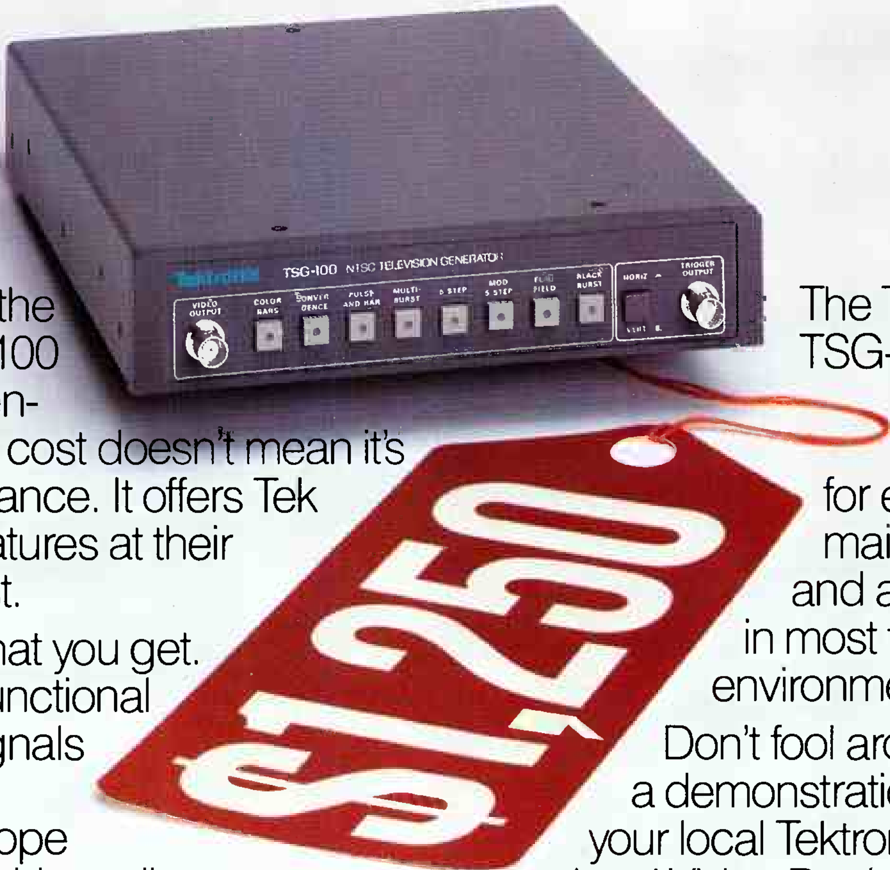

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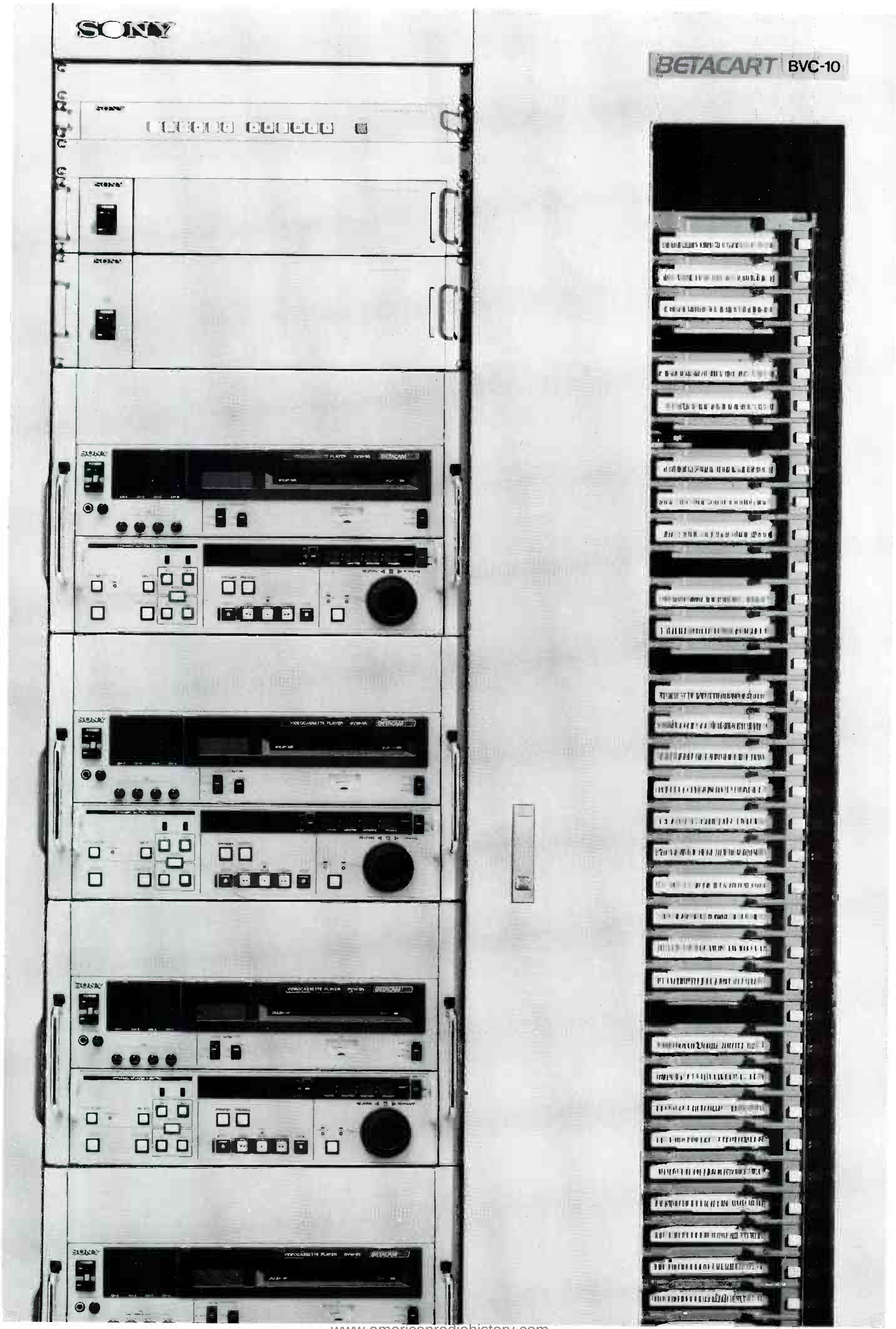
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Continued from page 70
backup power requirements. You could place the main computer and critical terminals and peripherals on one phase, while letting other parts of the system operate on another phase. A smaller UPS or generator could then be used to maintain power to the more important components.

Environment

Housing a computer system is relatively simple. Certainly it is much easier to locate and install than a transmitter. Simply put, the environment in which a computer resides should be comfortable. If the operators are satisfied, the computer will be too. Even so, be aware of certain aspects unique to a computer environment.

When designing the environment, consider how much heat will be generated. This translates into: *How much cooling will be needed?* The second consideration is that of flooring. TV stations often use raised flooring in control rooms or other

Continued on page 78

RS-232-who?

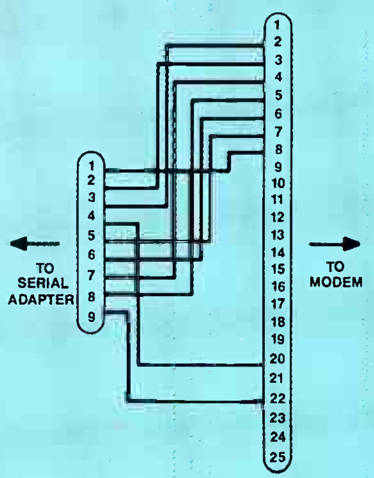
The RS-232C protocol is the most common technique for interconnecting computers with terminals, printers and modems. The official standard includes 13 specific interface configurations for interfacing data terminal equipment (DTE) with data communications equipment (DCE). The standard is applicable only to those devices using serial binary communications and operating at communications speeds up to 20kbaud.

Wiring a serial interface cable can be an exercise in frustration. Even when armed with the pin-outs of the two devices to be interconnected, an engineer still may be confused. One reason for the confusion is that the communications standard relies on unfamiliar terminology. In addition, because the standard must meet the requirements of a wide variety of devices, many more signals are listed than are typically required for common applications.

The table on page 76 lists the pin numbers and circuit descriptions for an RS-232C connector. Not all pins are used in every application. Modems, for instance, can be handled by far fewer than 25 pins. The IBM-AT (and some compatibles) use a 9-pin connector for serial communications instead of the more common DP-25 series connector.

The most common RS-232C wiring mistake is to simply connect across, pin to pin, all of the connectors. Although you probably won't damage anything, don't expect the devices to work together.

If the two devices to be interconnected are separated by a long distance, mo-



Typical IBM-AT computer-to-modem interface cable.

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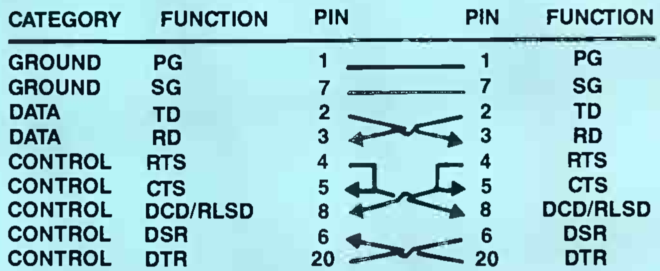
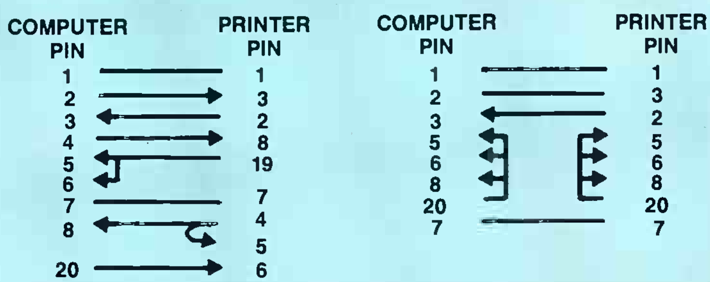


A full-feature null-modem cable may require several cross-connects.



Typical null-modem cable-wiring diagrams. The specific wiring details depend upon the equipment involved.

Pin number	Description
1	Protective ground
2	Transmitted data
3	Received data
4	Request to send
5	Clear to send
6	Data set ready
7	Signal ground (common return)
8	Received line signal detector
9	(Reserved for data set testing)
10	(Reserved for data set testing)
11	Unassigned
12	Secondary received line signal detector
13	Secondary clear to send
14	Secondary transmitted data
15	Transmission signal element timing (DCE source)
16	Secondary received data
17	Receiver signal element timing (DCE source)
18	Unassigned
19	Secondary request to send
20	Data terminal ready
21	Signal quality detector
22	Ring indicator
23	Data signal rate selector (DTE/DCE source)
24	Transmit signal element timing (DTE source)
25	Unassigned

RS-232C pin-out and signal description

dems are used to complete the interface. This allows standard telephone or dry-pair lines to be used between the devices. Communication then takes place in the form of tones, not dc level shifts. Within a station, however (private-line environments), the standard RS-232-C ±10Vdc levels can be transmitted between devices.

Null-modem cables

To eliminate the modems, the proper control signals (in addition to the data) must be exchanged between devices. Because there is no DCE when two devices are connected locally, a separate unit must be placed between them. This device is nothing more than a specially wired cable, called a *null-modem cable*. It is wired in such a way that the two DTEs act as though they are interconnected by modems, each providing or responding to the other with the proper control signals.

A general-purpose null-modem cable is diagrammed at top left. Note the cross connect between pins 2 and 3, 6 and 20 and the interconnect of 4 and 5 to 8. No single null-modem cable will serve all applications. Two other common configurations are shown at left. The particular cable wiring is device-dependent, so consult the equipment manuals for each device.

Serial printers

Serial printers often are interconnected with only three or four wires. Because printers operate much slower than the typical computer or terminal, a "stop" control signal is required. This signal, often called *printer control*, is used to tell the computer or terminal when to stop sending data. Pin 19, secondary (RTS) or pin 20, data terminal ready (DTR) usually provides such a printer status signal.

The computer, on the other hand, must have an input to accept this signal so it will know when to stop sending data. The data set ready (DSR), pin 6 often is used for this purpose. Once these two pins are interconnected, the computer and printer will communicate as if there were modems between the devices.

Many of today's computer systems use the *XON, XOFF* protocol. In the case of a printer, when the buffer becomes full, it transmits an XOFF character back to the computer, which stops data transmission. When the buffer empties, the printer transmits an XON signal to the computer, and data transmission resumes. The software handshaking configuration requires a full-duplex communications link. A hardware XON/XOFF function can be accomplished in half-duplex mode through the use of RS-232C secondary signals.

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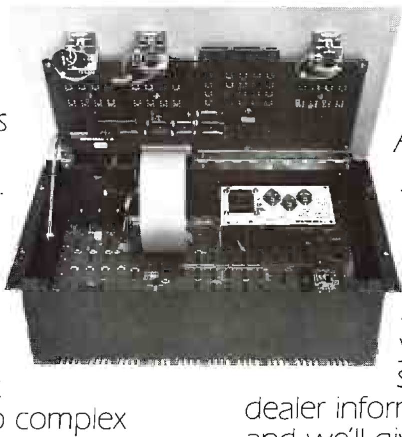

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Circle (46) on Reply Card

Main story continued from page 74
areas where large amounts of cable are involved. Computer installations require similar treatment.

The final environmental concern centers on equipment ergonomics. The key is to make operation of the computer as comfortable as possible for the users.

Heating/cooling

In some computer installations, a separate room is used for the main processor, hard disks, distribution equipment and certain printers. One advantage to providing a separate room is that traffic is greatly reduced. Another is that the support equipment, such as concentrators, patchbays and UPS control panels, can be located conveniently while eliminating the risk of station staff members inadvertently altering their operation.

Heat dissipation can be a problem, especially with larger computer systems. Even though you might think of computers as being cool and quiet, they can generate a surprising amount of heat and noise.

A typical 30-station newsroom system consumes approximately 8A, producing 6,000Btu/hour of heat load. If you are adding a large computer system to an existing HVAC system, be sure the cooling system can handle the extra heat produced.

Humidity usually is not a problem for computer hardware. However, cold weather can cause trouble. During long periods of cold weather, the heating system is heavily used, and unless the system has a humidifier, the air will become extremely dry. In cold climates, humidity levels of 20% or less are not uncommon. Such low humidity may result in static electricity as people move about the work areas.

As people move about and touch the hardware, the high static voltages generated can be discharged into the computer (see Table 1). In some cases, this discharge can produce data errors or even damage the equipment. In such situations, static mats are effective in reducing the discharge of electricity into the computer hardware. The optimum solution, however, is to add humidity to the air. If the humidity is this low, it may result in damage to other equipment, requiring extra maintenance.

	ELECTROSTATIC VOLTAGES	
MEANS OF STATIC GENERATION	10% TO 20% RELATIVE HUMIDITY	65% TO 90% RELATIVE HUMIDITY
WALKING ACROSS CARPET	35,000	1,500
WALKING OVER VINYL FLOOR	12,000	250
WORKER AT BENCH	6,000	100
VINYL ENVELOPES FOR WORK INSTRUCTIONS	7,000	600
COMMON POLY BAG PICKED UP FROM BENCH	20,000	1,200
WORK CHAIR PADDED WITH POLYURETHANE FOAM	18,000	1,500

Table 1. *High electrostatic voltages can be developed through normal working practices.*

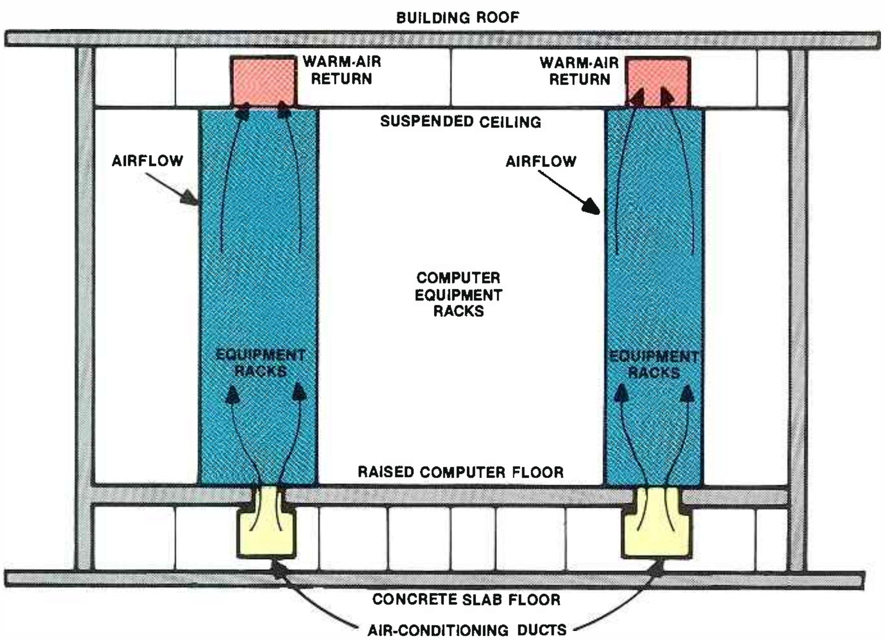

Figure 3. *Raised flooring allows cable and air-conditioning ducts to be installed easily. Mounting the racks above the ducts provides efficient cooling and airflow.*

Flooring

Computer flooring is more than a convenience; it is crucial to an effective installation. First, removable flooring makes cable installation much easier. Changes (and there will be many over the years) can be accomplished with ease and minimum disruption to the system and operators.

Second, raised flooring allows air-conditioning ducts to be placed in the floor. Rack cooling, as shown in Figure 3, becomes a simple matter of locating the racks over a duct of the proper size. If you are building a new facility, it's advisable to install raised flooring in some areas, in anticipation of adding a computer system later.

Equipment ergonomics

When considering where to locate computer equipment, be especially aware of the lighting. Glare on the terminal screen is a common problem. Uncorrected, it can cause eye fatigue and headaches. If glare seems to be a problem, try rotating the terminals slightly or adding glare screens. Reducing the overall overhead lighting also may help.

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Terminals may be difficult to read in high ambient light locations such as on a set. Placing the terminal behind a smoked glass often helps, but the screen intensity may have to be turned up to its highest setting.

Furniture is another critical factor in creating an efficient, pleasant work environment. Don't assume that you can simply replace your typewriters with terminals on the current desks. The typical typewriter well is too small for most computer terminals and keyboards. It may be necessary to lift the terminals above the desks with clamp-on adjustable supports. The terminals then can be rotated and tilted to provide convenient viewing.

This technique may not work for CRT users who wear bifocal eyeglasses. Bifocals require that the wearer use the lower part of the lenses for reading. If the terminal is too high, the person will have to look up continually to see through the lower part of the bifocals. This will create neck strain and result in complaints. Try to place the CRTs approximately 23 inches above the floor. Although this is somewhat lower than the height used for typewriters, it works well for terminals.

After terminals, the location of printers is the next most crucial aspect of equipment arrangement. Consider how the printers will be used. If some users require individual copies of their scripts, printers should be located close to those persons' desks. In this type of application, provide as many printers as possible.

If, on the other hand, a "paperless" approach is desired, hard copy may be needed only for final scripts or rundowns. Printers for these applications typically operate at high speeds, are expensive and noisy. Such printers should be located away from the users' desks whenever possible.

Consider the amount and type of storage that will be needed. Some printers spit out paper at the rate of 600 lines per minute. If you process much copy, a lot of paper will be used in a short amount of time. Be sure the staff doesn't have to carry heavy boxes of paper over long distances. Other supplies, such as ribbons and floppy disks, also should be easily accessible.

The type of paper used is important. High-speed applications require that the paper grab the ink quickly because the head is moving so fast. Paper that is too slick may not adequately absorb the ink, resulting in light images. Check with the printer manufacturer for recommendations, and use only that paper. The few cents you save on less expensive paper won't mean much in the face of high maintenance costs and downtime.

Interconnection

Interconnecting the computer with many devices (terminals, printers, modems and concentrators) is no easy task. Although the concept is straightforward, the practicalities are quite complex.

Cabling from the computer room to other areas must be carefully planned. You must not only decide where today's equipment will be located (and how to get there), but also plan for tomorrow. The expense of cable installation does not lie in the cost of the cable, but rather, in the cost of labor to install it. The additional cost to install enough cable for future growth is insignificant when compared with what it would cost to do it later.

This brings up a related topic: How do you know where to install cable? It all depends upon how the computer will be used. The first time you plan an installation, you may find that the amount of cable you originally planned to use is much less than the final configuration calls for.

Newsroom computer systems, for example, are usually thought of as being limited to the newsroom. Figure 4 is a block diagram of a typical newsroom computer system

Continued on page 84

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Continued from page 80
tem. Note that computer equipment is located in areas other than the newsroom. These installations require that terminals, and even printers, be located in control rooms, in tape edit rooms and near video cartridge machines. Failure to plan for these eventualities can be costly.

Cabling

Two general types of interconnection cable typically are used in computer systems: coax or shielded multipair. Some local area networks (LANs) can operate over relatively long distances on coax. Other schemes rely on shorter runs of shielded 25-pair cable, which offers the advantage of a single run of cable being able to support several pieces of equipment.

Larger systems often provide a patching system. A patchbay located in the computer room allows defective devices to be bypassed and lines rerouted as necessary. Because there is often a great deal of redundancy in larger systems, it's easy to substitute devices or "patch around" a problem.

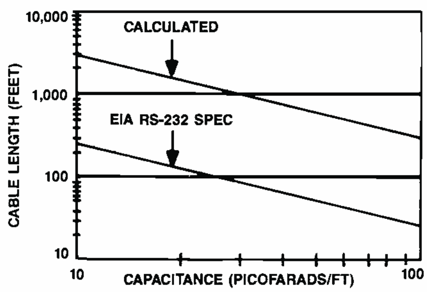

Figure 5. *The distance RS-232C signals can be transmitted depends upon cable capacitance as well as speed.*

When planning for cable runs, think about the future and provide sufficient data wall outlets. Combined with a patchbay, these spare outlets allow terminals, printers and even modems to be relocated quickly whenever necessary. RJ45 connectors can be used for the wall outlets. Note, however, that most devices, especially printers, require DP25 adapters to complete the connection.

Election coverage is a good example of how advance planning and extra cable runs can pay off. If an extra cable is run to the studio and connectors are installed, terminals or other devices can be moved from the newsroom to the studio as needed for election coverage.

The subject of moving terminals brings up again the importance of proper power-conditioning. Be sure that the power lines at these remote locations are sufficiently conditioned and properly grounded. The potential for disastrous ground loops is obvious.

Transmission distance

Today's computer systems are no longer limited to small areas. Technology has allowed devices to be widely spread and interconnected through a variety of methods. The exact amount of separation you can put between equipment depends on the speed of the communications, ambient noise and cable capacitance.

The original EIA specification recommended that RS-232C cables be limited to 50 feet. Longer cables are permitted, providing the total cable capacitance is less than 2,500pF. Experience has shown, however, that much longer distances are possible through adequate planning and careful installation.

Crosstalk is a major factor limiting the maximum cable distance between computer devices. Maximum cable use occurs when all channels (pairs) are running in the full-duplex mode. Unfortunately, this configuration also results in the shortest permissible cable length because the crosstalk interferes with the desired signal.

Cable manufacturer tests show that reliable half-duplex communications can occur on cables more than 1,300 feet long, when only one pair is being used. Maximum use of the cable (all pairs operating) reduces this distance to 1,100 feet.

Another mechanism limiting maximum transmission distance is *jitter*, a distortion of the original signal. Jitter produces errors in the received data and grows worse as the cable's length is increased. When jitter rises above 50%, the reconstructed data signal will contain errors. Note that this 50% figure represents the total jitter of the entire system including the cable and the electronics (line driver and receiver).

The electronics create 16% of the jitter because of the fixed receiver threshold. This threshold is 1.8Vdc in a No. 1489 line receiver integrated circuit, leaving only 34% jitter for the cable. Therefore, once the cable jitter reaches 34%, transmission errors will occur.

Use the following equation to predict the maximum cable distance for any cable and transmission speed:

$$L = \frac{\frac{0.52 \times 10^9}{0.9B} - 250pF}{C}$$

where: L = the maximum cable length in feet;
B = data signal baud rate in modulations per second; and
C = cable capacitance in pF per foot.

Figure 5 shows the predicted cable length for a 19.2kbaud signal. From the formula, it is apparent that a lower baud rate will permit longer cables. Although this is true, the formula does not take into account the large cable resistance that results from lengths greater than 5,000 feet. Experience shows that cutting the baud rate by a factor of four does not increase the maximum transmission rate by a similar factor.

The usable cable length is highly dependent on the cable capacitance, crosstalk and the driver and receiver electronics. External noise or ground loops will, of course, further reduce these distances. Even greater distances are possible through the use of fiber optics. At the Cable News Network, runs of more than

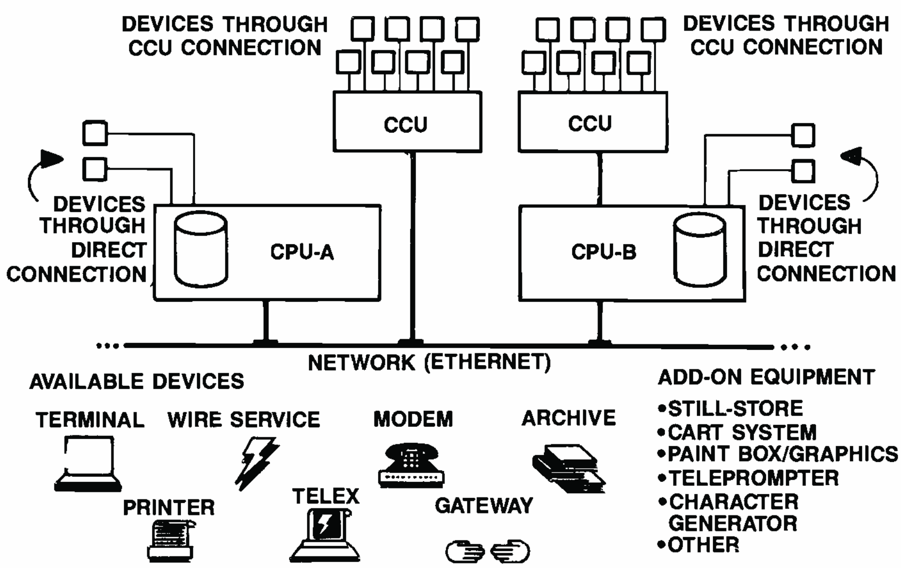

Figure 4. *A typical newsroom computer system requires that hardware be installed in many areas of the station.*

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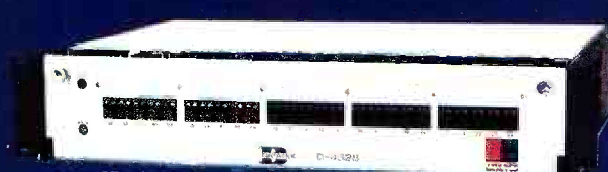

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3,000 feet were made with fiber-optic cables.

System supervision

The typical station staff seldom recognizes all the important aspects of installing a computer system. Although the basic premise of "computerizing the newsroom" or "adding a business computer" can be stated succinctly, many hidden factors must be considered.

