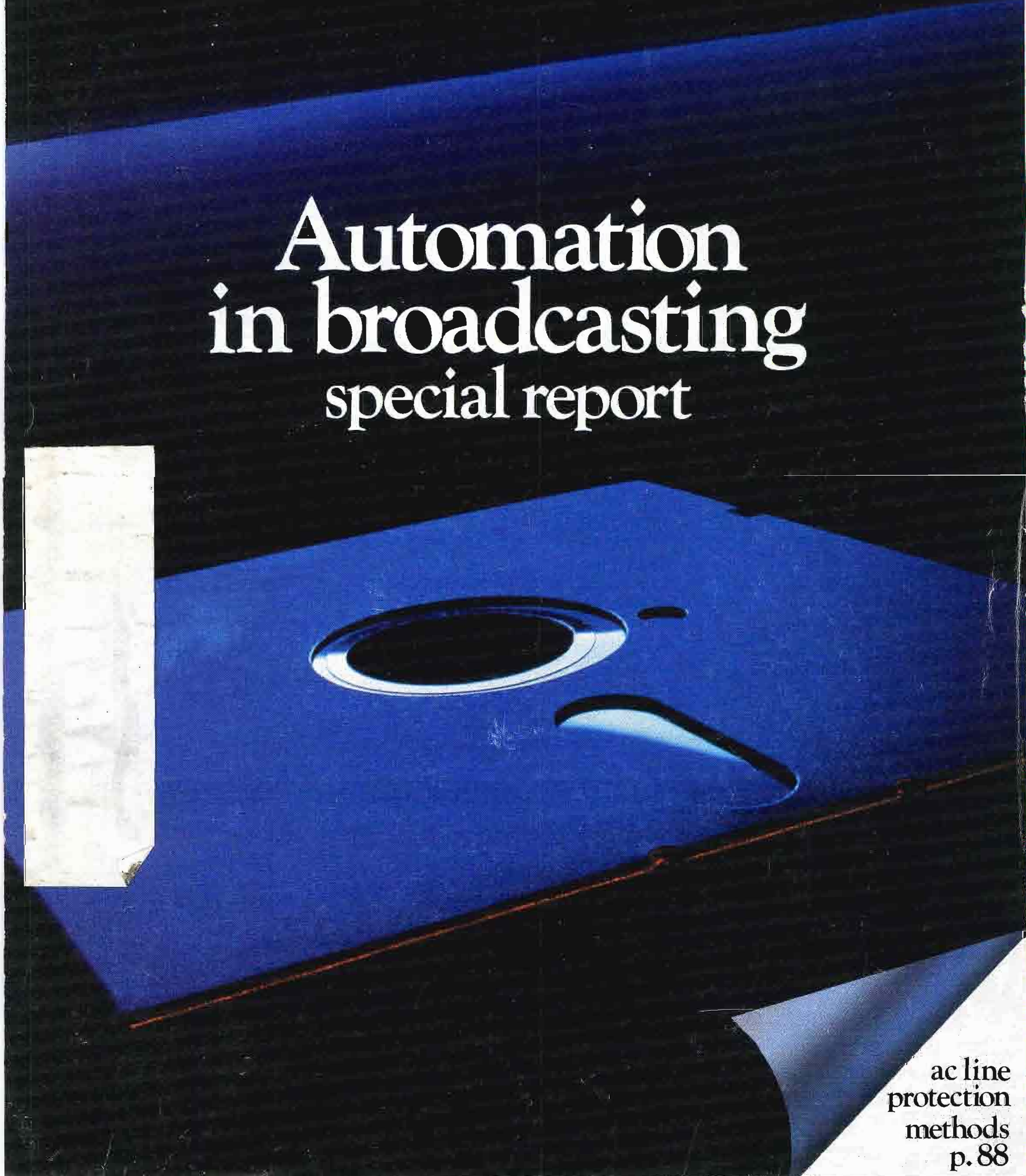
# BROADCAST ENGINEERING®

April 1987/$3

# Automation in broadcasting
## special report



ac line protection methods
p. 88

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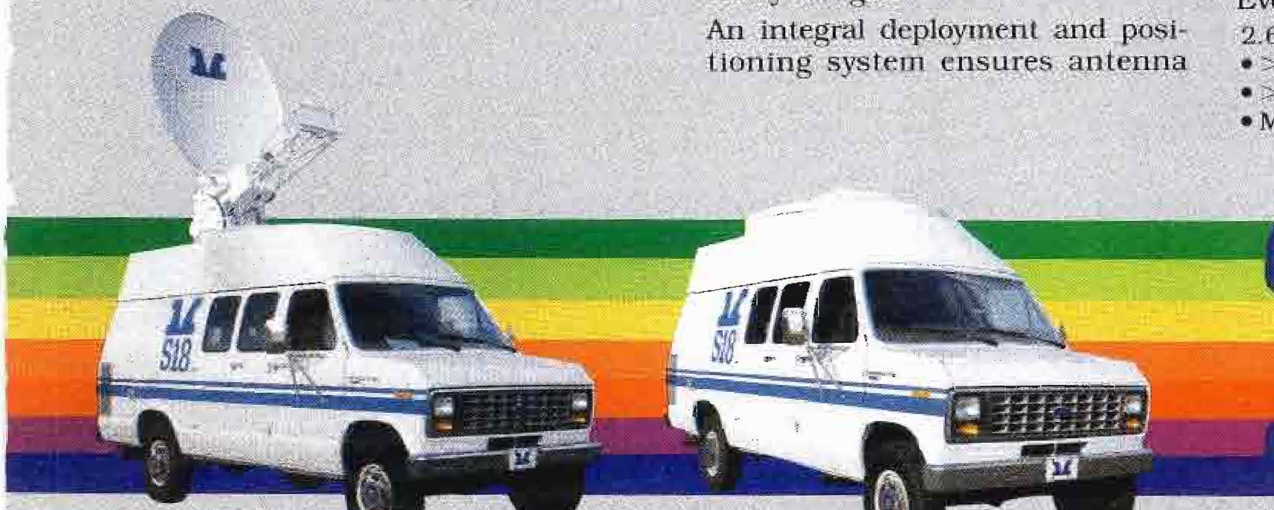


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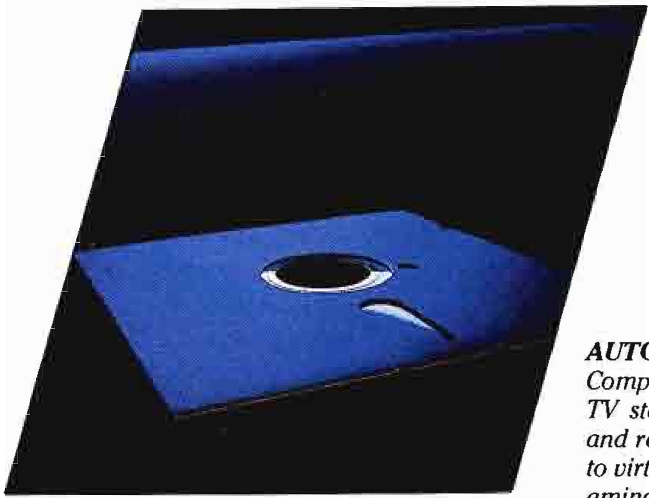

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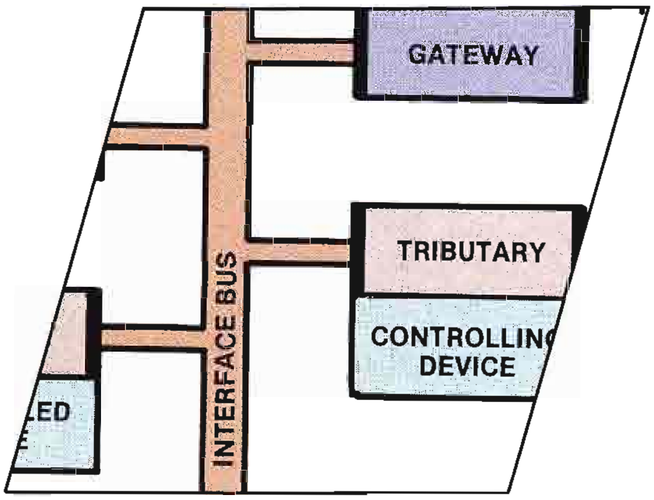
BROADCAST engineering

***AUTOMATION IN BROADCASTING:***
*Computers are changing the day-to-day operation of radio and TV stations across the country. Advancements in technology and reductions in cost have brought the power of the computer to virtually every area of a broadcast facility. This month we examine the computerization of broadcasting in four detailed reports.*



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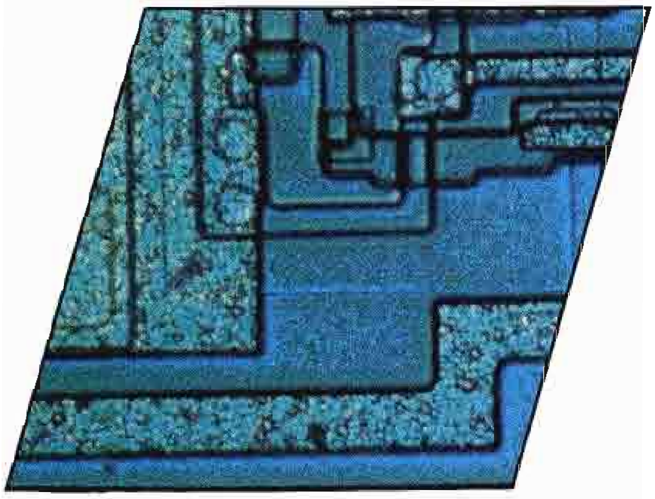

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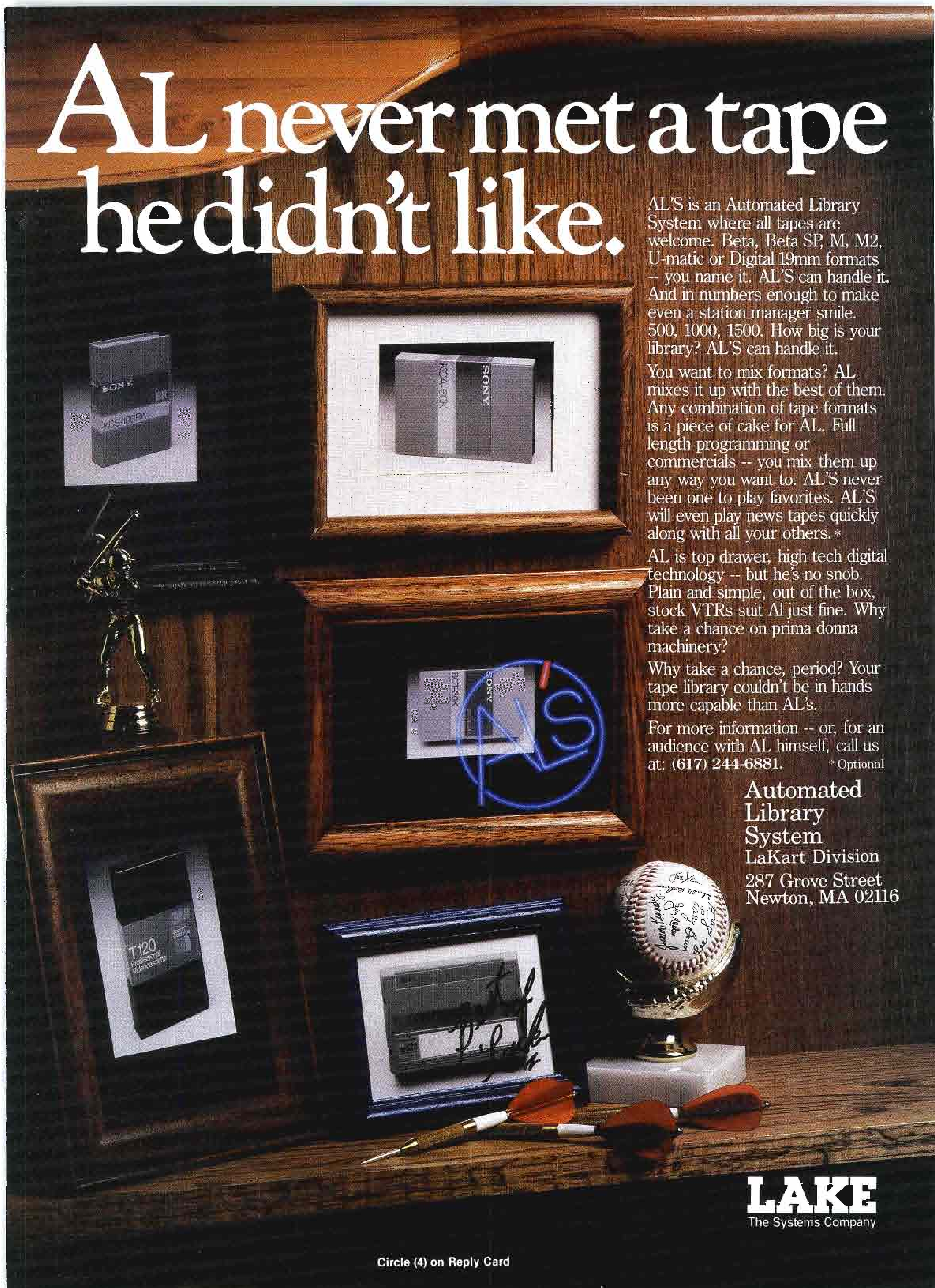
**ON THE COVER**
The primary benefit of automation is easy and efficient interchange of information. The floppy disk has, more than any other single medium, provided the means for moving data from one computer to another. Our cover this month illustrates the advancing pace of computerization in broadcasting. (Photo courtesy of DuPont Company, Wilmington, DE.)

**DEPARTMENTS**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## SBE group views Klystrode transmitter

A history-making event took place at Comark, Southwick, MA, on Feb. 12. The first public demonstration of an operating Klystrode TV transmitter was performed for the benefit of members from the Connecticut Valley SBE Chapter 14. This marked the first time an operating Klystrode was viewed and examined by members of the broadcast industry.

The transmitter model, CTT-U-60SK, was operating at more than 60kW peak output power while meeting all broadcast linearity requirements.

The advantage of the Klystrode over the klystron tube is its Class B mode of operation. This mode automatically modulates the beam power required by the tube as a function of RF drive. The 60kW Klystrode final amplifier operated during the demonstration required only 52kW of beam power to deliver 60kW peak RF output at 50% APL.

There were more than 30 attendees at the first public Klystrode demonstration including non-SBE members.

Comark held operating demonstrations of the transmitter at the NAB show.

## ABC Radio tests data system

ABC Radio Network has begun testing a digital, satellite-delivered data system. It is the first major radio network to use a high-speed, digital data delivery system for its affiliates.

Instantaneous data communications to affiliates will permit easier access to the audio services delivered across the network's 19 15kHz audio channels. The network also will be able to develop new products using data that will help affiliates to program their stations.

The system will be able to address each affiliate individually and also will be able to feed information simultaneously to the line-up.

The test of the satellite-delivered data service began in February with affiliate WABC in New York. The system will be fully tested by late spring and implementation with affiliates will begin in the second half of 1987.

## SMPTE issues call for papers

A call for papers for the program of the 129th technical conference and equipment exhibit of the Society of Motion Picture and Television Engineers has been issued.

The conference and exhibit will be held Oct. 30 to Nov. 4, at the convention center in Los Angeles.

Papers are being sought on the subjects of motion-picture and TV technology for presentation at the conference. Those interested in presenting a paper should send their name, address, title of proposed paper and a 100-word abstract

*Continued on page 120*

**BROADCAST ENGINEERING**

*Editorial and advertising correspondence should be addressed to: P.O. Box 12901, Overland Park, KS 66212-9981 (a suburb of Kansas City, MO); (913) 888-4664. Telex: 42-4156 Intertec OLPK. Circulation correspondence should be sent to the above address, under P.O. Box 12937.*



**BROADCAST ENGINEERING** is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities and government agencies. Qualified persons include consulting engineers and dealer/distributors of broadcast equipment.

**SUBSCRIPTIONS: BROADCAST ENGINEERING** is mailed free to qualified persons within the United States and Canada in occupations described above. Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $25.00. Qualified and non-qualified persons in all other countries; one year, $30.00 (surface mail); $108.00 (air mail). Back issue rates, $5, except for the Buyers' Guide/Spec Book, which is $20. Rates include postage. Adjustments necessitated by subscription termination at single copy rate. Allow 6-8 weeks for new subscriptions or for change of address. Second class postage paid at Shawnee Mission, KS.

**BROADCAST ENGINEERING** Volume 29, No. 4 (USPS 338-130) is published monthly (except in the fall, when two issues are published) by Intertec Publishing Corporation, 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212. Second Class Postage paid at Shawnee Mission, KS and additional mailing offices. POSTMASTER: Send address changes to BROADCAST ENGINEERING, P.O. Box 12983, Overland Park, KS 66212.



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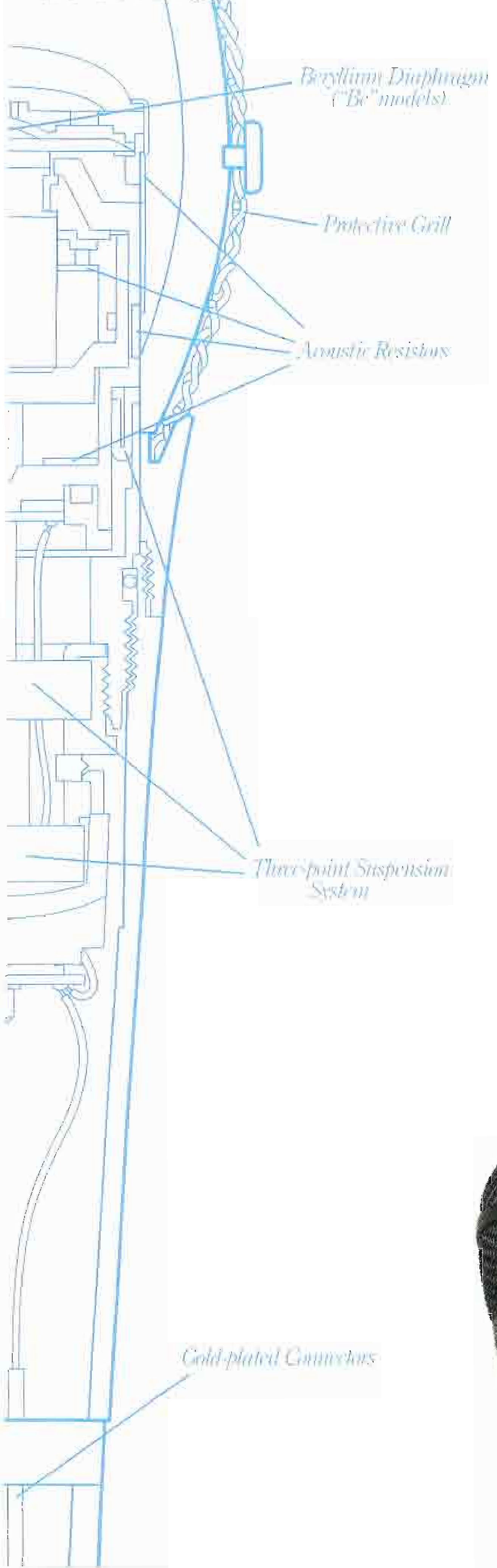
# Yamaha's newest musical instruments.




For years, Yamaha has been making musical instruments that allow performers to express what they feel. Our new line of MZ Series professional dynamic microphones continues this tradition.

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# People make it work

**A**utomation. From union meetings to coffee-shop talk, no single word sparks more emotion from broadcast engineers. As the cash value of broadcast property continues to climb at rates disproportionate to other segments of the economy, owners and managers have found themselves obligated to generate profits commensurate with the ever-increasing value of their property.

In this age of takeovers and buy-outs, raising profitability is a difficult challenge in the face of shrinking advertising revenues, increasing competition, accelerating equipment requirements and escalating expenses. The rapidly changing economic climate of local broadcasting compels station owners and managers to carefully evaluate, or re-evaluate, current automation technology, its ramifications and its effect on the bottom line.

The Manifest Destiny of local TV broadcasting is the optimized minimization of delivery overhead. More money must be budgeted toward the production and purchase of appealing programming that can successfully compete with the entertainment alternatives that are eroding the once captive local TV audience.

Typically, financial reviews seem to focus on one of the larger slices of the local broadcaster's budgetary pie: the on-going, non-revenue-producing operations payroll. Fortunately, the trend to increase profitability by reducing expensive professional staffing requirements comes at a time when many established TV stations are experiencing a peak of turnover.

For years, managers have looked to automation to provide the ticket to reducing the necessary technical skills required for routine station operations. Some have found success with automation. Others have attempted it only to abandon it. What's the mutual secret of those who've succeeded? Discipline.

One station's automation system is another station's sequencer. At one extreme are some who feel that a fully automated station must include controlling the HVAC system, the lock on the back door and the coffee pot. Then there are others that believe automation is necessary only for on-air playback assembly. Most managers' expectations fall somewhere in between. Today, there are many automation products on the market that can fulfill the range of management requirements. The question is, is management prepared to meet the requirements of the *system*?

The double-edged sword of automation, which promises improved profitability and a more consistent on-air look on one side, threatens management with serious problems on the other. These are not necessarily hardware or software problems, but *system* problems, and the system includes people.

Traditionally, a manual master control was relied upon by all departments as the filter for a multitude of seemingly minor discrepancies that could be identified and corrected before a mistake was actually aired. With automation, the computer doesn't watch the program; it only follows instructions. It is each department's responsibility to provide master control with accurate, verified information for computer entry and on-air execution.

The computer probably won't recognize competing products scheduled in the same break, mistimed segments, news bulletins or any of the other predictably unpredictable surprises that pepper the broadcast day. Poor split-second judgment by a master control operator can rob a station of revenue faster than you can say "production assistant" while leaving viewers and sponsors wondering, "What's the problem?"

The lifeblood of automation is well-organized implementation, meticulous discipline and result-oriented supervision. Each department must work with engineering operations to ensure that program segments, spots and IDs are in-house ahead of time, and timed accurately to the frame. Success depends upon the honesty of operator discrepancy reports, and management's commitment to follow up discrepancies without intimidation, ensuring that discrepancies do not recur.

The dream of eliminating skilled operators by automation is an illusion. Automation simply allows the redistribution of engineering talent within a station away from routine operating positions, and provides control for employee growth as demands on technical operators and engineers continue to grow.

THE NEW OPTIMOD®-AM 9100B

# Audio processing for AM improvement.


In the several years since its introduction, OPTIMOD-AM Model 9100A has become one of the most-often used tools for improving AM audio.

Now there is a new opportunity for AM improvement. Over a year ago, the National Radio Systems Committee brought broadcasters, equipment manufacturers, and receiver manufacturers together to talk about a voluntary national transmission standard that would make wideband high-fidelity AM radios practical.