For instance, most of today's station computers don't operate entirely within

A short history

Today, the station without a computer is rare indeed. Even small radio stations recognize the value of using computers for business management, billing and other office-related tasks. Much of modern broadcast equipment relies on microprocessors for intelligence and features.

Computers have been around in various forms for more than 40 years. The first generation of vacuum-tube digital computers were unveiled in 1946. The second-generation computers used discrete transistor logic and were released in the late 1950s. These monster-sized devices bore little resemblance to the small desk-sized computers used today.

Altair

The era of the personal computer began in 1975 when a company called MITS introduced the Altair 8080. Soon afterward, "Popular Electronics" magazine featured the computer as a kit on its cover, and the personal computer industry was born.

Steve Jobs and Steve Wozniak were close behind, and in 1976 released a computer they called the "Apple." Personal computers (PCs) or microcomputers (a term applied by serious users) were powered by 8-bit processors.

In those days, there were essentially two factions of supporters. The Intel 8080 processor and the Zilog Z80 processor comprised one group. The second faction, primarily Apple and Commodore systems, relied on the 6502 processor.

IBM PC

IBM entered the fray in 1981 with a PC using the 16-bit 8088 processor. This chip had the advantages of a 20-bit address bus, 16-bit internal bus and an 8-bit external bus. The chip was faster and could run larger programs because of its capability to access 1Mb of RAM. Yet, the 8-bit external bus allowed it to use the common 8-bit peripherals.

The next advance in PC computing power came about with the IBM PC-XT. Introduced in 1982, the XT provided 10Mb of hard-disk storage, making huge databases possible.

The 1984 IBM release of the Advanced Technology (AT) computer was significant in two ways. Using an 80286 processor, the computer featured 16-bit data and address buses. The chip was capable of addressing 16Mbytes of RAM, and with its memory management unit (MMU), could address 1Gbyte of virtual memory. This hardware represented a quantum leap in the design, but the software needed to execute these capabilities took three years to develop.

Mainframe on a chip

The industry is just now seeing computers with the new generation of chips, the 80386. The chip is capable of running 80286 applications and one or more 8086 applications, all at the same time, at speeds two or three times faster than its predecessor.

The 80386 chip contains 275,000 transistors, uses 32-bit addressing and can address up to 4Gbytes of memory. This is 62,500 times more memory than available from the original 8080 microprocessor. This level of processing power now approaches that available from minicomputers. Even so, the full power of this chip will not be realized until new software becomes available.

the studio. Instead, they hook up with other systems outside the station. The interconnection may be for gathering demographic or rating data, filing reports with the home office or providing access for reporters in the field. If your staff needs access to the computer from other locations, modems and telephone lines will be required.

If the technical staff will not be using the equipment, who will supervise its use? Who will oversee the training and maintenance? These questions should be answered early in the planning stages.

System maintenance

The issue of maintenance is one the engineering manager should raise early in the planning process. A number of factors must be considered before the question of system maintenance can be answered. The size of the computer system is only one relevant factor. Another is the expertise of the maintenance staff. The staff members at many TV stations may have the expertise to maintain most of the computer hardware, but would it be cost-effective?

Few radio or TV station staffs have the test equipment or skills necessary to perform all of the computer-hardware tests that might be needed. It may be possible, with the assistance of the manufacturer, to isolate a defective board, but that is probably the extent of it.

Stations typically contract with the manufacturer or an outside service agency to repair major components. This approach relieves the engineering staff from the pressure of having to quickly repair a system they seldom see, let alone use.

Individual devices (terminals and printers) are another matter. TV engineers and many radio engineers can tackle the common problems encountered with terminals and printers. Armed with a scope and some technical information, they usually can repair the device. Even so, it is often more cost-effective to contract out for the work.

Plan carefully

The key to an effective computer installation extends far beyond the mere technical parameters. Ask yourself, "Why do I want a system, and what do I want the system to do for me?" Complete answers to those questions are crucial.

When faced with the prospect of installing any form of computer system, begin by looking at the application. The major mistake made by many stations is that they never precisely defined their expectations of the computer. Be sure all departments are involved in the planning process. Each department's perspectives and needs will be important to the final configuration.

Allow for growth. Recognize at the beginning that a system installed today may change dramatically within 18 months. Experts say that most newsroom computer systems expand by 50% within two years. The more the staff uses computers, the more applications it finds.

If you complete all of the required analyses and provide proper power- and air-conditioning, your computer system should encounter only minimal problems. Taking shortcuts is a sure step toward misery and staff unrest. Computer systems are supposed to provide additional convenience and capabilities. Be sure you take advantage of these benefits through careful planning.

Acknowledgment: Appreciation is expressed to Jim Romeo, customer service manager, and Rich Pierceall, technical support supervisor, Basys, Mountain View, CA, for their help in the preparation of this article.

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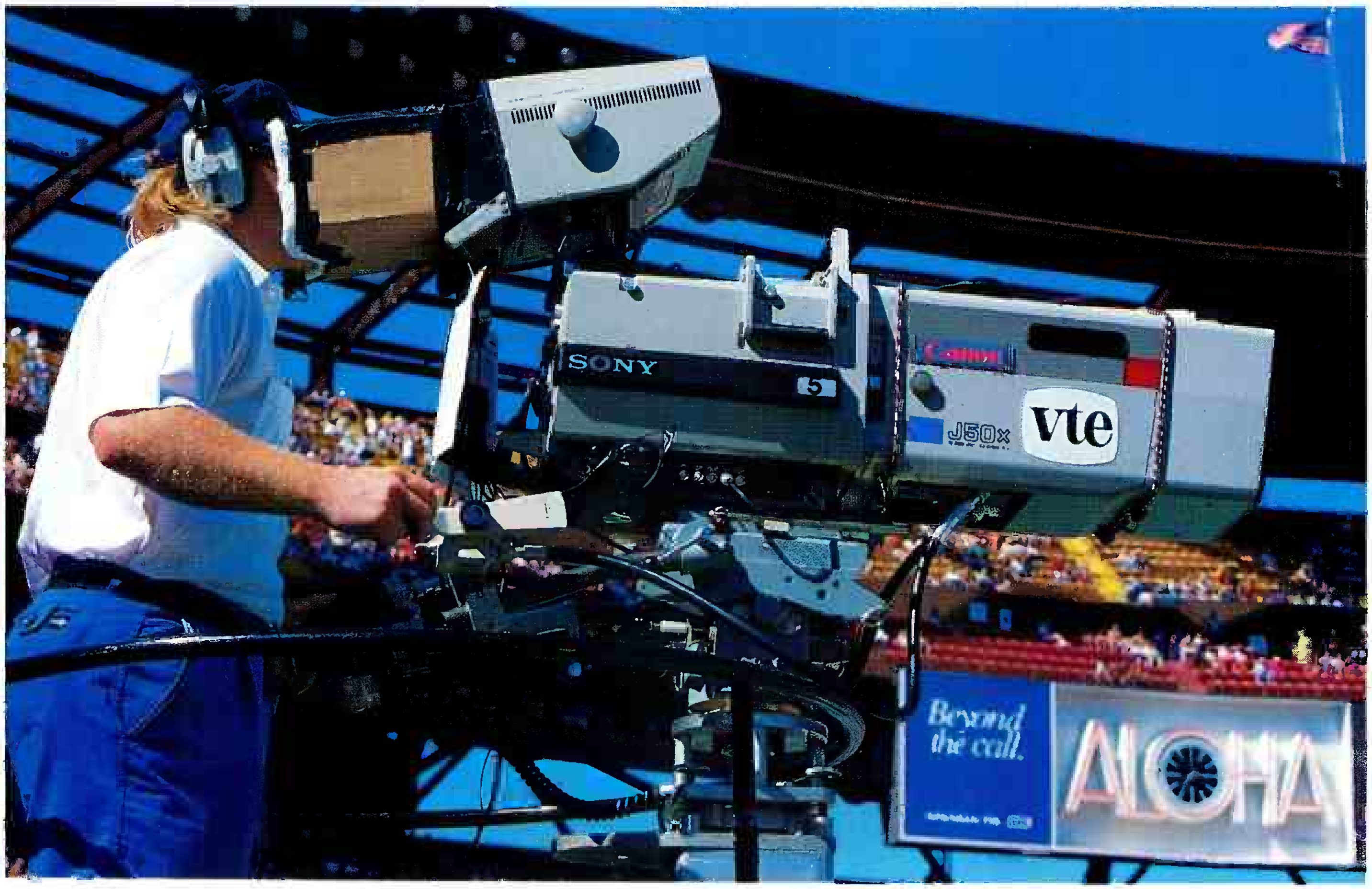
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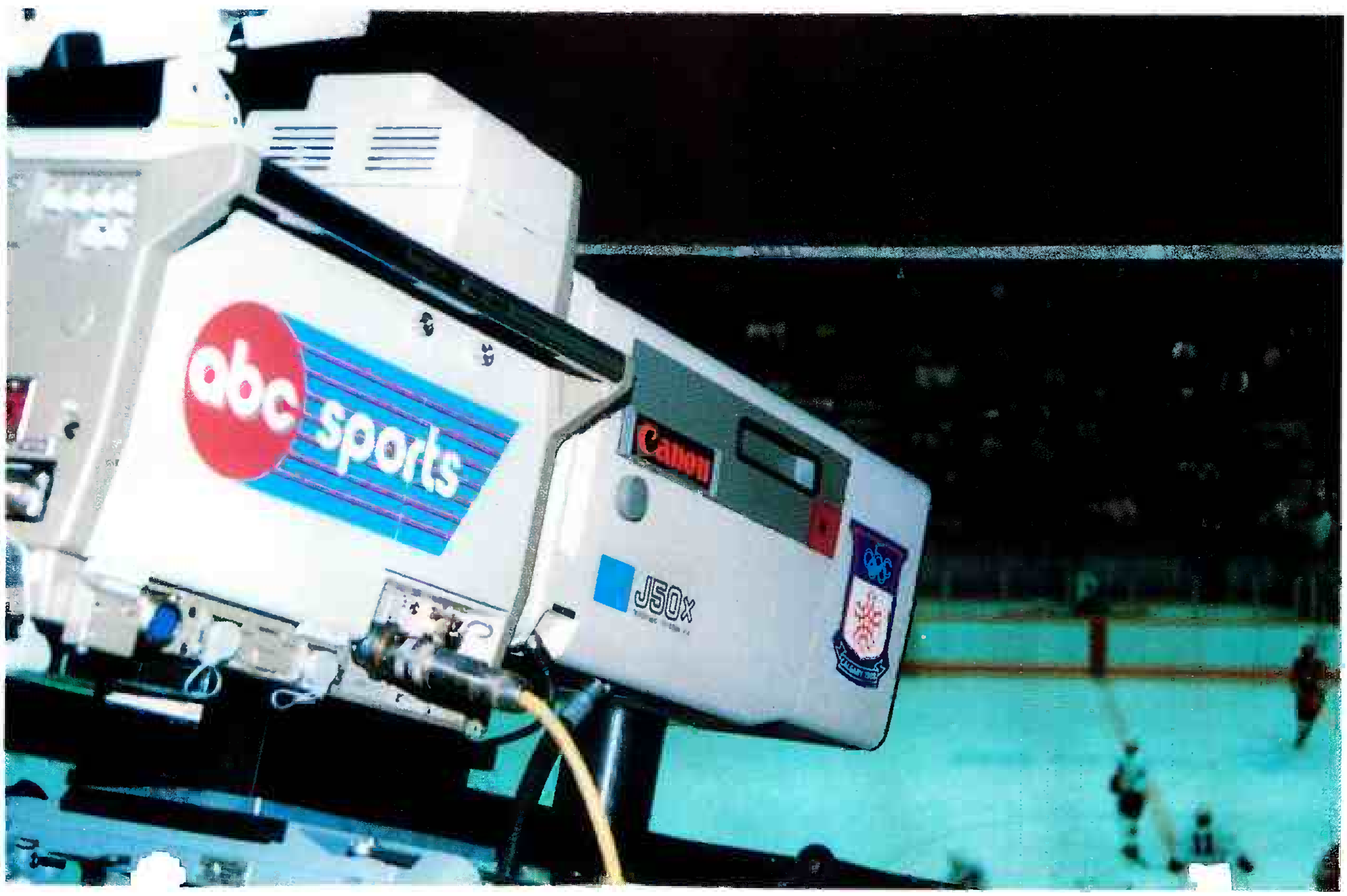
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Facility design using CAD

By Curtis Chan

Personal computers tackle tough problems and ease the tedium of system design.

In the past decade, fixed and mobile facility designs have become increasingly complex. Advanced production techniques have not only brought a higher level of creative freedom, but also have forced facility designers to change their ways of doing things. Digital video and digital audio are influencing systems design, as is optical distribution. Fortunately, computer technology has advanced to a point where facility designers can use it to cope with these changes through the use of *computer-aided design* (CAD) and *computer-aided engineering* (CAE) software. Although some of what is described here requires sophisticated computer systems, many of these programs, such as Auto-Cad and its competitors, can perform quite well on smaller PCs.

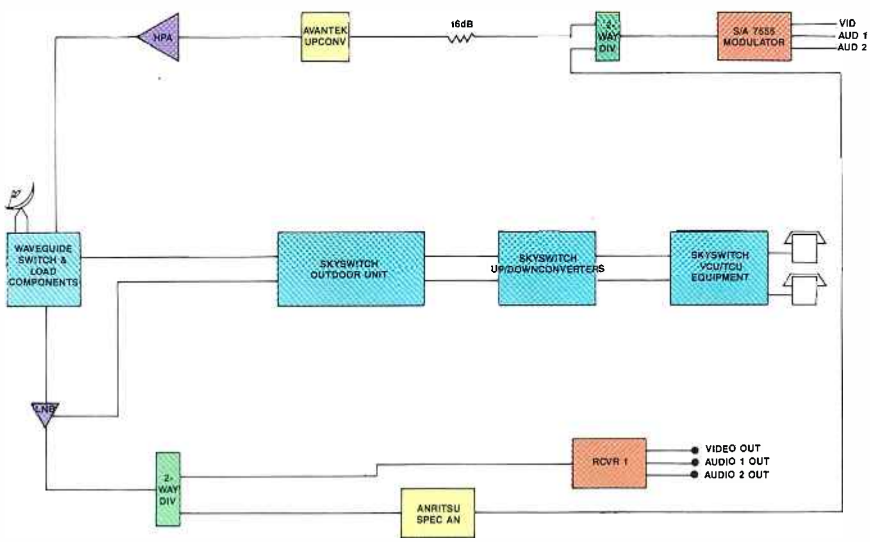
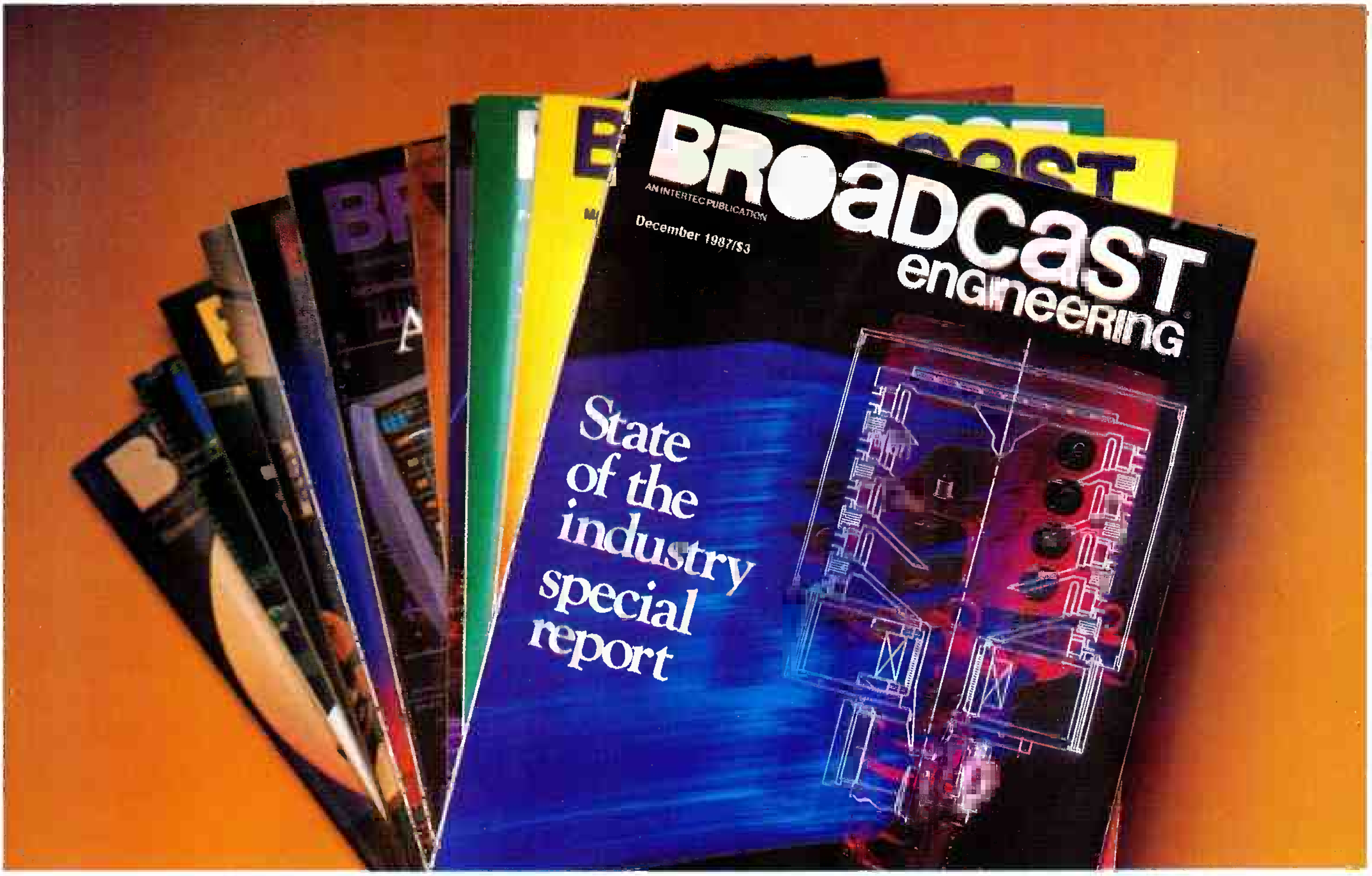


Figure 1. Block diagram of an SNV's transmit/receive electronics.

Yesterday's systems designers faced many tedious tasks. Whether the project was a circuit or an architectural or systems design, it still required that they track equipment, update parts lists, continually revise drawings, and perform lots of repetitive calculations. Because computers are well-suited to this type of work, designers can use CAD and CAE software to make precise, repeatable drawings; perform automatic measurements, dimensioning and calculations; and link up with other software packages to help automate system design.

Typical applications of CAD today in-

Chan is vice president of marketing and product development, Centro Corporation, Salt Lake City.



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- HVAC specification
- Calculating engineering attributes
- Electronic routing
- Preparing cost estimates
- Printing labels
- 2-D/3-D modeling and perspective

These applications result in major cost and time savings for both the designer and the client.

Benefits of CAD

Integrating many company disciplines and functions, such as project and facilities management, inventory control, database management, word processing and engineering design, makes CAD an invaluable tool. Working with CAD can help cut project lead times, minimize budgets and cope with staffing constraints. This is because in any design, whether it's a facility or mobile unit, a common set of tasks always is required. These include floor and space planning, equipment listing, signal flows, power loading, rack elevation considerations and HVAC (heating, ventilation, air-conditioning).

For facilities that do not have the use of CAD or CAE tools, these tasks require extensive repetitive labor. The equipment list must be updated as design changes occur. This requires updating the drawings and redoing the calculations for power loading and the like. If the client asks the "what if?" question, drawing and cost-estimation time are increased. It all becomes even more complex if different departments are executing each task, because communications must be coordinated to avoid errors and bottlenecking.

A few years ago, BC (before CAD)

The benefits of CAD can best be shown by a typical project attempted without the use of CAD. First, the approved project design objectives are given to the engineering department. The designer's drawing of the first revision of the system signal flow goes to the drafting department. There, tasks such as numbering, cable counts and layout of the complete system are done manually. When the drafting department finishes the drawing, it is returned to the designer to check for errors. If any are found, the drawing is sent back to drafting and rechecked by engineering. It is sent back as many times as needed until no more errors exist.

If the client wishes to add equipment or delete equipment from the initial order, the result is usually an engineering change. This means that all affected drawings and equipment lists must be updated. If the project is large, say a facility design, the workload and the opportunity for errors are increased. Also, aside from engineering-based documents, most facility designs include 3-D renderings by a design artist. Modifications to these drawings can be lengthy and expensive.

Parallel to this effort, the bill of materials is constantly being updated. The same is true for cost estimates and equipment and materials ordering. These tasks can best be handled by a computer-based system.

System design with CAD

The advantages of using CAD for systems design can be illustrated by reworking the previous example, this time with CAD. In the first place, initial signal flow diagrams are done once. (See Figure 1.) Repetitive sections or blocks of drawings can be stored individually for later retrieval. With additional software, cable count-

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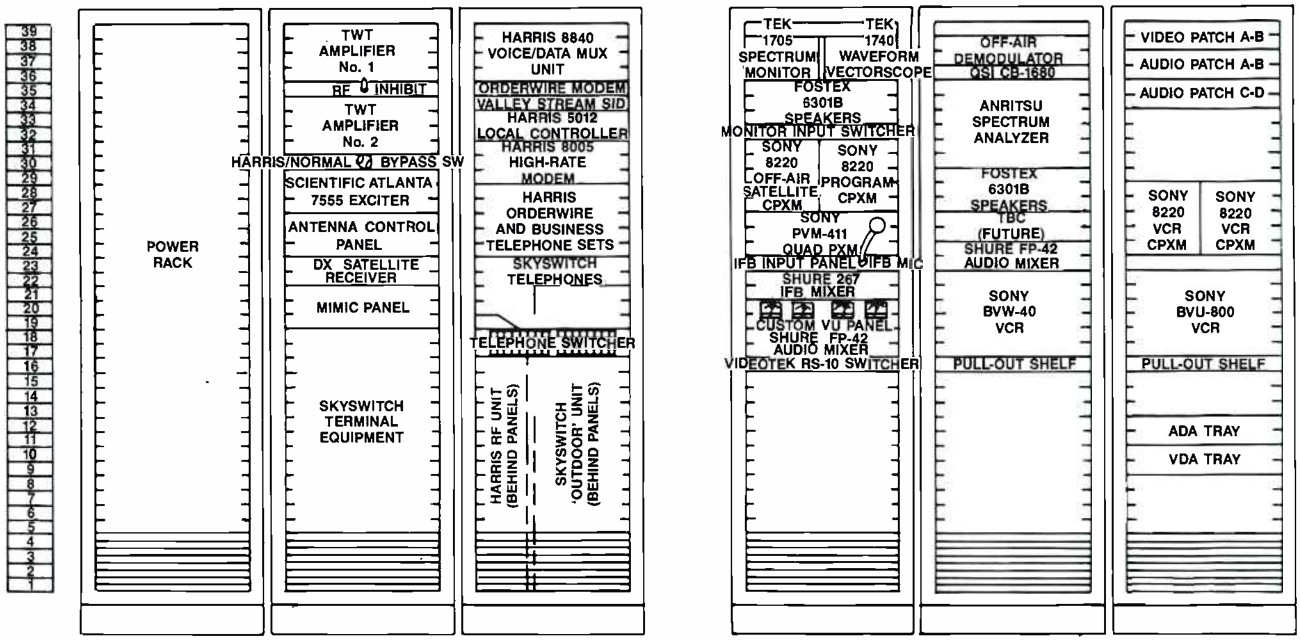

Figure 2. *Rack elevation shows placement of equipment in racks. Computer software also keeps track of wiring numbers, equipment tally, power distribution and heat dissipation, all automatically.*

ing, numbering and engineering calculations can be automatic. Because software can be linked, data entry from the drawing to the database also can be automatic. This data then can be used for tasks such as forecasting "what if" situations, updating the bill of materials and revising product management schedules for each new situation.

When an engineering change occurs, drawings can be updated by simply removing, inserting and manipulating re-

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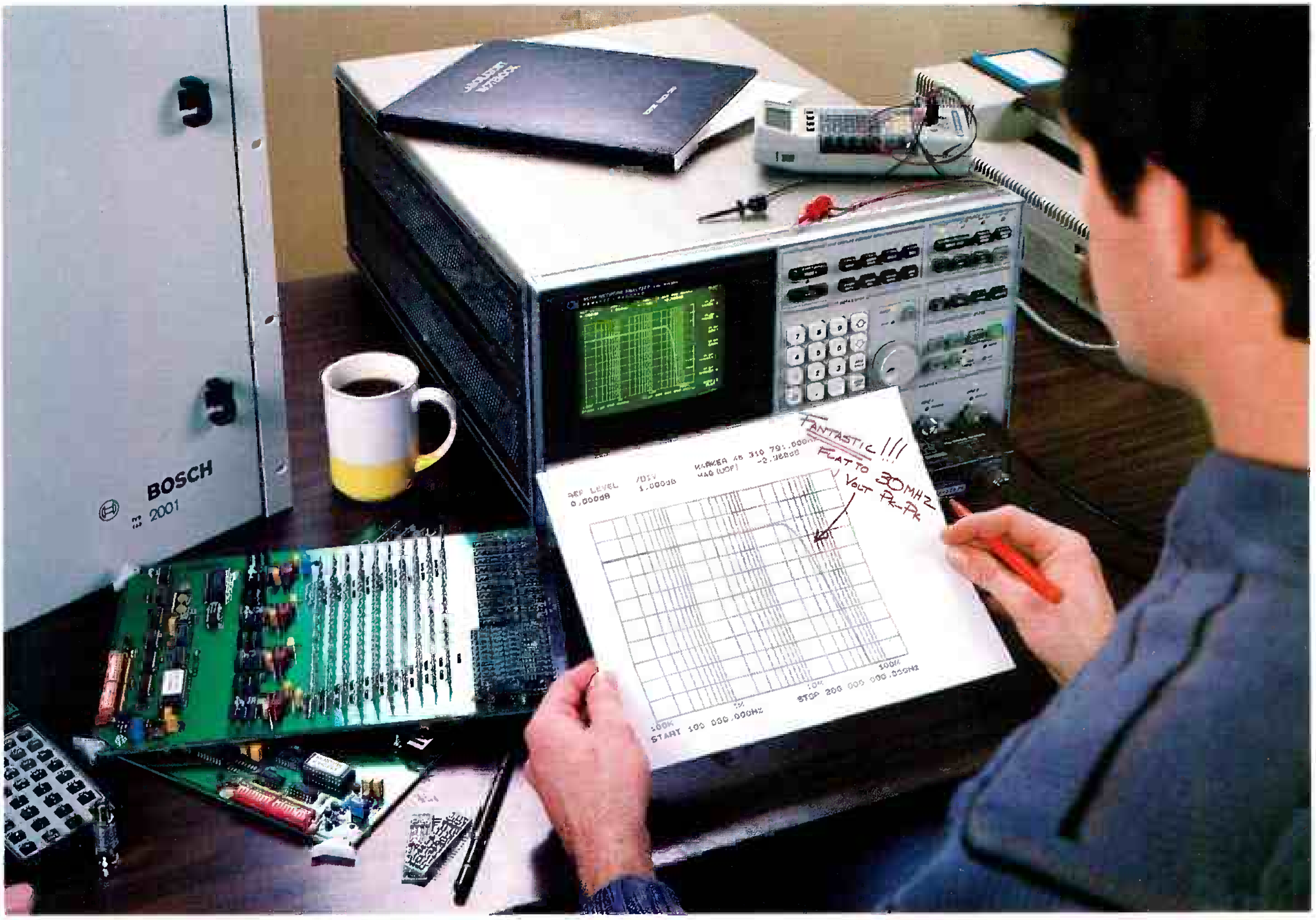

(Chart/image on analyzer is actual output from the 2001 switcher.)

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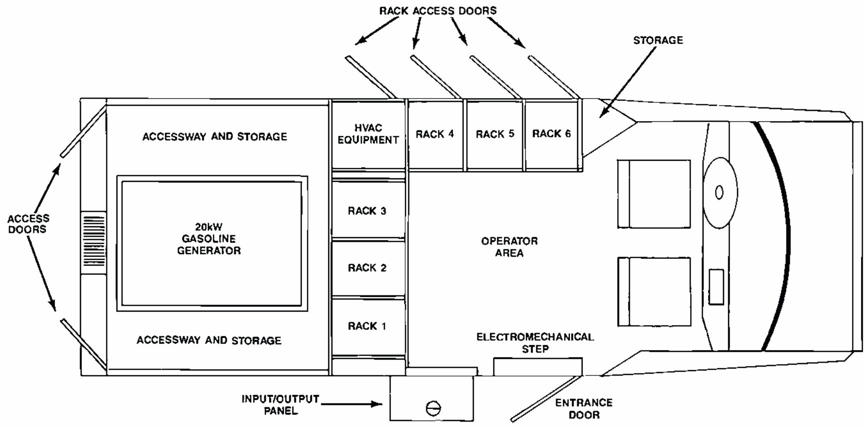


Figure 3. *Floor plan of vehicle designed for satellite news operations. Easily updated computer-created drawing allows positioning of modules on a "trial fit" basis before construction begins.*

spective sections of the originals, along with previously stored drawing blocks and symbols. This process carries through to the elevation drawings with the same ease of operation. (See Figure 2.)

Software packages allowing 3-D rendering can quickly transform 2-D drawings into 3-D forms showing color, perspective, surface shapes and features. Some specialized versions of CAD and CAE enable system designers to dynamically test their models before manufacturing them. An example would be the design of a satellite news vehicle or production trailer.

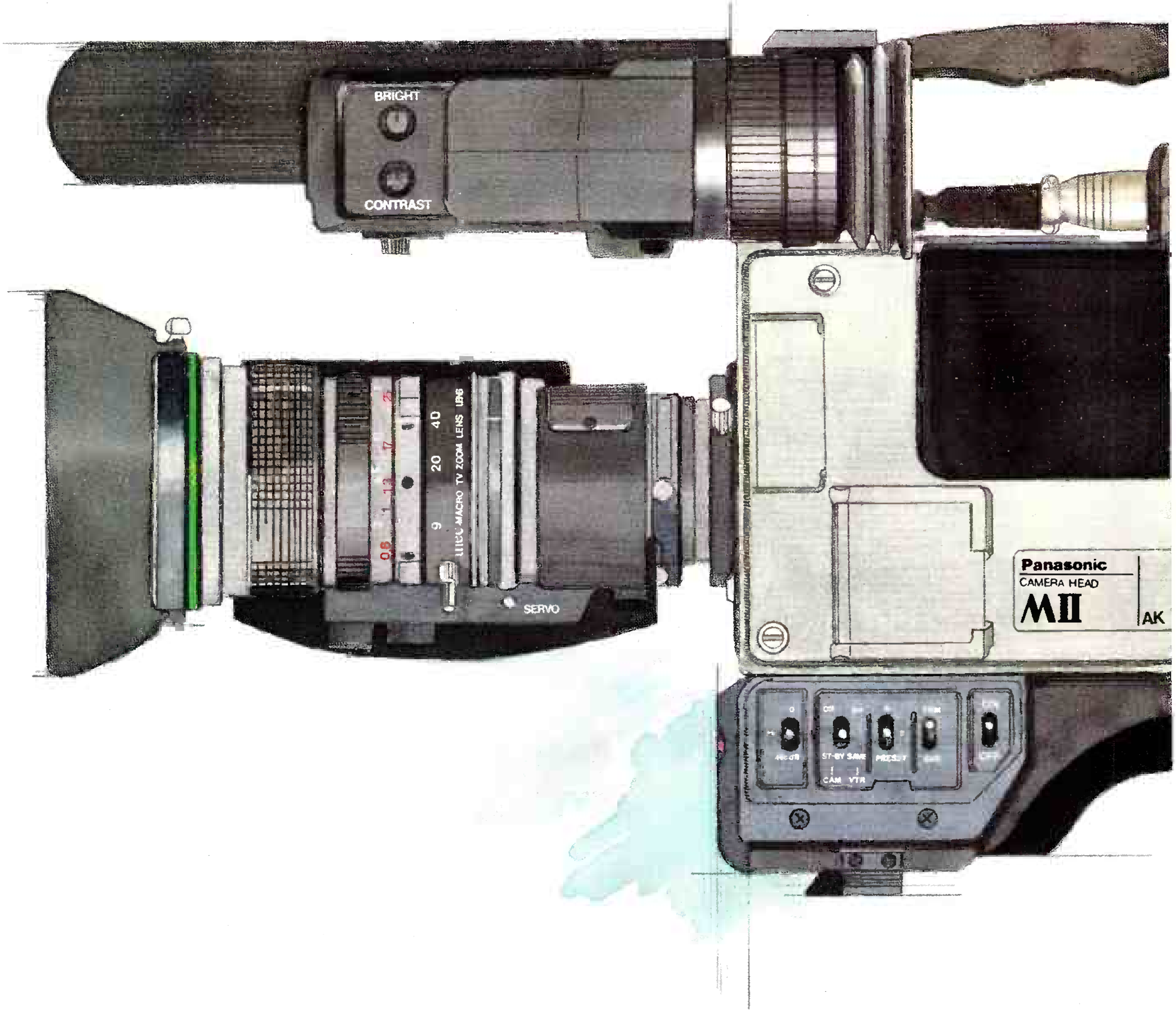
There are added benefits in the design of large projects, such as production facilities. With architectural software, CAD work stations allow the designer to create complete sets of drawings easily and quickly. Global commands from the master template can automatically insert, modify and update sections of the drawing. This is a great advantage in ergonomic design. The work station can place equipment and people in the drawing in simulated scale, then check the different views for human ergonomics. Designers can create and modify schematics, then have them converted to floor plans without any added labor. (See Figure 3.)

Additionally, shapes and symbols can be extracted and read into a database for quick, accurate generation of contracts and documents. Because drawings and order entries are kept in a common database, the work station can automatically track all equipment, calculate repetitive engineering functions (rack loading, weight distribution and power loading), then give accurate cost estimates and generate a variety of reports.

Last, because the information is stored on computer disks, users have a compact, consolidated archive of their work, which can be updated, copied or stored easily and efficiently.

CAD and associated software is extremely important in system design. It allows easily updated drawings, accurate tracking of equipment, quick engineering analysis, accurate cost analysis, and the ability to generate a variety of reports and documents from a common database. As computers increase in performance and decrease in price, CAD work stations may become indispensable tools. The use of CAD—which even now can shorten project lead times, avoid budget variances and allow better designs—will become of even greater importance to everyone involved in facility design.

Panasonic introduces the a field camera/recorder



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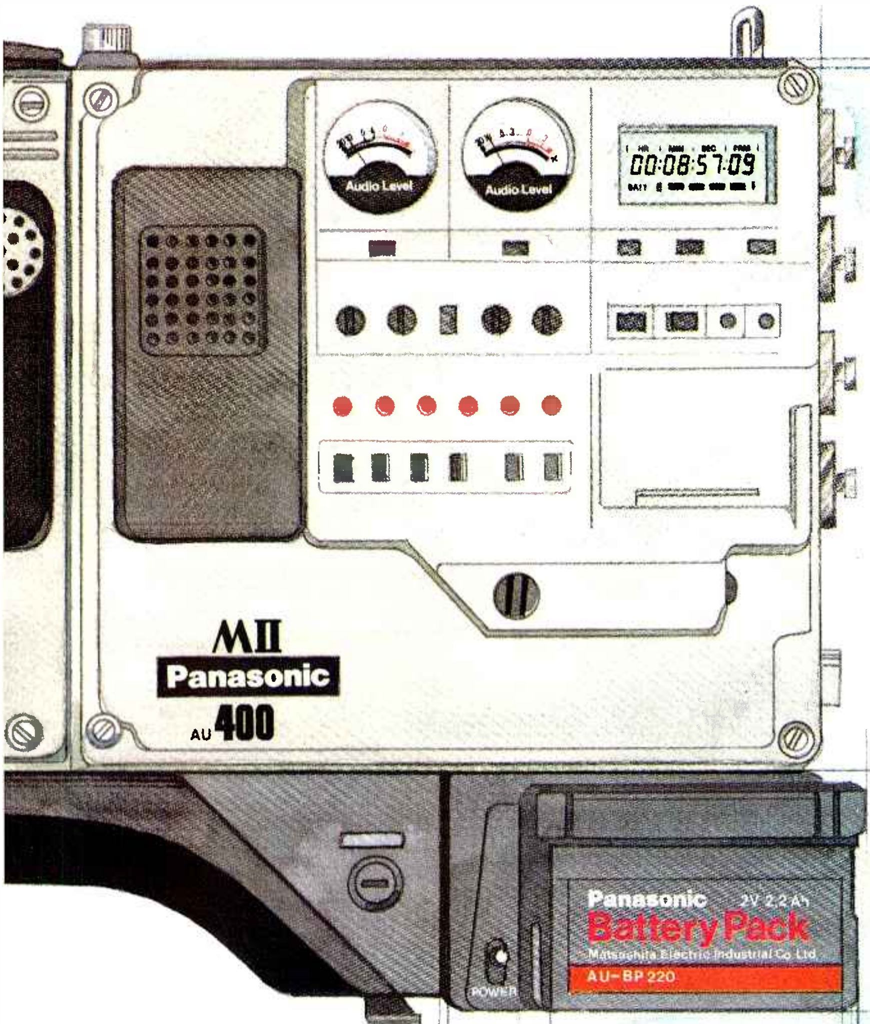

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t's about time

By Robert Kastigar

Suggested timing standards can improve your station's look and, in the long run, prevent make-goods.

There was a time, back in the days of "live" television (read: pre-VTR), that a 30-second spot was about half a minute long. The director punched the stopwatch and shouted "Go!"; and the singers sang, the dancers danced and the smooth-voiced baritone read the copy. If the spot went long or short you hurried or slowed the following troupe. When the break was over, you noted the time and fired up the film chain once more.

With the advent of VTRs, timing became much more precise. A too-long spot stayed that way as long as it was on the playlist. One-inch machines brought tremendous accuracy, right down to a single frame. Today, station automation systems force us to keep extremely close track of time. Aesthetic and technical requirements now demand it.

Broadcasters have done a good job of writing standards for the first two dimensions of television—audio and video. This article suggests that we develop standards for the third dimension of television—time. But first, ask yourself two questions: "How long is 30 seconds?" (it's not what you might think!) and "What can you do in that time?"

NOMINAL TIME (SECONDS)	ACTUAL FRAME COUNT (L)	ACTUAL TIME SECONDS + FRAMES	ACCURACY (PERCENT)
10	300	10—00	0.03%
15	450	15—00	0.05%
20	599	19—29	0.04%
30	899	29—29	0.01%
60	1,798	59—28	0.02%
120	3,596	119—26	0.04%

Table 1. *Several common commercial lengths, followed by their actual frame counts and actual times. Discrepancies between nominal times and actual times are shown as percentages.*

How long is half a minute?

Accuracy and resolution are the two criteria for TV time measurements.

TV accuracy is assured by relying on the color subcarrier frequency reference, which is divided down to the TV line, and finally to the TV frame. This reference is 3.579545MHz, ±10Hz. Most reference generators can hold tolerance to within a few hertz over long periods, guaranteeing accuracy.

Resolution, or how time is divided, is more troublesome. The smallest increment of TV "time" is the frame. Nothing of any significance is ever recorded or transmitted in less than one frame. This makes the frame the limit on resolution

Continued on page 100

Kastigar is an engineer-in-charge at WGN-TV, Chicago.

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ASP-15 Auto Setup Probe

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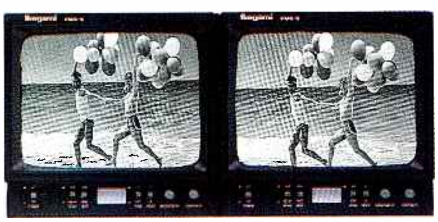
Consider the latest advancement in monitor technology: Auto Setup. Originally pioneered for Ikegami cameras and now available in the Ikegami 15-Series Broadcast Color Monitors.

With an optional Auto Setup Probe, the 15-Series is menu driven with data shown on the CRT. An optional Remocon Box provides for remote control operation. The CRT features a Fine Dot Pitch Shadow Mask for superior resolution, an In-line Self Converging Electron Gun, Controlled Phosphors and a Black Matrix. The 15-Series is available in 14″ and 20″ and uses a Digital Control System (DCS) to simplify monitor set up. When using the Auto Setup Probe, the following functions can be automatically set, at a reference level, and stored in less than 50 seconds: contrast, brightness, chrome, hue, RGB background and GB gain. Auto Setup is another Ikegami breakthrough.

The Ikegami 16-Series Low Cost Monitors feature an In-line Self Converging Electron Gun, a Black Matrix CRT, a Comb Filter/Trap, and front panel selectable A/B video and RGB video outputs. Specifically designed for a wide range of production and broadcast applications, the 16-Series is available in 14″ and 20″ at surprisingly low costs, making the series extremely competitive. The introduction of the 15-Series and 16-Series monitor comes as the 9-Series and


TM 20-15RH Auto Setup Monitor with Probe.

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10-Series continue to enjoy enormous popularity.

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The 10-Series Broadcast Color Monitors feature a high resolution (800 TV Lines) Delta Gun CRT, specifically developed for image quality, with nine-sector convergence controls and Feedback System (BFS) that detects and greatly reduces brightness changes due to current deviation in CRT emission. Available in 14″ and 20″ models, the 10-Series is remarkable for its picture quality. And this quality is equally evident in our 3H-Series Monochrome Monitors.

The 3H-Series of Professional Monochrome Monitors provides the high performance necessary for technical evaluations. 9-inch configurations are available as: bare chassis, cabinet with handle; and for 19-inch rack mounting in an 8¾-inch height for single, single with WFM, single with Vectorscope space, and dual unit uses. 14-inch configurations are for cabinet use or for 19-inch rack mounting in a 10½-inch height.

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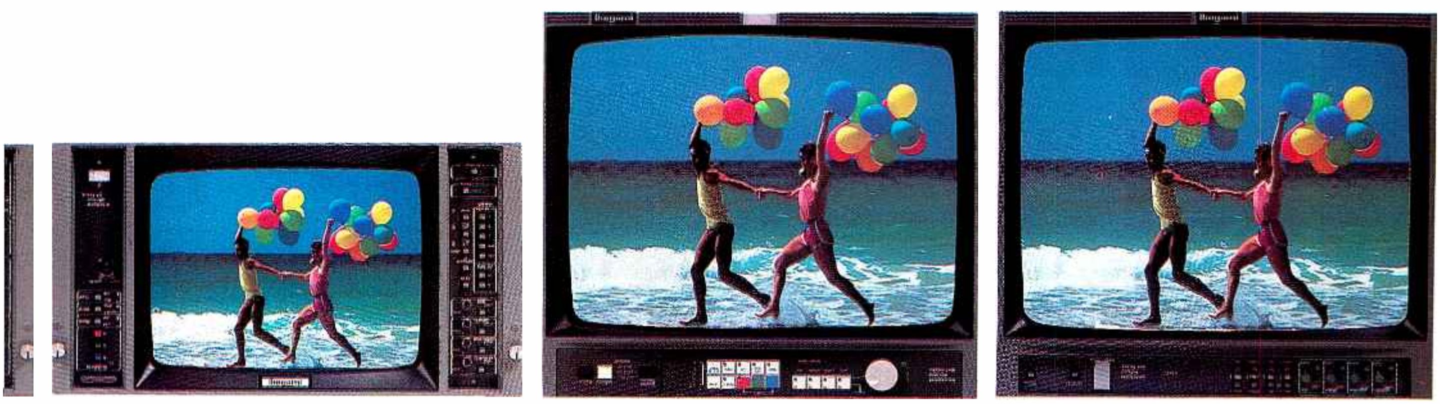


Circle (59) on Reply Card

D =	899 FRAMES	30 SECONDS NOMINAL, 29.997 ACTUAL
L =	899 FRAMES	
SV =	4 FRAMES	0.13 SECONDS
EV =	4 FRAMES	0.13 SECONDS
SA =	7 FRAMES	0.23 SECONDS
EA =	7 FRAMES	0.23 SECONDS
MV =	891 FRAMES	29.73 SECONDS
MA =	873 FRAMES	29.54 SECONDS

(NOTE: The time values are suggestions only, to initiate discussion. Experience may dictate that different values are required.)

Table 2. *A 30-second announcement as it would appear in the author's suggested procedure. Frame counts for each element and actual duration are listed.*

Continued from page 96
in TV time measurement.

In the early days of monochrome television, the frame rate was set at 30fps. This is a submultiple of the power line rate and, conveniently, is a nice round number. With the advent of color, the frame rate was modified slightly, to 29.97002617fps. This lower frequency, which results in slightly fewer frames being transmitted in a given time period, gave rise to the development of drop-frame time code. (Note the invitation to confusion: It's called drop-frame time code, but it's a count that's dropped, not a frame.)

You could time any TV event accurately by counting the frames during it. Unfortunately, the color TV frame rate makes integer division of time impossible. In other words, you cannot produce a true 30-second commercial; you can only come close.

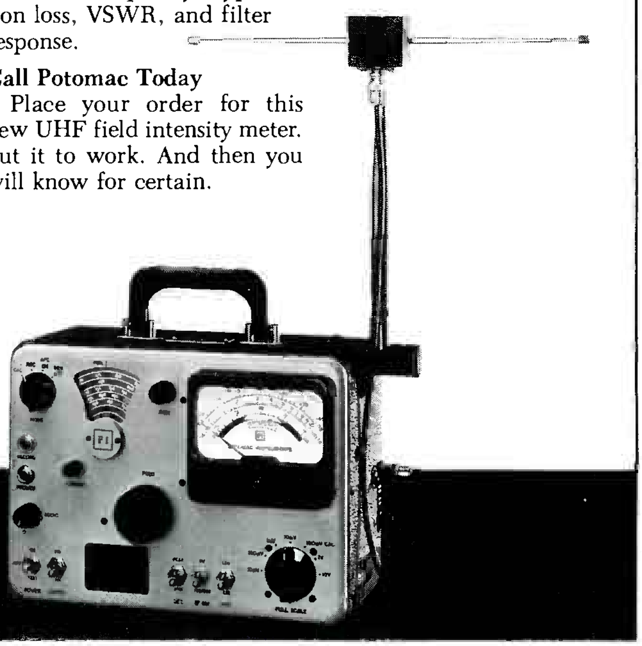
At 30fps, a 30-second commercial would have a length of 900 frames. However, with the color frame rate, a 900-frame commercial would be 30.03s long. This error amounts to 0.1%. The next lower integer frame count is 899 frames. Again, using the color TV frame rate, the resultant duration is 29.997s. Now the error is only 0.01%—a tenfold increase in accuracy. Table 1 lists several common announcement durations, the actual frame count corresponding most closely to these durations, and the accuracy expressed as a percentage of the overall length.

Although such small variances may seem trivial, the accumulated error throughout a broadcast day can be problematic for station automation systems. Furthermore, mechanical tolerances of automatic cart machines may introduce additional timing errors of their own. Finally, there is an aesthetic price to be paid for this kind of inaccuracy.

Framing your spots

What can we do with the time allotted? Questions about "upcut" and "downcut" commercial announcements constantly arise. Often an announcement is slightly longer than the specified time, so it's impossible to play it completely. A too-short spot may put extra "black" on the air. As a result, commercial television often has a choppy, ragged look.

Ideally, there should be a tiny segment of black and silence between each commercial announcement, or between program material and the commercial break. This black and silence—kept short, to



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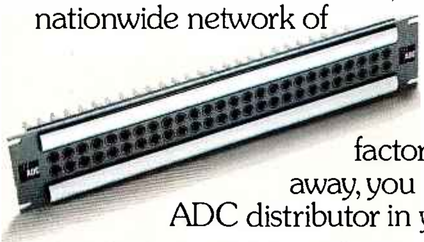

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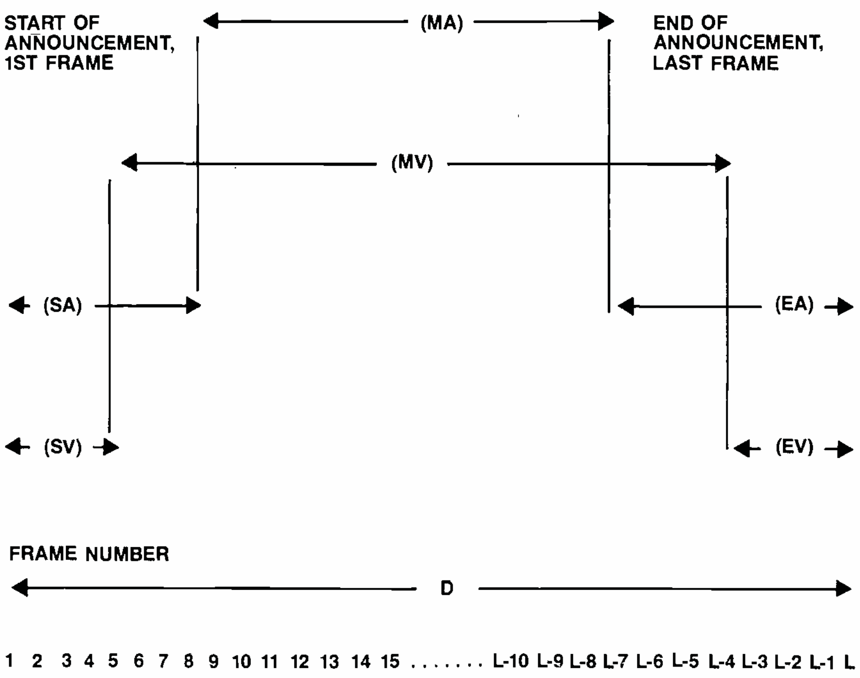


Definitions

SV (start video): The number of frames that color black should be recorded. If an announcement begins with a video fade-up, it starts after the SV frames.

SA (start audio): The length of silence that should be recorded. If an announcement begins with an audio fade-up, it starts after the SA frames. No significant announcement audio should occupy the time-period SA.

EV (end video): The end of the announcement where black should be recorded. If an announcement ends with a video fade-out, it should be completed by the last frame preceding this EV period.

EA (end audio): The time when silence should be recorded. If an announcement ends with an audio fade-out, it should be completed before the last frame that precedes the EA period.

(Subtracting these durations from the original duration time D; the actual announcement time is slightly less than the originally scheduled duration time.)

MV: Message video duration, expressed in seconds or frames.

MA: Message audio duration, expressed in seconds or frames.

***Figure 1.** Time line drawings of author's suggested format for commercial announcements. Message video and message audio are shorter than actual duration, providing "cadence beat" within breaks, and protection from up- or downcutting announcements.*

avoid wasted time when no information is transmitted—is a "buffer zone," protecting the spots before and after from upcutting or downcutting. It also provides a "beat," or punctuation time at the beginning and end of breaks.

Figure 1 is a time line of a postulated TV announcement period. The overall length of the announcement is D, the first frame is frame No. 1, and the last frame is frame L, where L is an integer. The value of L is determined from Table 1.

Let's look at a 30-second commercial, as it would be produced under this proposal. (See Table 2.) It is obvious that the message has been shortened slightly. You may need to persuade the sponsor of a commercial that this is being done to air the spot in its entirety, in a "clean" manner, separate from other unrelated material. The amount of reduction is a percentage of the overall nominal length. A 10-second announcement meeting these standards is shortened appreciably; a 2-minute, or 120-second, commercial is shortened almost not at all.

Suppose two announcements, spot No. 1 and spot No. 2, precisely met the proposed standard. The "beat" between announcements would be about ¼-second for video, and ½-second for the audio. Now further suppose that spot No. 1 has video and audio full up until the last frame, or indeed is downcut. If spot No. 2 meets the standard, some space will remain.

Testing announcements for meeting this standard is simple. Assuming the spot is on a 1-inch master, find the first frame of video. (This assumes the tape is recorded with clean "black" ahead of the announcement, to allow run-up time for playback lockup.) From this point, reverse the tape exactly four frames. This is the first frame, or the beginning point for subsequent measurements. From this point forward, the 896th frame (and following frames) should be black. The 895th frame is permitted to contain active video. Note that the 895th frame is precisely 29 seconds and 25 frames from the reference point.

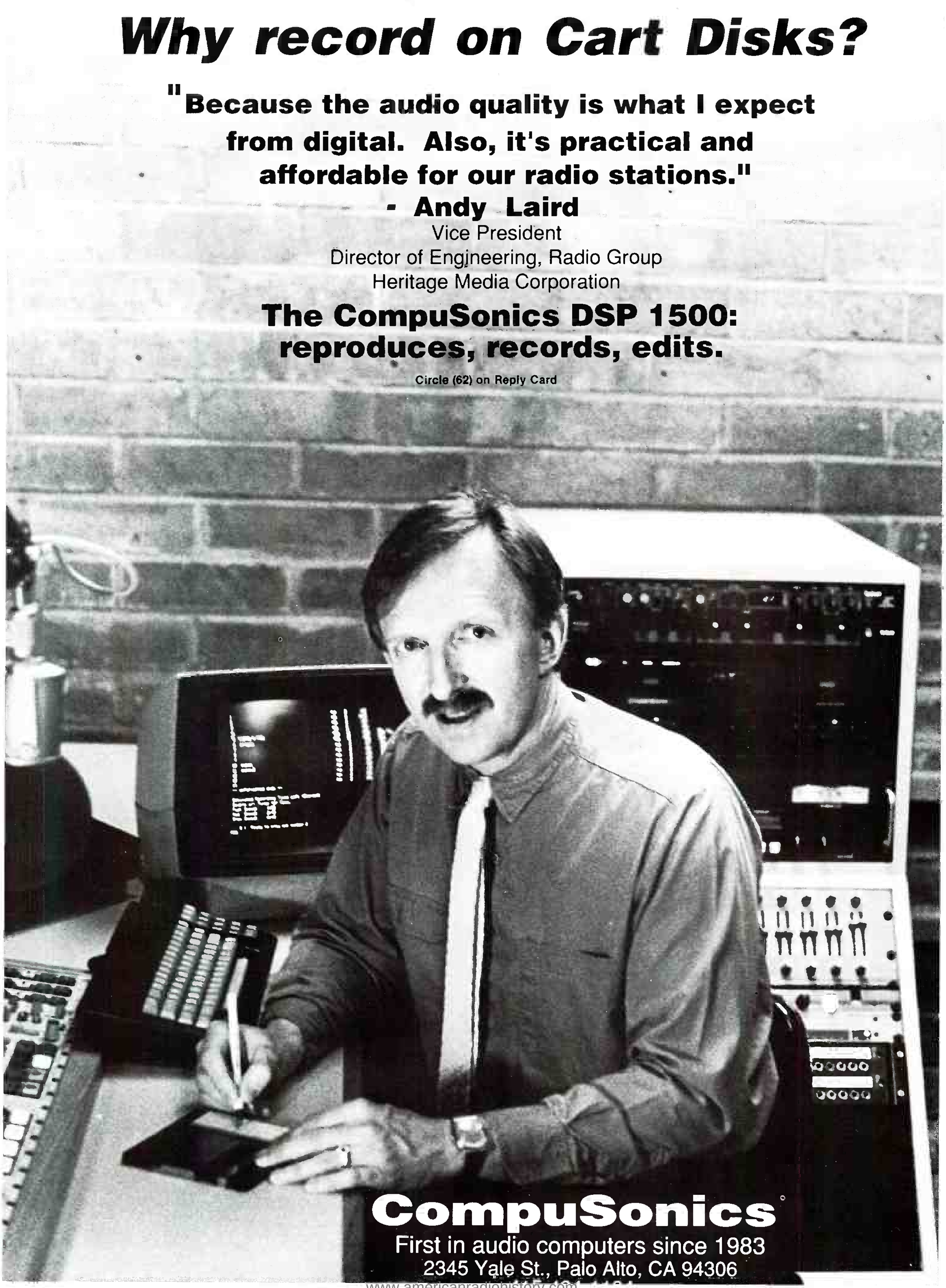
If the 895th frame is already on black, then the announcement exceeds these specifications. If the announcement material is significantly shorter than the allowed 891 frames in length, a decision may be made to "center" this shortened video between equal amounts of black before and after the announcement.