Today, after hundreds of hours of discussion and study, the standard finally exists that will allow receiver manufacturers to increase and flatten their frequency response without risk of increased interference. But for them to do this, broadcasters must implement the standard: a "modified 75$\mu$s" pre-emphasis specification brightens up the sound on older radios while minimizing interference to adjacent stations, while a sharp-cutoff 10kHz low-pass filter specification protects the second adjacencies by limiting occupied bandwidth.

Receiver manufacturers have stated their willingness to replace their current AM receiver designs (with their telephone-quality fidelity) with AM receivers having full 10kHz frequency response—but *only* if and when the NRSC standard is fully adopted by broadcasters. For the NRSC standards to be successful, broadcasters must change over *quickly*. If the new high-fidelity receivers generate complaints of interference caused by stations not complying with the new standard, the receiver manufacturers will revert back to the present low fidelity 3kHz designs! *Everyone* will lose.

Orban was the first to propose and implement AM pre-emphasis and low-pass filtering, and we were heavily involved in the Committee work and research. We strongly endorse the new NRSC standard. It's good engineering *and* good business, and we are making it easy for all OPTIMOD-AM owners to comply.

**Introducing the *new* Model 9100B:**

It complies fully with the NRSC standard while retaining the features that have made OPTIMOD-AM Model 9100A the choice of so many stations concerned about competing with FM. The 9100B increases coverage, improves source-to-source consistency, and yields superb quality on both voice and music. And, the new standard allows us to make the new OPTIMOD-AM even louder!

Like its predecessor, the new 9100B can be configured to operate optimally in mono, C-QUAM® stereo, or Kahn stereo. Mono units can be field-upgraded to stereo by simply plugging in additional cards.

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To find our more about the NRSC standard, and about Orban's *new* 9100B OPTIMOD-AM, or the Upgrade Kits for the 9100A and 9000A, please call or write.

| Why not copy this ad for others at your station who would like to know what's in store for AM radio. |
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# FCC update

## FCC examines call letter restrictions

**By Harry C. Martin**

The FCC is proposing the elimination of most of its long-standing restrictions with respect to the assignment and use of call letters by broadcast stations. The proposed changes are as follows:

• *K and W assignments.* The commission is proposing to eliminate the current requirement that call signs beginning with the letter K be assigned only to broadcast stations located west of the Mississippi River and those with the letter W be assigned only to stations east of the Mississippi. These restrictions would be eliminated in all broadcast services, including LPTV.

• *Conforming call letters.* Under current rules, only commonly controlled stations in different broadcast services (AM and FM) can be assigned identical basic call letters. The commission is proposing to permit any licensee to request any call letters not assigned to another station in its own service, except within the same market.

• *Procedures upon changes of ownership.* Under current rules, a licensee seeking a new call sign must request a call letter change and, at the same time, relinquish its existing call sign. A relinquished call sign is not available for use by any other licensee until the effective date of the call letter change. It is then assigned to the first applicant who requests it. The commission is proposing to amend its rules to permit an exception to this first-come-first-served policy in instances where an existing broadcaster wishes to transfer a long-standing call sign to a new facility in the market. There will be no change in the commission's policy allowing call sign swaps between commonly owned stations licensed to the same city.

### New rules for booster stations

The commission is proposing to allow increases in the output power of on-channel FM booster stations and to eliminate the restriction that such stations rebroadcast only signals received over the air. The commission also is proposing the establishment of a TV broadcast booster station service. The specifics are:

• *FM boosters.* Currently FM booster stations are limited to 10W of power. Under the proposal, operating power at higher levels would be permitted as long as the 1mV/m service contour of the primary FM station is not expanded or interference to other stations is caused. Co-channel stations would be protected by subjecting boosters to a requirement that the signal of any co-channel station must exceed the signal of the booster by 20dB at all points within the 1mV/m predicted contour of the co-channel station.

The commission also proposed eliminating the restriction that FM boosters broadcast only over-the-air signals. This would allow FM licensees to feed signals to boosters by whatever technical means they wish, and to use aural broadcast auxiliary facilities for this purpose.

• *Establishment of TV boosters.* The commission also proposed establishing a new broadcast booster service that would provide the service equivalent to FM boosters. Under the proposed rules, the licensee of a full-service TV station would be authorized to operate on-channel booster stations to simultaneously retransmit the primary station's signal to areas within its predicted Grade B contour that are not receiving Grade B quality signals directly over the air.

The operating power and location of such boosters would be limited only to the extent that they not provide Grade B or higher level service beyond the predicted Grade B contour of the primary TV station or increase interference to other TV stations. Initially, the commission would authorize these boosters only at low power levels, as is the case for TV translators and LPTVs.

Because the proposed booster service essentially would represent a technical expansion of the TV station being rebroadcast, it would limit ownership of TV boosters to the licensees of stations being rebroadcast and exempt such licensees from the competitive applications process.

### LPTV and TV translator rules amended

In rule changes affecting the LPTV and TV translator services, the commission has imposed a limit of five applications per filing window on a single applicant or entity having a 1% or greater interest in an application filed during the window period. There will be no cap on major change applications filed by authorized stations during a specified window period. This rule change is designed to discourage the mass filings of speculative applications that have clogged LPTV processing for the past several years.

The commission also has changed its rules to permit the licensee or permittee of an LPTV or TV translator station displaced by a new full-powered station or by a land mobile operator, to specify operation on a different output channel without competition. To make the switch, the displaced station must show that there are no pending applications on the new channel and that its operations would not interfere with any other pending applications or protected primary services. The commission has adopted the same displacement standards for LPTV and TV translator stations forced to change channels due to cable headend or output converter interference.

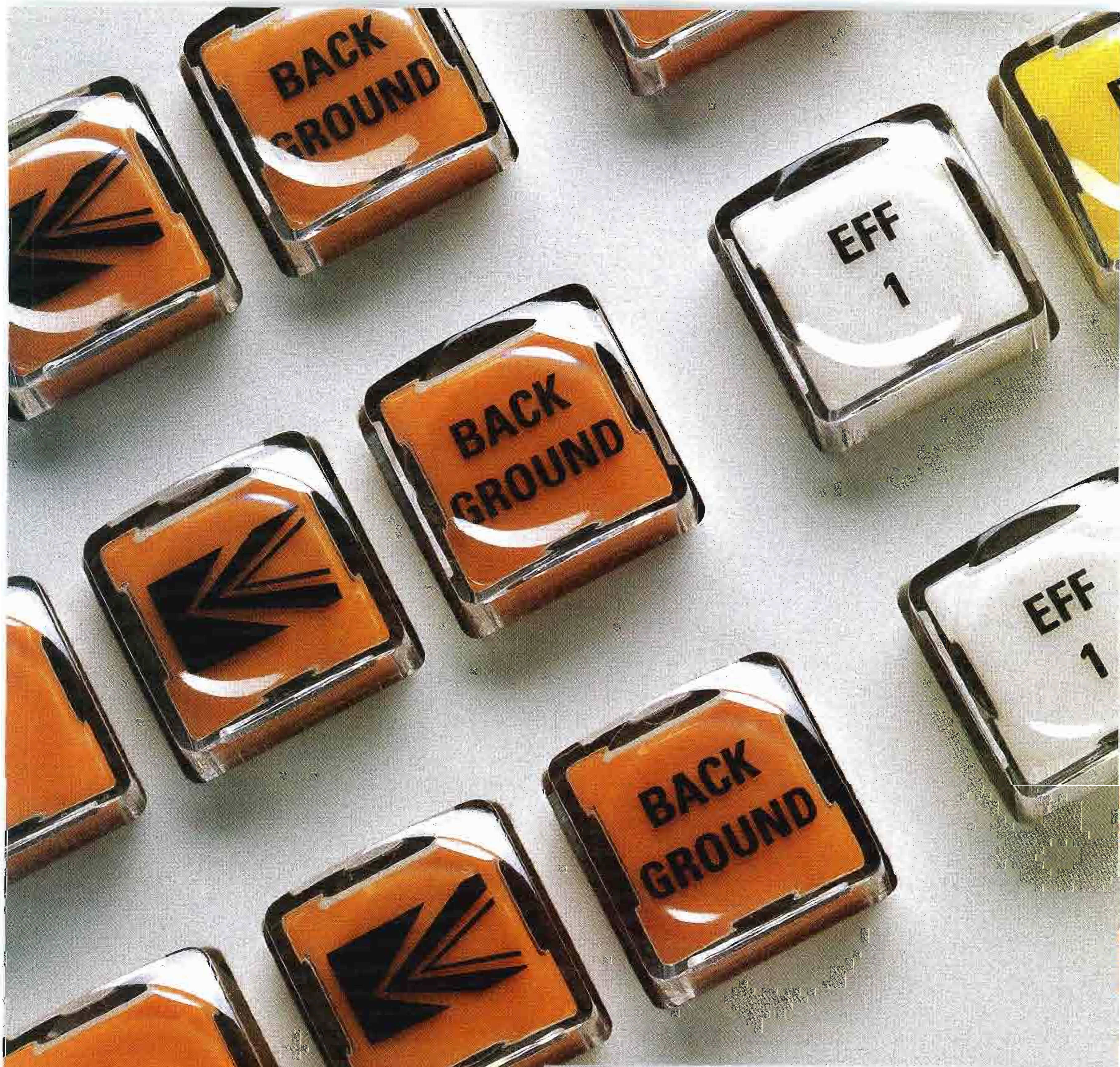
It is expected that a nationwide filing window, on all channels, will be opened as soon as the commission can modify its application forms so they give sufficient information to ensure compliance with the 5-application cap.

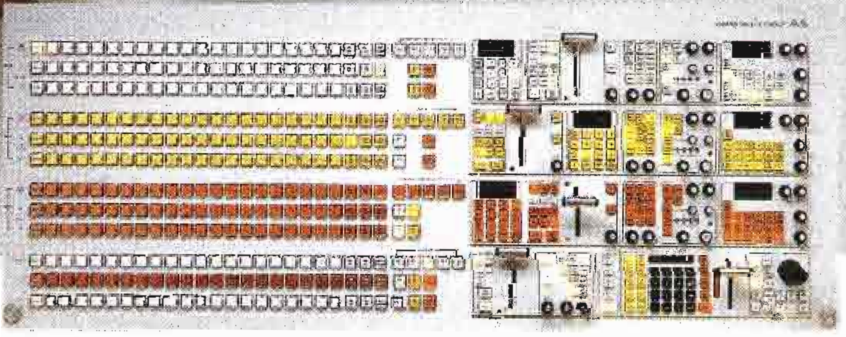
### Filing fees imposed

Effective April 1, the commission began collecting filing fees for nearly all broadcast applications.

Fees for applications for new TV, AM and FM stations are $2,250, $2,000 and $1,800, respectively. The fee for filing a minor change application for a radio or TV station is $500. Fees for filing applications for the assignment or transfer of AM, FM or TV stations are $500 per station. The filing fee for pro forma assignments and transfers is $70. A complete list of Mass Media Bureau fees was published in **BE**'s June 1986 issue.

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



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## In answer to that....

**By Carl Bentz, special projects editor**

Broadband communications systems, such as CATV and CCTV, have definite advantages compared with broadcast television for interactive audience response measurements. Conceivably, the cable that connects every viewer's television to a central location can carry signals in both directions. CATV subscribers should be able to respond electronically from their living rooms.

Two-way communications on CATV systems have been under way for at least 15 years. Some early experiments in home-bound education, shopping services and the early morning coffee klatsch were remarkable, albeit sometimes flawed, when the Voice of America leaked into the cable.

In a wired medium, two different RF signals can be directed to their own amplifiers through bandpass filtering and frequency separation. CATV uses forward signals of standard channels 2-3, 5-6 and 7-13. Those systems with a full schedule of satellite programs also use midband (between 6 and 7), superband (above 13) and some sub-band (below 2) channels. However, there is still a good deal of spectrum below 50MHz for numerous narrowband, non-video reverse carriers.

In some locations, cable systems, now with better signal security through improved coaxial cable and connectors, are aiding cities in controlling automotive traffic flow. A stream of digital information moves between terminals at each traffic light and a central controller computer. Such digital signaling is used by the cable company, linking subscriber terminals and the CATV accounting computer for pay-per-view and other special subscriber services.

Although numerous locations are tied to the CATV hub point by a single, highly branched conductor, broadcasters have had to rely on multiple telephone lines and enough people or computers to answer them. That could change if results of an experiment currently in the planning stages are successful.

The idea behind *TV Answer* is relatively simple. During a TV program, yes/no questions are given to viewers through normal on-screen video, VBI encoding or audio. Viewers respond through a unit that transmits yes responses back to the TV station on VHF radio frequencies. The equipment required at the station includes a computer to control the system, to interrogate the remote transmitters and to tally responses. In the viewer's home is a modified receiver and VHF transmitter. At the station, a receiver with a high-gain antenna receives return transmissions and directs them to the computer for counting.

You might wonder how more than a few in-home units could be individually identified (for a correct tally), in as much as they essentially could respond at the same time. The problem would seem compounded as all responses are transmitted on the same frequency. The solution to that problem is one of the parts of the system that allows almost a million responses per minute to be logged.

After the question is presented on the air, the interrogation process begins. The computer begins to encode a 2-bit signal into a 0.01H portion of every active video line immediately after the color burst. On most receivers, the 0-1 bits will not be visible on typically overscanned CRTs. The decoder device looks for the 0-1 bit signal on a specified video line that is uniquely assigned to that decoder. Each decoder has been preassigned a specific line number, allowing a sequential interrogation of all units to proceed.

Connected to the decoder is a response device with a single button. If the button is pressed, a yes response will be given. If the button is not depressed, a no answer is assumed for that unit.

Reception of the 0-1 bits also enables and initiates a transmission from the 20W ERP solid-state transmitter that is built into the response unit. The transmission, according to the application to the FCC for an experimental license, is best considered a N0N-type emission. Although the signal from the transmitter is a single pulse, it is filtered and shaped to reduce the number of harmonics that would typically be generated by fast rise and fall time pulses.

In order to derive an accurate count of responses, a special timing system is put into play. Theoretically, responding transmitters could be placed in locations that would result in more than one response being received at the same time. Such a coincidence in two or more responses would probably result in an error in the tally. However, if an idea modified from radar range validation is applied, such conflicts can be solved.

The database in the computer will know where each of the units are placed. Therefore, upon the generation of an interrogation enable pulse for unit M, a valid reception window is opened. The length of the window, for any unit, is determined from the known distance to the unit and, therefore, a time delay experienced by a TV signal transmitted to that location and the additional time required for the radio signal to return. If a pulse is received within that window, it is considered valid. If no pulse is received, the response is considered negative.

Although limited modification would actually be required to install the necessary decoder in a television, the equipment planned for use in this experiment is a modified VCR. The remote-control unit will include the yes response button. Also packaged in the VCR case is the 20W transmitter and its input-filtering circuit.

The license application requests a 500kHz bandwidth for the experiment. It is known that pulses consist of an infinite bandwidth of frequencies. With filtering and shaping circuits, the required bandwidth is reduced to 200kHz, although it is doubled by modulating an RF carrier. Accuracy of the crystals controlling the radio carriers will demonstrate an estimated $\pm 100$ parts per million (22kHz at 220MHz). Adding the variance of carriers caused by crystals and the RF envelope, the absolute band requirement is estimated at 422kHz.

This system provides some interesting possibilities for the broadcaster. Not only could it allow almost immediate ratings to be determined, it could be used as a means of taking opinion polls. Also, depending upon how well the identity of each pulse can be determined, it could be used for shop-at-home programming.

The schedule for the experimental operation of *TV Answer* is uncertain, but the FCC has given approval.


# The mic mixer you would have designed yourself–The Shure M267.

In the space of just two years, the Shure M267 has become one of the most well-known and widely used mixers in the broadcast industry. One look at it will tell you why.

The M267 gives you the improvements you've told us were most important. Every channel has a mic line level switch for maximum flexibility. There's also a built-in limiter to keep the M267 from overloading at critical moments. The unit contains a built-in battery pack that utilizes three standard 9-volt batteries. Simplex (phantom) power and a peak LED are standard, too.

The M267 oscillator provides a clean 1 kHz tone, and is located on the front of the unit for simple access. The headphone output is also on the front and includes a level control. IC design, along with active gain controls, provides greater headroom and quieter operation.

For location work or even studio post-production, the M267 carries on Shure's reputation for reliability and ruggedness.

For more information on Shure's complete line of mixers, call or write Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, IL 60202, (312) 866-2553.

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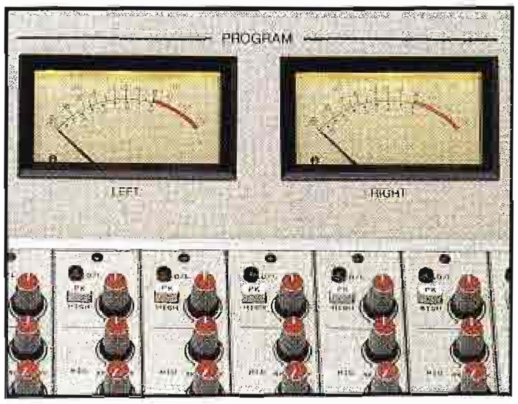


## Reviewing FCC field-strength rules

**By John Battison, P.E.**

During my travels to various stations, I have the opportunity to talk with many station and contract engineers. I also make it a practice to keep up with the FCC's *Daily Digest* and the FCC rules. Based on my conversations and the number of fines levied, it seems that many stations do not have a current copy of the FCC's rules and regulations. And just as important, many engineers are not familiar with some of the rules' requirements. A recent perusal of the *Daily Digest* indicated that a number of violations are occurring with alarming regularity, with fines of $800 and more being levied on licensees. Some of these fines are being levied because of out-of-band emissions.

### The rules

Some time ago, the commission deleted the requirement that AM and FM stations make complete annual audio proof-of-performance checks. However, a little hook was left in the rules, one which many engineers appear to have overlooked. It is to those readers that this month's column is addressed.

Section 73.1590 of the rules on equipment performance measurements requires that the licensee of each AM, FM and TV station, except 10W Class D stations, make equipment performance measurements for each main transmitter. Although the audio requirements are gone, spurious and harmonic emission tests are still required. The rules specify the different criteria for AM, FM and TV stations.

### AM transmitters

Section 73.1590 (a) (6) indicates that these tests must be conducted on an annual basis. The rules require measuring for spurious and harmonic emissions. The tests must show compliance with the transmission requirements of 73.44 for AM stations and 73.317 for FM stations. The TV requirements are specified in 73.687.

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

Let's examine rule 73.44, which addresses the requirements for AM stations. The requirements are broken down into two sections. The first applies to transmitters type accepted or notified after Jan. 1, 1960. The other rule applies to transmitters installed or type accepted before Jan. 1, 1960. The particular transmitter date of installation or acceptance determines which section of the rules applies.

The commission's requirements are centered on possible interference with other stations or services. In these more enlightened days of attention to AM response, bandwidth, top-end rolloff and pre-emphasis curves, eliminating spurious emissions can become more important than ever before.

### Requirements

If your transmitter falls in the post-January 1960 class, you must be sure the following tests are performed. (The wording has been abbreviated, so check the rules for complete information.)

*Section 73.44(a):*

(1) Any emission appearing on a frequency removed from the carrier by between 15kHz and 30kHz inclusive, must be attenuated at least 25dB below the unmodulated carrier level. Compliance indicates that the occupied bandwidth is no greater than 30kHz.

(2) Any emission removed from the carrier by more than 30kHz and up to and including 75kHz must be at least 35dB below the unmodulated carrier level.

(3) Any emission appearing more than 75kHz from the carrier must be attenuated by 80dB or 43 + 10 $\log_{10}$ (power in watts) dB below the carrier, whichever is the lesser attenuation.

*Section 73.44(b):*

Requires old transmitters (prior to 1960) to achieve the highest possible compliance with paragraph (a).

In any case, if harmful interference is caused by out-of-band emissions, the licensee must achieve a greater degree of attenuation. Greater spurious signal attenuation might be possible through transmitter retuning and the use of additional output stage bandpass and harmonic filtering.

### Measurement process

How are these tests to be performed? In general, the measurements should be made about 1km from the antenna at ground level. If your station is non-directional, you can use a field-strength meter. A spectrum analyzer might be better, but few of us have access to one.

The decibel level can be read from the scale by following the instructions provided with the meter. The spurious emission value also can be calculated from the fundamental and off-fundamental field-strength meter readings.

If you have a directional pattern, the procedure is a bit more involved. The commission specifies a preferred order for obtaining the carrier reference field strength:

- Measured non-directional field strength;
- The rms field strength determined from the measured directional radiation pattern; and
- The calculated expected field strength that would be radiated by a non-directional antenna at the station authorized power.

Many stations may not be able to switch to non-directional operation simply by pressing a button (although it would be quite nice if they could). It may be possible to use the measured non-DA field strength from the original station proof-of-performance. In many cases though, these values may have been taken long ago and a new reference might be better.

Many engineers will probably be required to go into the field to take a set of measurements. Once those values are obtained, they must be recorded.

There is no special report form for this purpose. You can devise your own form as needed. Next month, I'll show you a form I devised that works well for me.

I suggest that a copy of the test results be placed in the station's public file. You should continue to perform the test on an annual basis, with no more than 14 months between tests.

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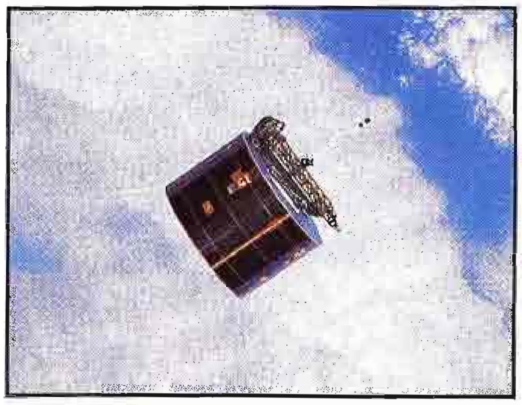

## Advantages of SCPC satellite services

**By Elmer Smalling III**

Unlike video, which requires a bandwidth of at least 6MHz, high-quality audio signals require 100 times less bandwidth for FM transmission, normally 60kHz. Audio signals transmitted over satellites can be computer data or high-fidelity audio originated by one of many satellite networks or radio news-gathering units. Although thousands of non-broadcast, narrowband telephone calls are distributed by satellite, their transmission (by common carriers) is not within the scope of this column.

It is important to understand the difference between SCPC (single channel per carrier) and subcarrier systems. SCPC systems consist of a discrete modulated carrier transmitted over a satellite transponder. One transmission mode for audio is a subcarrier system where the signal is transmitted using a carrier that is locked to a video carrier much the same as the sound portion of a TV signal (see Figure 1). The SCPC carrier (see Figure 2) is generated separately from any other signals using the transponder and must be received in a like manner. To detect (receive) the audio from a subcarrier system, the receiver must be locked to the video carrier.