While these precision timing measurements are being made, the VTR's time-code reader must be operated in the non-drop-frame mode. The drop-frame mode is intended to eliminate long-term timing errors and, within limits, it works well. However, you are dealing with very short periods, and the drop-frame mode could introduce ambiguity into the measurements. (For an excellent discussion of TV time and the time-code theory, see "The Time Code Handbook," by Walter A. Hickmann and Milan Merhar, published by Datametrics-Dresser Industries.)

Audio timing follows the same procedure as video timing, although some subjectivity may be involved because of the difficulty in detecting audio on slowly moving videotape.

The advent of station automation systems brought the problems of precision timing into focus. Much time and effort goes into the production of commercial announcements for television, with highly sophisticated and complex editing systems. In the final analysis, however, these announcements are played on the air, and if they are upcut or they look bad, the production effort is for naught.

An on-air operation—even an automated one—may be likened to an editing system, with one important difference: Errors made during on-air playback can be fixed only by make-goods. You cannot simply rewind the tapes and start over. A standard such as the one proposed here allows a window of tolerance. It may reduce the error rate, and it just might improve the look of your station.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GE is Light.

GE Lighting

Circle (63) on Reply Card

Time Code: bridging the gap

By Rick Lehtinen, TV technical editor

Time code is the key that unlocks new audio-video post-production possibilities.

If you hold a piece of videotape up to the light, you won't see much. Even if you could somehow look at the tracks, you wouldn't learn a great deal. Looking at a film frame, on the other hand, tells you something about it, but a video frame is a tenuous, 16-inch encoded "thread" stretched onto some brown oxide goo. Film is roomy, and each image is printed in full clarity. In contrast, tape is tightly compressed; the contents of several heavy cans of film can be squeezed into a single 90-minute reel.

Tape and film do have one thing in common, however. To edit either one properly, you must be able to see what you're doing. In film, you can use edge numbers. For tape, you need a method appropriate to the format. Enter time code. Enter computer control of video. Enter modern-day post-production.

But all the world is not pictures alone. Just as video elements are processed and combined to make a production, creative audio must be constructed to accompany the video. Both processes rely on time code.

Editing through the ages

Engineers and operators can edit audiotape by shuttling to the right section and cutting out or splicing in material. Early videotape editing was accomplished in basically the same way. The edit points were marked with a grease pencil. The tape was pulled off the heads and laid on a splicing fixture. The editor sprinkled the tape with a dark powder that contained iron, which clung to the magnetized tracks on the tape. Peering through a microscope, the editor located the distinctive pattern made by vertical sync, then carefully cut through the tape between head swipes.

The joints then were taped together with a sticky metallic foil. It was a tricky process. The tape was narrow, and the splice was long. The pressure created by

pulling the tape through the guide block could easily break it apart. When you were finished, you had to make a copy of the edited master—not so much for protection, but so you would have something that wouldn't fall apart on the air.

It was primitive, yes. But it worked.

Electronic editing was much simpler. When the source and record reels both got to the right place, the edit machine was dropped into the record mode, recording the desired material from the source deck or some other input. Unfortunately, with this *punch-and-crunch* editing, there was no way to preview the edit or to fix it if the edit didn't work.

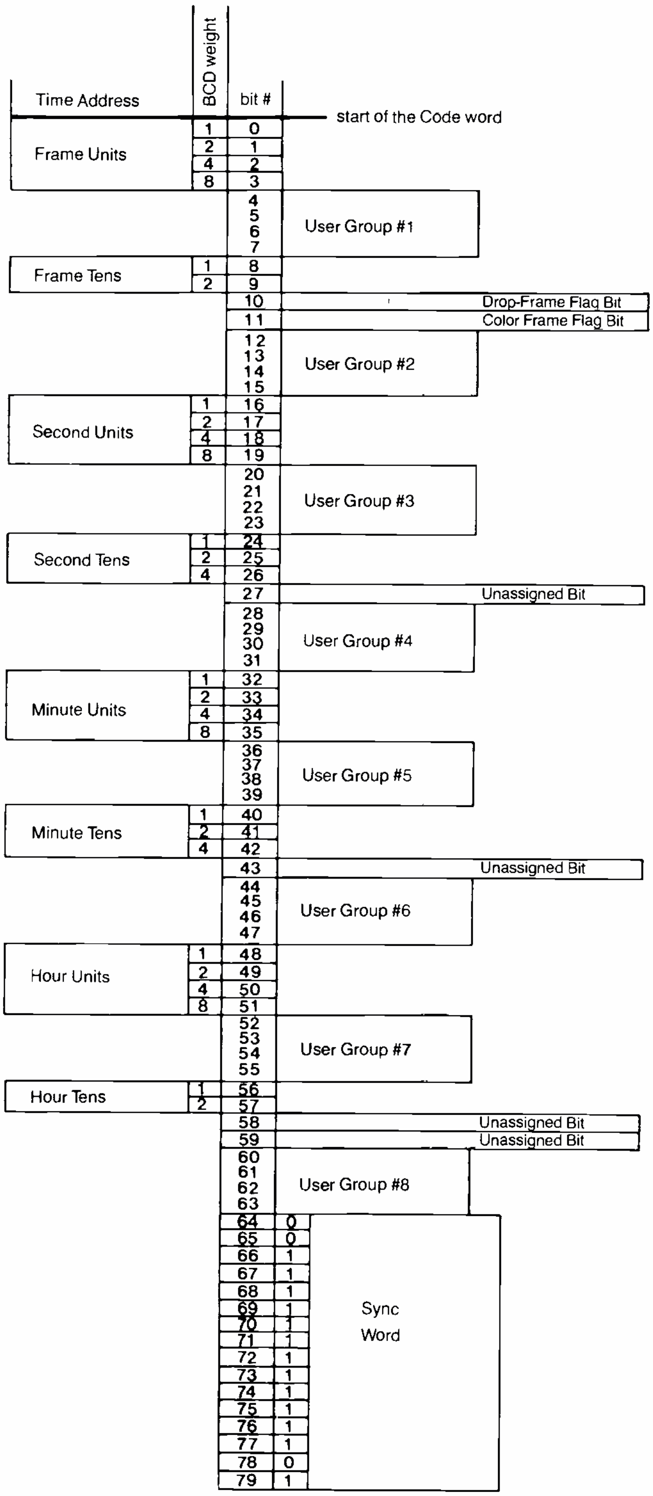

Figure 1. The basic structure of SMPTE time code. Unassigned bits are provided for special applications. (Source "Datametrics Time Code Handbook.")

Later systems used cue tones for editing, laying tones onto a narrow linear track located just inside the control track on 2-inch tape. When the cue-tone sensor detected the proper signal, it activated the record heads and, depending on the length of the edit, the erase head. An advantage of the cue-tone system was that an operator could preview the edit and commit it to tape only if it was satisfactory. But neither system really worked well, compared with a production shot on film, edited on film, and aired from a telecine or transferred to a dub tape and then aired.

Slant track machines, which wrapped the tape helically around the scanner, certainly were not suited for splice-tape edits. The guard band was too narrow, and the track was too long to reliably cut it straight. Because anything other than a track-length cut would result in a line of dropout moving down the picture, electronic editors were the only option. Punch and crunch for helical recorders is subject to the same problems previously discussed, and cue tones never made a mark with these formats.

Instead, manufacturers added accurate tachometers to their machines to give an approximation of tape running time. Unfortunately, this timing was relative to the start of the reel, or to when the counter was last reset. It could not serve as a convenient way to permanently describe the location of a given scene on tape.

Broadcasters and video post-production facilities had to wait for 20 years after the invention of videotape machines for a frame-accurate method of editing. That method involved laying down a digital code on tape that corresponded to each frame. Editing was accomplished by loading desired entrance and exit points into buffers. When the on-tape frame number matched the stored number, the desired action was performed. The signal used in this type of editing generally is considered as the predecessor of modern SMPTE time code.

Inside time code

SMPTE time code is a series of *binary coded decimal* (BCD) words, recorded using a biphase Manchester modulation scheme. (See Figure 1.) A unique 80-bit word is assigned to each frame of video. The word is divided into two sections: *frame count* and *user bits*. The frame count is the frame address along the track (with respect to the starting point). The user bits are for whatever you want them to be.

A bit is considered a *zero* if the code changes state at the start of a bit interval and stays there. If the signal changes state again in the middle of a bit interval, the bit is considered a *one*. This concept is illustrated in Figure 2.

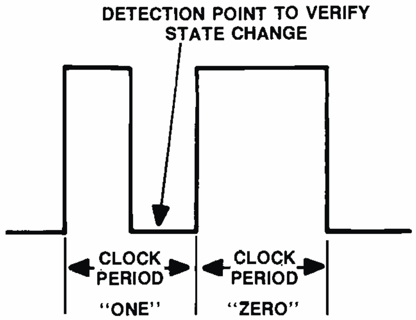

Figure 2. Detection of SMPTE time-code state changes. Because of the format structure, the signal is immune to 180° phase shifts.

The format is self-clocking. You can extract data from the code itself without having to make reference to an external clock. It can be thought of as a *frequency-shift keying* system (FSK) because a *one* has twice the frequency of a *zero.*

SMPTE time code uses zero-crossing detector circuitry, making the format immune to low-amplitude noise on the signal line. Because a transition denotes a bit, not a level, it is not affected by polarity reversal. The clocking scheme permits signals to be read in either direction.

Time code usually is recorded on an audio track of the video recorder or on a dedicated time-code track. The signal is a square wave and, therefore, could interfere with other audio signals. That's why it generally is placed on a track located as far away as possible from any program signals.

Format limitations

SMPTE *longitudinal time code* (LTC) is extremely useful, but it has two clear drawbacks. First, it occupies an audio track that could be used for something else. Second, it resides on a linear track, which means the tape has to be moving if any signal is to go to the time-code head. If you are operating in still-frame mode or moving the tape slowly, the recovered signal is unreliable.

To correct this problem, a variation of SMPTE code was proposed in 1978 and standardized in 1980. The revised code, *vertical interval code* (VITC), is inserted into the vertical interval of video, one time-code word for each field. This approach provides twice the resolution of linear SMPTE code, which is addressed once each frame. VITC does not have to be bidirectional, because each video field is read off tape in the same direction, top to bottom.

A chart of VITC and LTC is shown in Figure 3. The VITC structure within the video waveform is illustrated in Figure 4.

Another benefit of VITC is that it does not require an audio path for distribution. Where the video goes, so goes the VITC. Burned-in off-line tapes are not needed.

Although VITC solves the problems of slow-speed playback and field-by-field identification, the format has its own difficulties. VITC cannot be read at high shuttle speeds, one line is required to transmit one word, and the format consumes a line that could be used for other purposes (such as teletext or closed-captioning). When a tape is shuttling, not every portion of a track may be readable. In this case, LTC is superior.

Working together, VITC and LTC can keep a tape machine informed as to tape location. But time code certainly is not the only way to keep track of events on tape. There's always the good old stopwatch and tape timer. The tape timer uses an idler wheel that feeds a tachometer, and circuitry to monitor control track pulses. In high-speed wind modes or when you're dealing with a tape that has no time code recorded on it, tape timers are a reasonable approach. Mechanical slippage, however, can allow the idler to roll without any tape present, introducing counter error.

Synchronizing multiple machines

So how do you synchronize audio for video? In the simplest of productions (fortunately, this includes most of what takes place in a TV studio), you don't. The activities and sounds in a studio are recorded onto a tape machine. That tape is played back and, on verbal cues from the director, supplemental sounds (applause, crowd noise, effects) are mixed into the audio and recorded on a second machine. At the same time, video effects are performed, and the result is a video master.

But what if you want more sound? Or separate mono and stereo mixes? Or second languages? This is where audio sweetening comes in.

As a first step, the rough audio and time code from the edited master is laid off onto an audio recorder. This becomes the master that you work from. A copy of the program with time code burned into a window is made at the same time, and this guides the editor in decisions about when to drop in the necessary steps.

Using MIDI

The process of audio sweetening is much more complex today than it was 10 or even five years ago. The introduction of sophisticated special audio effects devices and synthesizers has opened new possibilities for audio and video post-production. However, with increased complexity comes the need to control the new hardware. That's what the *musical instrument digital interface* (MIDI) protocol is all about.

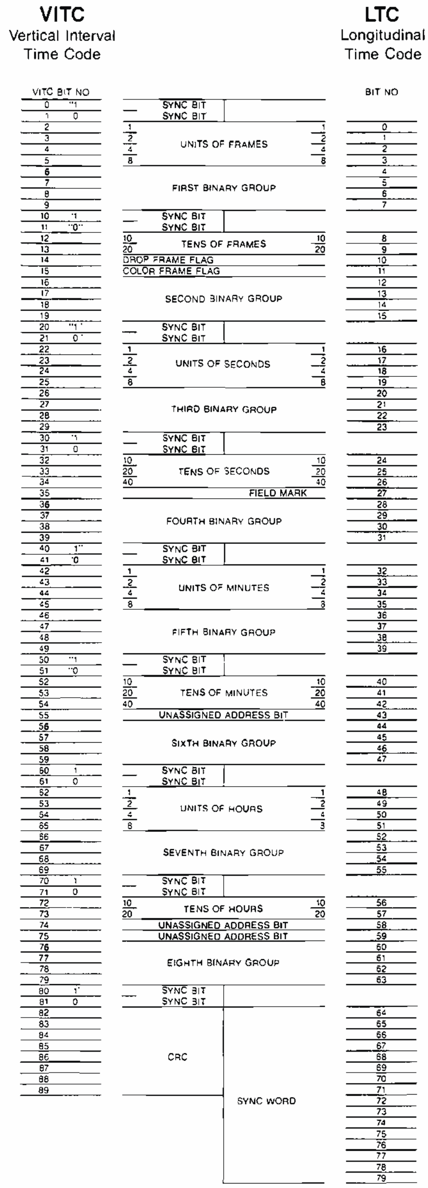

Figure 3. Comparison of LTC and VITC formats. The two formats operate in essentially the same manner. (Source "Understanding Synchronization," a publication of Tascam Corporation.)

MIDI is a language of digital words that describe controls and key strokes for a given instrument. This concept is easiest to describe in terms of a keyboard. Each of the keys, buttons and adjustments on a keyboard device are defined under the MIDI system. Like a player piano roll, MIDI code tells an instrument what to do and when. An expanding variety of mixing consoles, audio processors and effects devices also use MIDI for machine and system control.

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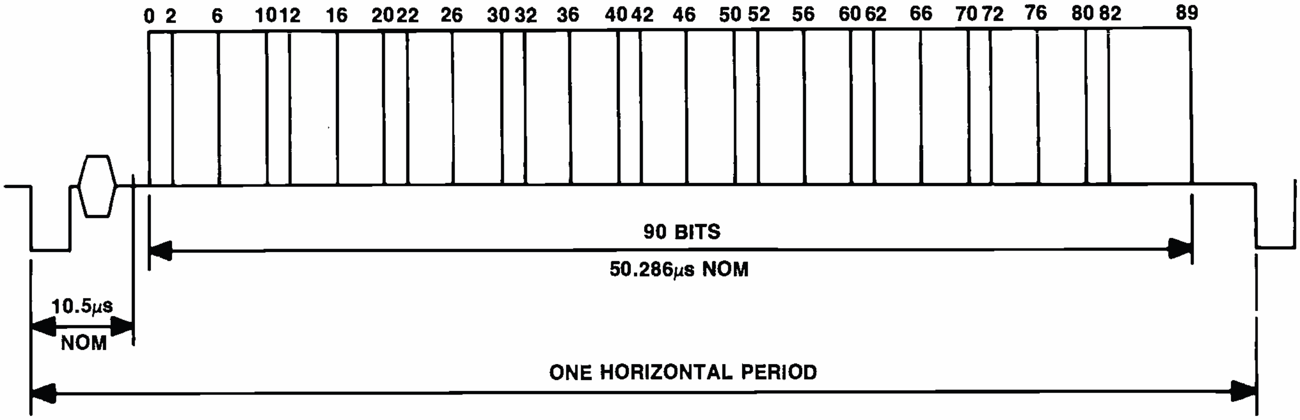


Figure 4. *Organization of the VITC format on the vertical interval signal. See Figure 3 for an explanation of the code bit numbers.*

instruments to talk to each other, MIDI has found a home in music production studios. MIDI sends data, not tones, down its interconnect lines. This means that when an artist on a keyboard strikes a key, a synthesizer across the room can receive the message, decode it and produce the proper effect. One keyboard can control a number of other instruments, and just one computer can control a whole roomful of instruments. This is an enormous advance in power for music makers.

MIDI is more of a protocol than a format. It comprises 8-bit words surrounded by start and stop bits. The communications rate is 31.5kb per second, talking through a 5-pin DIN connector and 5mA current loop. Every musical instrument that has a computer on board also has a MIDI input and output port. The I/O ports are opto-isolated to prevent interference or ground loop problems.

MIDI applications

So why should video people care? Let's say that a commercial has background music, and that at a designated time the actor drops something. The action is accompanied by a comic "bump" in the music, such as a cymbal crash or a trombone slide. Everything is recorded and put in the can, and you are ready to layback the audio onto the video master. But the producer shows up and says that the client wants the actor to spill milk with a "glug-glug" sound.

In conventional terms, this is bad news. In an electronic environment, however, it is merely a matter of changing the MIDI program. Everyone sits down again, the tape machines start up, and the change is implemented. Under MIDI control, the music and special effects are repeated identically every single pass.

Just as you're ready to go to lunch, the producer shows up again and says the spot has to run 28 seconds, not 28.5. Rebuilding a mix can be a horribly expensive project. If it involves calling back musicians, the change is probably out of the question. But adding a few keystrokes to a program is comparatively easy.

A promising use of MIDI involves the concept of a *virtual-track* audio recorder. Assume that you have a 4-track tape recorder. One track is used for time code, leaving three for program audio, but you determine that three isn't enough. Using MIDI-based gear, you can expand the number of apparent tracks. A MIDI sequencer monitors the time-code track and, at the appropriate point, tells the various instruments what to do. Because any number of instruments can play along, it is feasible that you could add a symphony to your audio track.

A symphony may be more than what you have in mind, but the MIDI-based virtual-track approach is a slick way to build up a sophisticated effects track. Remember also that you don't have to commit electronically assembled material to tape until it sounds perfect. This assures first-generation quality on the final mix.

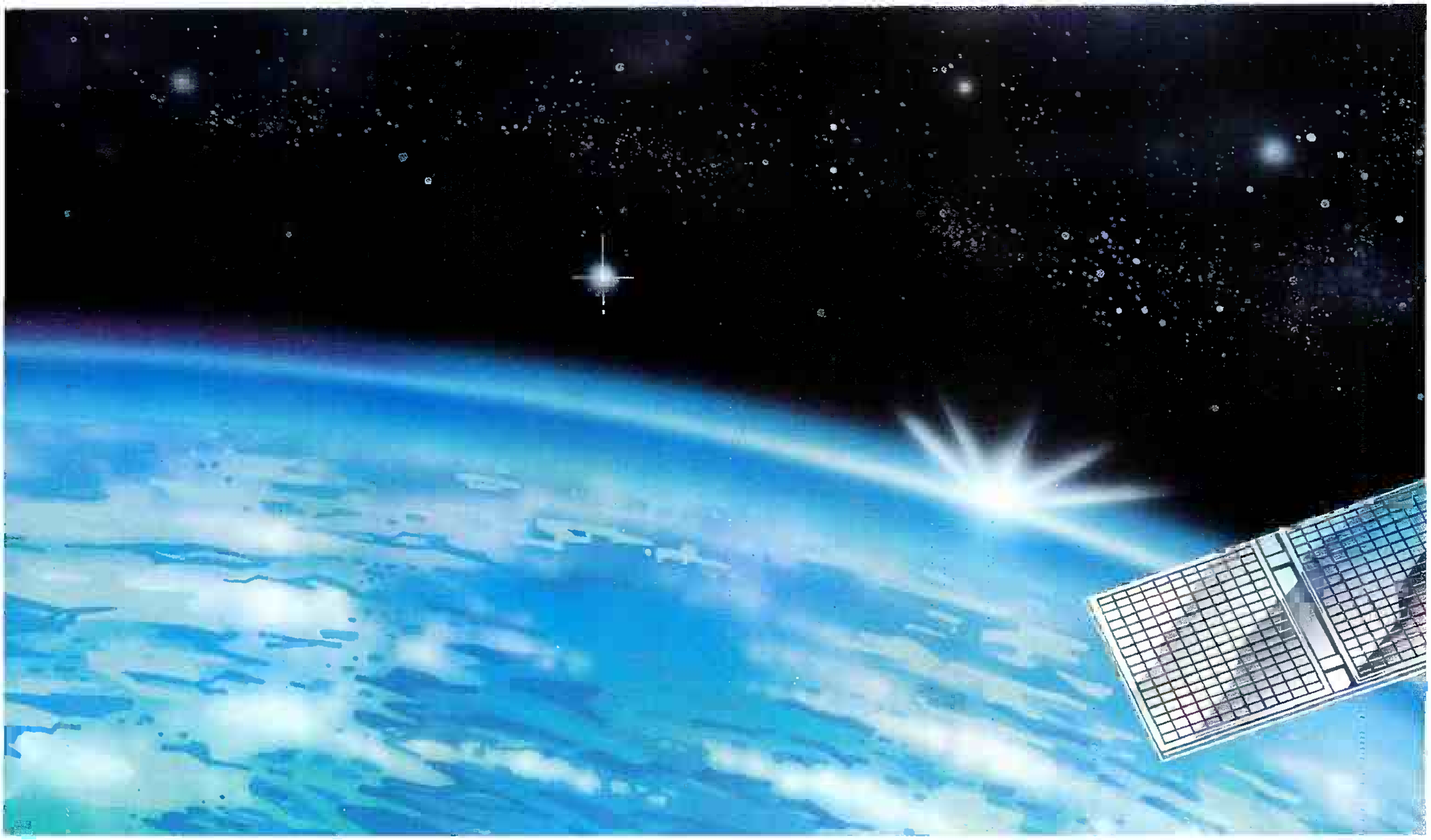
A marriage of formats?

Unfortunately, true MIDI code suffers from the same problem of control track-based editors. The code is relative, not absolute. For this reason, a merging of MIDI and SMPTE time code is afoot. Called *MIDI time code,* it exists as a plan for translating the 80-bit SMPTE words into strings of 8-bit MIDI code. It's too soon to gauge the impact of this approach.

Some experts say users would be better off to assign spare bits in the existing time-code format to trigger MIDI sequences. Others believe the solution lies in SMPTE-to-MIDI conversion boxes, preserving time code for the video world and MIDI for the audio world.

Most users agree, however, that a marriage of the two formats would provide the best of both worlds. The distinctions between audio sweetening and video post-production are beginning to disappear as high-quality audio becomes more important to video producers. In light of this trend, the electronic dialogue between the audio and video camps must approach a greater clarity and efficiency.

Heres a far out way



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Vital station automation manager

By Robert Kastigar

In a sense, automation is live television, with the many elements (program segments and commercials) composed of prerecorded material. From another viewpoint, this is where the glitter and glamour of show business ends and the moneymaking begins. The show is in the can, and the commercials, which took hours of shooting and editing, are complete. The task now is to air this material with as much precision and accuracy as possible. One way to maximize this accuracy is through the use of an automation system. The Station Automation Manager (SAM) system from Vital Industries is one such machine.

Performance at a glance
- *Bidirectional interface with business/traffic computers*
- *Audio-video switching plus machine control*
- *Communication with intelligent devices*
- *Automatic logging*
- *Automatic time calculations to within 0.1s*
- *Report generator with optional formats*
- *Flexible configuration, user-adaptable*
- *Operator intervention*

Master-control switcher

The heart of this automation system is the audio-video master-control switcher. The master-control switcher (shown in the upper right corner of Figure 1) performs the actual switches under the control of SAM. The automation system is not limited to Vital's master-control switcher; it can be interfaced to many other master-control switchers.

WGN-TV, Chicago, has a 4-bank master-control switcher with program, preset, audio breakaway and preview. The switcher has 30 audio-video inputs and nine audio-only inputs. The switcher alone provides the machine control for the tape machines, the film islands and the audio cart machines. The switcher is controlled by the automation system during the station's 24-hour broadcast day.

The black lines in Figure 1 represent program (audio and video) signals carried by coax or shielded pairs. The blue lines represent parallel data lines, for control and tally. The red lines represent RS-222 or RS-422 data control lines. Without the automation system, these cables would connect directly between the control panel and frame. The switcher's control panel may be located several hundred feet from the actual switcher's electronics.

Adding intelligence

Adding the SAM interface makes the master-control switcher intelligent. The interface is fully solid-state, without relays or adjustments. Moreover, the connections between the control panel and the switcher frame itself are loop-through connections, meaning that control of the switcher can never be lost. This architecture allows conversion of most standard manual switchers to fully automated intelligent switchers. In terms of troubleshooting, this design also means quick and positive isolation of switcher hardware and automation system problems.

Although operation of a master-control switcher may seem formidable, it can be reduced to two basic actions: following the log schedule and performing the necessary switches. The automation system, then, may be likened to an operator. First, SAM is provided with a schedule of events. Second, the required program segments (events) are loaded on various source machines. Finally, the automation is directed to play these events using the available sources.

Hardware/software

The automation system is based on a Digital Equipment Corporation (DEC) PDP-11 minicomputer. The computer resides in a plain brown box that occupies only five inches of rack space. The computer's front panel has only two lamps and three switches. This computer may be the most popular "brain" for broadcast automation systems.

The computer uses DEC's RSX-11M operating system (DOS). This system is capable of multitasking and is designed to operate in a real-time environment. These features are ideal for an automated, real-time TV station automation system.

SAM software is written in Pascal and compiled in task form. As new TV devices (program sources) become available, new tasks can be written to accommodate them. For example, at WGN, SAM originally was interfaced to both the RCA and Ampex cartridge machines. When the ½-inch cart machines became available, a new task was written to control the equipment.

It doesn't take detailed computer or programming expertise to write tasks or to change the system's operating parameters. An individual broadcast station's parameters can be changed by the user, eliminating the need for custom software. Programming the system relies on the use of a forms management system. The system is customized by data entry, rather than by a modified computer program.

Attached to the system are various devices that couple peripheral equipment to the computer. These interfaces are numbered 1 through 7 on Figure 1. All interface communications take place using either RS-232 or RS-422 protocols.

Traffic department

Interface No. 6 contains a serial communications card for connection to the traffic department's computers. SAM is capable of interfacing with many popular business services. At WGN, we use the BIAS business service. The assembled *tomorrow's log*, prepared by the traffic department, is transmitted to SAM through this interface. On the following day, *yesterday's log* is delivered back to the traffic computer for automatic billing reconciliation. Actual airtimes for all the previous day's events are transferred automatically.

The system relies on *distributed intelligence*. This design allows the on-air operations computer to be independent of the traffic computer. An interruption or failure in one system does not disturb the other system or that department's staff. The two systems simply communicate the necessary information and otherwise remain independent.

Logs and schedules

Although the colloquialism "tomorrow's

Kastigar is an engineer at WGN-TV, Chicago.

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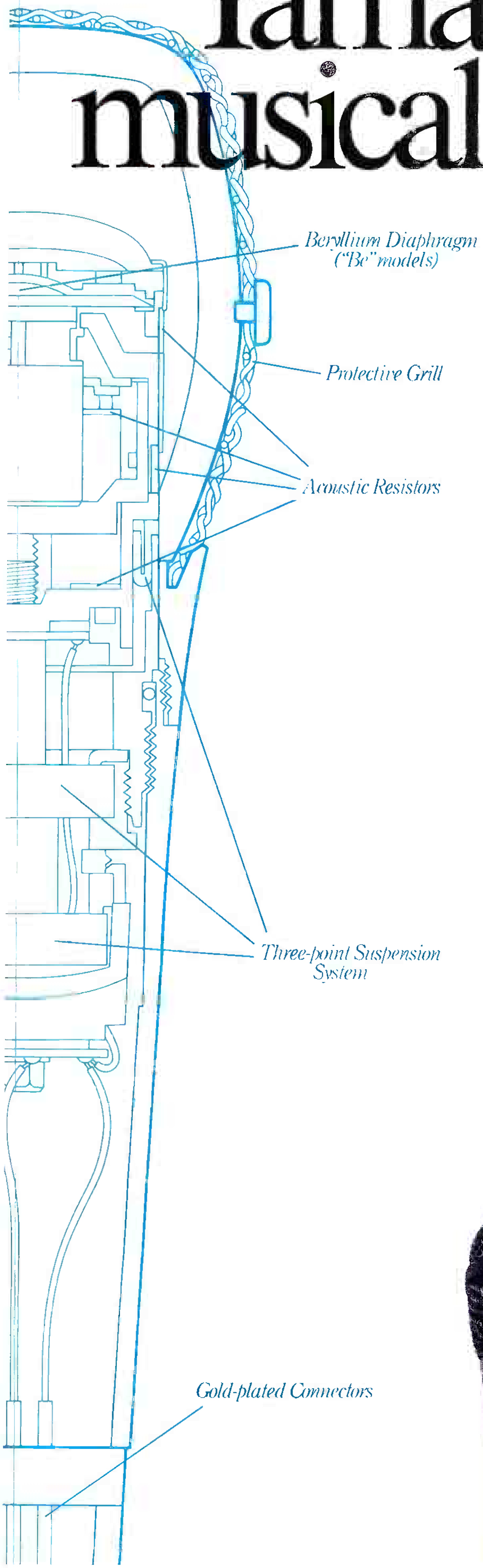

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Circle (69) on Reply Card

log" often is used in broadcasting, this phrase is a contradiction in terms. A *log* is a record of events that have happened in the past, with a list of actual occurrence times. A *schedule*, on the other hand, is a list of events that will happen in the future, with projected times of occurrence.

What happened yesterday should be called a log. What is going to happen tomorrow should be called a schedule. The list of shows and commercials for today has elements of both, and the division between the two is now, or the present. What happened earlier today forms a part of what eventually will become the com-

One day for SAM

During the course of any "day," reference is always made with respect to that day. Three days must be considered: yesterday, today and tomorrow.

The broadcast day at WGN-TV begins at 0600 (6 a.m.) each day. Because it is a 24-hour station, each broadcast day ends at the same time. Each day is started by terminating yesterday and beginning today.

Shortly after today begins, the final logging of the last events from yesterday is completed. A short time later, a Discrepancy Report (DR) is produced on the log printer with 2-copy paper. The engineer removes the DR and log and sets them aside. Additional copies of the DR are printed and distributed to other departments. At a short meeting of the various departments, the DR is examined in detail.

Within the first few hours of today, the log from yesterday is electronically processed, and the billing reconciliation data is sent back to the business service. During this time, SAM is on the air performing routine operational chores. Minor changes are made in the schedule to accommodate missing announcements or material that is lost or not yet transferred to videocart. Pull lists are generated as requested by the other operators or departments. If technical problems occur, they are noted in the electronic DR. The official log is printed as the day progresses, and these comments are attached to individual events.

In the afternoon, air-control operations will receive a call from the traffic department stating that tomorrow's schedule has been completed and released. We ask SAM to receive and process the schedule into its format. Within a short time, the entire schedule (one copy only) is printed. We refer to this as the "virgin" schedule; it is the schedule as it was originally developed, before any editing or changes.

Later in the day, someone will carefulplete log. Events slated to occur later today are still in the schedule stage. It's important to keep these definitions clearly in mind for the following discussion.

SAM is not a traffic computer. Although events scheduled throughout the day may be manipulated and changed, SAM is primarily intended to execute, not develop, schedules. The automation system holds a total of seven days of schedules/logs. A schedule can be loaded up to seven days in advance or a log can be held for a week before being sent out. Normal practice is to return the log as soon as convenient

Continued on page 122

ly look over this schedule and note any changes or additions that need to be made. This is the human input that is so important in maintaining a good on-air look. We call it "massaging" the schedule.

After it is massaged, several copies of the completed schedule are printed and distributed to those who need tomorrow's schedule. At the same time, the play lists (material in the sequence scheduled to play) are printed for the films and tapes department, so that a final check can be made. The pull lists (commercial material, but sorted in ascending house number order) are printed as required. As much as possible of tomorrow's material is prepared today. A list of scheduled promos is compiled by SAM and sent to the promotions department. Similarly, a list of public service announcements could be printed and given to the public service department.

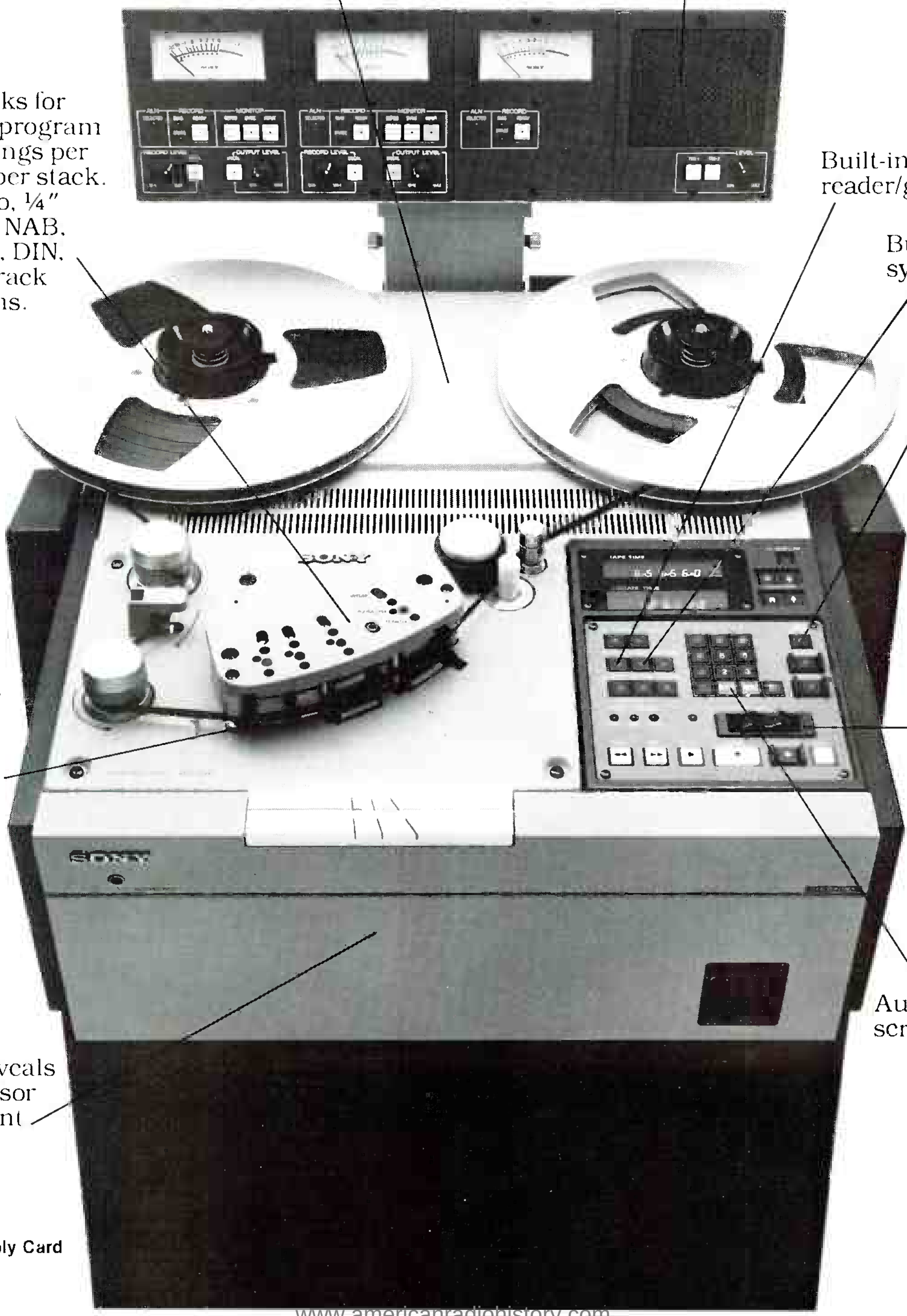
Following this step, the data is backed up on a backup disk, a process that takes less than two minutes. In three years, this backup data has been needed only once, when a fan failed and the drive overheated.

Two file folders—future and history—are kept in air control. The future file allows other information to be sent to air control 30 days in advance.

The history file goes back to only the past seven days. Every day, a copy of the paperwork from the past 24 hours is placed in the history file. This includes the virgin schedule, the timing sheets, the working schedules and all miscellaneous notes. This material is sometimes valuable for tracing problems. At the end of seven days, each file is discarded to make room for the next day.

Friday has three tomorrows: Saturday, Sunday and Monday. Similarly, every Monday has three yesterdays: the previous weekend, plus last Friday. Long holiday weekends extend these periods.

n' the only thing



Circle (74) on Reply Card

Continued from page 119
after the air day. Allowing for long holiday weekends, this 7-day rotation is sufficient for ordinary operations.

Terminals and printers

Box No. 3 of Figure 1 represents a 4-channel multiplexer. Depending on the number of terminals, printers and intelligent devices desired, only one multiplexer may be required. Expansion simply requires the installation of an additional multiplexer, as shown in box No. 4.

The SAM master terminal (there can be only one) is connected to this interface. This terminal has total control of the automation system and can issue all of the necessary commands. It normally is located in master control, near the switcher-control panel.

A remote SAM terminal is shown in Figure 1. In the WGN installation, this terminal is located in the traffic department. This slave terminal should not be confused with the traffic department computer. Any commands that can directly affect the on-air operations are excluded from this terminal. The terminal allows the traffic department to make changes in the schedule (within limits) as needed.

The master terminal has the provision to set traffic modification limits. Any events that are within these limits (that is, approaching airtime) cannot be modified or changed by the traffic terminal.

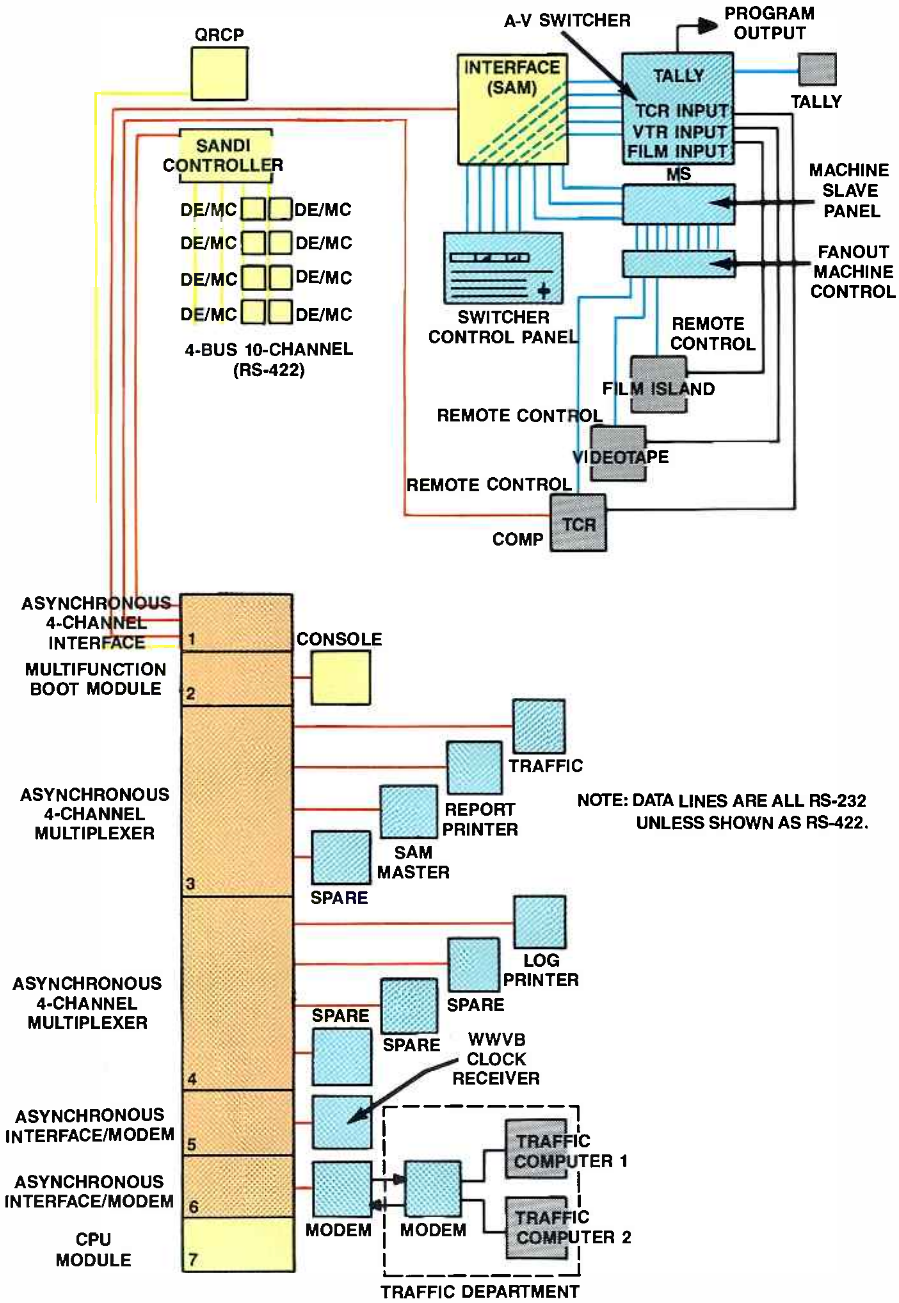


Figure 1. *System diagram for the WGN-TV automation system.*

The automation system's video display matches the printed schedule. The terminals operate in both 80- and 132-column display modes and can be user-configured to display the current event and the next 16 events, future schedules or past logs. The master terminal also provides a video output, which can be distributed to other locations as needed.

The system provides for two types of printed outputs—the FCC log and user-generated reports. The official FCC log is the daily listing of the events after they have been aired. The official log can be printed all at once at the end of the broadcast day, or in increments as the day progresses. The next day's schedule also can be printed as needed. The reports can be generated by category in a variety of ways; events can be sorted by source, such as VTR, film or videocart, or by content, such as ID or promo. Also, these reports can be printed in time sequence (play list) or in sorted ascending numerical house number order (pull lists). A high-speed printer is used to output these reports.

The official log could be printed on the same printer, but usually it's desirable to use a separate printer so that one can act as backup for the other.

Attached to box No. 2 in Figure 1 is a combination printer/terminal. This device acts as a background RSX-control console, which means it can be used to initiate commands directly to the operating system. Also, it will print out error messages in case of imminent system failure, or the failure of anything in the host computer's operational environment.

As events run through the on-air list, the information is preserved, but not yet logged. The operator has an opportunity to attach to each event an appended comment for additional information. Periodically, the operator must push a button to continue logging. If the button doesn't get pushed, SAM will remind the operator to do so. Once events and comments are logged, the entries cannot be changed. The idea is to preserve the log's integrity through a paper document and an electronic file that cannot be tampered with or changed.

The Discrepancy Report

At the end of a broadcast day (which is not necessarily midnight, but can be changed any time at the option of the station), a *Discrepancy Report* (DR) is printed. Any events that have been missed or any events that have appended comments are compiled and printed. When the appended comments are added, a special delineator can be used to determine whether all, part or none of the comment is printed on the official log. This feature prevents extraneous material from being included

The QRCP control panel provides immediate control of the automation system.

in the official log. However, the entire comment is always printed on the DR.

The log and appended comments, coupled with the DR, provide a powerful tool for tracking the cause of errors. The comments provide insight that is useful to all departments, including engineering. Problems can be identified and corrected before they become major issues or repetitive mistakes.

Real-time operation

The PDP-11 operates as a resource-sharing system. The computer handles many tasks on a priority basis, one at a time. None of the tasks described here so far are critical-time tasks. Screen updating, log printing, report generating and schedule editing can and should be done at your convenience, or at the convenience of the computer. Other tasks, however, need to be handled immediately.

Interface No. 1 in Figure 1 is a 4-channel independent communications device. These lines are effectively coupled directly to the computer internals, without a multiplexer. The four lines represent devices that demand critical and immediate attention from the computer.

The line labeled *switcher* issues commands to the switcher interface unit. Machine control and on-air switching have the highest priorities. Regardless of the current task of the computer, switcher operation takes precedence.

QRCP

Also attached to this unit is the *quick-reaction control panel* (QRCP), pronounced "crisp." This small panel usually is mounted adjacent to the switcher-control panel. QRCP contains only 16 buttons and lamps, but it affords almost instantaneous control of SAM. All of the QRCP commands can be issued from the master terminal, but doing so is much slower and requires several keystrokes. The QRCP relies on switches and a high-speed RS-422 line for control. The QRCP control-panel layout is shown in Figure 2.

The three panic buttons available on this panel are particularly significant. *Take black* does just what it implies, by switching to the black input on the switcher. A second press of the same button returns to the previous source.

Take panic slide works the same way, except the operator determines in advance what source will be selected at the press of the button. This source also can be programmed into the regular operating schedule, if desired. When take black or take panic slide are selected, the time also is noted on the log, providing an event/time record of what happened.

The third button, *take backup source*, toggles between a main program source, such as a VTR, and a backup source. In some cases, the backup might be another VTR running an identical show in parallel and in sync with the main program. For those critical programs, this is a great convenience.

The primary and backup machines are entered in advance into the SAM schedule. The system then rolls both machines together, with the correct preroll for each machine. Each switch to the backup source is recorded and logged, along with occurrence time.

Skip next event also is used in panic situations. If something fails or a program is unable to air at the last moment, the event can be skipped and the next scheduled one can be activated. This helps maintain a smooth, continuous on-air look.

Intelligent sources

It is important for any automation system to be capable of communicating directly with intelligent program sources, such as VCRs, TCRs and the ½-inch cart machines. These devices are used primarily for commercials. Each announcement or cart has its own unique identifying house or agency number. A table of contents from the cart machine, listing the loaded carts, is transmitted to SAM. The automation system then compares the data with the list of announcements scheduled to air. Any missing announcements are highlighted for operator correction or intervention.

A play list showing the sequence and airtime then is returned to the cart deck. The operator is in control at all times and can intervene to correct problems before the problems appear on air.

Digital devices such as character generators and electronic still stores also can communicate directly with SAM. Page numbers and slide numbers become house numbers and are brought up by the system as the schedule requires.

Material identification

The automation system offers an option that verifies the airing of program material. This feature, called *serial access network for data interchange* (SANDI), is an independent PDP-11 computer. SANDI communicates through this computer with several *data entry/machine control* (DE/MC, pronounced "Dempsy") panels.

As the operator loads each reel or cassette, a unique identifying number is entered via a numeric keypad or a bar-code wand. If the number matches one listed in the schedule, the scheduled airtime for the material is flashed on the DE/MC display panel. The machine identification is given to SAM for display on the terminal. If the message *material not scheduled* is displayed, the operator knows the wrong tape has been loaded. At this point, there is still time to find and load the correct reel. If a machine is unavailable for use, perhaps because of a hardware error, the system informs the operator so that tapes will not be loaded on a defective source.

After each segment plays, the time of each subsequent segment's airing is displayed. When the show is over, aired material is displayed, informing the operator to unload the machine. Backup material identification is entered in the same manner. All of this information is communicated between SAM and SANDI.

SANDI also can exercise machine control, if desired. This information can be coupled to machine-control panels located in other control rooms if the machines must be shared between on-air and production facilities.

On-air operations usually require three controls: start, stop and ready. Other machine controls, such as record, can be executed via the machine-control portion of the DE/MC panels and the SANDI system. Machine-control assignment is used to ensure that false commands are not inadvertently issued.

The SANDI controller is connected to SAM using an RS-232 link, but the DE/MC panels are linked via an RS-422 balanced data line. Each DE/MC has its own user-changeable SMPTE address, as well as machine identification (also user-changeable).

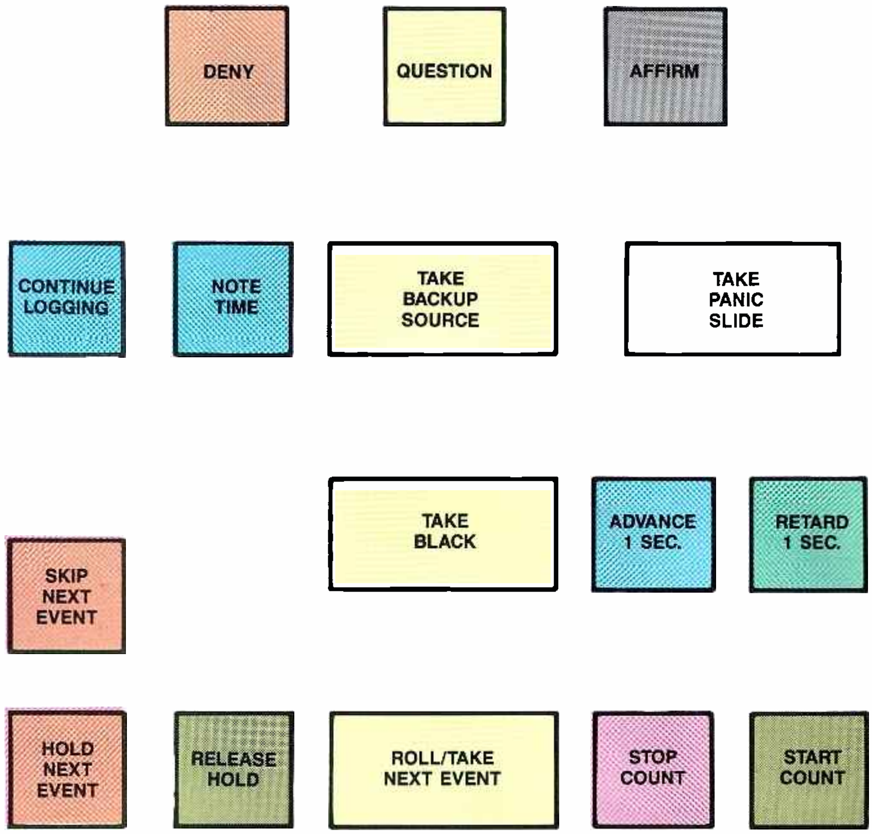


Figure 2. *The QRCP control panel provides immediate access to important system commands.*

Maintenance

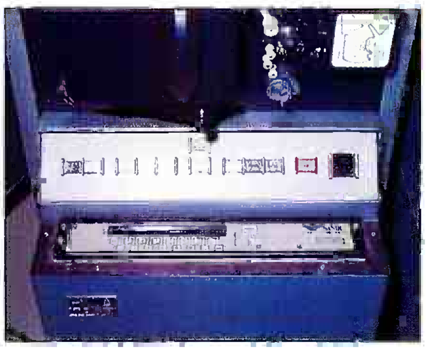
Troubleshooting the entire system isn't as formidable as it may seem. The first step is to isolate the problem. With the *computer off line* button on the switcher control panel, the system is divided between SAM and the switcher. In a similar fashion, the SANDI subsystem, or individual machines or sources, can be disconnected.

The SAM system runs on one removable 10Mb disk cartridge. If two disk drives are available, the second drive is used only to make backup copies of the SAM disk. The software is not copy-protected, so to make any changes in the station configuration, you must begin by making a backup copy. The changes then are made and tested on that copy. If any problems occur, the unmodified pack is available for use. Most of the operating system utilities and commands can be invoked as low-priority background tasks while the on-air operations continue, unaffected by the background activity.

The automation system can even assist in hardware troubleshooting. The operating system provides utilities that aid in the maintenance of the switcher, the interface and the QRCP panel.

Power interruptions are a typical operational problem for some stations. If a 1s or 2s interruption occurs, the computer may continue to run. If the PDP-11 detects

The SAM terminal (at the far right) is used by the videotape operator to access the automation system for informational purposes. No changes in the air schedule can be made from this terminal.



A DE/MC control panel mounted on a TP-66 film projector.

an imminent power failure, all information is dumped to disk. When power is restored, the computer is simply rebooted and returns to operation at the same point in the schedule where it was before the power interruption.

Installation is simplified because no hardware "handshaking" between devices is required. Although the standard RS-232 connector has 25 pins, only three pins are needed for interconnection. Most of the system's interconnecting data cables are standard shielded audio cable.

Means to an end

Operating the Vital automation system requires a knowledge of television, not a knowledge of computers. Once you know your goals, they can be defined as a set of events for the system. Each item on the air is considered to be one event. At completion of an event—either because time has elapsed or the event has concluded—the next event is initiated. Overall, the system executes a complex set of tasks, one at a time.

Details that sometimes can overwhelm an operator (such as different preroll times, dissolve, mix or fade transitions, audio under and/or over, key inserts and character generator sources) all can be preset in SAM or predetermined in the traffic computer. Such organization frees the operator to concentrate on picture and sound quality.