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

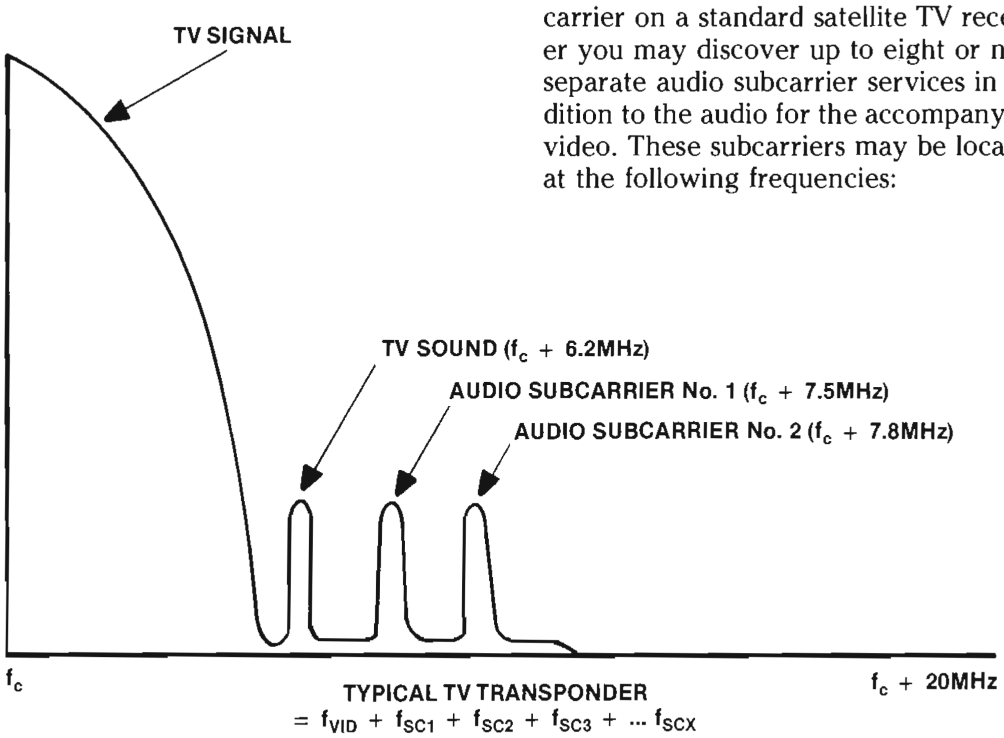


*Figure 1. The SCPC carrier is generated independently from other signals on the same transponder.*

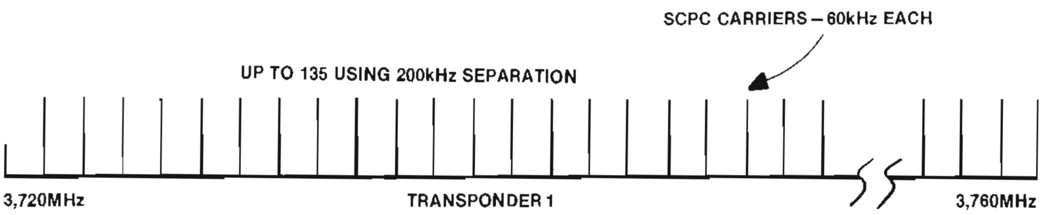


*Figure 2. Audio subcarriers, locked to a video carrier, may contain a number of channels per transponder carrier.*

As an example of the two kinds of transmission modes, the audio subcarrier for transponder No. 6 on F3 is at 6.8MHz and is identified as such. If it was an SCPC signal it would be called a 3826.8MHz signal transmitted through satellite F3. Tuning out from the video carrier on a standard satellite TV receiver you may discover up to eight or nine separate audio subcarrier services in addition to the audio for the accompanying video. These subcarriers may be located at the following frequencies:

**AUDIO SUBCARRIER**

| | |
|---|---|
| Audio for video | 6.8MHz |
| Service No. 1 left | 5.40MHz |
| Service No. 1 right | 5.94MHz |
| Service No. 2 left | 5.58MHz |
| Service No. 2 right | 5.76MHz |
| Service No. 3 mono | 6.435MHz |
| Service No. 3 left | 7.38MHz |
| Service No. 3 right | 7.56MHz |
| Service No. 4 mono | 7.69MHz |
| Service No. 5 mono | 7.78MHZ |
| Service No. 6 mono | 7.87MHz |

Any one of these hypothetical subcarriers (there are many possible configurations) may be received using a standard, tunable satellite receiver. SCPC signals can be received only with a special SCPC receiver that is normally tuned to a single carrier. To tune more than one carrier you must use additional receiver cards or special FM receivers capable of tuning the frequency range of the transponder on which the SCPC is transmitted.

Single carrier per channel systems do not require a video carrier and, therefore, many can share the entire transponder bandwidth of 36MHz to accommodate up to 1,200 narrowband telephone signals or 100-plus high-fidelity audio discrete channels (carriers). Most of the radio networks and those transmitting analog data employ SCPC transmission. Westar III alone handles more than 130 SCPC broadcast quality signals on five of its transponders.

Advantages of SCPC transmission:

- SCPC does not require the great bandwidth of a video carrier and, therefore, sky sector (satellite) lease costs are far less than for a video transponder and attendant subcarriers.
- The antenna required for SCPC systems is usually one-third the size of a TV TVRO unit.
- Higher fidelity is possible using SCPC because of reduced demodulation loss and less distortion due to main carrier video and other subcarriers.

SCPC has a big future on the Ku- and Ka-bands where antenna sizes will allow comfortable rooftop antennas and set-top tuners for hundreds of audio services. This satellite service may some day replace the existing use of VHF radio for audio program distribution.

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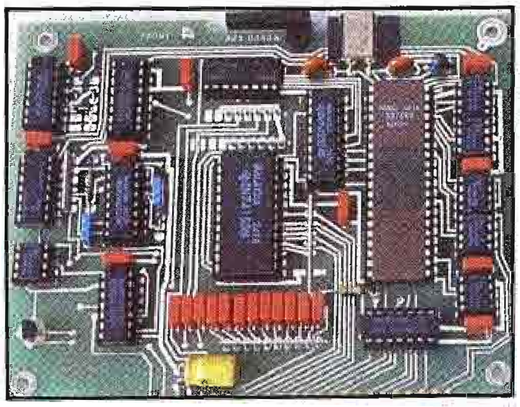
Part 7

# Circuits



## Inside digital technology

**By Gerry Kaufhold II**

Many factors affect the timing of signals in a digital circuit. The master clock frequency sets the upper limit on how fast signal transitions can occur. *Divide-by* circuits, made up of flip-flops, reduce the clock rate for use by decoders, which develop and then distribute timing signals that are synchronized with the master clock.

As timing pulses travel down printed circuit paths and pass through buffer ICs and edge connectors, part of their energy is dissipated. This causes rise times to stretch, and reflected energy from previous pulses causes overshoots, undershoots and adds distortion, similar to timing errors in a TV plant.

At the destination gate, a timing signal has an effect only after it goes above (or below) the switching threshold of the transistors that form the input of that circuit. For a system using a 5V supply, CMOS logic recognizes anything above 3.5V as a high-level logic 1, and TTL recognizes anything above 2V. The width of a pulse may depend on the logic threshold.

Kaufhold is an independent consultant located in Tempe, AZ.

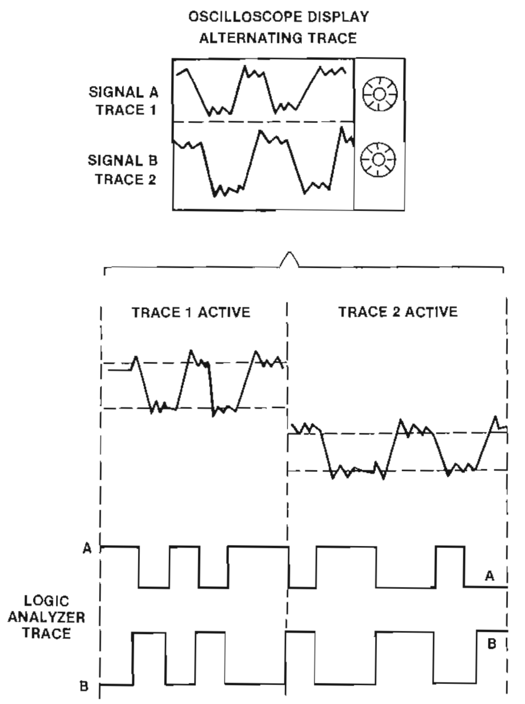



***Figure 1.*** *Although the logic analyzer provides accurate timing of displays of two digital signals, the dual-trace oscilloscope erroneously shows signal B to be a slightly delayed version of signal A.*

Determining that the transition of a timing signal is arriving at the correct time and at the proper voltage level is trickier than might first be expected. Adding to the complexity is the interdependence of many signals that must perform together for the entire circuit to operate properly.

### Oscilloscopes and digital timing

Dual-trace oscilloscopes are easy to use, convenient and readily available. Because digital timing signals occur in sync with the master clock, it is a good idea to use the master clock (or a divided-down version of it) as external sync for the scope. Although two signals can be viewed, only a few hundred microseconds of each can be seen.

If the *chop* mode is selected, portions of the signal can be viewed and the timing of the two signals, relative to each other, will be correct. However, if the rate-of-change of the signals under test is above the chopping frequency of the scope, some signal transitions will be lost. Because most oscilloscopes chop at a slow rate compared to the duration of timing signals, the *chop* mode may not be adequate for viewing most timing signals.

If the *alternating trace* mode is selected, the situation illustrated in Figure 1 may occur. Many uninitiated digital technicians make the mistake of incorrectly interpreting the waveforms they see in the *alternating trace* mode. There really isn't anything about signal A or B that can be determined from the setup in Figure 1, other than that a signal is present. Nothing relating to timing can be verified accurately.

What about voltage threshold levels? Using an analog scope requires looking very closely at the graticule and then making a judgment call about which point of the waveform actually causes the destination circuit to operate. What would be the case if the timing problem occurred only when a particular chip was being accessed—how would the scope be triggered?

### Logic analyzers

Logic analyzers solve the voltage threshold problem by actually providing a CMOS- or TTL-level threshold circuit right at the inputs of the data acquisition probes. By connecting the clock input of the logic analyzer to the master clock, all subsequent timing signals will be viewed in sync with the clock of the device under test. The logic analyzer will display the transitions of the digital signal exactly as the circuit under test will use them.

Unlike the oscilloscope that can display signals only while they are occurring, logic analyzers store the data so it can be analyzed carefully. Many of today's logic analyzers provide for storing important triggering setups, so that tests can be semi-automated or keyed to specific types of problems. By repeatedly experimenting with the triggering scheme, a technician can zero in on a problem and then save the final setup.

Not only is this process effective for troubleshooting, but having a logic analyzer in-house can be an excellent learning tool. Many technical colleges use logic analyzers in their core courses in digital electronics. Broadcast engineers, through SBE, might contact a school and schedule a visit to see logic analyzers in action. Considering the amount of broadcast equipment that contains digital circuits, learning about logic analyzers can be a useful and enjoyable excursion.

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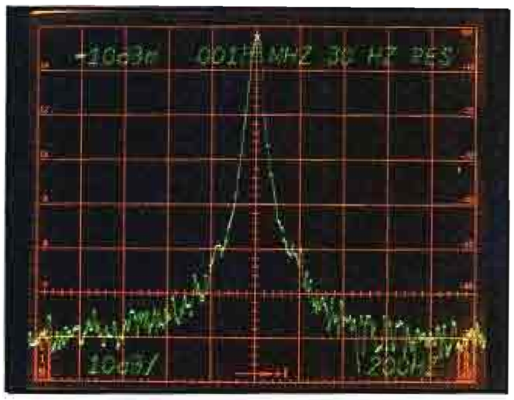

# Plan for changes in DMM design

**By Rey P. Harju**

General trends in electronic manufacturing will bring some significant changes in hand-held digital multimeters (DMMs). Some of these changes are appearing already and some are just on the horizon. Begin taking advantage of these trends now by reviewing your plans for specifying, purchasing and repairing DMMs for the next few years.

### Areas of change

The current trend toward smaller and less expensive electronic equipment, including portable test instruments, is expected to continue. A trade-off for this convenience and economy might be reduced repairability, especially in the field.

Another major trend is toward further large-scale circuit integration and compact packaging. Silicon-foundry chip technology is making it feasible for manufacturers to develop more custom designs and to offer a wider variety of products.

Small, compact DMM circuits are being made possible through surface-mount assembly of printed circuit boards (PCBs). This technique uses a single reflow solder operation to fuse solder tails of components to preformed puddles of solder on the PCB. This eliminates the need to machine through holes in PCBs, a high-cost, precision process.

### Advanced DMM circuitry

The basic functions of tomorrow's DMMs will not differ radically from products available today. Yet, future refinement of existing designs may result in instruments that appear quite different.

Harju is new business manager for Beckman Industrial, Brea, CA.

DMM circuitry comprises five basic stages: input protection, switching, input conditioning, analog-to-digital conversion, measurement and display.

The input protection stage of the DMM is designed to prevent electrical overloads from damaging subsequent stages of the instrument. Replacing the conventional spark-gap high-voltage input protection is the metal oxide varistor (MOV). When an MOV reaches the voltage breakdown point, its characteristics change from a resistor to a conductor, shunting the overload to ground. The MOVs currently found in some professional and heavy-duty DMMs can handle overloads of several thousand volts. Watch for MOVs to be used more extensively in DMMs.

In the DMM's switching stage, the user typically selects the measurement function and range by push-button or rotary switch. Because a mechanical switch in any electronic device is a common source of error, or even failure, future DMM designs should incorporate all-electronic, microprocessor-controlled switching. However, eliminating mechanical switching entirely may not be feasible. Look for touchpads of sealed, flexible plastic or conductive rubber.

The analog inputs of a DMM are sampled digitally by a microprocessor. Measurement is performed typically by one IC chip in a dual-slope integration process, which is accurate and repeatable. Look for custom LSI CMOS IC designs to bring true rms measurement to DMMs.

In most of today's DMMs, display control is integrated with A/D and measurement functions in a single microprocessor chip. In the future, display control may be implemented in a separate chip. This will allow the display controller to be customized for each model. The user would be able to choose from a variety of display formats, perhaps by keying selections on a touchpad.

For example, a numeric reading might be converted to a bar-graph display, as is done on some DMMs today to simulate d'Arsonval movement. With the increased capabilities of a separate display controller, bar graphs can be rendered more accurately and with finer gradations.

### Longer battery life

The useful life of DMM batteries has grown longer in recent years. This is due primarily to lower working voltages within the meter as a result of LCDs and the use of CMOS chip technology for the internal microprocessor. Today's state-of-the-art DMMs may expect about 2,000 hours of service from batteries but in the near future, battery lifetime could be about 4,000 hours.

Increased battery life should follow the introduction of lithium batteries to the industrial marketplace. The technology is not new, but the toxicity of lithium has been a barrier. New battery designs are intended to prevent the chemicals from leaking out, even if the case is damaged.

### Increased sensitivity

A related improvement in DMM performance will accompany a trend toward lower working voltages. Many DMMs apply test voltages of 3Vdc to 4Vdc in component test mode. Test voltages in this range can cause diode switching in the circuit being tested, perhaps activating a device accidentally. When dealing with microcircuitry, it is desirable to use test voltages in the millivolt range. Improved DMM sensitivity will make it practical.

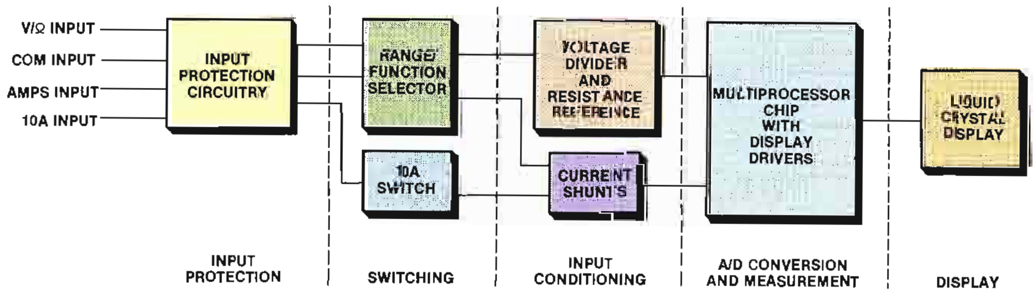


***Figure 1.*** *Simplified block diagram of a DMM. True rms conversion, if provided, is handled in the multiprocessor.*

**Editor's note:** This article was adapted from "The Future of DMMs," which appeared in the March 1987 issue of *Microservice Management* magazine, an Intertec publication.

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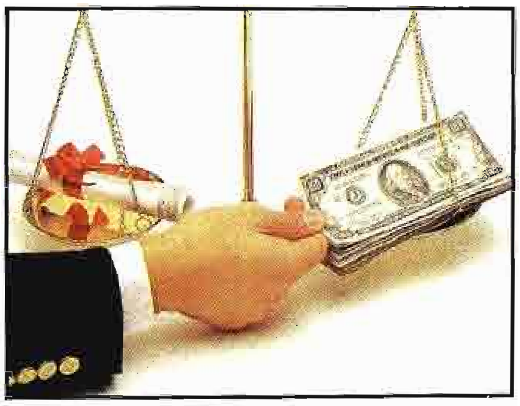
# Management
## for engineers



# You'll find a balance by combining theories

**By Brad Dick, radio technical editor**

Are you a *Kissy-Face Huggy Bear* (KFHB) or a *Stupid Son of a Bear* (SSOB)? We all know of supervisors or managers who are befitting of these labels, which represent two extremes of management style. The KFHB is concerned primarily with people, and the SSOB, with task.

These two popular labels are the results of two opposing management theories developed in the early 1960s by Douglas McGregor. His theories, which have become known as theory X and theory Y, deal with the spirit of human nature, motivation and the manager. Each theory is based on its own assumptions about human nature.

Some theory X assumptions are that people:

- are basically lazy creatures, do not like work and complete tasks only when forced;
- avoid responsibility and would rather be told what to do;
- lack creativity and should not be involved in the decision-making process;
- become motivated only when their basic survival needs are threatened; and
- must be closely supervised.

Some theory Y assumptions are that people:

- enjoy work because it is an activity employing the same elements as play;
- need to feel they are in control of elements of the organization's goals;
- can creatively control themselves in their jobs if given the opportunity; and
- should be allowed to participate in the goal-setting process.

### Leadership style

A leadership style based on theory X assumptions about human nature might be called the *task master* philosophy. A theory X style manager is concerned only with production. This type of manager decides who makes the decisions. A task master may attempt to manage employees through physical force, power or moral authority coupled with monetary compensation.

On the contrary, a manager who bases a leadership style on theory Y assumptions emphasizes participation and communication as motivational tools. A theory Y manager allows input, probably talks with the workers about decisions and looks for ways to integrate the employees' goals with the company's goals.

As you study these leadership styles, keep in mind that neither is completely right or wrong. The truth about what motivates a person lies between these two assumptions. Although the majority of managers say that they believe in theory Y management, most company policies, rules and procedures are based on the control of human behavior through theory X practices.

### Managerial grid

The grid shown in Figure 1, developed by Robert Blake and Jane Mouton, may help to explain the range of management styles available. The horizontal axis scales the degree of concern for task. The vertical axis measures concern for people. The SSOB could be placed at the 9/1 coordinate position on the managerial grid. This type of manager treats workers as commodities, as if they were machines. The KFHB, at the opposite end of the spectrum, could be placed at the 1/9 coordinate position. This manager would place importance on good fellowship and a country-club atmosphere in the workplace.

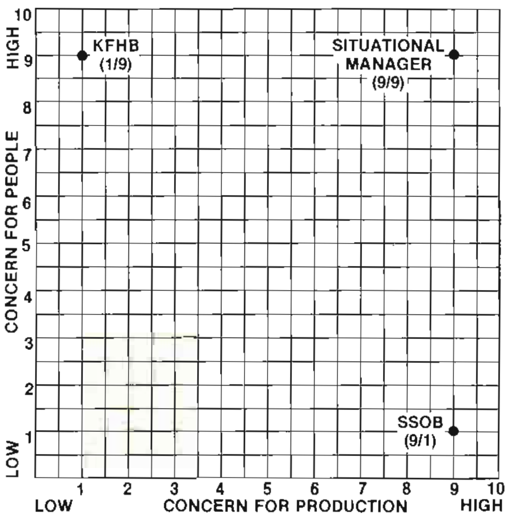



***Figure 1.*** *Are you people-oriented or task-oriented? The managerial grid provides a visual representation of a supervisor's attitude toward the work as well as the people who perform it.*

### Your style

You may not see yourself as either of these types of leaders; instead, you might think of yourself as a mixture of the two styles. If you are really brave, ask your subordinates where they would place you on the managerial grid.

Theory Y management practices may, in the long run, be more effective in promoting employee support. However, this is not to say that theory Y is always the best approach. A combination of theory X and theory Y principles, appropriately applied, can result in the best overall organizational operation. The term often used to describe a person with such skills is *situational* manager. This person recognizes that productivity results from a successful integration of tasks and human elements.

### Reader feedback

The December "Management" column about Kate, the tardy videotape operator, and Jim, her supervisor, drew many reader responses. Most of you who responded agreed that Jim made several mistakes in handling the situation.

His first mistake was in not dealing promptly with her tardiness. The second was his failure to maintain proper records of each meeting. Readers emphasized the importance of thorough documentation in dealing with any personnel problems. In regard to the lawsuit Kate later brought against the station, one reader said, "Jim's company got exactly what it deserved."

Others suggested that the station was partly at fault for not providing employee handbooks to its workers. Companies should provide such manuals, and should require new employees to sign a statement acknowledging receipt of the manual. This procedure might be helpful at your station.

If you are in a supervisory position, consider carefully what can happen when an employee is terminated. There may be more than just the employee's future on the line.