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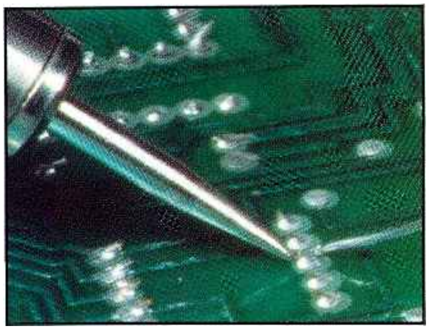


Test signal is more than reference level

By Frederick M. Baumgartner

Many stations rely on some type of setup tone oscillator for reference levels, especially on tapes. The generators used in these systems often are unstable and contain high distortion. After all, the tone is used only for reference levels—right?

The circuit that will be described here provides much more than a simple reference level. The special test signal can be used to set levels, check phase, measure tape speed, wow and flutter and even to identify individual channels of audio.

The signal is meant to be recorded at the head of a tape, then used as a reference when playing tapes or making adjustments. It provides a user-friendly, quick indication, making it suitable for both operator and automated setup for playback.

Four-part signal

The test signal is composed of four parts. They can run slowly over a period of 10s, or fast, taking 1s. Figure 1 shows the signal over a 10s period. The test sequence contains 100Hz, 1kHz and 10kHz at 0vu followed by a clipped 1kHz sine wave.

Five important operational features are provided by this unique test signal. First, the signal contains a reference-level tone for both ends of the audio band, providing a quick frequency-response check. In a matter of 10s, the operator has an idea of the relative frequency response of the system.

Second, the clipped sine wave provides an absolute polarity reference. The signal is polarized so that you can work on a single channel without needing any other reference. Maintaining absolute phase in each channel means that no matter what channels are mixed (left, right, background, beds, natural sound), in any studio, the stereo phase (mono compatibility) will be correct. The signal produces an easily identifiable pattern for a correctly phased signal, as shown in Figure 2. The other displays represent various out-of-phase conditions.

The third advantage offered by this test signal is a clipped sine wave that can be used to encode specific information about the audio signal itself. The waveform can be used to automatically identify the particular audio signal as left, right, L+R, etc. An example of how the encoded signal would appear is shown in Figure 3. This feature allows an automatic audio router to locate, process, dematrix and assign tape tracks. For example, the four tracks of a 1-inch tape might be identified as left with noise reduction, right with noise reduction, mono natural sound background and an SAP channel.

An automatic router could then detect the test signals and route the left and right channels through the noise-reduction decoders, mix in the background sound and send the SAP second-language program with mixed-in background to the second-language subcarrier exciter. For manual applications, a simple reader, such as the one in Figure 4, could be set up to read each track and provide a display for the operator. An example of switch settings and signal assignments is shown in Table 1.

Another advantage is that the crystal-based test signal has little phase (or time error) distortion and, therefore, can be used to check tape speed and wow and flutter. An automatic speed checker operating in the fast mode can detect the 10kHz signal, using it to read tape speed out to 0.1% (0.01% in the slow mode).

Fifth, the test signal makes stereo tape alignment much easier. As the tape-head azimuth is adjusted, the vectors created by the three tones move around the center of the X–Y scope display. The 100Hz vector moves slowly, and the 10kHz moves quickly. At most tape speeds, it is nearly impossible to have all three vectors in line without having perfect alignment. The photo on page 129 shows a display produced by a properly aligned playback head. Composed of a left and right signal, it clearly indicates not only correct phase, but also correct absolute phase.

The advantage of this technique, compared with the use of a single tone, is obvious. However, its advantage over the use of noise may not be as clear. With in-phase noise, the higher-frequency material may beat with the bias oscillators. The process creates out-of-phase by-products that appear on the scope as "trash" around the center of the display. This trash makes identification of the correct head azimuth much more difficult.

Circuit description

In the circuit schematic, shown in Figure 5, a 10MHz clock oscillator drives a chain of 7490 divide-by-10 counters. All the needed reference frequencies are provided by this time base. The last divider (U7) provides the slow sequence of 10s. A switch selects either the slow (10s) or fast (1s) sweep rates or ground for a hold position.

An additional 7490 (U8) is used along with a series of gates to generate the sequence-gate signals. Four LEDs indicate in which part of the sequence the generator is operating. Series 7400 NAND gates (U11 and U12) route the symmetrical square waves from the time base to the square-wave-to-sine-wave converter.

The MF10 (U13) is a dual switched-capacitor filter configured as a fourth-order chebyshev bandpass filter. A square wave at the desired output frequency enters through dc blocking capacitor C3. As configured here, the MF10 requires a clocking frequency on pins 10 and 11 of 100 times the output frequency. The output signal has about 1% distortion plus noise. The noise is composed primarily of hash from the filter's switching action and contains few harmonics.

Two other designs were examined in an effort to reduce the distortion (or, more accurately, switching noise). The first design relied on three low-pass filters. It required complex switching and level-matching. The other design used three phase-locked oscillators. Although both approaches resulted in distortion-plus-noise values below 0.2%, each required three times as many electronic components and six analog pots. In the interest of the cost-benefit ratio, the dual switched-capacitor filter design was selected.

The sequenced sine wave from MF10 passes through a precision rectifier composed of U14 (a 741) and D9 (a 1N4148). The components remove precisely the negative portion of the wave. Diode D9 is forward-biased by Q3 when the clipper is disabled. This reduces the circuit to a unity-gain stage and allows it to pass an unclipped sine wave "marker."

Baumgartner is chief engineer for KHOW-AM and KSYY-FM, Denver.

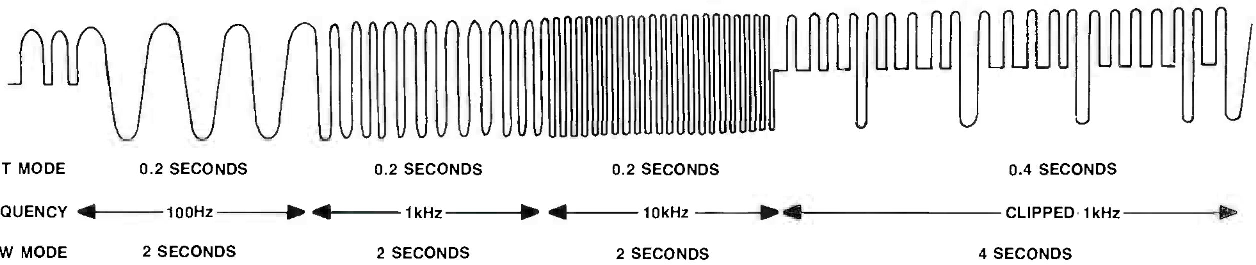


Figure 1. *The repeating test signal sequences from 100Hz to 1kHz to 10kHz. The 4s (or 0.4s) clipped waveform provides a unique identification signal, which is explained in the text.*

During the frequency sweep portion of the cycle, a "high" is sent via steering diode D1 to Q3, which prevents clipping. During the clipped portion of the cycle, bias is removed, and only selected sine waves are allowed to pass unclipped.

Presettable counter U15 uses four DIP switches (SW1) to select the number (0 to 15) of clipped cycles before an unclipped cycle is allowed to pass. The time base clocks the IC at a 1kHz rate, which is synchronized with the output signal. Al-

SW POS. NO.	1248	PURPOSE
0	0000	UNDEFINED
1	1000	L + R/MONO
2	0100	LEFT STEREO
3	1100	RIGHT STEREO
4	0010	L – R MATRIX
5	1010	SAP/2ND LANGUAGE
6	0110	PRO/VOICE INFORMATION
7	1110	TIME CODE
8	0001	SAP W/NOISE REDUCTION
9	1001	MONO NAT. SOUND/BED
10	0101	LEFT NAT. SOUND/BED
11	1101	RIGHT NAT. SOUND/BED
12	0011	L + R W/NOISE REDUCTION
13	0011	LEFT W/NOISE REDUCTION
14	0111	RIGHT W/NOISE REDUCTION
15	1111	DATA (TO FOLLOW) USED TO INDICATE A MORE COMPLICATED SETUP OR INFORMATION TO FOLLOW ON THIS TRACK.

Table 1. *The switches for U15 allow each output stage to generate a unique code, identifiable by scope or other display. The purposes listed are only suggestions and can be tailored as desired by the engineer. However, if a standard were agreed upon, the system would ease interplant tape exchange without forcing a track-by-track standard and its inherent limitations in editing and transport.*

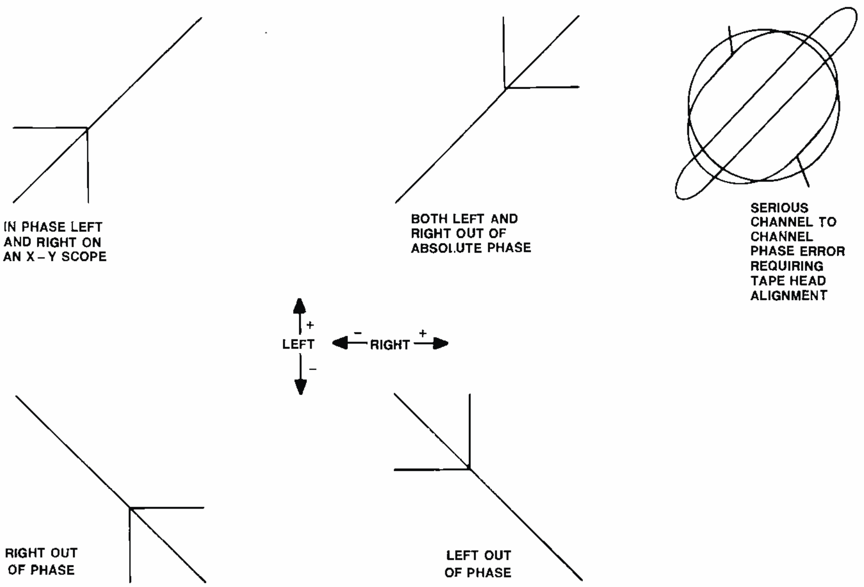


Figure 2. *The test signal provides reliable and identifiable phase displays on an X–Y scope as well as meaningful phase information with only one signal, mono, left or right.*

though not shown, the clear input can be used to ensure that a complete count begins with the start of the clipped portion of the sequence.

Transistor Q3 has a pot on the input to adjust the on/off points of the clipper. Use a scope when making this adjustment. If the control is misadjusted, the clipper either will not clip or clips only a portion of the waveform. A single-turn pot provides adequate adjustment range. Adjusting the clip point to a position below the zero crossing reduces the inherent dc shift. This makes it easier to read the signal on a scope by reducing the trace bounce. The bounce can become especially noticeable after the signal has passed through several ac-coupled stages.

The output stage is a simple differential-to-ground amplifier with a gain of 5. If long lines or low Z loads are anticipated, a "beefier" output section should be used. In this case the routing switcher was allowed to perform this function. A 5kΩ pot adjusts the signal level. Any number of outputs can be developed. Each output section needs a presettable counter, clipper and output stage. Multiple outputs allow the generation of different encoding tags (such as left, right and SAP) while maintaining the necessary phase alignment.

A key element in this design is that minimum phase shifts between outputs are maintained. The circuit uses dc coupling and no analog filtering to generate the signal. The result is a phase-, frequency- and level-stable design. Note that only one output stage is shown in these drawings.

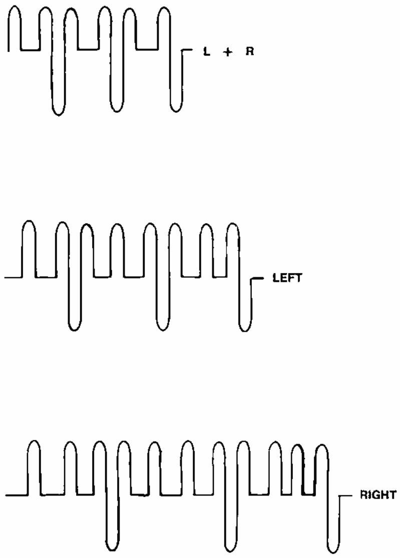


Figure 3. *The clipped sine wave provides encoding for identification or automatic switching or routing.*

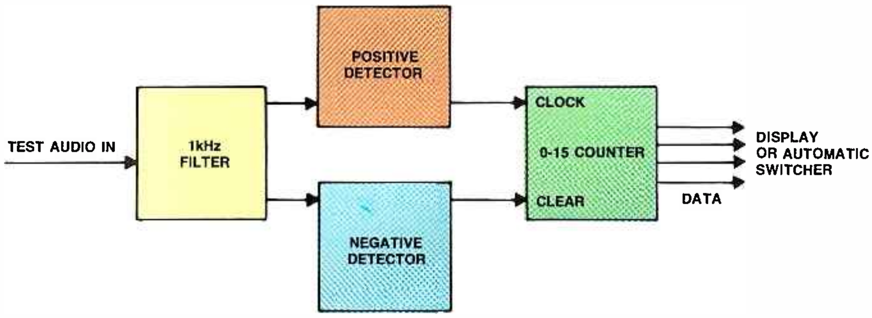
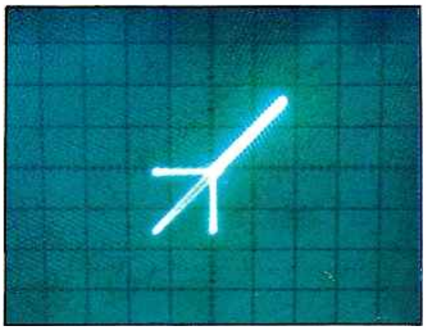


Figure 4. *Conceptual block diagram of a possible reader for the test signal.*

Construction

The components are available at most electronic supply stores (with the exception of the MF10, once sold by Radio Shack and now available at Digi-Key). Preventing



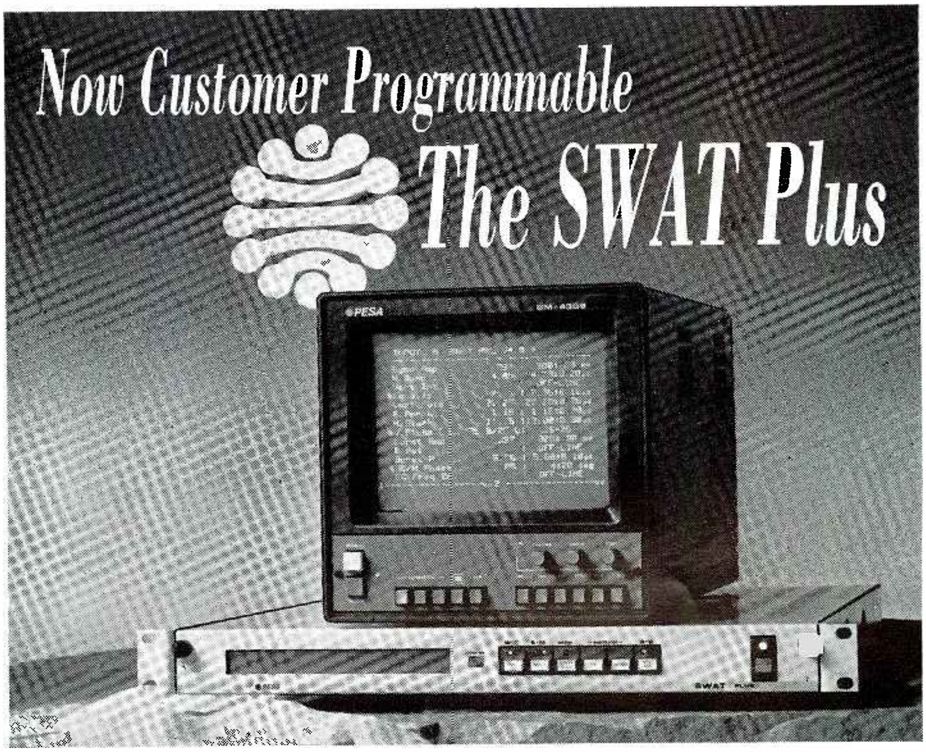
Generator display from a properly aligned playback head.

stray signals from entering the audio via the power supply or interconnecting leads is a critical part of construction.

The power supply is not shown. The circuit requires less than 500mA for the +5Vdc supply, which should be separate from the ±5Vdc, 50mA supply needed for the MF10. The ±15V supply requirements are defined by the number of outputs and their loads.

Applications

The generator can be used on transmission facilities as well as recorded tapes. Such applications would help take the



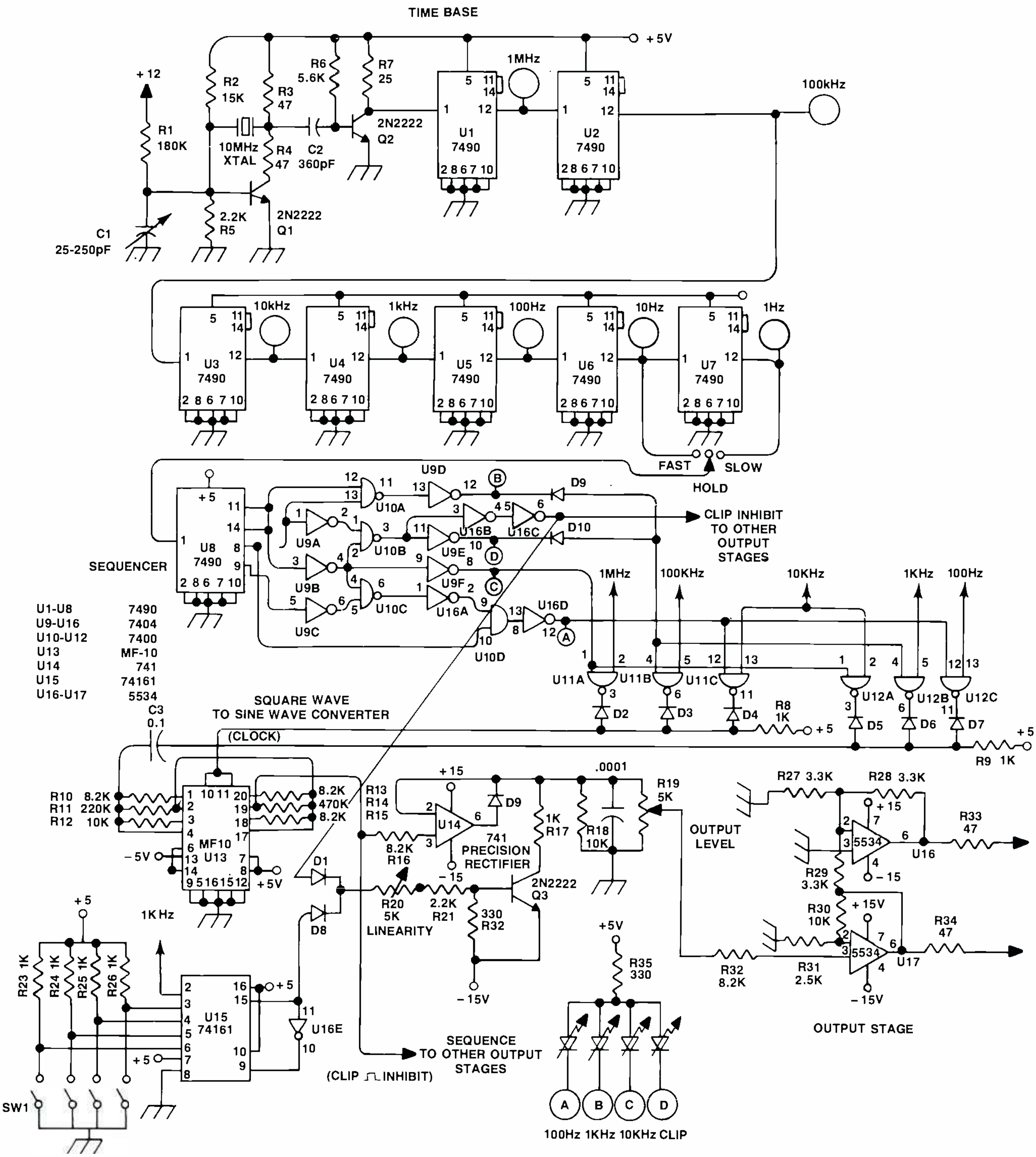


***Figure 5.** Automated test signal schematic.*

guesswork out of channel assignments on satellites as well as storage media. This test signal is to audio what bars are to video. The audio signal provides a convenient reference to adjust reception or playback equipment for adequate operation in a short period of time.

The test signal is not meant to replace the system's test signals or to complete a "proof." If this signal were widely used, it would allow outside tapes with complex audio protocols to be played back correctly with little effort on the part of the playback operator.

Using the test signal could be the first part of a systems approach. An automated reader could adjust levels, equalize, phase align, check tape speed, and route audio to the correct destination. This test signal offers many benefits to a stereo station. For stations transmitting more than two channels of audio (bilingual, SAP), proper identification of each signal is more than a convenience, it's a necessity. This test signal meets this need.

News
Continued from page 4

els needed to generate the satellite primary power. They failed to deploy fully, and despite repeated attempts by the satellite control center in Bavaria to remedy the problem, remedial measures have finally been abandoned.

TV SAT-1 was built by Eurosatellite, a European manufacturing consortium involving the German companies AEG, ANT and MBB, the French Aerospatiale and Alcatel Espace and the Belgian ETCA/ACEC. The company also is building the German TV SAT-2 as well as the French TDF-1 and -2 and the Scandanavian TELEX-X.

The West German authorities, who were relying heavily on DBS for two channels for private television as well as two additional state-run TV broadcast channels, must now turn to other solutions.

First, an intensive campaign to extend the cable coverage of West Germany, begun as an adjunct to the TV SAT-1 launch, will continue.

Second, a re-examination of the availability of conventional terrestrial broadcast channels is already under way. Other European countries have already followed this course, accepting the degradation of existing service that inevitably accompanies increased channel loading as a necessary price to pay for additional outlets.

And finally, there are always other satellites. West German TV SAT-2, already under construction and originally intended as a backup for TV SAT-1, is an obvious high-priority choice, but even with an accelerated construction schedule, won't be ready until sometime in 1990. TV SAT-1's French twin, TDF-1, was originally scheduled for launch in May but has been delayed until October for any lessons that might be learned from the German failure. TDF-1 will have five high-power TV broadcast channels, and although the "footprint" differs somewhat from that of TV SAT-1, it is being considered for the two German non-commercial channels.

Fortunately, the satellite isn't a total loss. There is still enough primary power for various communications transponders needed by the Deutsche Bundespost (German Post Office). But, all of this is still a setback for DBS in Europe.

Conference provides technical forum

The Society of Motion Picture and Television Engineers (SMPTE) has issued a call for papers for the program of the 130th SMPTE Technical Conference and Equipment Exhibit.

The event, which annually provides a forum for discussions and demonstrations on advanced motion-picture and TV technology, will be held Oct. 15 to 19, at the Jacob K. Javits Convention Center in New York City. The theme is "Innovations in Imaging and Sound."

Ed Burns (Eastman Kodak Company), program chairman, is soliciting technical papers from engineers, researchers and executives in the motion-picture, television and allied industries. TV papers will cover video recording, electronic production and post-production, digital systems, image processing, video graphics and special effects, audio, test and measurement, signal routing and distribution, extended- and high-definition television.

Motion-picture papers will cover new films, innovative uses of lighting, applications of computers in the laboratory, techniques for film-to-tape transfers and production and post-production.

In order for papers to be considered for the program, authors must send their name, company affiliation, address, telephone number and a 100-word abstract to SMPTE, Attn: Editorial/Program Coordinator, 595 West Hartsdale Ave., White Plains, New York 10607, by June 15.

Submitted manuscripts will be preprinted and made available for sale at the conference. They also will be considered for publication in the *SMPTE Journal*.

New York is site for SBE convention

The 16th annual Society of Broadcast Engineers regional convention will be held Friday, Sept. 16, at the Sheraton Convention Center in Liverpool, NY, near Syracuse.

For more information, contact John Soergel, convention chairman, at 315-437-5805.

AES presents awards program

The Audio Engineering Society (AES) Educational Foundation has announced the opening of its 1988 educational grant program for university studies with emphasis on audio topics. Awards, for graduate students only, are made annually, and successful applicants may request a 1-time renewal of their grants. Last year, awards were made to students at McGill University, Northwestern University, University of Miami, Georgia Institute of Technology and Brigham Young University.

Additional information and application forms are available from the AES Educational Foundation, 60 East 42nd Street, New York, NY 10165. Applications must be received by June 1.

Goals, committees set for coming year

By Bob Van Buhler

Committee assignments and goals recently announced by new SBE president, Jack McKain, will draw upon the talents of the national board members and past leaders as well as the membership. The members of the executive committee, the "nuts and bolts" group responsible for implementing policies established by the board of directors, were named in last month's column. Members should know who sits on the other committees too, and what the goals of those groups will be for the coming year.

McKain has appointed an executive director search committee. This action supports his goal of hiring a professional executive director and moving the headquarters to Washington, DC. This committee will develop a job description and time frame and complete a study to determine an effective and economical location for the national office in or around the Washington area. The site-selection process, job description and implementation schedule are to be completed by September.

Co-chairing the committee are Glenn Lahman of Westinghouse and Roger Johnson of KOY-AM, both of whom are past presidents. Other committee members include past presidents Bob Flanders and Jim Wulliman and vice president Bob Van Buhler.

Convention-related committees

Several committees are needed to plan the national convention. The professional convention services committee has performed its initial mandate by securing a contract with Eddie Barker Associates, the company selected to manage the 1988 convention. This committee, chaired by Andy Butler, includes Jack McKain and SBE counsel Chris Imlay.

Because the success of the convention is so closely tied to the satisfaction of the exhibitors, the work of the exhibitors committee is vital to the outcome. This committee, composed of members who are involved in the manufacture and sale of broadcast equipment, is working to prevent convention problems for exhibitors and will represent exhibitor viewpoints in regard to future convention dates and locations. The committee is chaired by Jack Williams of Pacific Records. Members include Bill Ammons of CRL, board member David Harry of Potomac Instruments, Chuck Kelly of ITC/3M and Jesse Maxenchs of TFT.

The convention/core committee works in conjunction with the professional convention manager to handle logistics. Chairman Andy Butler and members Sam Caputa, Bob Goza and Don Strauss have years of experience, including the planning of the first two national conventions and the original series of St. Louis regional conventions. Other committee members include treasurer and Denver chapter member Bill Harris, Chris Imlay and David Harry.

Public relations

Two committees are working to disseminate information about the society, both internally and externally. The first of these is the editorial and public relations committee, which produces press releases on SBE activities and viewpoints to the trade and general press. The committee also is working to enhance the visibility and acceptance of SBE within the broadcast industry. Chaired by Bob Van Buhler, the committee includes past secretary Brad Dick, past president Roger Johnson and member Jerry Whitaker.

The chapter liaison committee is responsible for getting the word out to members through the "Short Circuits" newsletter and other means. One goal of the committee is to see that chapter chairmen pass on information to the members. Although they receive extensive information through the chapter chairmen's copies of the newsletters, many chapters never receive the data. Members will be the direct beneficiaries of this effort as chairman Steve Brown, treasurer Richard Farquhar and member Don Hogg work to improve national-to-local-chapter communication.

Membership committees

The fellowship committee, composed of chairman Nile Hunt and past president Ron Arendal, is charged with identifying individuals who have contributed significantly to the society and the broadcast industry. These candidates then are considered for election to the grade of SBE Fellow. The committee develops a suggested list of candidates and presents it to the board of directors. The directors then vote whether to approve each candidate.