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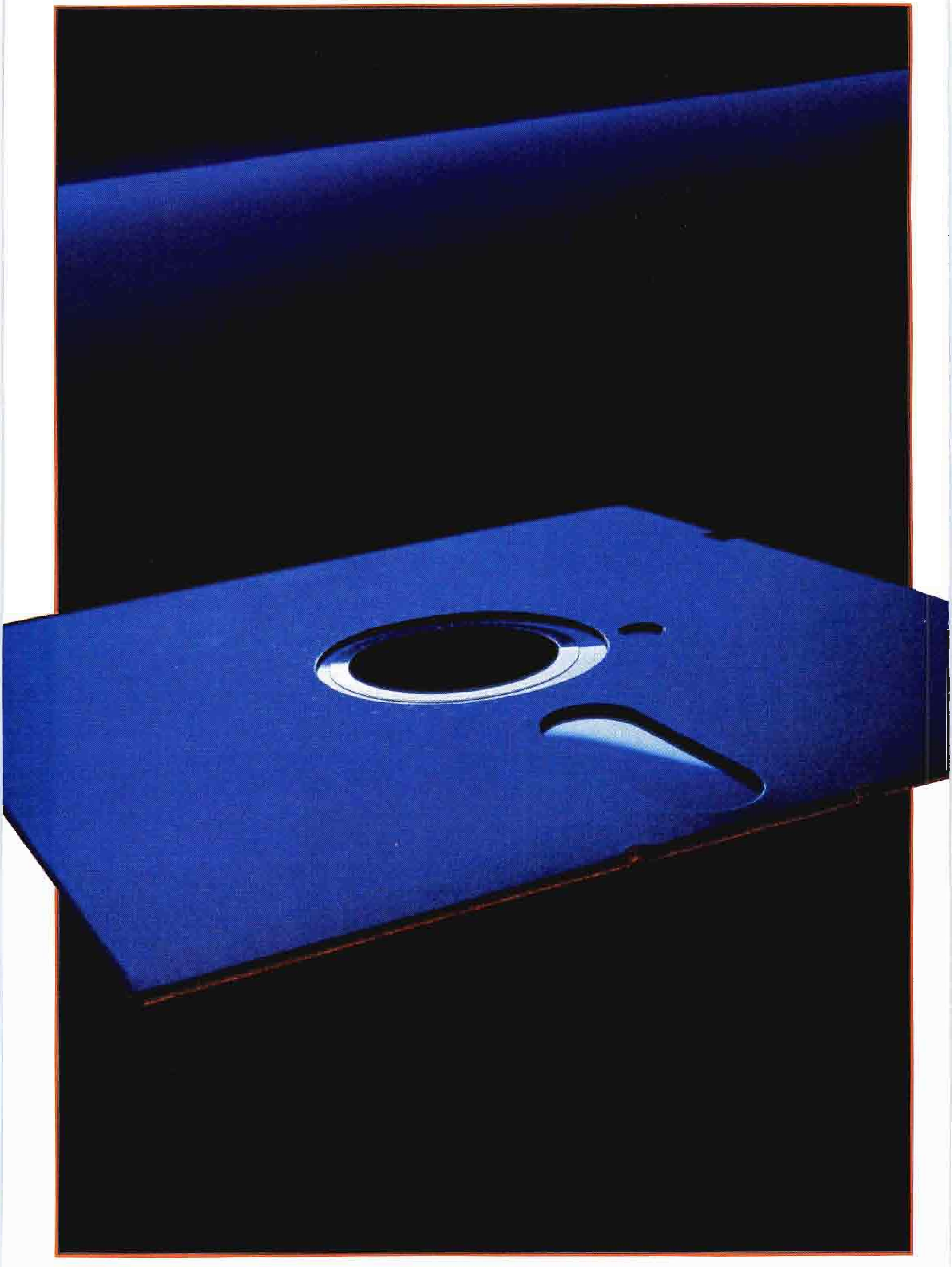

# Automation in broadcasting

## special report

When you get right down to it, radio and TV automation is nothing particularly new. Sure, you'll say that the computer revolution brought about by the exponential growth of the personal computer has led to advancements in hardware and software that make implementation into broadcast facilities practical and affordable. No argument there. But consider this.

The first issue of **Broadcast Engineering**, published in May 1959, contained a fascinating article titled, "A Building Block to Television Program Automation." It described an automation system for TV master control. The electromechanical monster ran VTRs, film chains, an audio-video switcher and related equipment to completely automate spot breaks. The "high-tech" system included mechanical switches and lights, relays (lots of relays!) and an interesting device called the *beam switch tube* (a neat little component that never quite made it into general circulation).

The need to bring the many varied elements of a broadcast station together into a more manageable configuration through the use of automation has been known for a long time. By and large, the needs of the industry have remained constant over the past two or three decades. The *technology*, however, has changed drastically.

Stations today are looking to automation as a way to reduce operating costs and improve program quality. Advancements in technology for the computer, aerospace and consumer industries have made a significant impact on radio and TV broadcasting. Spin-off technologies have permitted the introduction of sophisticated, affordable automation equipment that would have been impossible (or at least cost-prohibitive) 10—or even five—years ago. Plus, fluid market conditions and new economic realities have changed the way many broadcasters view automation. The options are numerous and growing each year.

The following series of articles examines *Automation in Broadcasting:* where the industry is today and where it is going in the future.



The only way to plan for the future is to understand the technology that will shape it. I hope this special report will help you decide how to proceed with automation at your facility.

Jerry Whitaker

Jerry Whitaker,
editorial director

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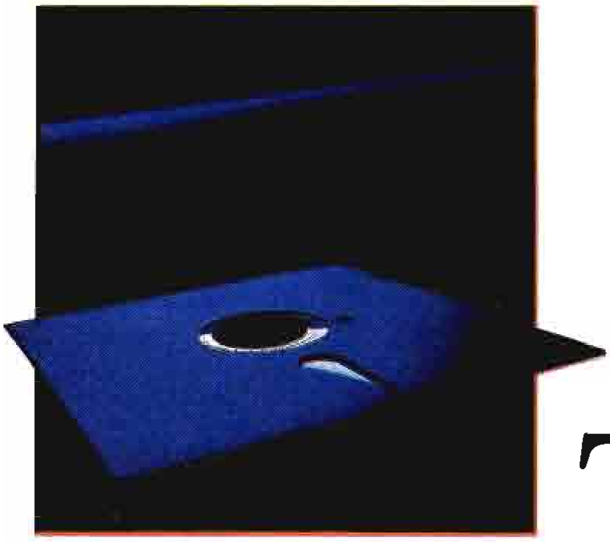


# Planning for TV automation

By Don Edvalson

**Management wants it, engineering must live with it. Successful automation is a detail-oriented science.**

Despite perceived advantages and great expectations, there is probably no other major commitment that is put off and avoided more than a station automation system. This is largely because the automation system must be interfaced to nearly everything else in the station, making the selection and installation of a system an overwhelming task. In addition, there are many questions about what a TV automation system can and cannot do, what features are desirable or important, and what effect automation will have on staffing and personnel.

### Interfacing to the operator

The bottom line is that an automation system's entire purpose is to assist the operator. If it does not do this, it has failed. The failure to provide a good human interface is probably the biggest single problem with most automation systems of the past. How many times have you looked at an automation system and had no idea how to operate it? This is a sure sign of an improperly designed human interface.

A well-designed automation system is easy to use. An operator should be comfortably using the system within a few minutes after sitting down at the terminal for the first time. If this is not the case, something is wrong with the system, not with the operator.

Prompting is one of the most important considerations. Any human interface that requires you to know that you are supposed to push a Control-H or some other obscure key is more difficult to use than it should be. All user entries should come either as the result of a prompt ("Enter the source name, then hit return"), a labeled function key, or an on-screen labeled soft-key. The operator should not have to remember that Control-I means "cursor up" or that Control-D means "delete event."

Edvalson is product manager for BTS Broadcast Television Systems, Salt Lake City.

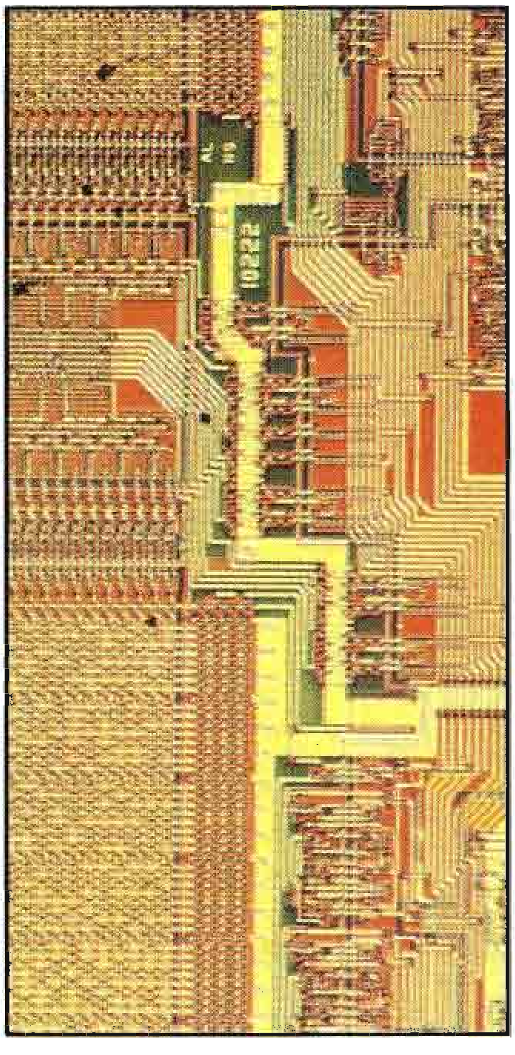


Photo by Timothy Schefter

*The microprocessor is changing the way broadcast stations are operated. Intelligent controllers can provide full automation, live-assist or business system interface.*

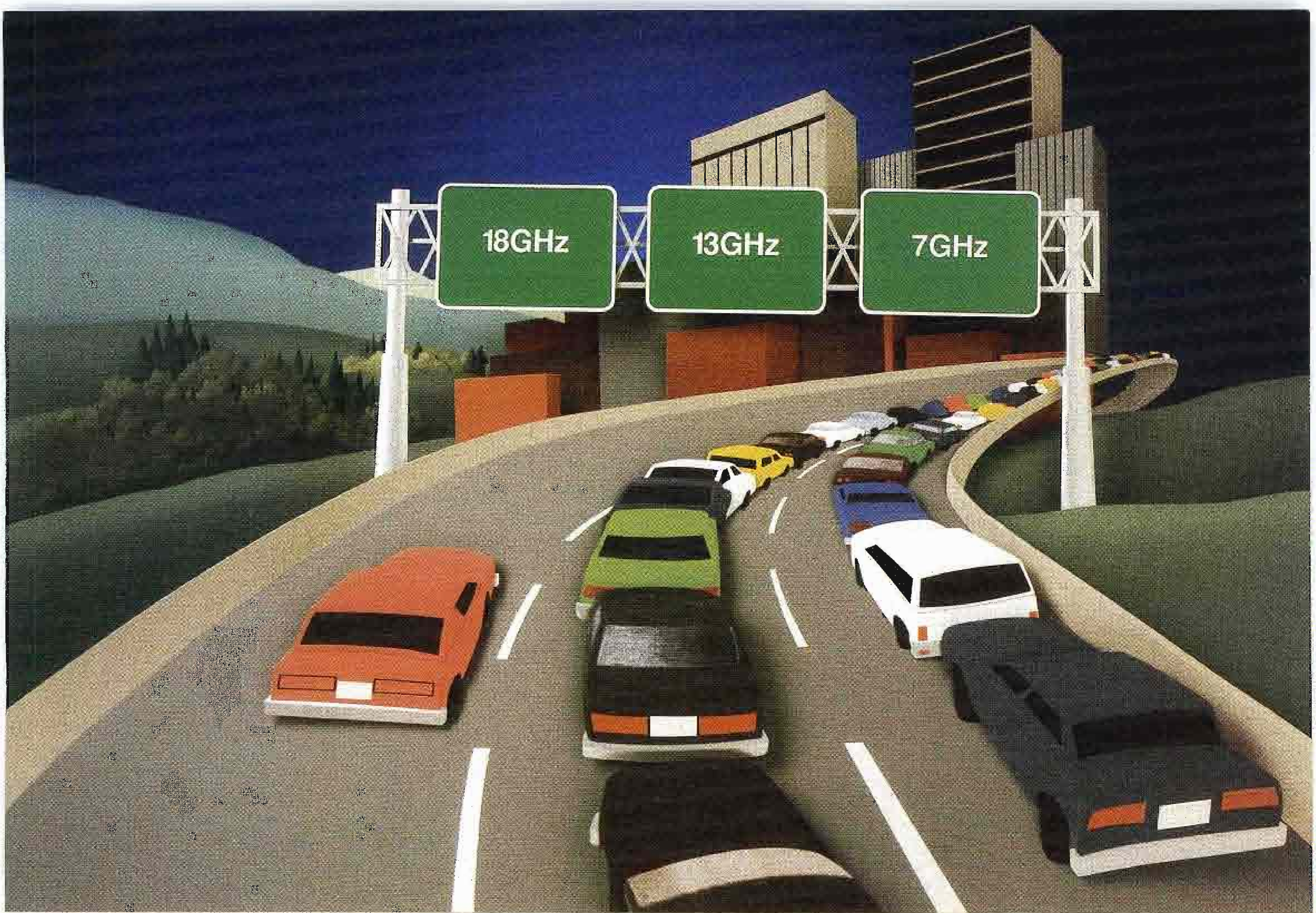
Another significant factor is terminal design. Computer terminals have changed tremendously in the past three to five years. These changes in terminal design are the result of many studies in the area of operator efficiency and fatigue. The same things that make a terminal design good for word processing or data entry make it good for an automation system. For example, keyboards should be as flat as possible and should have properly placed keys that do not require excessive actuation force. The keyboard should have dedicated cursor and editor keys and a dedicated numeric keypad. The screen should be non-glare and have the highest resolution possible.

Some systems provide monochrome video outputs and use standard monitors in place of high-resolution terminals. This should be avoided because usually there is not enough resolution in standard 525- or 625-line video to make quality characters at the size required. Also, flicker and the lack of resolution may cause considerable operator fatigue.

The use of color terminals can substantially impact operator efficiency. High-resolution RGB color displays allow the use of color while maintaining character quality. The presence of color greatly enhances what can be displayed on the screen. Important information can be displayed in magenta or red, and less significant information can be displayed in dark blue or green. This helps the operator to quickly and efficiently observe and correct problem conditions.

Modern data entry methods such as the mouse and touch screen benefit cursor movement and pointing. It is usually best for both to be available. A mouse is the easier, faster pointing method for the seated operator who is working with the system much of the time. A touch screen is more useful to the standing, occasional user, such as a VTR operator.

Finally, the automation system should be designed to assist everyone in the facility, not just the master control operator. For example, many automation systems provide only a list of upcoming events. This screen is valuable to the

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master control operator and, in fact, is just what that person should be looking at. However, the list is not nearly as useful to the VTR operator. The automation system should provide a special display, tailored to the needs of the VTR operator, that indicates which machines are in use, which are available, and which need tape loaded or recuing. Similar displays and reports should be available for use by traffic personnel, the videotape librarian and in other departments.

### The master control switcher interface

The first and foremost job of a station automation system is to control the master control switcher. This can be done in one of several ways, depending on the switcher involved. Some master control switchers provide an RS-232 or RS-422 serial port (see Figure 1). These switchers are easy to control, assuming the protocol used by the serial port provides enough control of the switcher. Ideally, all switcher functions that can be controlled from the switcher front panel also should be controllable from the automation port. If this is not the case, the automation system cannot adequately control the switcher, and added manual intervention will be necessary.

Some master control switchers don't have a serial port for automation. These switchers usually are interfaced with a box of relays and opto-isolators that connects into the multiconductor line between the control panel and the electronics (see Figure 2). This approach is more expensive and less reliable than the serial port. The relay box is a potential failure point that doesn't exist with a serial interface. Also, because the relay box is between the control panel and the electronics, relay failure can cause control of the switcher to be lost both from automation and from the front panel, making it impossible to control the on-air signal.

Regardless of the method used to connect to the switcher, the most important element of the master control interface is the automation software. It is imperative that the software fully utilize all of the features of the master control switcher. If the automation system cannot control everything normally controlled by the front panel, important functionality may be lost, and excess manual intervention

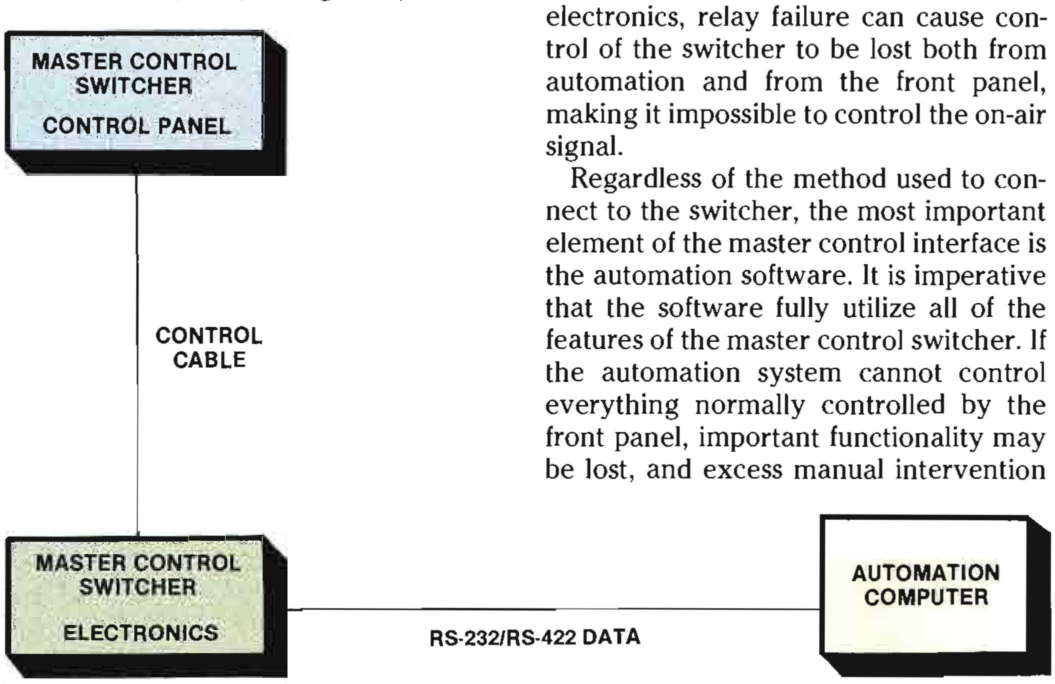


***Figure 1.*** *A master control switcher with a serial port is the easiest to automate.*

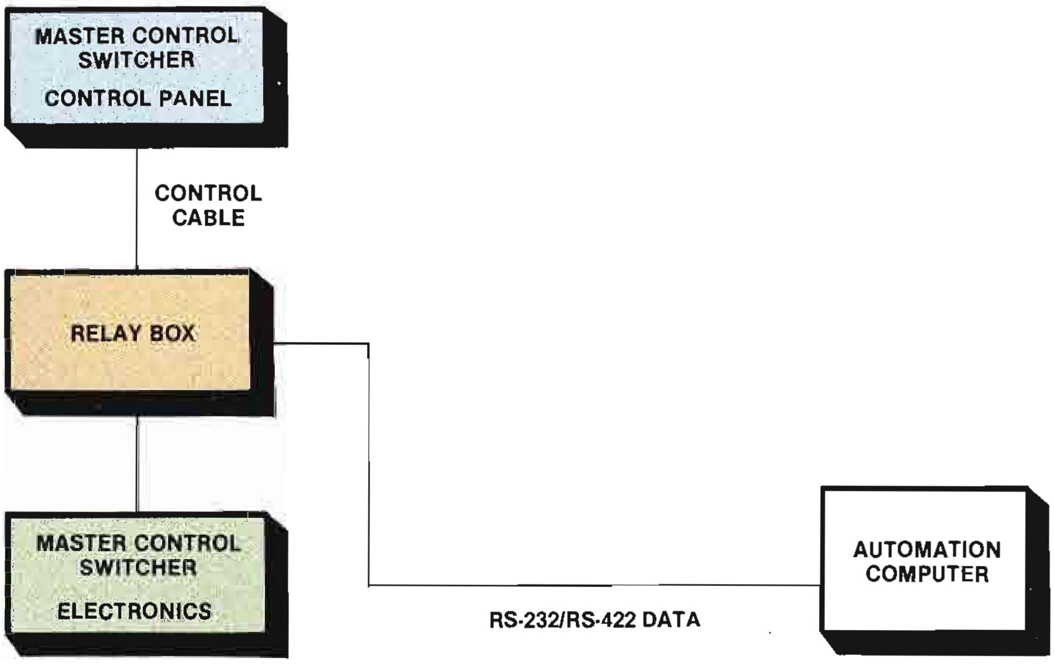


***Figure 2.*** *A master control switcher without a serial port requires a relay box.*

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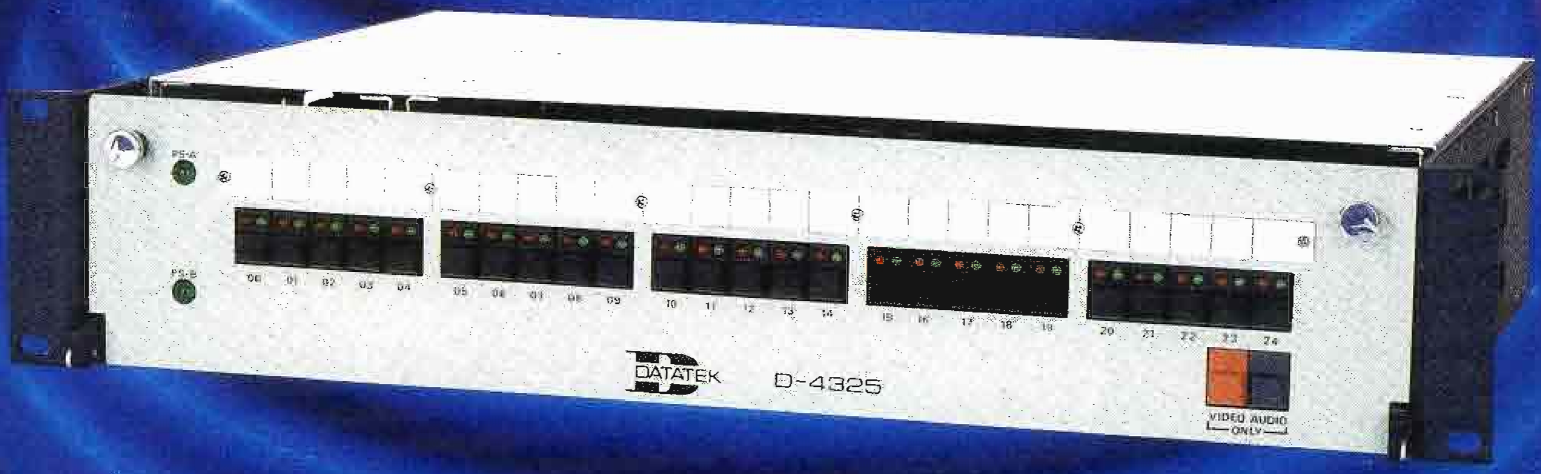


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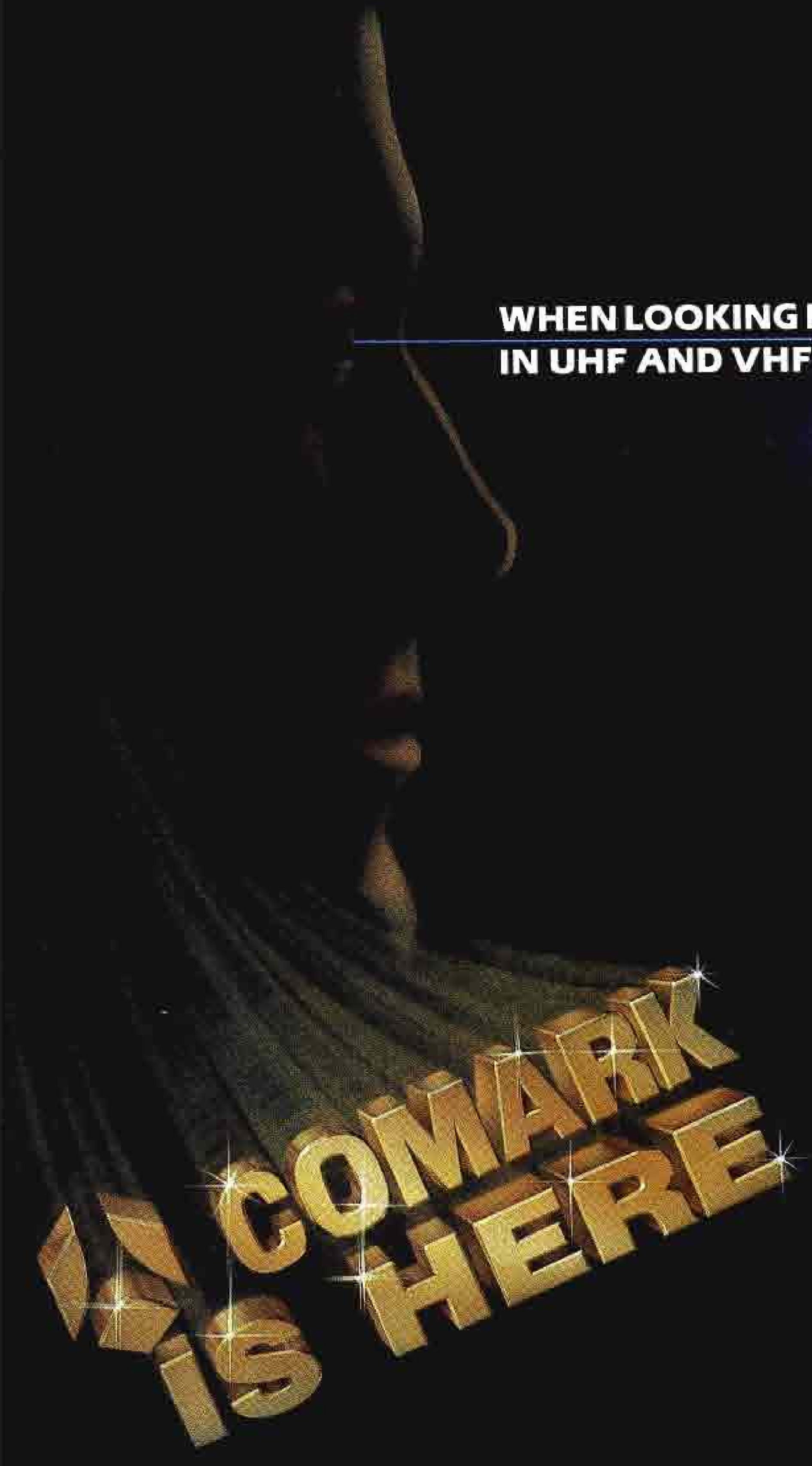


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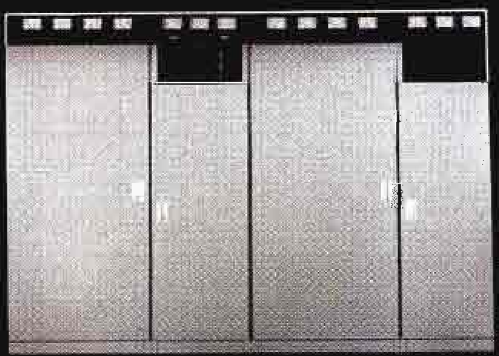

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may be required.

**The machine control interface**

The next most important function of the automation system is to control the machines being used on-air. The minimum acceptable level of control is the capability to start machines. However, the more machine control flexibility a system provides, the more useful it will be. For example, the capability to set a cue point, stop the machine and then to search back to that cue point makes possible the automatic recuing of a machine during a break. This frees the VTR operator from having to recue the

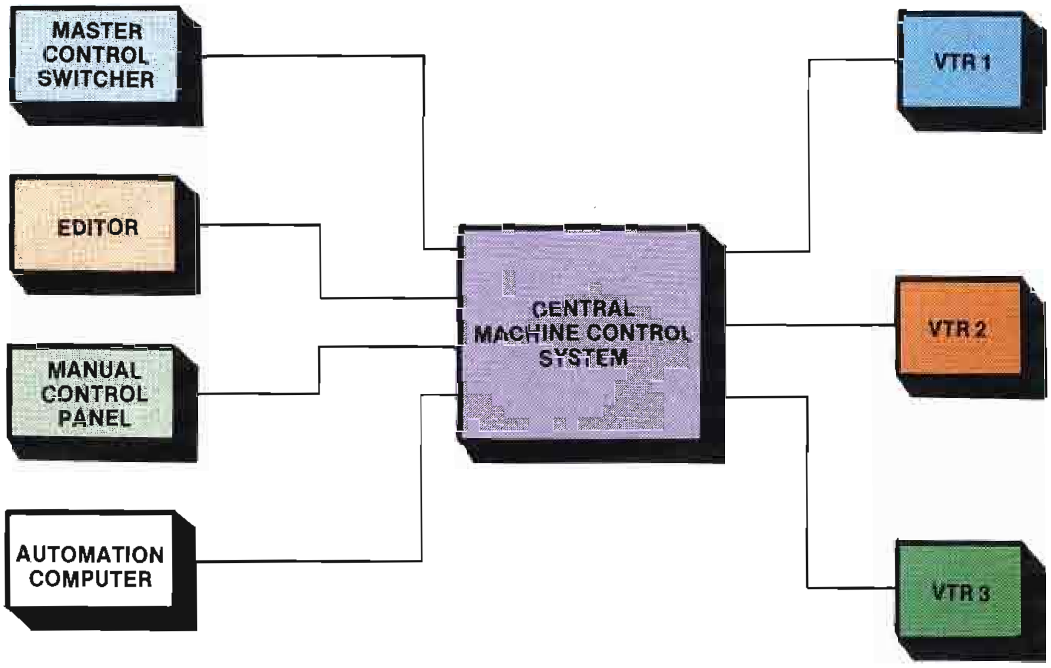


*Figure 3. The automation system's machine control must be integrated with the machine control functions of other equipment in the plant.*

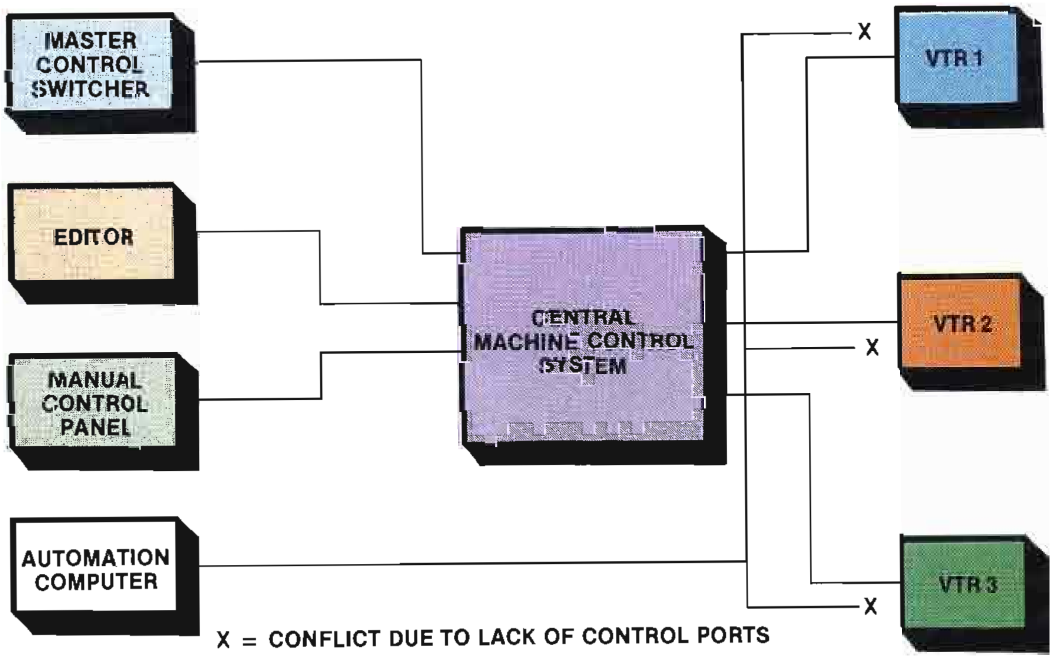


*Figure 4. An automation system without a central machine control system requires dedicated machines.*


*Figure 5. Traffic may be included in the automation system with simple serial interconnection.*

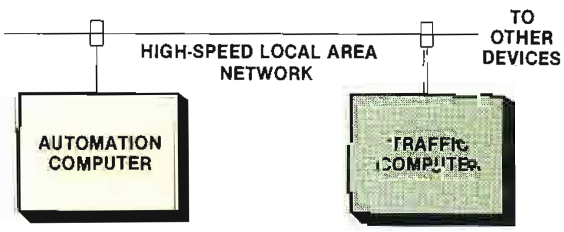


*Figure 6. A high-speed network also may be used to interface traffic with automation.*

program machines during breaks.

Another important aspect of machine control is status reporting. An automation system that doesn't check for proper machine status is "running blind" and must assume that a machine rolls when it is told to. A system that observes and reports machine status can warn an operator if a machine fails to roll.

Finally, the issue of machine control integration is important to a TV facility. The automation system's machine control must be integrated with the machine control functions of other equipment in the plant (see Figure 3). For example, the master control switcher must preroll the machines when running manually, editors need to control the machines, and there are usually manual control panels in production control rooms and other places throughout the facility.

If the automation system is not part of an integrated machine control system, it would be difficult to provide the necessary control of the machines from all of the required locations (see Figure 4). This is particularly true with the newer, serially controlled machines. An automation system that uses an existing machine control system is much easier to install and operate than one that provides relay closures to be connected to each machine.

### The traffic interface

For an automation system to be fully effective, it must be interfaced to the station traffic or business system so it can receive schedules and return logs without retyping by an operator. This interface can be accomplished in several ways. One way is to use floppy disks or other removable media. Another is to use a serial port such as an RS-232 line between the two (see Figure 5). A high-speed Ethernet-type network also can be used (see Figure 6).

Each of these methods has advantages and disadvantages. The floppy disk or tape method is usually the least preferred because it requires the operator to physically move media and to deal with both computer systems. The network approach is probably the best method because of its speed and reliability, but few traffic systems support this kind of interface.

Regardless of the method used to connect the automation computer to the traffic computer, the interface software makes the difference between a system that is easy to use and one that is not. The automation system should do as much of the busy work of the transfer as possible. The operator should not have to deal with the details of operating either computer to make the transfer. The automation system should extract the information it needs from the traffic

*Continued on page 36*

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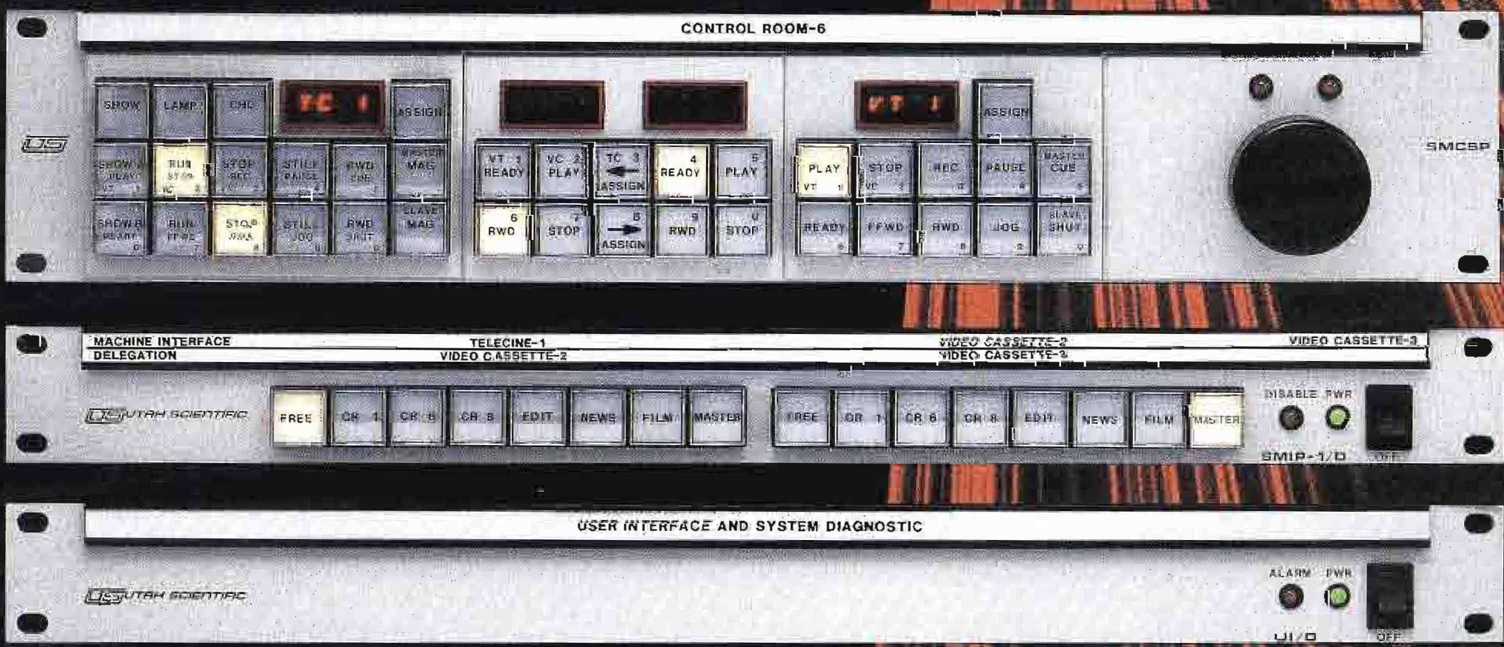


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*Continued from page 32*
log, ignore any unneeded information, and ask the operator for any essential information that is not present.

The storage capacity of the system is another factor to consider. It is desirable for the automation system to store several days worth of schedules and logs so there will be a backup in the event of a traffic system failure. Many stations keep a skeleton schedule in the automation system for a full week. This skeleton is a typical schedule for each day of the week, and can be edited manually if the day's actual schedule is not available from the traffic system.

Storage of logs allows as-run logs to be saved until the traffic system is operating again. The alternative is to manually enter logs into the traffic system from the printed listing. Considering that most traffic personnel do not work weekends or holidays, this storage capacity can be a real asset when no one is in the traffic department.

### The automated cart machine interface

In the last two years a new breed of automated cart machine has been introduced. These machines can do more than those of the past and it is essential that an automation system take advantage of these capabilities. A system should be capable of interfacing to these

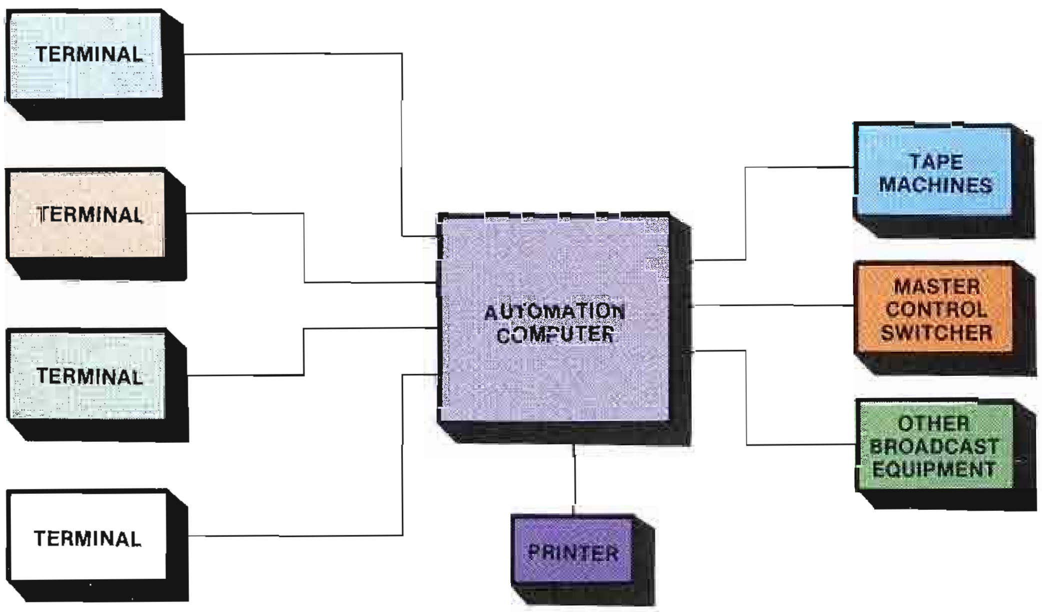


***Figure 7.*** *Some systems use a central CPU and remote terminal hardware configurations.*

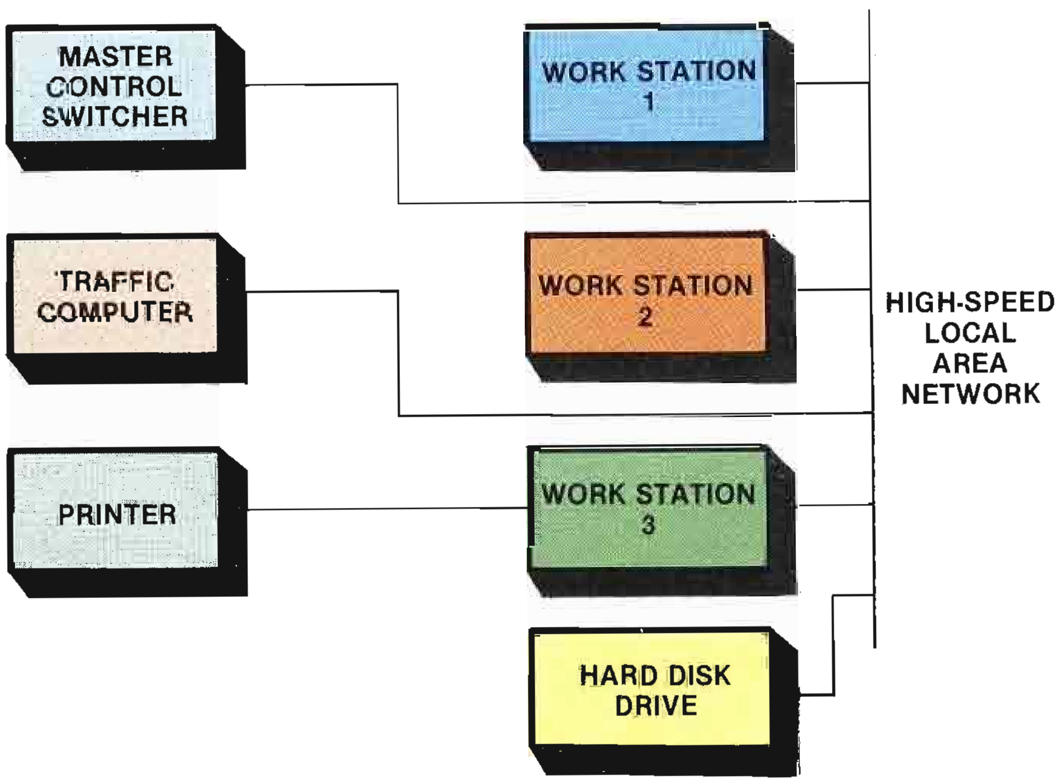


***Figure 8.*** *The traditional network-based hardware configuration approach.*

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machines serially and directly downloading schedules and play lists into them. Information about machine status and carts not present should be reported back to the automation system and, in turn, back to the operator. Play lists should be updated automatically when the schedule is edited at the automation system. Ideally, the only operator interface to the cart machine would be to load or unload carts as instructed by the system.

### The automation hardware

Because computers have changed so much in the past five years, so should the computer hardware used for automation systems. It is important that automation systems use modern hardware with an up-to-date design. For example, hard disks have become reasonably priced, and an automation system without a 50Mb to 100Mb hard disk may not have sufficient storage capacity for the needed schedules and logs. Eight- and 16-bit processors have been replaced by 32-bit machines, which are much faster and, often, no more expensive. It also is important to have sufficient memory in the system to store current lists and schedules.

In general, evaluate the hardware being used in the same way you would any other computer equipment purchase and don't settle for hardware that you wouldn't buy for general use.

The computer should use a standard, industry-recognized operating system. Examples include UNIX, VMS, MS-DOS and several others. Automation systems that do not use a standard operating system are difficult to modify and maintain. If the utilities for maintaining the computer system are missing, disk backups and other similar functions will be difficult. These utilities always are present with standard operating systems, but usually are missing otherwise.

A final and important consideration is the hardware configuration. Some systems use a main CPU and remote terminals (see Figure 7). Others use remote work stations, tied together by a network of some kind. At first glance, the network approach seems to be more reliable, but may not be. The reason is that, generally, the master control switcher is connected to one work station, the traffic system to a second, and system printers to a third (see Figure 8). This means that if the work station controlling the master control switcher fails, the system is down and the other work stations don't do any good.

Similarly, if any one of the others fails, the functions associated with that work station are lost, and the other work stations can't replace them. Also, the hard disk has to tie into the network, and wherever it ties in is a potential severe failure point. Without the hard disk, the

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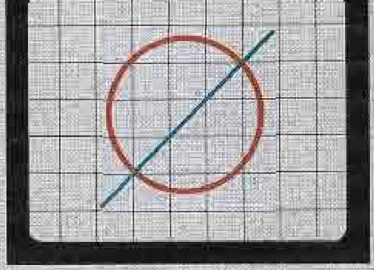

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system is down.

Finally, any work station can take the network down, again shutting down the system. It is possible for a networked system to increase the number of failure points rather than decrease them. This can be prevented by proper network design, by making the master control switcher and the disk drives actual network nodes instead of connecting them to a work station (see Figure 9). So far, however, this approach is not well supported.

Large computers and operating systems often have difficulty executing events with split-second accuracy. They often are supplemented by a small computer running some kind of a real-time executor, usually locked to a house master clock system (see Figure 10). The main computer sends events to the small one ahead of time, and the small one actually executes them. This can substantially increase switching accuracy.

In general, be sure the hardware architecture used makes sense, has a minimum of failure points, and features sufficient memory, CPU, disk and operating system capacity for your application.

### Automation system software

An automation system's software is what makes it operate. It must be properly written and documented. Nearly all modern automation systems are written in the *C* programming language. This language is powerful and it is structured, meaning that it encourages good programming practices. It also is extremely transportable and available on nearly all machines. An automation system written in a simple language, such as Basic, or in assembly language is not likely to provide the power and flexibility required.

Be sure to find out about software update policies. Software always contains bugs, and the manufacturer should be willing to provide new releases and updates of the software as the bugs are fixed and new features are added. Know the policies of the vendor on new software releases. Some do not provide any ongoing releases; others provide them regularly; and some offer updates as part of a maintenance agreement at an additional cost. Make sure that you know the details of what you do and do not get with your system.