The awards committee, co-chaired by board members Tom Weems and Phil Aaland, includes members Brad Dick, Richard Farquhar and Robert Parkhurst. This committee looks for excellence in local chapter work.

The 1988 nominating committee, chaired by Tom Weems, includes Bill Harris, Nile Hunt, Brad Dick and Joe Snelson. The purpose of this committee is to identify from the membership qualified candidates to serve as directors and officers. The committee must ensure that the candidates are not only fully qualified, but also that they understand what is expected from them. In recent years, it has been easier to find qualified candidates to seek election. However, it is prohibitive for some qualified individuals to serve because officers and board members must pay for all their SBE-related expenses. The society does not reimburse officers and board members for travel costs.

Job bank

Some interesting employment opportunities have been listed in the SBE job bank. According to executive secretary Helen Pfeiffer, most of the jobs are in TV engineering. However, some of the listed openings are for positions in major-market radio stations. Even the FCC listed openings with the job bank, advertising several positions at handsome pay levels for the private radio bureau. Check with the national office for more details.

National office expands

Not yet ready to move to Washington, but rapidly running out of space, the national office recently moved up one floor, to Suite 216, 7002 Graham Road, Indianapolis. The old office provided 718 square feet of working space, and the new space provides 1,120 square feet. The additional space was needed for everyday office work as well as for a conference table for visiting officers and directors.

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

Our bold new technology has created a shotgun 55% lighter, 55% hotter, and 28% shorter,* yet with 100% of the sound you need!

Model 4071
Line + Gradient Condenser Microphone
(shown with AT8415 Shock Mount)

Model 4073
Line + Gradient Condenser Microphone

These two new Audio-Technica studio condenser microphones represent a small revolution in shotgun design…inside and out. Meet the Model AT4071 (just 15½" long) and the AT4073 (a mere 9"). They may look like other shotguns (although somewhat shorter than most), but the resemblance stops as soon as you plug them in.

New Coaxial Tube Design

First, both 40-Series microphones perform far "longer" than their actual size. In effect, the ingenious coaxial interference tubes perform as though the microphones were half again as long. Our unique tube design goes far beyond the normal phase cancellation that occurs in a simple resistance-damped tube. There is actually a tube-within-a-tube, creating a separate, acoustically longer path for the lowest frequencies. Low frequency directivity (normally a simple function of tube length) is maintained, yet the microphone size is reduced to a far more practical length.

The Result: Far More Versatile

This shorter length for a given acceptance angle is a practical benefit in the studio and the field. It's easier to avoid shadows and to stay well out of the frame. Cancellation from the back is also impressive, making exact mike placement less critical. And their very light weight (far less than the others) will be appreciated by every user. As a bonus, the nested internal construction makes the 40-Series shotguns unusually resistant to accidental damage.

Clean Transformerless Output

Listen carefully to the 40-Series sound. The transformerless output insures fast, distortion-free response to transients. You'll hear crisp, natural dynamics over an extended frequency range, even under high SPL conditions. Output is extremely high, making the 40-Series hotter than any other shotgun available. A built-in high-pass filter is included, of course.

Quiet in Every Way

The low noise of these new microphones is impressive. Self-noise is almost immeasurable at about 12dB for the AT4071, and just 14dB for the shorter AT4073. Equally important, the rejection of wind and handling noise is outstanding. Coupled with excellent sensitivity, the 40-Series design allows you to take full advantage of the finest digital and analog studio electronics.

Compatible and Competitively Priced

Finally, both can be powered from any 12-48V phantom power supply. They come complete with foam windscreen, stand clamp, and case. Yet, with all their advances and performance superiorities, the new A-T 40-Series microphones are priced competitively with the best known shotguns.

The significant performance advances of these new 40-Series microphones demand a trial in your most difficult environment. Heft them. Hear them. Compare them in every way. This bold new technology has raised the standards for shotgun performance!

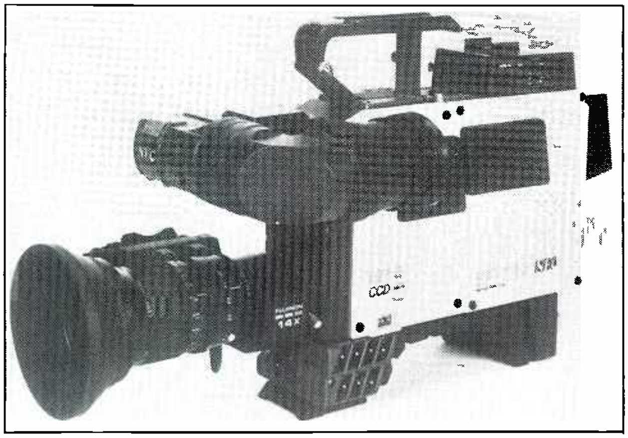
*Model AT4071 compared with Sennheiser MKH816P48-U. For complete shotgun comparison, call or write.

audio-technica.
1221 Commerce Drive, Stow, OH 44224
(216) 686-2600

Circle (89) on Reply Card

High-resolution CCD camera

NEC America has introduced the EP-3 camera, a second-generation high-resolution CCD camera. The camera features horizontal resolution of 700 TV lines; a S/N ratio of 62dB; sensitivity of 2,000 lux at f/5.6; and a built-in electronic shutter with seven selectable speeds for smear-free, dynamic, high-resolution pictures. Microprocessor-based, switchable auto functions provide operators with increased control for testing and setup in field conditions. The 3541 CCD chip employs a high-density array with 380,000 elements. The viewfinder is adjustable horizontally to accommodate left or right eye viewing. It is cabled separately from the camera head. The camera operates in camcorder configurations with Sony BVV-1 or BVV-5 component recorders as well as Panasonic AU-400 component M2 recorders. The camera also provides all the needed features for stand-alone VTRs, multicore EFP, studio and triax configurations.



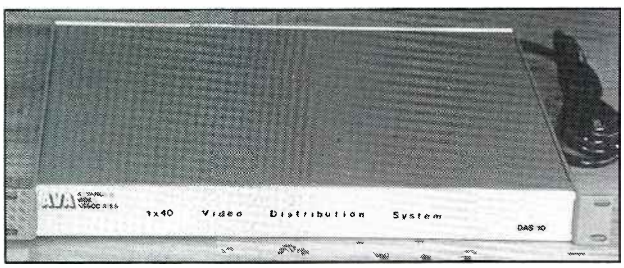
Circle (350) on Reply Card

Automation system

Amek/TAC and *Steinberg* have developed a console fader, mute and switch automation system. The R&D team at Amek has designed the necessary hardware and automation interface and has cooperated with Steinberg on automation techniques and the development of software. The automation system runs on the Atari ST computer and also will be configured for the Apple MacIntosh. Up to 128 faders and 15 switches per channel may be automated. Synchronization is via SMPTE time code. The system is available on the Amek/TAC range of consoles, as well as a retrofit to consoles of other manufacturers, by using Amek interface and hardware.

Circle (351) on Reply Card

Distribution amplifier system

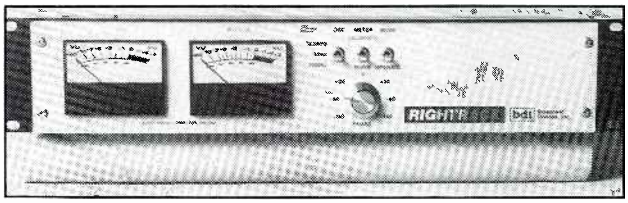


Advanced Video Associates has introduced the DAS-10 distribution amplifier system. The VBB-1 hybrid chip allows an extremely small module to be used, making it possible to package a 1x40 distribution system in a 1¾-inch EIA 19-inch rack-mounted chassis.

Circle (352) on Reply Card

Audio phase corrector

Broadcast Devices has announced the RIGHTRACK APC-200 audio phase corrector. It allows the user to correct audio phase errors in virtually any stereo tape source. Azimuth errors are electronically corrected providing maximum monaural frequency-response performance. The unit can be interfaced with playback media. It also can be interfaced with a standard broadcast audio cartridge recorder to provide phase correction of the individual cartridge as it is being recorded on. The corrector is a manual, user-controlled device. It features an internal oscillator, and metering allows for adjustment and monitoring of the tape system's performance.



Circle (353) on Reply Card

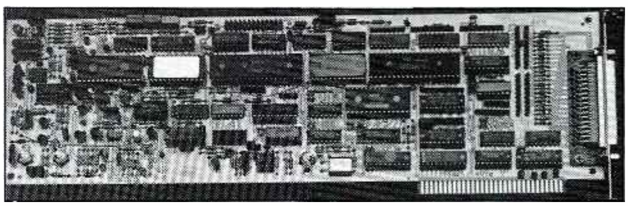
Splatter monitor

Delta Electronics has introduced the Splatter Monitor, which measures out-of-band emissions. A taut-band meter provides visual measurement, a front-panel speaker and headphone jack offer aural confirmation of the meter display. An adjustable remote output also is available. The monitor is frequency-agile, allowing measurements throughout the AM broadcast band. A 12V power input and optional active loop antenna permit field measurements from a vehicle. The precision-synchronous detector allows measurement of both envelope and quadrature information.

Circle (354) on Reply Card

VTR controller

Diaquest has announced the DQ-50P videographics interface for videotape recorders with parallel control ports. The board and software integrates PC-based or host computer 2-D and 3-D graphics systems with videotape recorders for the creation of frame-accurate animation sequences. The controller features on-board SMPTE or EBU time-code generator/reader, and an NTSC or PAL sync generator with full drives and blackburst.

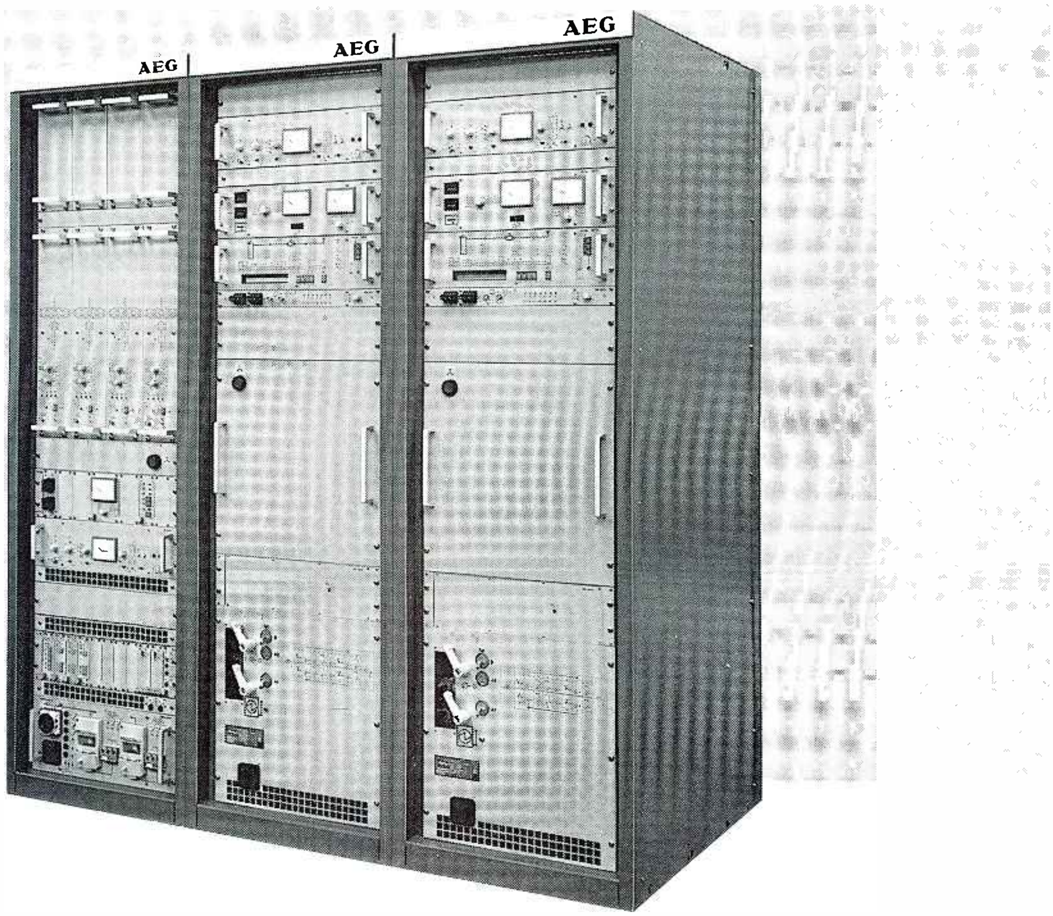


Circle (355) on Reply Card

TBC/synchronizer/digital effects units

CEL Electronics has introduced the P164 series of TBC/synchronizer/digital effects units. They were designed to meet the P147 series, but will meet full 8-bit digital 4:2:2 standard to EBU 601 broadcast specifications.

Circle (356) on Reply Card



Hi-Fi quality with AEG VHF/FM transmitters.

Radio listeners all over the world daily receive broadcasts from VHF/FM transmitters around the clock – thrillers, hit parades, news spots, concerts, sports and a variety of other programs to their entertainment – and this of superior Hi-Fi stereo quality.
For over 60 years AEG has been pacemaker in the development of VHF/FM transmitter-technology. Long standing experience in VHF/FM work has lead to professional equipment with outstanding performance. This established know-how and experience has been to the benefit of national and commercial broadcasters as well as "International Telecommunications Organisations". The fact that AEG has supplied more than 2,000 VHF/FM transmitters worldwide speaks for itself.

Fully solid-state modules with inherent redundancies give the user maintenance-free operation with minimum down-time. Automatic stand-by facilities keep stations on air around the clock.

Consistent to the concept of AEG VHF/FM transmitters supplies light and compact VHF antenna arrays proven to withstand the most adverse weather conditions, too. VHF/FM radio equipment is just one of the many facets of the wide scope of products and services we can furnish to broadcasters.

The information and communications technology of AEG and the office automation technology of Olympia AG have united to form AEG Olympia AG – a new, international sphere of activities for the technology company AEG.

AEG Olympia AG
Sickingenstrasse 20–28
D-1000 Berlin 21
Telephone (030) 3463-0
Telex: 181819
Telefax: (030) 34632419

Please send me further information of VHF/FM transmitters:

Name ______________________

____

Company ______________________

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Address ______________________

____

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AO WAK 4127 E

AEG
OLYMPIA

Circle (104) on Reply Card

Battery pack and replacement battery

Soft pack power source

Energex has introduced the following products:

• The XP13 and XP14 soft packs can be used as a primary power source or as a backup power supply. The design features a Cordura-type bag measuring 6″x4¾″x3″. Standard features include: GE or Sanyo matched capacity cells; high-temperature sensors monitoring all cells; replaceable plug-in fuse (two spare fuses included); extra wide tab stock connections and multiple weld points to minimize IR voltage drops; bonded cells; and secured wiring. Output power is delivered through a 4-pin XLR connector.

• The XP90 replacement battery features GE or Sanyo premium matched capacity cells; high-temperature sensors monitoring all 10 cells; replaceable plug-in fuse (two spare fuses included); extra wide tab stock connections and multiple weld points to minimize IR voltage drops; high-impact, abrasion-resistant ABS case; bonded cells; and secured wiring.

Circle (357) on Reply Card

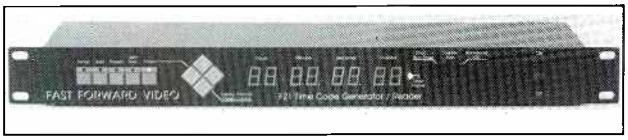
Audio time base corrector

Howe Technologies has introduced the 2300A Phase Chaser, a fourth-generation audio time base corrector. It provides automatic detection and correction of all interchannel time delays in stereo audio program material. The corrector can discriminate between systematic time delay and intentional phase fluctuations. The system features balanced inputs and outputs (XLR connectors), the inputs accept levels from −40dBm to +20dBm, the outputs are nominal 20dBm, and peak at +28dBm. Frequency response is essentially flat: dc to 20kHz, ±1dB. Time-delay error correction is available out to ±150μs, and is functional over the entire dynamic range of >90dB.

Circle (358) on Reply Card

Time-code generator/reader/character inserter

Fast Forward Video has introduced the F21 SMPTE time-code generator/reader series. The unit, when generating, presents time code as an audio signal at the time-code out jack (RCA type), as characters superimposed on the video signal at the video out jack (BNC type) and on the LED display on the front panel. This configuration allows the user to record time code as an audio signal on either channel 1 or 2 of a master tape, and also simultaneously create a work copy with a window dub by running the video out to a second VCR. While in read mode, the unit will read any longitudinal SMPTE time code and display the time code on the outgoing video signal and on the LED display. Two other features include the jam sync and regen modes. The unit also gives a choice of two display sizes and the ability to position the display anywhere on the screen as well as placing it in the vertical interval. The contrast of the display can be adjusted from black on white to white on black or the background can be eliminated altogether. The hours, minutes and seconds positions can all be preset within the SMPTE specification with the exception that the hours position can go all the way to 99.



Circle (359) on Reply Card

Compact zoom lenses

Fujinon has introduced the following zoom lenses:

• The D6X8.5-SND52B has a focal length of 8.5mm to 51mm and an f/1.2 aperture. It has an auto iris with an aperture range from f/1.2 to T64 plus 12Vdc motorized zoom and focus. It also features a neutral density filter on the tip of the iris blade.

• The D6X8.5-MD3 has a focal length of 8.5mm to 51mm with an aperture of f/1.2. All functions are 12Vdc motorized zoom, focus and iris.

• The H6X12.5R-MD3 features 12Vdc motorized zoom, focus and iris. It has a focal length from 12.5mm to 75mm and an f/1.2 aperture.

• The H6X12.5W-SND43 has an auto aperture range from f/1.2 to T400 with a 12Vdc motorized zoom and focus. It has a focal length from 12.5mm to 75mm; and a neutral density filter.

• The H6X12.5R-AMD3 has an auto iris aperture range of f/1.2 to f/16. It has a 12Vdc motorized zoom and focus; and a focal length from 12.5mm to 75mm.

Circle (360) on Reply Card

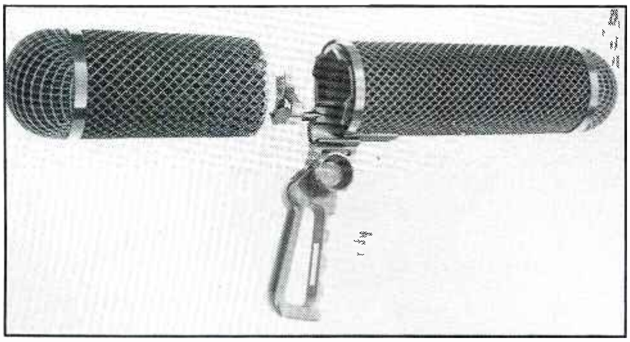
Terminations

JFW Industries has introduced a full line of terminations. Power ratings range from 1W through 300W depending on the model. Connector types include BNC, SMA and type N standard. Frequency ranges include dc-2GHz, dc-8GHz and dc-18GHz.

Circle (361) on Reply Card

Windscreen systems

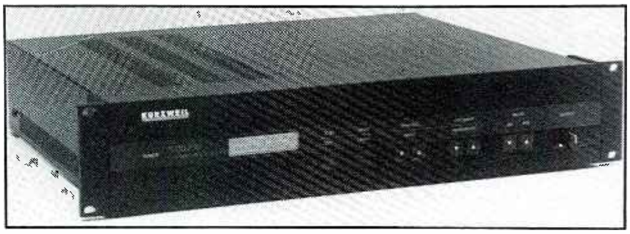
Alan Gordon Enterprises of Hollywood has introduced the Light Wave Zeppelin windscreen systems. The windscreen consists of an anti-rumble shock mount. The screens are lightweight and can be used in boom-mounted, fishpole or handheld situations. The windscreen provides 25dB or more attenuation of unwanted wind noise, and the accessory windsock provides additional noise dampening for high winds. Boom or mount rumble is cancelled by the double-cantilevered suspension system.



Circle (362) on Reply Card

Second-generation series

Kurzweil has introduced the second-generation technology 1000 series. Included in the series are four rack-mounted expanders: the 1000 HX horn expander, 1000 SX string expander, 1000 GX guitar expander and 1000 PX professional expander. Rounding out the series is the K1000 keyboard. Each member of the series can function as a stand-alone product. But users also can combine all four modules to create an 84-voice, 8-output super-system.



Circle (363) on Reply Card

Inserter board

K-Systems has introduced the VO-CGA, a CGA/video inserter board for the PC/XT/AT. It synchronizes (gen-locks) graphics or alphanumerics and inserts into a composite video signal. An on-board color graphics adapter (CGA) generates graphics or alphanumerics using unmodified PC software and BIOS for graphics annotation, which are inserted in black or white over a B&W or color video signal. The unit's gen-locking capability synchronizes the CGA to a video source, which eliminates the need for cameras to lock to the CGA. Using only one bus slot, the unit also can operate in non-gen-lock CGA mode. The output in either mode is a composite video signal to a monitor or VCR. The unit includes a light pen interface and a parallel printer port.

Circle (364) on Reply Card

Real-time event controllers

Leightronix has introduced the following products:

• The TCD-RT real-time event controller features battery backed internal real-time clock, 250 battery backed events, 16 relay/TTL/opto-isolated outputs, 12/24-hour operation, optional 10×1 switcher control with auto take, optional matrix switcher control for salvo or manual assignments, optional PC-based event manager program, serial printer option, LED output status indicators, manual force mode and a fluorescent display.

• The MINI-T real-time event controller features battery backed internal real-time clock, 64 battery backed events, four independent output channels, optional switcher control with auto take, optional internal 5×1 video/audio switcher, optional CG control, random event entry, a 2-line LCD display and manual force mode.

Circle (365) on Reply Card

Camera support systems

Miller Fluid Heads has introduced five camera support systems:

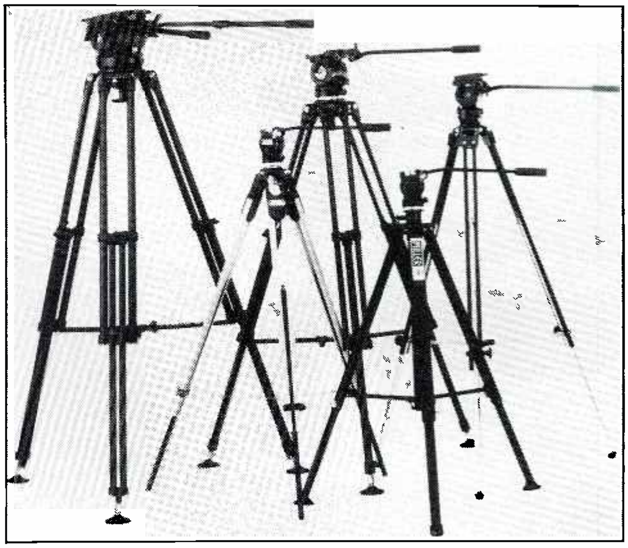
• The System 80 designed for TV field production, accommodates cameras equipped with top-mount monitor, zoom lens, rear controls and prompting systems weighing 80 pounds. It also supports similar weight 16mm and 35mm film cameras.

• The System 20 Special features the company's Featherlite tripod. It handles CCD cameras in ENG configuration.

• The System 40 ENG Special has lighter weight tripod and single, non-telescopic panhandle.

• The System 10A features the company's Junior fluid head in combination with an aluminum tripod.

• The System 10W features the company's Junior fluid head on wooden legs.



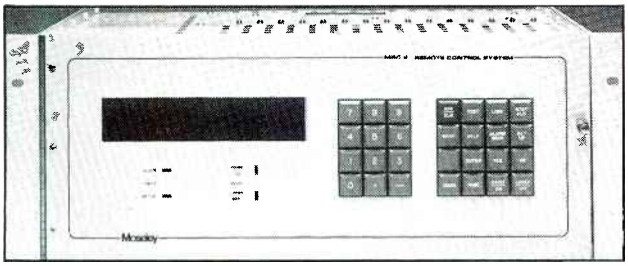
Circle (366) on Reply Card

Voice response option, software update and PC option

Moseley Associates has introduced the following products:

• The MRC-1600 dial access/voice response option that monitors and controls a transmission facility through any DTMF telephone. The DAVR will notify up to nine predetermined phone numbers of any change in status or telemetry data that triggers an alarm. After password acceptance, a digitally-synthesized voice reports the events. Through the DTMF keypad, the user can monitor and control the standard 32 command outputs, 16 status and 16 telemetry inputs. A control lockout feature allows the duty operator at the control point to prevent control from any unauthorized entry. An RS-232 port pro-

vides standard serial interface for PC or modem control.
• Software to give the MRC-2 microprocessor remote-control user instantaneous telemetry updates and eliminate delays. The software is compatible to existing MRC-2 systems.
• The ARS-256 is a digital-quality audio routing/mixing system with a versatile control interface. It uses the RS-232C port for PC control interface to monitor and control the switcher through a menu-driven program. The program allows a user to schedule automatic switching patterns for up to one week. All events are stored for later viewing or printing. The Smart Switcher routes the signal with 100dB SNR, 0.004% THD, and a 0.1dB frequency response for transparent, high-quality sound. Non-volatile preset matrices are standard. The system allows control of up to 256 crosspoints via digital inputs, configured in groups of eight inputs and eight outputs along with 64 crosspoints.

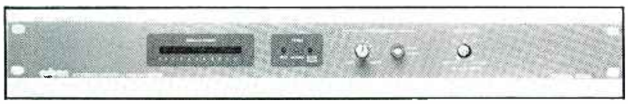


MRC-2 remote-control system

Circle (367) on Reply Card

Stereo spatial enhancer

Orban Associates has announced the model 222A stereo spatial enhancer. The unit can detect and enhance psychoacoustic directional cues that are present in all stereo program material. It operates only on attack transients, and does not increase sensitivity to vertical tracing distortion in disc playback, does not exaggerate reverberation, and does not increase multipath distortion. The system is fully mono-compatible. An enhancement control allows the user to determine the amount of processing that is desired.



Circle (368) on Reply Card

Nicad battery packs

Paco Electronics has introduced the DP-11 line of nicad battery packs. The DP-11 high-power cells enable a 1.9Ah with 0.2C discharge rate, which translates into a 20% longer battery life. It also has a built-in thermal protector, which helps guard against malfunctions or short circuits. The pack is completely rechargeable, with the use of the Paco KD-120A and KD-11 chargers.

Circle (369) on Reply Card

Short-haul microwave communication series

Racon has introduced the Micropass 8000 series of equipment for short-distance, line-of-sight, microwave communication of voice, data and video information. The user can expand the system from one to four T-1 lines as required. Features include a typical system gain of 169dB; modular construction that allows upgrading to 4T1-6.32Mbps; and a choice of 1-, 2- or 4-foot antennas. The high-performance radio is designed for operation in the 21.2GHz to 23.6GHz frequency band, both common carrier and private radio portions, and is engineered for future expansion capabilities. The series' one or two foot antennas and electronics are incorporated in a lightweight, weatherproof package. Additional features include full duplex operation and elimination of waveguides and multiple interfaces.