### Controlling the rest of the station

All automation systems control the on-air signal. Most provide some additional features. An automation system that can control your central house routing switcher and start and stop your machines can take care of recording incoming feeds, playing back tapes for outgoing feeds, dubbing, network delays and many other routine tasks. It is desirable to maintain these events in a

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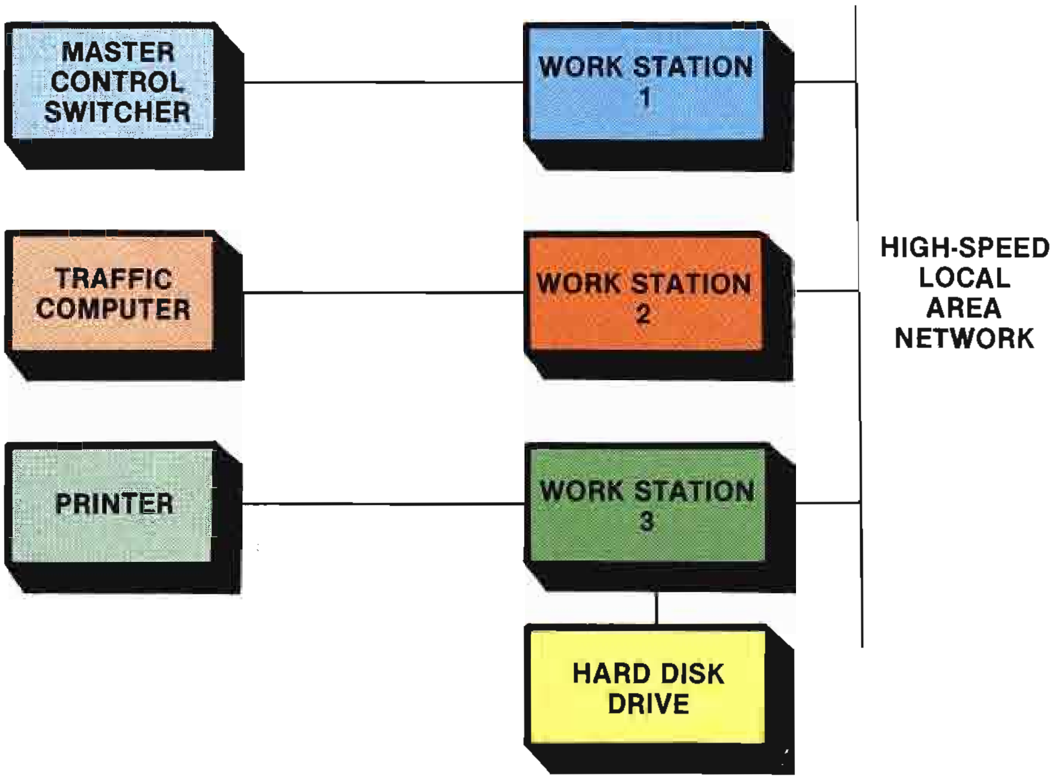


***Figure 9.*** *An alternative to the traditional approach has fewer failure points, but is not as well supported.*

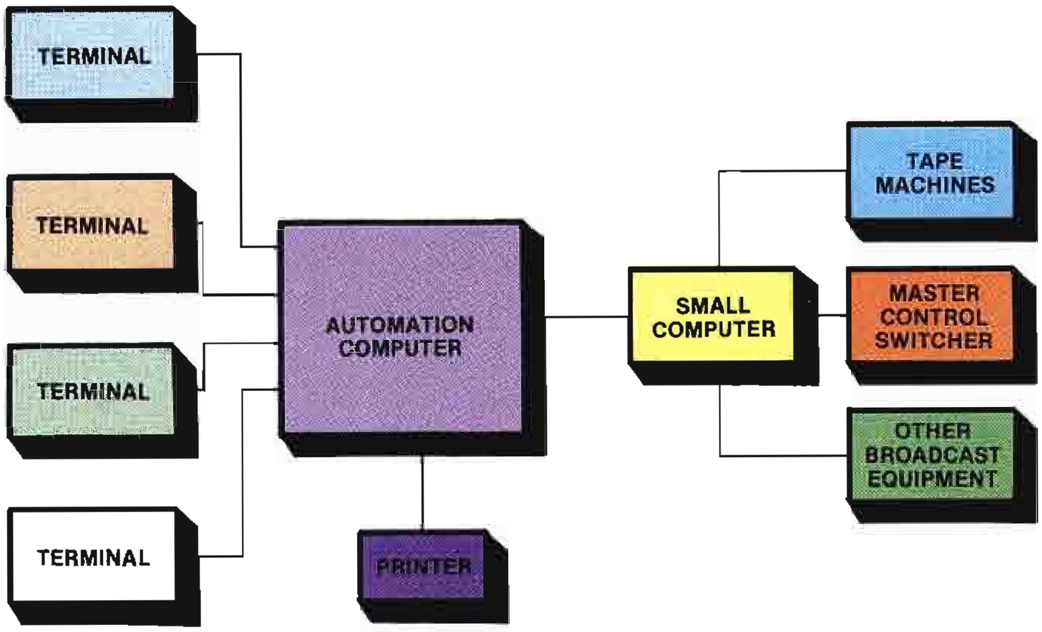


***Figure 10.*** *A small computer locked to the master house clock can increase switching accuracy.*

separate schedule from the on-air events so that they don't get in the way of the master control operator. The maintenance of separate schedules also protects the on-air events from someone who is editing the non-on-air schedule. These facilities can be extremely useful and, in fact, some stations have purchased automation systems just for these features, and do not control their on-air feed from automation.

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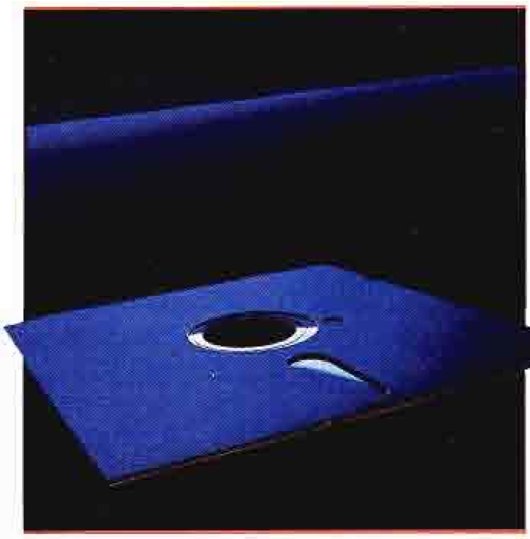


# Serial data control systems

By Waldemar S. Wisniewski

**Here's a guide to popular serial data communications for remote-control applications.**

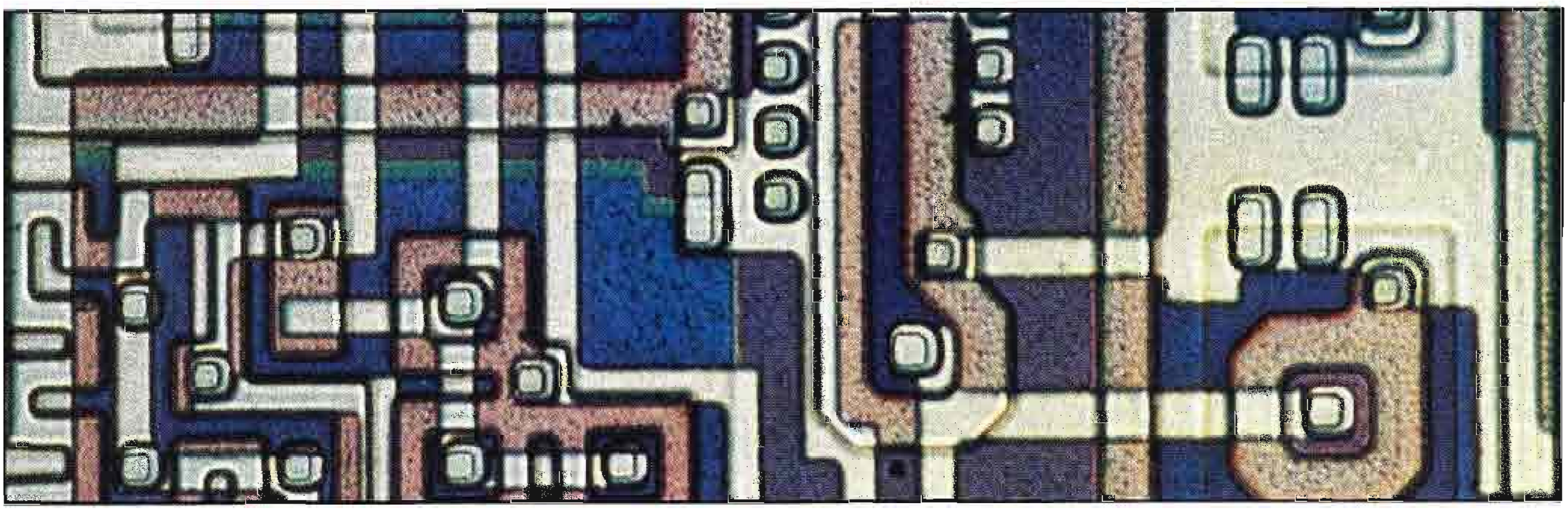


Photo by Timothy Schefter

*Integrated circuit technology is pushing the broadcast industry ahead in ways that would have been considered only science fiction a decade ago. A key element in this technological revolution is exchange of data between separate controllers and source machines.*

Traditionally, the broadcast industry has controlled video and audio crosspoint matrices by means of single line control schemes using familiar wire-per-crosspoint control panels. As switching systems become larger, or smaller switchers are incorporated into an integrated switching network, the wire-per-crosspoint approach becomes unacceptably complex.

The current proliferation of microprocessors and affordable personal computers has allowed the manufacturers of switchgear components to use digital computers to control the actual crosspoint operations of a large switching system. However, because the crosspoint array may be separated from the actual control site by a distance of many meters, a means of communicating between the switching matrices and the control console must be developed. Before control techniques can be explored, the meaning of *digital communications* must be explained.

## Digital data

Digital data are derived from the binary system based upon a state that is either on or off. Each element of this binary system is termed a *bit*, and has a state signified as 1 for on or 0 for off. As with any numbering or communications system, several basic elements must be combined to make meaningful data terms. The most common arrangement of bits in a digital system is a collection of eight bits to form what is termed a *byte*. The byte is the most easily handled data packet in most computers and has become the de facto standard of the digital communications and control field.

The position of each bit within a byte is significant to the meaning or value of the byte. According to convention, when the elements of a byte are listed, the *least significant bit* (LSB) is written on the right, as shown in Figure 1. The bit positions gain place-holder values in powers of two in the same manner the digits in the familiar decimal system gain in powers of 10.

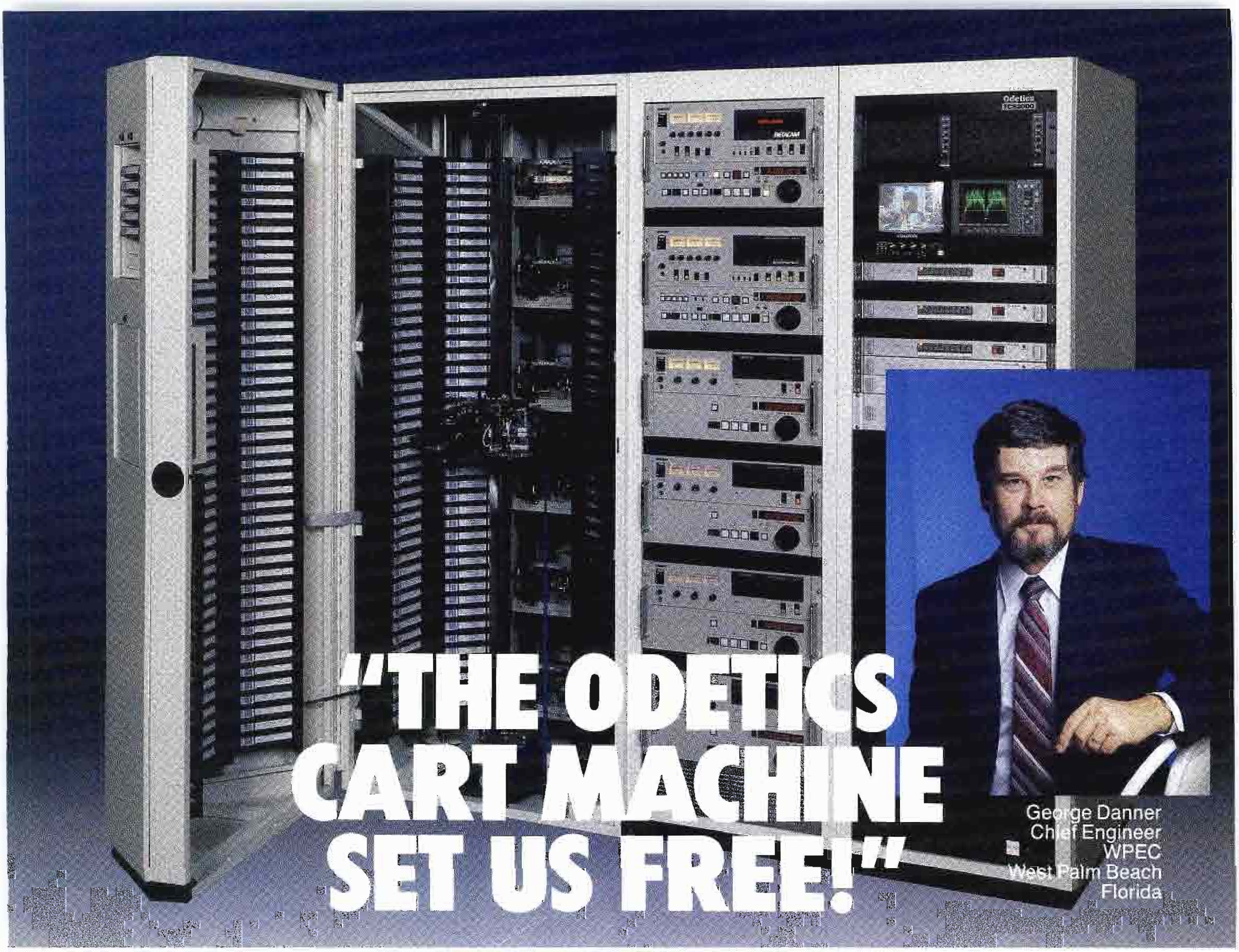
The effective value of the digit can be determined by adding the place-holder values of all digits that are 1s. There are two notable exceptions to this rule. In systems that support negative numbers, the *most significant bit* (bit 7) indicates the sign of the byte; a 1 indicates a negative value. In this case, the remaining seven bits indicate the actual value in a *twos complement* form. In this convention, the equivalent positive value of the byte is complemented (1s are set to 0s, and 0s set to 1s) and 1 is added to the result to form the byte representing a negative number. This gives a numeric range of −128 through +127 (an unsigned byte ranges from 0 through 255).

The second significant exception to the meaning of bit positions in a byte is the convention of encoding text-type data into a binary format. This encoding follows the ASCII (*American Standard Code for Information Interchange*) standard established by the EIA (*Electronic Industries Association*). In this convention, each distinct pattern established by the least significant seven bits represents a specific character or control function. The eighth bit is often used as a *parity* bit for error detection, which is discussed at another point in this article.

It is frequently convenient or necessary to combine bytes to form larger numbers. Two common combinations are encountered. The 16-bit result of combining two bytes is termed a *word* with an unsigned range of 0 to 65,535, or a signed range of −32,768 to +32,767. When four bytes are combined, this forms the 32-bit *long word* with an unsigned range of 0 to 4,294,967,295 or a signed range from −2,147,483,648 to +2,147,483,647.

Because writing eight digits to represent each byte becomes tiresome and confusing, the use of base 16 (the hexadecimal system of 0 to 9, A to F) often is

Wisniewski is senior design engineer at HEDCO, Grass Valley, CA.

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employed to represent the bits into groups of four (called *nibbles*). In this way, a byte can be written with two hexadecimal digits, a word with four, and a long word with eight.

### Parallel data transmission

Originally, the transfer of digital data was performed in a parallel manner. In this transmission format, all bits of a data packet are presented to the target device at the same time with control lines used to indicate the presence of the data packet and the direction of transmission. This technique is inherently efficient and fast and is the transmission format of choice within computer and microprocessor systems. A parallel transmission scheme allows the system to determine the address of the data or unit of interest, the actual data or command involved, and the function required within one operation whose time period is often less than 1$\mu$s.

The efficiency and speed of a parallel system is not obtained without penalty. The primary objection to using a parallel approach in remote control is the number of wires required to effect the system. A typical microprocessor busing may need 50 to 100 or more wires to operate. Even simple and less efficient schemes require a minimum of 16 wires. When the installation of cables of 25 or more pairs is considered, a parallel system rapidly becomes cost-ineffective if several remote-control sites are needed. Even if cable costs were ignored, the operational speed of today's processors severely limits the distance over which parallel systems can operate.

The reliable operational distance of a typical microprocessor bus system is measured in centimeters due to the transmission line and delay requirements encountered at these speeds (some systems operate at up to 10 million data transfers per second). Even the popular IEEE-488 GPIB (*general-purpose instrumentation bus*) is not reliable beyond 10 meters and still requires the use of a 24-wire cable.

### Serial data transmission

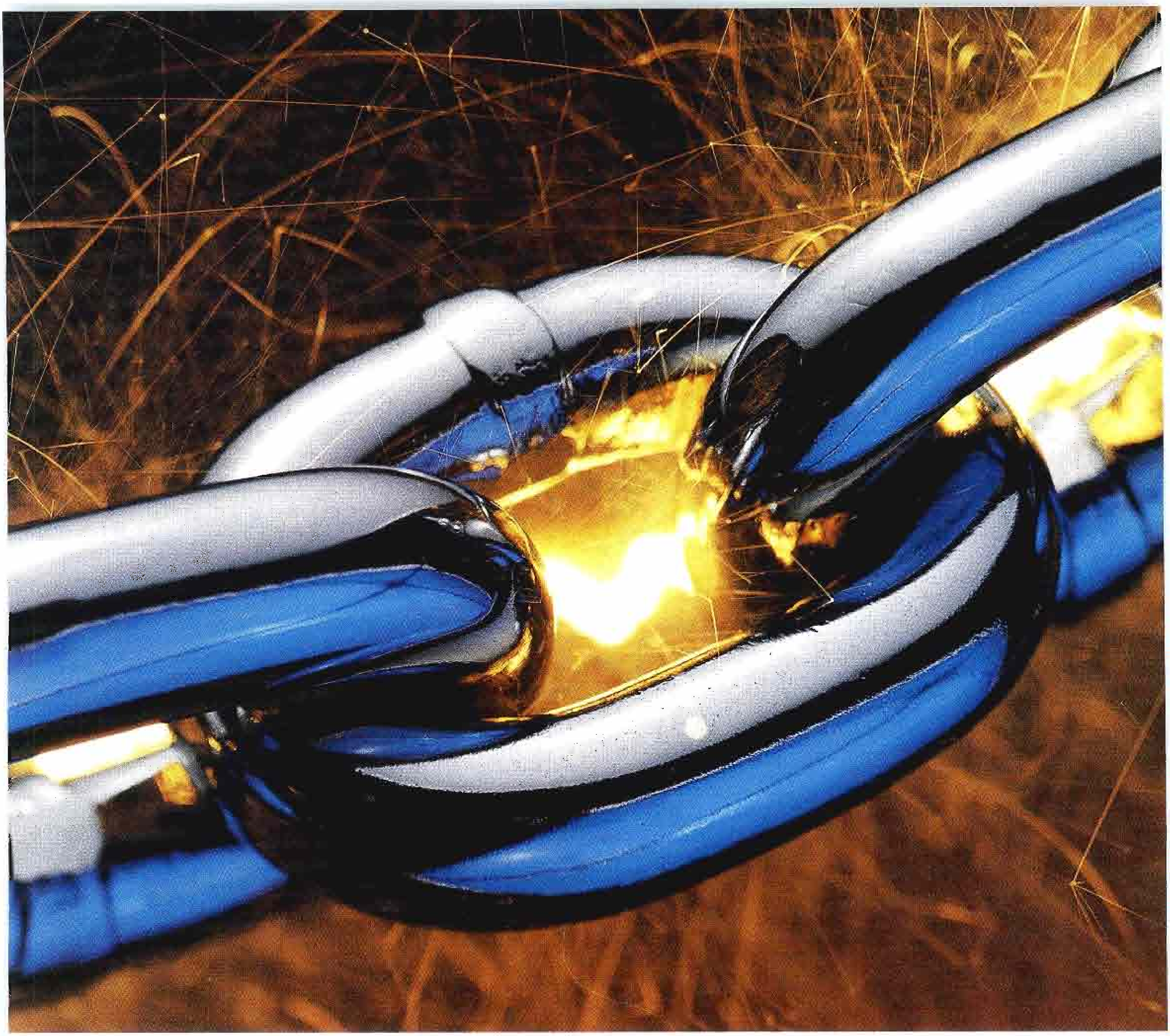
The need of the broadcast industry to remotely control switching systems is accommodated by the use of serial data transmission. Serial data transmission is accomplished by presenting the data to the target one bit at a time until all the data have been transferred. This technique, originally developed for the teletype communications network, is similar in approach to the telegraph systems of the 19th century. Each databit is presented in its own time slot, and when all bits composing the desired data packet (most commonly a byte) have been received, the data packet is processed by the target in the normal parallel mode.

The major advantage of this approach is that the communication system requires few wires to implement (typically two wires with a maximum of eight in an extremely high-speed system). This is a boon when a major installation must be cabled.

The main drawback in a serial data transmission system implementation is the time required to assemble the received bitstream into a meaningful packet. Some of the faster systems typically operate at one million bits per second. Many more commonly used applications reach only 1,200 or 9,600 bits per second. Although this loss of efficiency is equivalent to two orders of magnitude as compared to parallel systems, serial transmission overcomes this loss in the distances over which the system can be applied.

Even the simplest systems routinely operate over a distance of 100 meters, while sophisticated systems can operate over several kilometers. It is this effective operational distance, coupled with the reduced cabling costs, that make a

*Main story continues on page 52*



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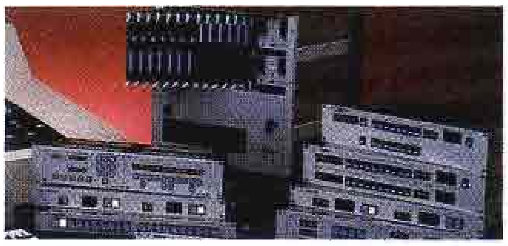

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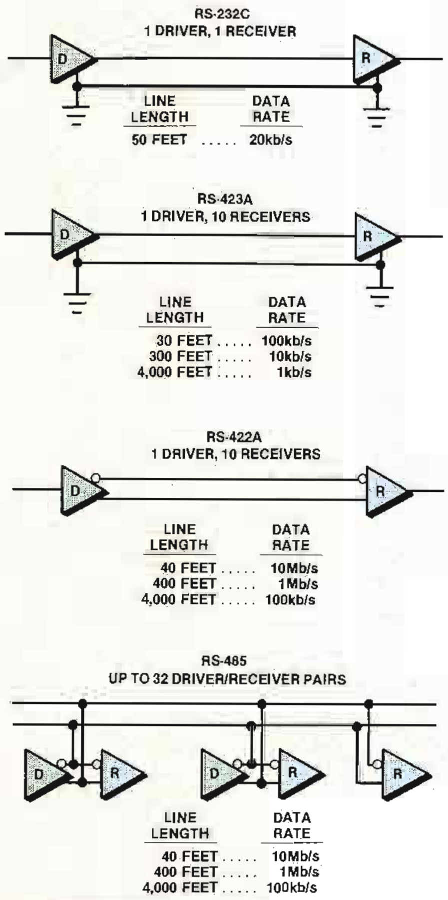
# Comparing standards




*Configurations of popular EIA interfaces.*

Only RS-232 defines all aspects of asynchronous serial data communications typically used with data terminals and modems. It specifies a controlling device (DCE) connected to an operating device (DTE) via a dedicated data link. The data are transmitted in an asynchronous manner with a leading *start* bit (a *space*), followed by five to eight databits, transmitted least significant bit first. The data information is optionally followed by a parity bit, and the packet is completed with one or two *stop* bits (a *mark*). When the data link is idle, the line is maintained in a marking state. All bits use NRZ encoding.

RS-422, RS-423 and RS-485 specify only the electrical characteristics of the transmission environment.

| PARAMETER | | RS-232C | RS-423A | RS-422A | RS-485 |
|---|---|---|---|---|---|
| MODE OF OPERATION | | SINGLE-ENDED | SINGLE-ENDED | DIFFERENTIAL | DIFFERENTIAL |
| NUMBER OF DRIVERS AND RECEIVERS ALLOWED | | 1 DRIVER 1 RECEIVER | 1 DRIVER 10 RECEIVERS | 1 DRIVER 10 RECEIVERS | 32 DRIVERS 32 RECEIVERS |
| MAXIMUM CABLE LENGTH (FEET) | | 50 | 4,000 | 4,000 | 4,000 |
| MAXIMUM DATA RATE BITS/SECOND | | 20k | 100k | 10M | 10M |
| MAXIMUM COMMON-MODE VOLTAGE | | ±25V | ±6V | 6V −0.25V | 12V 7V |
| DRIVER OUTPUT | | ±5V MIN ±15V MAX | ±3.6V MIN ±6.0V MAX | ±2V MIN | ±1.5V MIN |
| DRIVER LOAD | | 3kΩ TO 7kΩ | 450Ω MIN | 100Ω MIN | 60Ω MIN |
| DRIVER SLEW RATE | | 30V/μs MAX | EXTERNALLY CONTROLLED | NA | NA |
| DRIVER OUTPUT SHORT-CIRCUIT CURRENT LIMIT | | 500mA TO VCC OR GRD | 150mA to GRD | 150mA TO GRD | 150mA TO GRD 250mA TO 8V or 12V |
| DRIVER OUTPUT RESISTANCE (HIGH Z STATE) | POWER ON | NA | NA | NA | 120kΩ |
| | POWER OFF | 300Ω | 60kΩ | 60kΩ | 120kΩ |
| RECEIVER INPUT RESISTANCE | | 3kΩ TO 7kΩ | 4kΩ | 4kΩ | 12kΩ |
| RECEIVER SENSITIVITY | | ±3V | ±200mV | ±200mV | ±200mV |

*Comparison of popular EIA circuit standards.*

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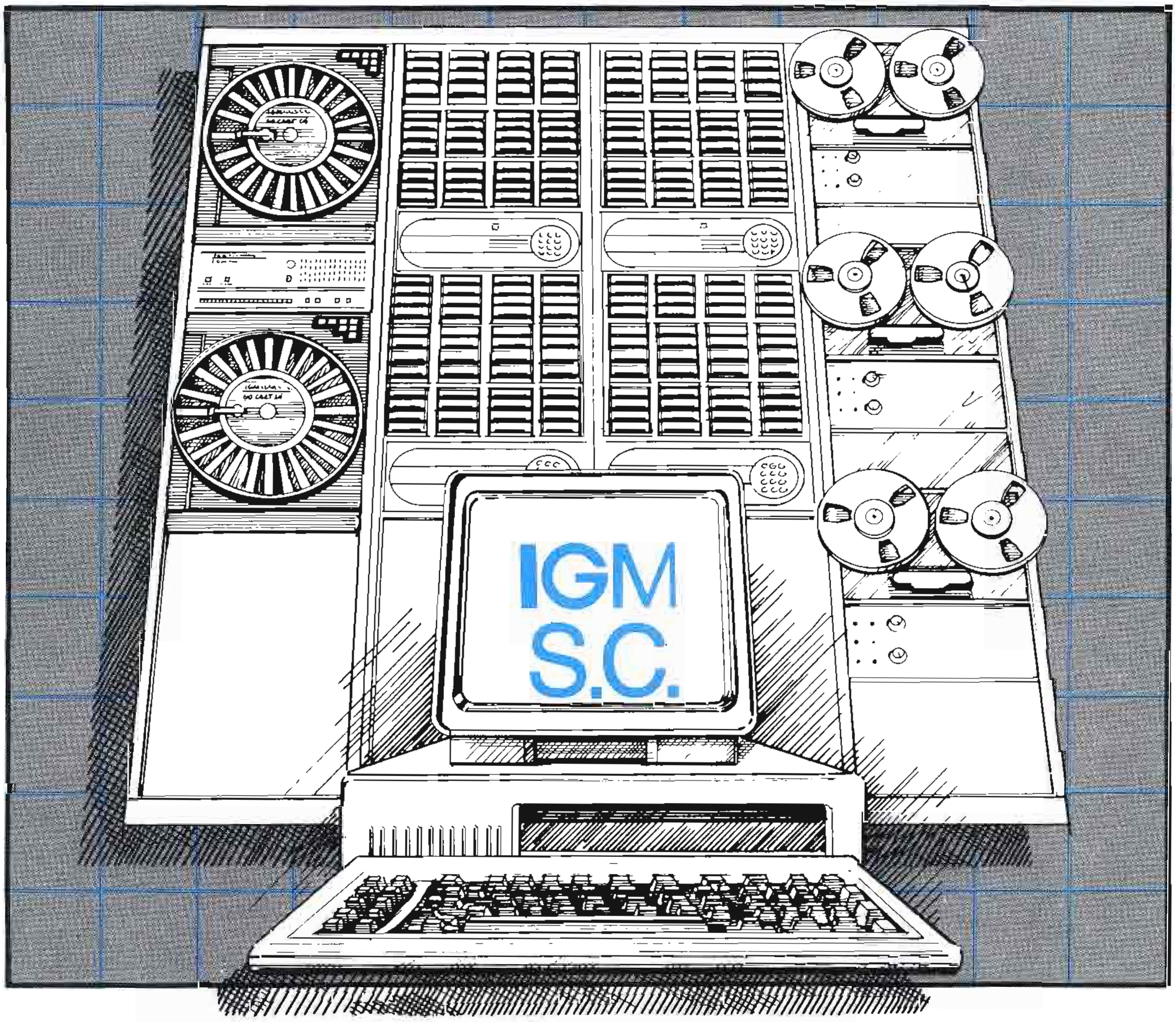


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*Over the years, Harris has treated us very well. Other manufacturers may make good equipment, but not all can give the kind of support we get from Harris."*

## KNOB, FM-RADIO
**John R. Banoczi,** General Manager
Anaheim, CA:

*"When it came time to buy a 35 kW transmitter, we found that Harris had the right product with the right features at the right price — so we went with the Harris FM-35K.*

*Besides — Harris has an excellent reputation for backing and servicing the products it sells."*

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*"Our SX-1A, 1 kW AM transmitter performs as advertised. It gives us a stand-out presence on the dial — especially in our fringe areas.*

*And Harris's SunWatch has completely solved our PSA/PSSA power scheduling problems. I don't know how a station could do it otherwise.*

*When we've needed service, Harris has always come through."*

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*"Most AM broadcasters who have upgraded their facilities in this part of the state have gone with Harris SX transmitters. As you are well aware, this is a lightning prone area of the country, and our SX-5A has performed well above our expectations in the area of maintenance and downtime.*

*We chose Harris for its professional service and support. I have a good rapport with Harris people."*

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*Harris knows how to treat its customers. Harris is going to win!"*

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**Dale Eggert,** General Manager
Algoma, WI:

*"Our FM-3.5K, 3.5 kW transmitter has operated flawlessly since our sign-on last November.*

*And our Harris representative not only helped us put our equipment package together, but stayed on duty* **after** *the sale to see that we met our critical air date!"*

## WKNO, VHF-TV
**Pat Lane,** Chief Engineer
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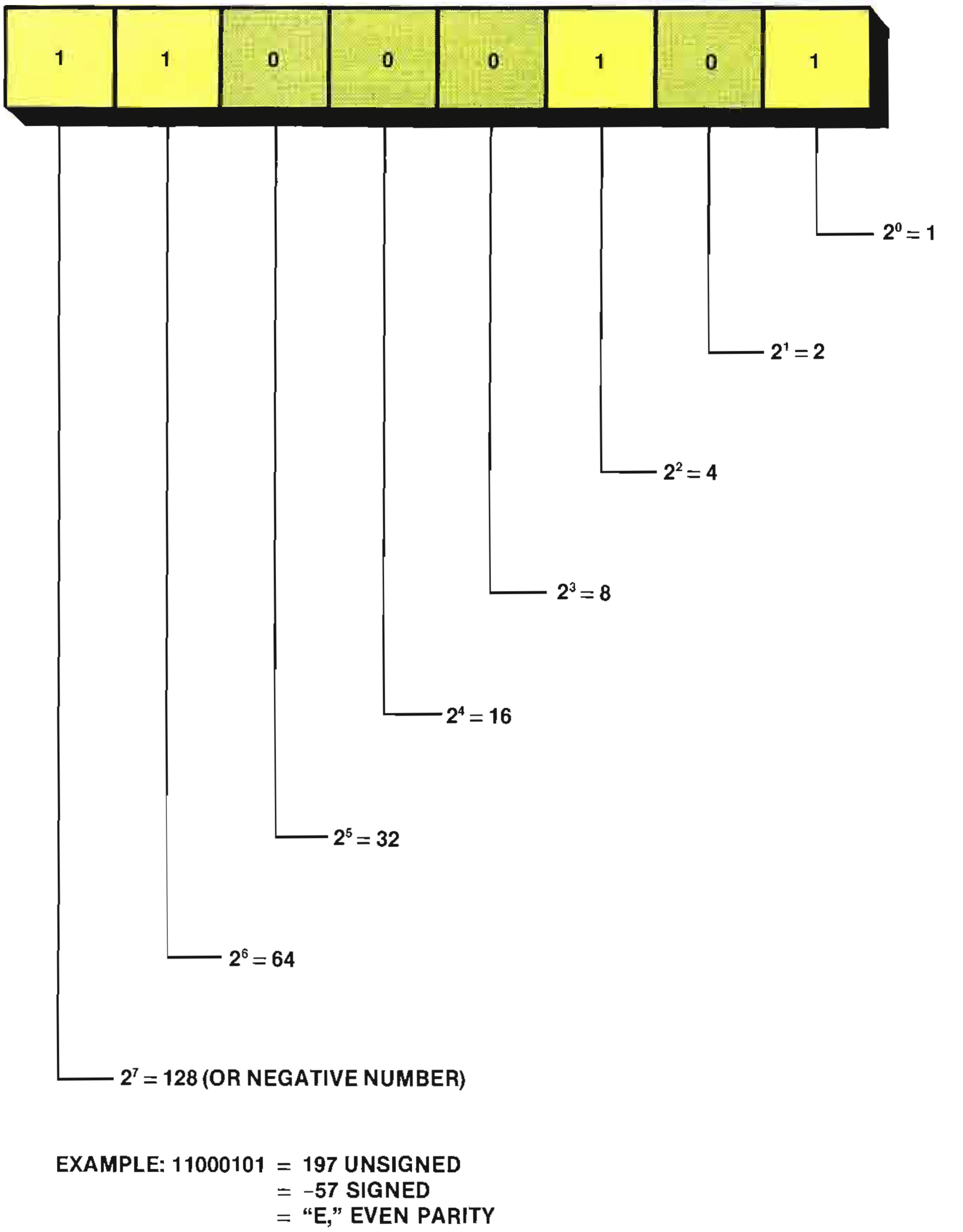


***Figure 1.*** *Bit positions in a byte gain place-holder values by powers of two.*

*Continued from page 46*

serial data communications system attractive in the control of broadcast switchgear.

### Principles of serial data transmission

Several items must be considered when attempting to implement a serial data transmission system. The first of these is the type of data link to be used. Once the basic serial data communications link is selected, the actual means of controlling the serial datastream must be determined. Although these two decisions are treated separately in this discussion, the choice of one often will dictate the other.

There are four common types of data links. The simplest form of serial communications is the dedicated data link (see Figure 2). In this approach, one set of lines is used to connect two locations. Usually, one location is the controller (termed data circuit-terminating equipment, or DCE) and the other is a data terminal (called data terminal equipment, or DTE); often, however, both ends of the data link are given equal status.

The only major concern in this type of system is whether the individual devices possess sufficient processing power to transmit and receive data at the same time (*full duplex*) or must transmit and receive data on a time-sharing basis (*half-duplex*). Because only two devices can operate in this manner, the use of dedicated data links typically is limited in broadcast switchgear to the connection of an external computer or master control console.

### The star connection

A second type of data link is the *star* connection, as shown in Figure 3. In this system each remote device is connected to the central unit via a dedicated data link. Although the central unit can be a switching exchange such as a data router, most often it is the processor of the primary switching matrix or a separate computer. The main advantage of this technique is that all remote devices can be active simultaneously within the limitations of the central unit.

Two primary limitations exist with the star approach. Because each unit is using a dedicated data link, the operation of one unit is hidden from the balance of the system unless the central unit rebroadcasts the operation, thus tying up the other data links during the rebroadcast time.

The second limitation consists of remote unit logistics. If a remote unit must be moved, its associated data link must be moved with it. In many installations, this means abandoning the existing cable and running another cable to the new location.

However, the star connection has a definite application in situations in which current system operation is not important to the remote site and the remote sites are essentially permanent. An example of this type of situation would be a teleconference.

### The loop

Another type of data link is the loop approach (see Figure 4). In this approach the system controller also is connected to the first device in the system. The next device is connected to the first. This daisy-chaining is continued until the last device is connected.

The last device is then connected to the system controller. The system controller initiates a message to the first device. This unit then passes the initial message down the daisy-chain and adds its own data (if any) to the end of the serial stream. This process is repeated until the final modified serial datastream is received by the system controller.

Although it is quite simple to implement, the loop approach is limited in a broadcast environment. As with the star data link, only the system controller is aware of the entire system operation while the remote units are blind to downstream operations. Unlike the star system, however, the loop approach allows a remote unit to be relocated and reinserted anywhere in the loop. The danger in applying the loop data link in a multi-unit control scheme is that if a remote unit fails, or is removed without closing the loop, the entire system is put out of service.

### The party line

By far the most popular multidevice data link is the *party line* (see Figure 5). In this approach, all devices are connected to a common serial bus. The limitations and advantages of this system are determined by the actual party line usage (not that a party line is half-duplex by definition).


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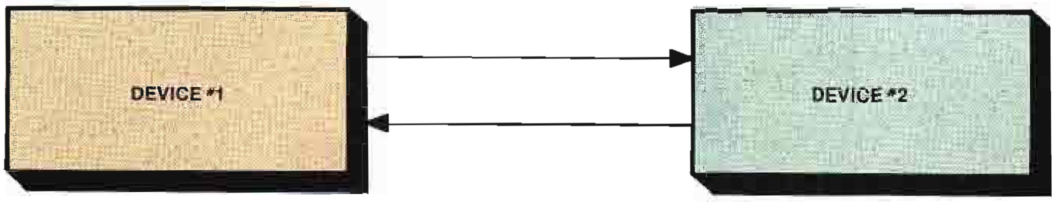


***Figure 2.*** *The dedicated data link is the simplest form of data communications.*

Three primary communication techniques currently are used. All of them share the advantages of reduced cabling and device position independence, and, because communication is performed over a common data line, all devices can monitor the system operation. However, each technique has its own distinct advantages and disadvantages.

**Polling**

The first party line technique is termed *polling.* This type of system contains a single control unit similar to that used in both the star and loop implementations. The central control unit polls each remote unit in turn to determine whether data communications are required by that unit. If a positive response is encountered, the required data transfer function is performed, then the central unit polls the next remote unit.

This approach has the advantage of being the easiest to design and implement. The main disadvantages of a polled system are the time lost polling non-active units and that the data link can have only one system controller.

A modification of the polling approach is *token passing.* In this application, the current system controller relinquishes system control by passing a *token* or software command to another system controller. This new system controller operates the bus in the normal polling manner until the token is passed to another controller.

This is the simplest implementation of multiple controllers on a single serial communications bus. Because the token will be passed to another controller, each controller can be designated to optimize bus usage and reduce time spent polling non-active units.

Two major disadvantages are encountered in using a token-passing scheme. If a controller does not service a specific remote unit during the time it has the token, communications with that remote unit are postponed until another controller is established. This can be a serious limitation if the remote unit is requesting a crosspoint operation that must be acted upon immediately. The second disadvantage is that if the controller that has the token fails, the system becomes inoperative unless some form of bus monitor is used.

The most efficient use of a party line data link is through the use of a *collision detection* scheme. In this approach, all devices on the party line have equal access to the serial databus. When one device must communicate with another, it monitors the bus to verify that no other device is currently transmitting and then transmits its data. Because all devices monitor the serial databus, the intended device receives the message. If more than one device attempts to use the bus at the same time, a *collision* occurs, and the data transmitted are meaningless.

In the collision detection scheme, a transmitting unit monitors the actual data placed on the bus. If the bus data differ from the data being sent, a collision is assumed and the transmission is aborted.

*Continued on page 58*

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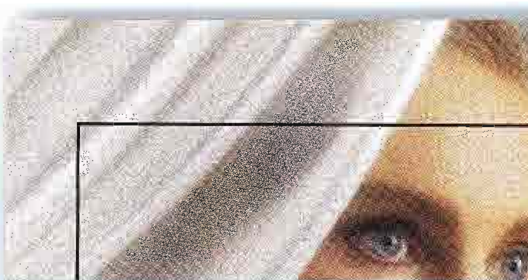


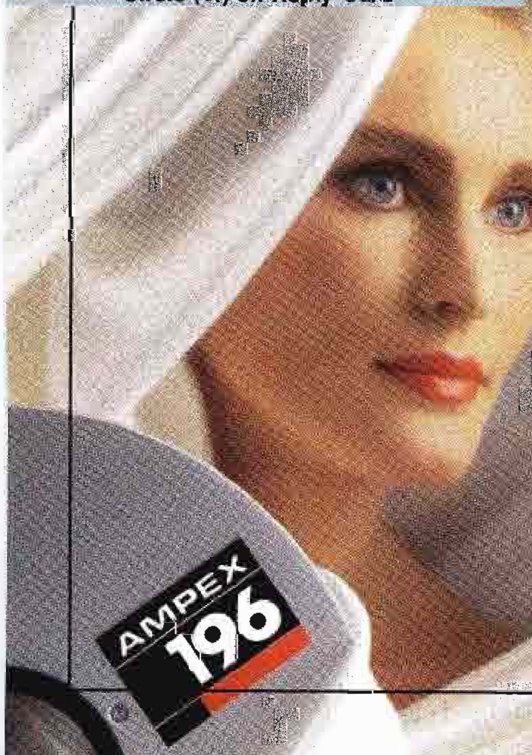

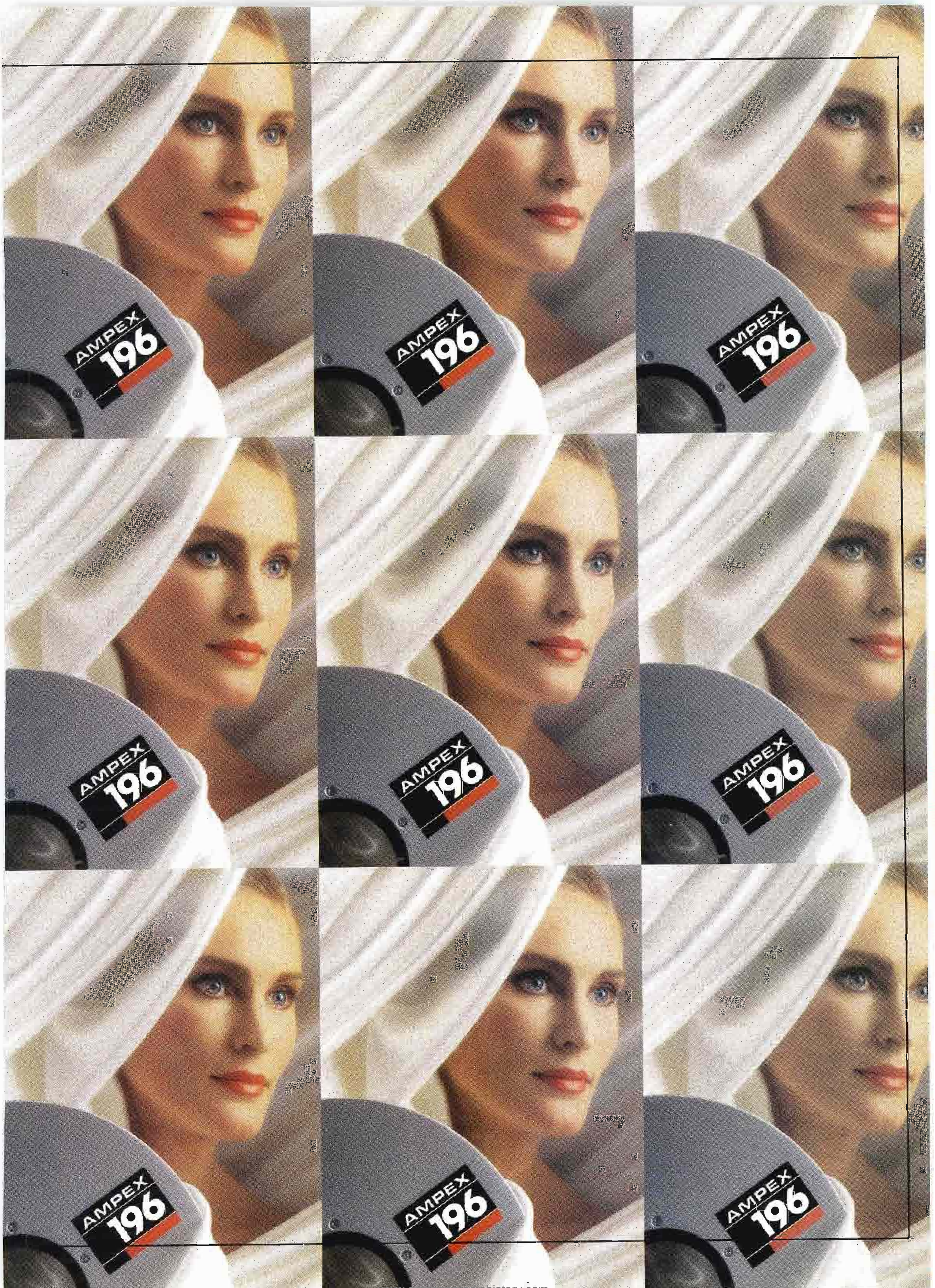
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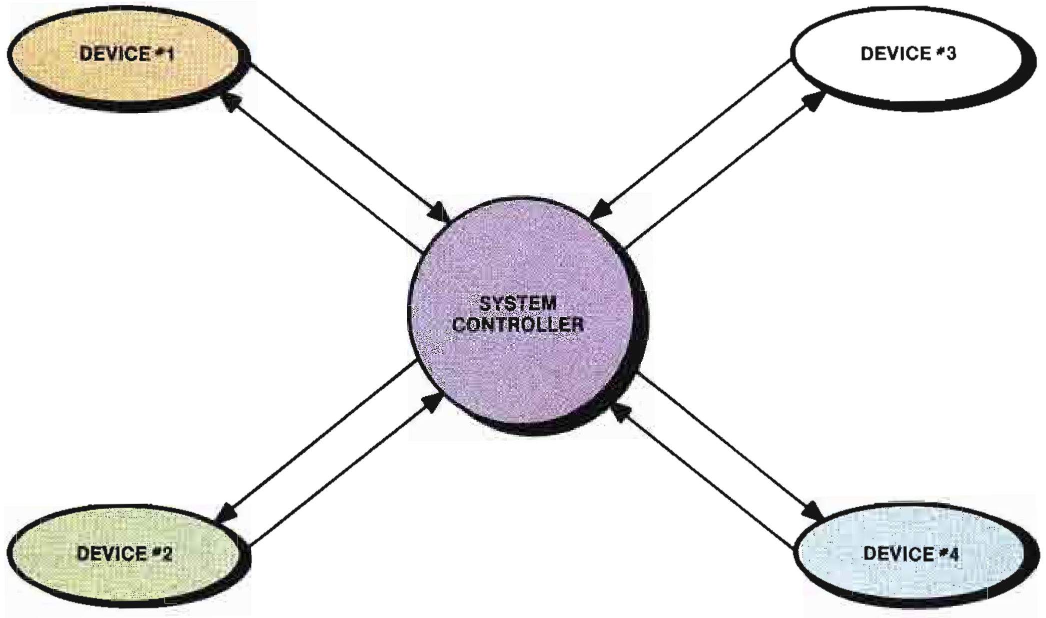