Circle (370) on Reply Card

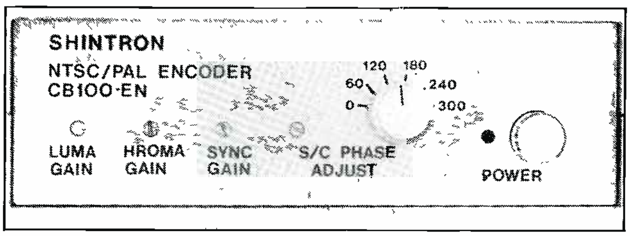
Grounding kit module

PolyPhaser has introduced the PolyRod chemical ground rod that has been expanded into a grounding kit module. It allows electrolyte to be dispersed along 25 feet of interconnecting copper tubing between PolyRods. This gives faster surge dissipation by having less inductance and resistance. Modules can interconnect up to three other modules to form a completely tailored ground system for equipment vaults and towers. An external water source may be attached. Modules are available for no soil, minimal soil or more than eight feet of soil.

Circle (371) on Reply Card

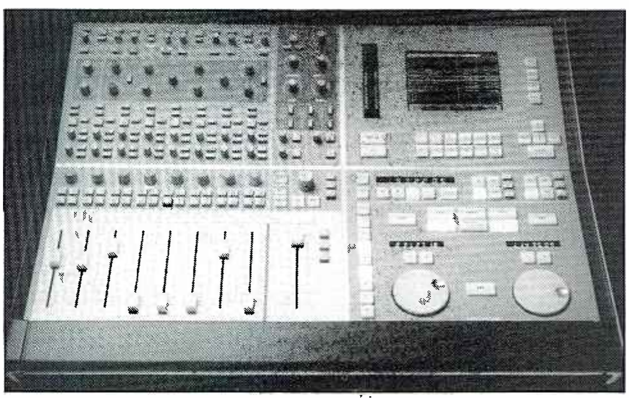
NTSC/PAL encoder

Shintron has announced the model CB100-EN, NTSC/PAL encoder. The encoder requires system color black only to encode an RGB signal into NTSC or PAL. An internal jumper is provided to generate rerun subcarrier. The encoder gen-locks to incoming computer-generated sync and generates its own subcarrier. The encoder also is capable of removing sync when it is superimposed on the green channel. The encoder is equipped with RGB loop-through inputs, two encoded video outputs, loop-through color black input and loop-through pulse input. The front-panel adjustments are coarse and fine phase delay of subcarrier, chroma and luma levels. The oscillator is within ±5Hz of the respective subcarrier.



Circle (372) on Reply Card

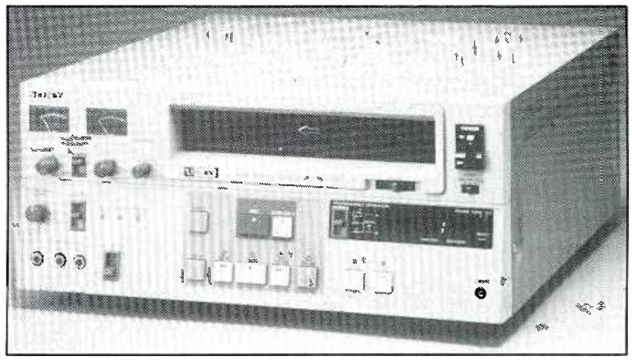
Digital console



Solid State Logic has announced the 01 digital production center. It combines signal processing, storage, mixing and editing functions in a single compact system. It comes with an 8-channel mixer, three stereo tape machines, synchronizer and edit controller, time-code reader/generator, analog-to-digital converters, a sampling rate converter and sync generator. It is possible to take analog or digital inputs, add equalization, compression and expansion, record and edit, combine them with existing sound files, and output the results—all within the digital domain. Integration removes the need for D to A and A to D conversion within the system, so the original sound fidelity is preserved.

Circle (373) on Reply Card

U-matic series and color video monitor



VO-7600 videocassette recorder

Sony Communications Products Company has introduced the following products:

- Two new models in the Type VII include the VO-7600 (NTSC) and VO-7630 (Trident). An improvement of smear in the luminance signal is achieved by automatic smear compensation circuitry. It is possible to achieve color pictures at five times the normal speed in both the forward and reverse directions using the picture search mode. When the frame code/CTL switch is set to frame code, the information appears on the real-time LED display that goes up to ±99 minutes and 59 seconds. Additional features include a self-diagnostics function that improves equipment serviceability.
- The PVM-1390 video/RGB 13-inch color video monitor is equipped with a fine pitch Trinitron CRT. Its high-resolution capabilities of 450 TV lines (video) and 2,000 characters (RGB) (80 characters x 25 lines) enable the monitor to serve as a computer display. A built-in speaker assures sound-monitoring capability along with high-quality pictures. An S video connector makes it possible for separate luminance/chrominance video signals to be fed to the monitor. The monitor has two video inputs (BNC, 8-pin/S video) and a computer input (D-sub 25-pin). The monitor also is equipped with two audio inputs for connection to a phonograph or other audio source

Circle (374) on Reply Card

Recording and broadcast equipment

Valley International has announced the Micro FX line:

- The Micro FX compressor is a single-channel device that adds gain to signals below its threshold setting and decreases gain for signals above the threshold setting. It features an automatic expander that tracks the compressor control settings and acts to remove unwanted noise in the absence of compression.
- The Micro FX noise gate is a single-channel device to turn off or greatly attenuate an audio signal when the level falls below the user-adjustable threshold. It also offers an adjustable hold control that allows the attenuation action of the noise gate

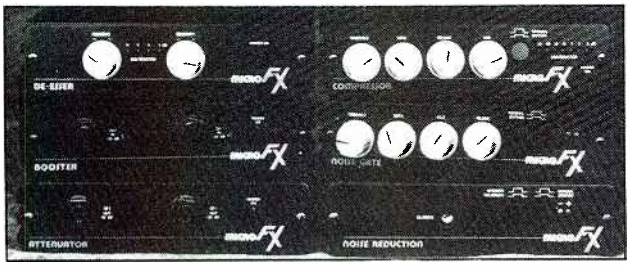
to be postponed.

• The Micro FX de-esser is a single-channel device to reduce excessive sibilance in voice and vocal material. It features a front-panel LED gain-reduction display that offers confirmation of the de-essing action.

• The Micro FX noise-reduction unit is a single-channel, single-ended device that removes unwanted noise from audio signals. Up to 30dB of noise reduction may be attained with any source without previous encoding of the signal.

• The Micro FX booster is a stereo device capable of accepting either −10dB or −20dB unbalanced signal level inputs and amplifying, impedance-matching, and balancing them, to ensure interface with equipment requiring +4dB or +8dB input levels. It also may be used as two independent mono channels.

• The Micro FX attenuator is a stereo device capable of attenuating +4dB operating levels to −10dB or −20dB operating levels. It also may be used as two independent mono channels.

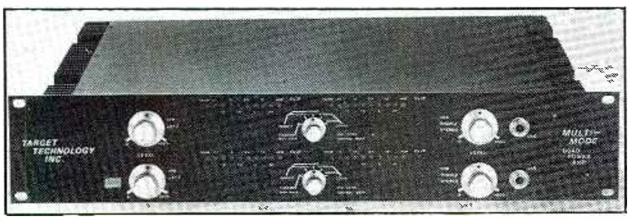


Micro FX noise-reduction unit

Circle (375) on Reply Card

Audio power amplifiers

Target Technology has introduced the TTQ-400, a four, 40W RMS (8) amplifier using four 150W LM12 power op-amps. Each amplifier has a voltage-controlled gain stage that permits remote control of level either individually or in parallel. LED power monitoring on the front panel indicates the actual RMS power being delivered to the load.



Circle (376) on Reply Card

CCD camera

Thomson Video Equipment has introduced the TTV 1640 3-CCD camera. It features sensitivity giving full output level at lighting levels down to less than 15 lux. The camera is microprocessor-based; more color balance settings can be stored, and these settings automatically change with filter selection. Alphanumeric messages are displayed in the viewfinder image. The level of message detail is selectable, and a time-out feature is built-in to accommodate individual preferences.

Circle (377) on Reply Card

Component dissolve option

Videomedia has introduced a component dissolve option for the MICKEY II editing system. It allows the user to perform A/B rolls with dissolve in either S-VHS, Betacam or M-II component formats. Type of component must be specified at time

Circle (94) on Reply Card

of order. MIX-S denotes S-VHS, MIX-B denotes Betacam, MIX-M denotes M-II.

Circle (378) on Reply Card

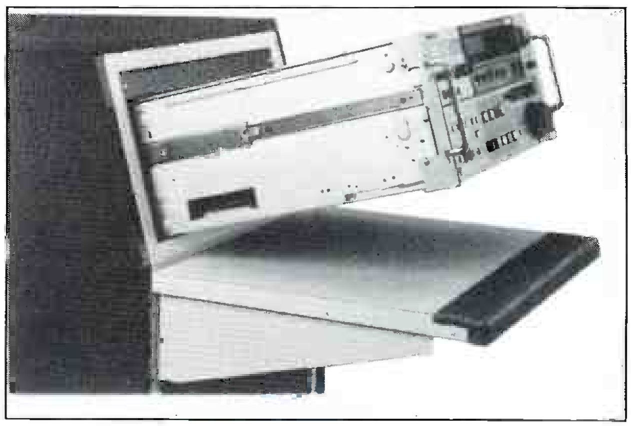
On-air radio console

Wheatstone has introduced the A-20 on-air radio console. It is available in a 10-input console with module construction. Available modules include mono/mic, stereo line, control room, studio and full-function machine modules. Other features include program and audition meters, digital timer, remote starts and external input controls.

Circle (379) on Reply Card

Rack slide kits

The Winsted Corporation has announced rack slide kits for Sony BVU-950 VCRs. The kits attach to the BVU-950 for mounting in a Winsted 19-inch EIA rack cabinet. Full-extension ball bearing slides have positive lock at full extension for easy service and maintenance.



Circle (380) on Reply Card

Stereo power amplifier

Electro-Voice has introduced the 7300 stereo power amplifier. It delivers 300W into 4Ω and 200W into 8Ω over the full audio bandwidth. In the mono bridge mode—activated by a mode switch on the back of the unit—the amplifier delivers 600W into 8Ω. The amplifier features a steel chassis, 16 metal output transistors and heat sinks.

Circle (381) on Reply Card

Frequency counters and ac/dc probe

Simpson Electric has introduced the following products:

- The 1GHz model 9810 and 100MHz model 9800 multifunction frequency counters provide period measurement, period average and totalize functions. Both frequency counters feature a large 8-digit LED display with annunciators. All inputs and functions are front-panel mounted. The 9800 counter has a 10Hz to 100MHz range. The 9810 has a 10Hz to 1GHz range.

• The model 159 ac/dc clamp-on current probe extends the range and capabilities of a VOM or DMM in power and control circuit measurements. The design allows access to cables mounted in almost any position and the circuit under test does not have to be broken. Features include 0.1A to 500A ac or dc measurement range; dc to 440Hz frequency range; autoranging; and maximum operating voltage of 660Vrms. It can be used with digital or analog meters and has a maximum jaw opening of 1.3 inches.

Circle (382) on Reply Card

Gated compressor

Ashly Audio has introduced the model CG-85 gated limiter compressor. It features a detector section that incorporates gated release. An internal gate monitors the audio signal and interrupts changes in gain during periods of silence. The compressor distinguishes between actual changes in program level and the absence of program (pauses). During such a pause, the compressor locks the gain at its current level and waits for the next audio signal before deciding whether to increase or decrease gain. The compressor's controls include input gain, attack threshold, ratio, attack time, release threshold, release time and output level. The gated release function is switchable, as is overall gain reduction. Metering is comprehensive, including a 20-segment gain-reduction meter and an 11-segment level meter. The unit is housed in a steel chassis, which occupies a single rack space.

Circle (383) on Reply Card

Computerized teleprompting system

Dreamdata has announced the INTELLIPROMPTER II, a computerized teleprompting system. It is based on the IBM PC/MS-DOS computer system and will run on all IBM compatibles. The system will replace the Atari-based Compu=Prompt system. The system features pull-down menus; context sensitive help; full-function text editor; built-in macro capability; style sheets (16 color combinations); multiple fonts; and 6-function, programmable hand controller with a slide-pot for bidirectional scrolling.

Circle (384) on Reply Card

Adjustable mixer stand

Solid Support Industries has introduced the AM-10 adjustable mixer stand to fit all mid-size mixing consoles. The stand conforms to mixers ranging in size from 27 inches to 47 inches wide and holds up to 250 pounds. Two crossbars use allen wrench-type screws. The console is cradled by 2-inch lips to prevent slipping and is ergonomically set at 26½ inches high. The unit features four casters (two locking).

Circle (385) on Reply Card

Equalized video delay lines

Broadcast Video Systems has announced the MSD series of boxed, equalized video delay lines from BAL Components. The series is available in two versions: 10-167ns and 10-327ns in 2ns steps plus fine trim. They may be freestanding or mounted in a 3½-inch rack frame that will hold up to 19 boxes.

Circle (386) on Reply Card

Circle (95) on Reply Card

Circle (97) on Reply Card

AMS-USA opens distribution office

A distribution and support office for the entire range of AMS and Calrec products has been opened in the United States. The office will supply AMS and Calrec reps and dealers across the United States and become the service center for everything from AMS audio processors and the Audiofile to Calrec consoles and the Soundfield microphone.

CMX introduces bulletin board service

CMX, Los Gatos, CA, has announced the multi-user Bulletin Board Service (BBS). The service provides free support to users of post-production editing systems. In addition to electronic mail, post-production conferences are available for TV engineers, TV editors, audio editors, film editors and members of the CMX Editor's Advisory Panel.

Upload to download of public domain software is available in IBM, Apple II and Apple Macintosh formats. CMX product information, CMX operations and maintenance class schedules, as well as current CMX software/firmware lists also are scheduled to be added to the BBS.

The BBS is accessible at 408-988-4398 at 300/1200/2400 baud 8-N-1. Call CMX Technical Support at 408-988-2000 for more information.

Aston begins manufacturing in U.S.

Aston Electronics, Surrey England, has manufacturing facilities in Olathe, KS. The 5,000-square-foot facility includes a complete spares inventory including electronic components, hardware and frames. The products produced in the Kansas City plant will be identical to the products produced in Surrey. The plant manufactures and ships the Aston 4 character generator. Several new products are scheduled for this spring.

Intergroup Video Systems changes name

Intergroup Video Systems, Gainesville, FL, has changed its name to *Intergroup Technologies*. The focus of Intergroup will continue to be in the Broadcast Products Group. The Video Products Group will continue to market Intergroup products such as the 9300 and 9400 series switchers, 8000 master control and 1100 routing switchers.

Microtime renames graphics system

Microtime, Bloomfield, CT, has renamed its 3-D graphics and animation system as the ImagePlus. The name change reflects the advancements in hardware and software capabilities in the system since Microtime assumed responsibility for development, manufacturing and marketing of the product line under the original names Ani-Maker and Image-Maker.

Richardson Electronics moves to larger facility

Richardson Electronics, Canada, a subsidiary of Richardson Electronics, LaFox, IL, has moved to a larger facility in Brampton, Ontario, Canada. The address is: 4 Baker Road Unit 2, Brampton, Ontario L6T 4E3 Canada; telephone 416-458-5333; 1-800-387-2280.

New company forms

Peter Hughes, founder and former president of HEDCO, has established *Target Technology* in Penn Valley, CA. The initial equipment offering will include audio power amplifiers featuring remote level control capability.

LEE Colortran forms new division

LEE Filters has been incorporated as a division of LEE Colortran International, Burbank, CA, the manufacturing and distribution arm of LEE International. LEE Colortran will distribute LEE filters in North and South America.

Austrian TV service switches to Panasonic M-II

The ORF, the Austrian state TV service, is the first European network to install the M-II format system from *Panasonic Broadcast Systems*, Secaucus, NJ. Over the next three years, it will replace its U-matic 1-inch equipment with the ½-inch format. The order, announced by Panasonic Broadcast Europe, includes 220 pieces of M-II equipment.

GE Support Services handles parts/service

Ongoing support of RCA Broadcast Systems equipment has been transferred to *GE Support Services* in Mt. Laurel, NJ. Since the 1985 phase-out of manufacturing/marketing of the equipment, spare parts had been available from the RCA distributor and special products division in Deptford, NJ.

Scientific-Atlanta sells studio products line

Scientific-Atlanta, Atlanta, has sold the studio products line of its Digital Video Systems subsidiary to a new company formed by John Fazackerley, a former sales and marketing manager for the Atlanta-based studio products line. Fazackerley's new Ontario-based company, Digital Processing Systems, will continue to manufacture and market the present studio products line, plus new products it plans to introduce.

Cubicomp completes final purchase of Vertigo

Cubicomp, Hayward, CA, has completed its acquisition of the assets and technologies of Vertigo Systems International, a manufacturer of high-performance 3-D computer animations systems located in Vancouver, British Columbia. The consolidated company, operating under the Cubicomp banner, offers a complete range of 3-D animation graphics systems.

Cubicomp also has instituted the PicturePartners directory, a service to benefit users of its PictureMaker 3-D computer graphics/animation and ModelMaker solid modeling systems. Designed to facilitate the integration of third-party software programs into the company's installed user base, the PicturePartners directory lists a range of software programs that extend the utility of PictureMaker and ModelMaker systems. All software programs listed in the directory were written and are manufactured by Cubicomp customers. The PicturePartners directory contains descriptions of third-party programs that benefit the line of the company's 3-D graphics systems, including all members of the PictureMaker and ModelMaker families. Programs available in the PicturePartners directory include utilities for extending PictureMaker's special effects capabilities, adding modeling options, providing advanced motion control, and supporting advanced imaging and color control for slide making.

GE American Communications offers free antennas to TV stations

GE American Communications and Cycle Sat Satellite Couriers has announced a program to distribute up to 100 free antennas and receivers to TV stations that have agreed to receive programming from Cycle Sat via GE's Satcom K-2 satellite.

In a separate program, NBC equipped its network affiliates with Ku-band equipment to receive network programming via Satcom K-2 as well as for satellite newsgathering. Occasional users of Satcom K-2 include CBS and ABC.

People

Donald C. McCroskey, consulting editor for **Broadcast Engineering** magazine, has a held a number of jobs in radio. He joined the American Broadcasting Company (ABC) (radio) in 1948, and transferred to television in 1949. He manned various studio and field positions until 1953 and then moved into network master control. In 1957, he became transmission engineer for the West Coast TV network. He was appointed supervisor of engineering maintenance in 1960.

He is a member and Fellow of SMPTE. He also is a 32-year member of the Audio Engineering Society and member of the IEEE.

He retired from ABC in 1985 as editorial director of television. He continues to be active in professional society activities and conferences, in addition to doing part-time consulting work.

Andre J. Leysen, immediate past chairman of Agfa-Gevaert, Ridgefield Park, NJ, has been named to the supervisory board of Bayer AG, Leverkusen, West Germany. He also is chairman of the supervisory board of the Agfa-Gevaert Group, and chairman of Gevaert N.V., Antwerp, Belgium. **Johan Bisschops** is chairman of Agfa Gevaert.

Philip M. Ritti has been promoted from director of marketing to the newly created position of general manager, audio and videotape at Ampex Magnetic Tape Division, Redwood City, CA. He is responsible for supervising the development of the division's present and future audio and videotape product lines. He also maintains directorial responsibility for the division's marketing and marketing communications support programs. **Greg Emery** assumes the newly created post of product marketing manager. He will assist the coordination of all marketing programs.

Michael Brunsky has been appointed to a national sales position with Aston Electronics, Olathe, KS. He is responsible for development of formal proposals and telemarketing programs targeting the broadcast industrial facilities across the United States.

Paul F. Wagschal and **Terry A. Edwards** have been appointed to positions with Cubicomp, Hayward, CA. Wagschal is corporate vice president. He also will function as vice president and general manager of Cubicomp Canada. Edwards is international sales manager. He is responsible for managing the company's international distribution network using dealers and distributors worldwide.

Robert A. Switzer has been named national sales manager for EECO/Convergence, Santa Ana, CA. He is responsible for supervising sales development and support for all national marketing of the company's post-production editing systems and videodisc products.

Gary Carter has been appointed national sales manager with For-A, Newton, MA. He will be based at the company's headquarters in Newton.

Norman Blake has been named manager of marketing and new product development for the industrial/commercial section of GTE's U.S. Lighting Division, Danvers, MA. He is responsible for marketing programs involving new products and targeted audiences.

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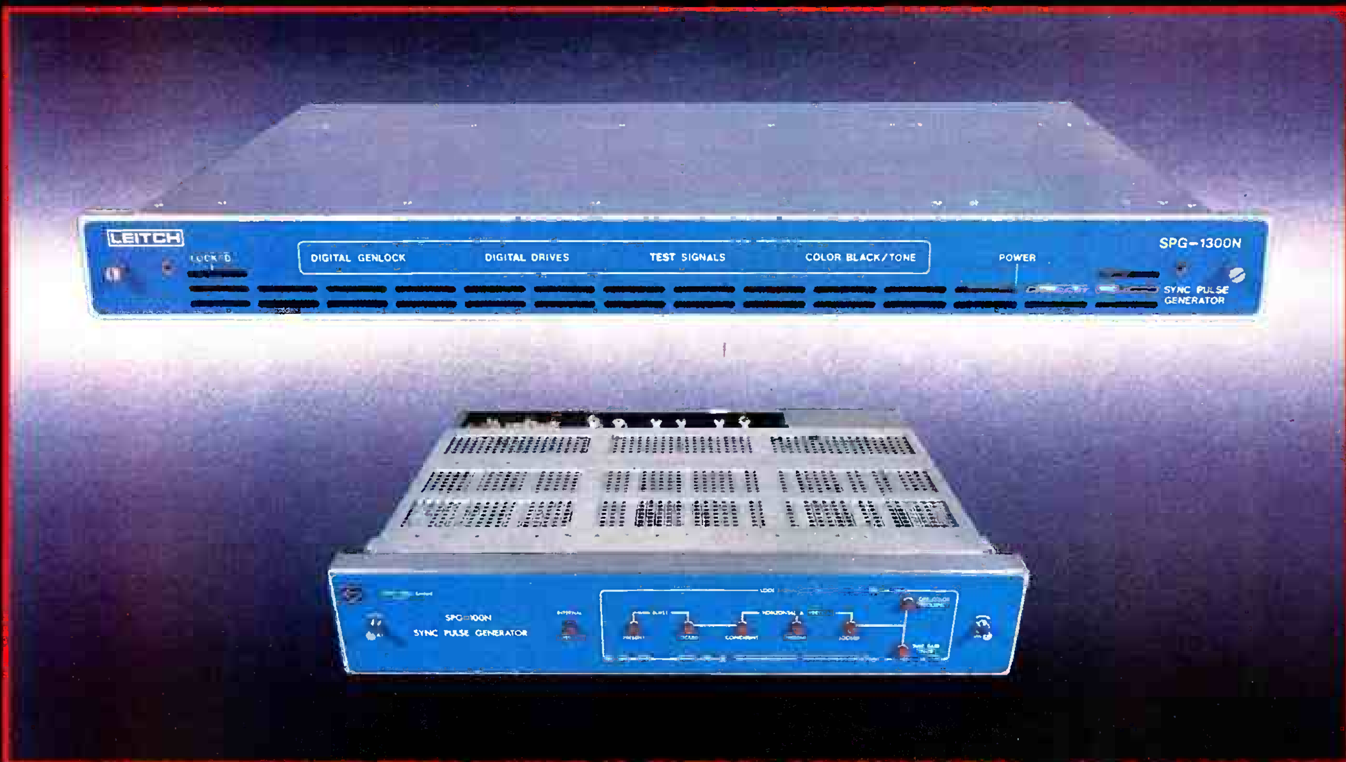

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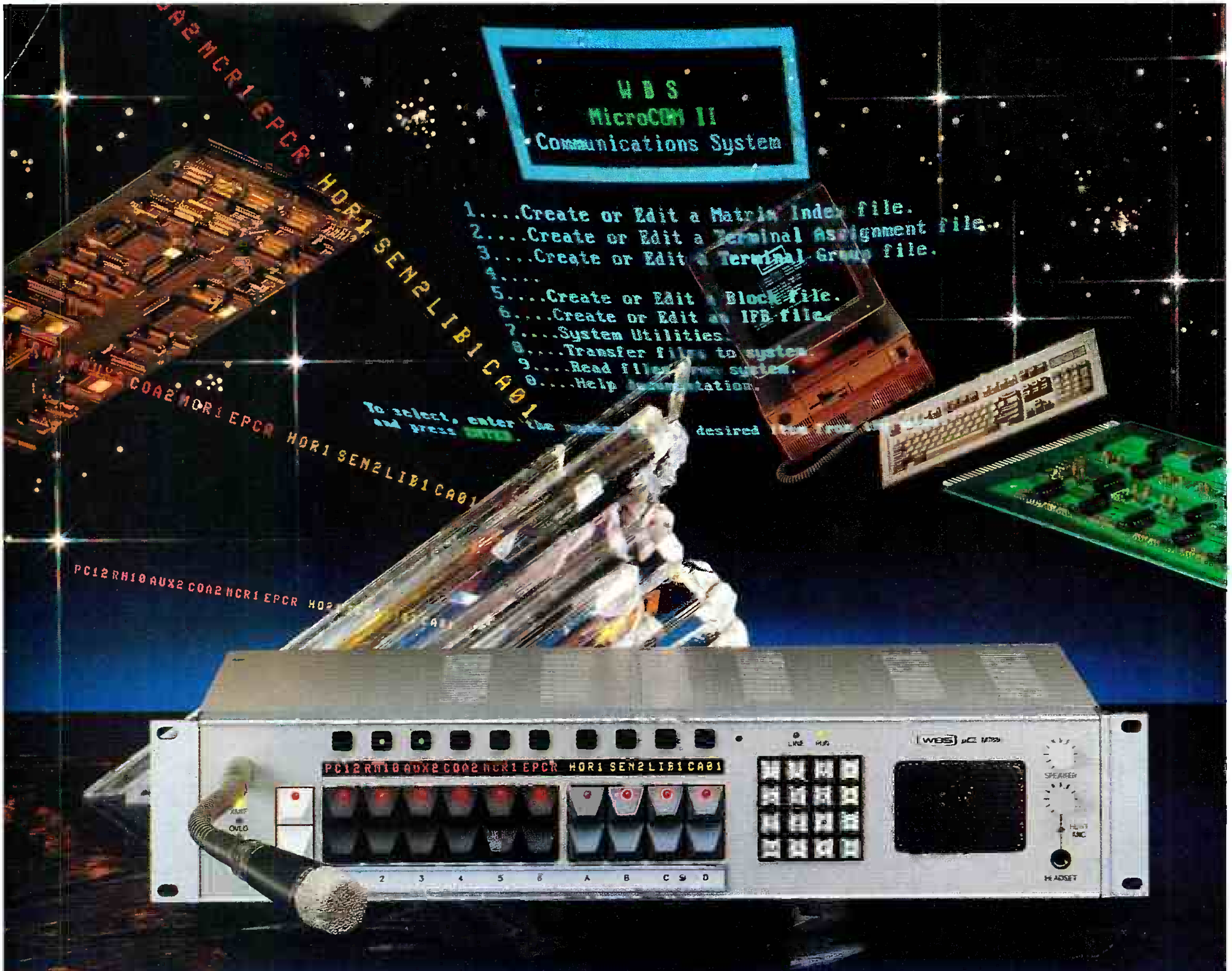

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