***Figure 3.*** *The* star *data link is characterized by dedicated data links between each remote device and the central unit.*

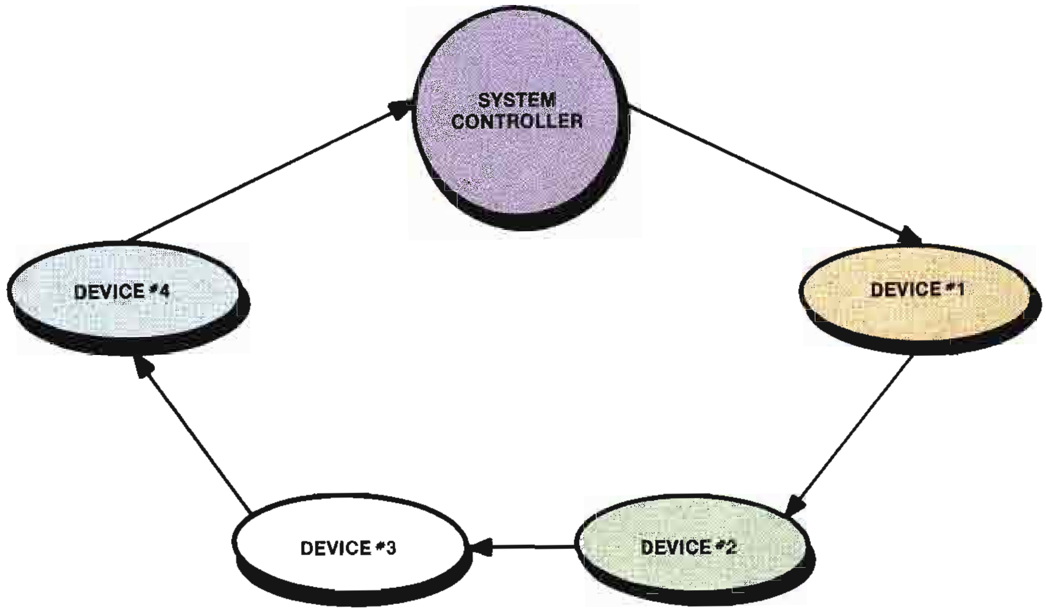


***Figure 4.*** *The* loop *data link is simply a double-ended daisy-chain.*

*Continued from page 54*

A pseudorandom amount of time passes before the unit attempts to use the bus. This pseudorandom time prevents the continual bus-crashing that would occur with fixed wait periods.

The use of a collision detection technique optimizes the bus usage, reduces response time to a system communications request and allows for device removal without disabling the system operation. The costs for these advantages are increased device complexity necessary to detect and respond to a bus collision and extensive system planning to account for independent unit accesses to the serial data link.

### Control of the serial datastream

The simplest way to control the data flow of a serial stream is to use a synchronous clocking scheme. In this approach, two wires are used in each data direction. One contains the actual databits being transmitted, and the other line is used to inform the receiver when the databit is valid. The advantages of this technique are that its speed is greater than any serial control approach and that the communication rate is system-independent because the transmitter lets the receiver know when the data are valid.

Although of major benefit in star or loop systems, a fully synchronous approach is not always the technique of choice in a broadcast switchgear control environment. Because a separate clock line is required for both directions of communications, five to eight wires are required to implement this technique. The requirement of a separate clock line also precludes the use of a fully synchronous system in a party line data link.

Several techniques have been devised to transmit synchronous serial data without a separate clock line. All of them require the system to assume a fixed clock rate and encode the clocking information into the actual datastream. Although these encoding approaches make the communications rate application-dependent, they remove the requirement for separate clocking lines and allow for use of a party line data link. Most effective multiple-device serial control systems use some form of encoded-clock synchronous technique.

An extremely popular means of transmitting serial data is to use an asynchronous technique. The most common protocol used is the EIA RS-232 standard for information exchange. This data format is asynchronous only in the timing of each data packet; the individual bits are located by an assumed clocking rate (thus an asynchronous serial data communications rate is application-dependent).

The datastream is used to synchronize the timing clock by going from the idle *mark* state (typically a 1) to the *space* state for a 1- bit time period. The balance of the serial data packet of up to eight databits follows, least significant bit first. An optional parity bit may be included after the data packet. The end of transmission for the packet is set by a stop bit that remains in the mark state for one (or optionally, two) bit periods.

Although the asynchronous technique is inefficient due to the overhead of the start and stop bits, it is the easiest to implement in dedicated data links and is universally employed under the RS-232 protocols in interfacing computers, modems or data terminals to broadcast switchgear.

After the type of serial data communications has been decided there is usually confusion about what else to specify in order to implement the system. Often, buzz words such as RS-232 or RS-422 are used as a description of a serial data system. In order to complete the specification of the communications system, the data-encoding technique, system electrical characteristics and the actual data-handling protocols must be firmed.

### Data encoding

Data encoding refers to the actual means of defining a 1 and a 0 condition of a serial databit. The need to include the clocking information in the datastream has caused the emergence of several different encoding schemes (see Figure 6).

The original encoding is called *NRZ* (non-return to zero). In this technique, a stream of data that contains 1s remains in the mark state until a 0 is encountered. The datastream then stays in the space condition until another 1 occurs.

This is the easiest design to implement. However, unless a separate clocking line is supplied, the time slots of the in-

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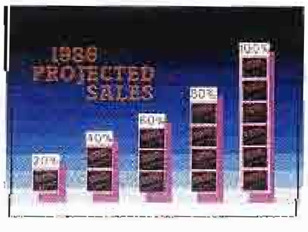




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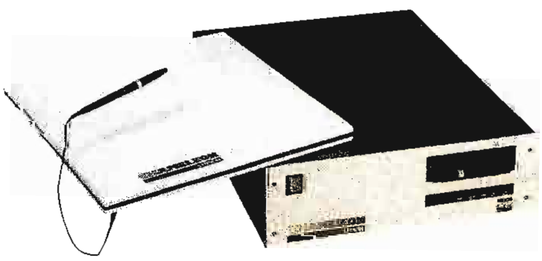

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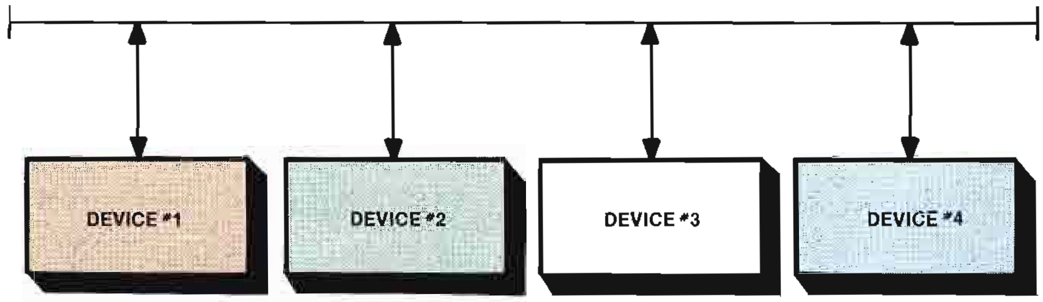


***Figure 5.*** *The* party line *data link is the most popular multidevice data link. All devices are connected to a common serial bus.*



dividual bits are unknown. Even with the assumed clocking of the asynchronous encoding specified by RS-232, only a few bits (typically less than 12 to 15) can be accommodated before the time slot for subsequent bits becomes uncertain without packet resynchronization. Despite this limitation, the NRZ encoding, combined with the additional specifications of EIA standard RS-232, remains the technique of choice for dedicated data links and is the only serious alternative for communicating with standard data terminals or modems.

The advent of cassette tape units for external data storage posed a problem that could not be solved by NRZ data encoding. Because magnetic media is used to store data on tape, the stored data require some form of alternating field to be read by the pickup heads.

This requirement led to the development of the *bi-phase* encoding technique (sometimes referred to as Manchester I). This encoding scheme uses a state transition at the time boundary of each bit in the datastream. The direction of this transition (whether mark to space, or space to mark) is insignificant because this technique monitors only state transitions rather than the actual mark or space states of NRZ. Because the data rate is assumed by the system, the approximate times of these transitions are known and the receiver can synchronize easily with the serial datastream.

To determine the presence of a 0 or 1 state of the current databit, the receiver monitors any transition at the middle of the bit time slot. A transition at this time indicates that the bit is a 1, while the lack of a transition indicates a 0.

The bi-phase technique has the advantage of offering clocking information within the datastream as well as an encoding that has no effective dc component while the datastream is active (a requirement of magnetic or transformer-coupled serial data systems). The primary disadvantage of the bi-phase encoding is the difficulty in decoding the transmitted datastream.

To relieve some of the decoding problems of bi-phase, the technique has been updated to what is now termed Manchester II (commonly referred to simply as "Manchester"). This encoding technique is similar to bi-phase. Only state transitions are used to extract the clocking information and to determine the value of the databit. The main difference is that the transition in the Manchester II approach occurs at the mid-bit interval. If the bit is a 1, the transition is from mark to space; otherwise the transition is from space to mark.

This approach shares all the benefits of bi-phase (clocking information and no dc component) and is easier to generate and decode. Manchester II encoding is the

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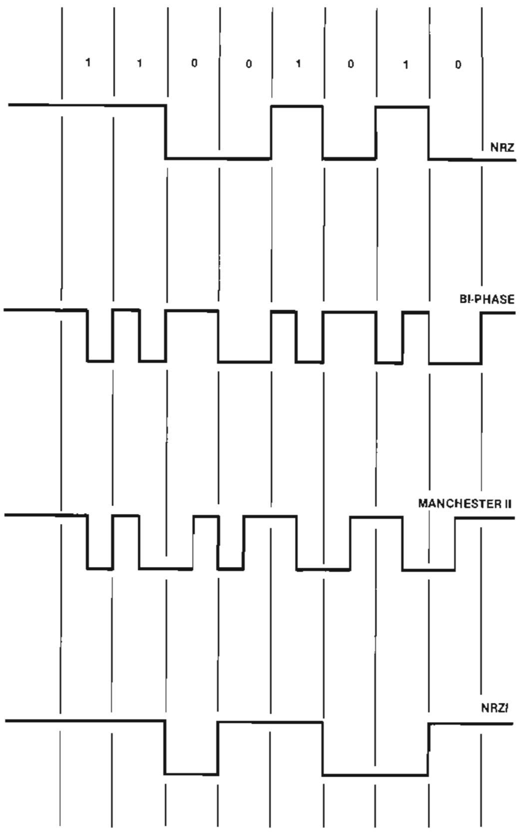


***Figure 6.*** *Typical data-encoding formats.*

technique of choice in modern transformer-coupled serial communications systems using a party line data link.

A fourth encoding scheme has been developed for *high-level data link control* (HDLC) applications. The *non-return to zero inverting* technique (NRZI) maintains the basic advantages of the NRZ encoding while presenting clock synchronization information at sufficient intervals. In NRZI, the clock rate is assumed and the datastream maintains its current mark or space state as long as the databits are 1s. Whenever a 0 is encountered, the stream changes to the opposite state. This transition defines the location of 0s in the datastream as well as providing a bit boundary for clock resynchronization in long datastreams.

This encoding technique, however, must be reserved for use with the HDLC/SDLC (synchronous data link control) communications protocols, because only these protocols guarantee a sufficient number of 0s within any datastream to provide adequate clock resynchronizing transitions.

### Baud rate

The term *baud rate* often is used in defining the data transmission rate of a serial data link. Because baud rate is actually the maximum possible transitions rate, this term is correct when applied to bit rates of NRZ and NRZI encoding. However, the maximum transitions rate in bi-phase or Manchester II encoding is twice the actual data transmission rate (hence the baud rate is twice the bit rate). Unless NRZ or NRZI encoding is used, the transmission rate should be specified in bits per second rather than baud.

### Electrical characteristics

The electrical characteristics of a serial data link are fairly easy to describe, because they are well defined in industry-established standards. Following are descriptions of the four standards commonly encountered in the broadcast industry:

The most familiar of all serial data communications standards is RS-232, established by the EIA (see Figure 7). Although its use is limited to dedicated data links, this is the only standard commonly used in the broadcast industry that defines all aspects of implementing a serial data link (except for the data rate). As noted previously, RS-232 specifies NRZ encoding. A mark state (1) is established at −5Vdc to −15Vdc while a space state (0) is set at +5Vdc to +15Vdc.

The undefined region between –5Vdc to +5Vdc is used as a buffer to reduce the effects of electrical noise on the serial datastream. This noise can originate from motors, power wiring, lighting equipment or other electrical equipment

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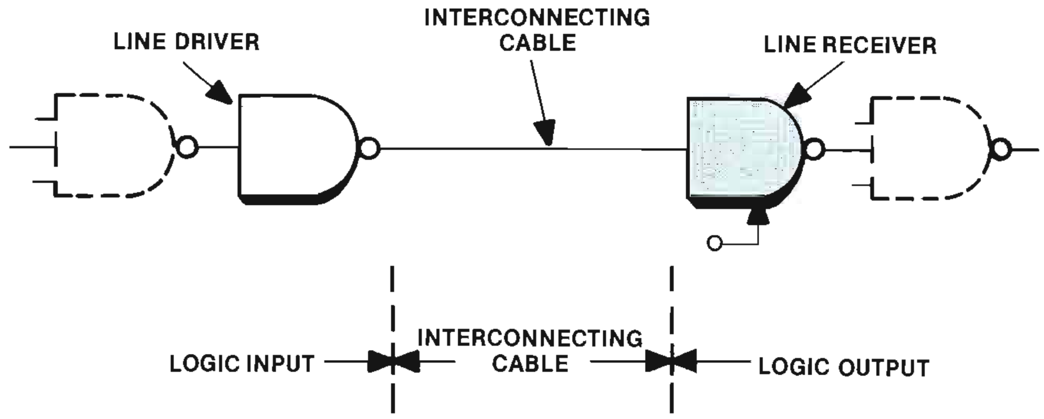



*Figure 7. The most familiar of all serial data communications: RS-232.*

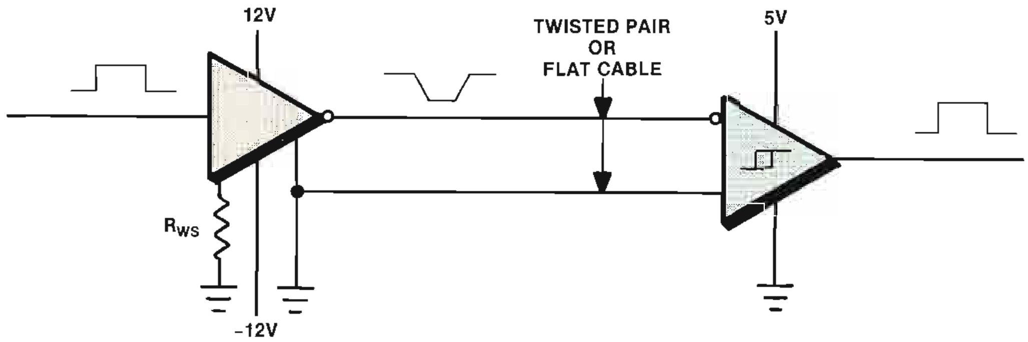



*Figure 8. RS-423 communications forms a link between RS-232 and RS-422.*

operating in the vicinity of the data link.

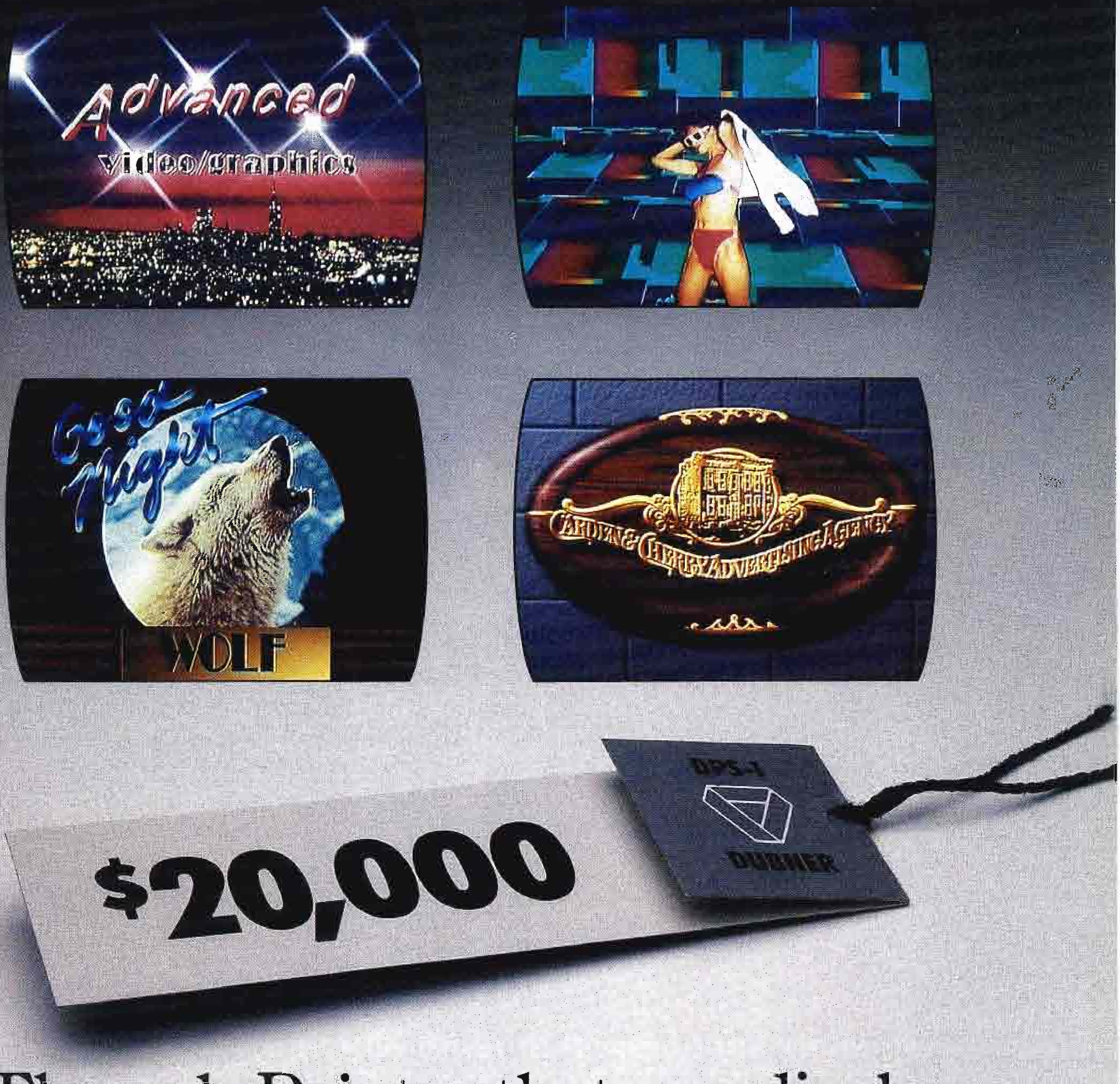
Three items limit the application of RS-232 in high-speed serial data communications. Because the specification limits the rate of change from one state to another (called *slew rate*) to reduce noise radiation from the cable, the data rate is limited to 19,600 baud. This rate is too slow for most multidevice serial links. The nature of the RS-232 standard does not allow for party line data links, thus limiting RS-232 to dedicated or star data connections. The third limitation is distance. Although installations occasionally have RS-232 cable runs in excess of 50m, the standard specifies a maximum length of 15m.

### Other standards

EIA standard RS-423 (see Figure 8) forms a link between RS-232 and RS-422. Like RS-232, this standard establishes a single-ended data link, a link that is effected with only one active wire and a signal return line such as a coaxial cable. The receivers are typically identical to those used in implementing RS-422 data links. Multiple receivers can be used, greater transmission speed is attainable and longer cable can be used. Data rates up to 100 kilobaud are possible with 50m of cable. More than 1km of cable can be used if the transmission rate is kept below 10 kilobaud.

The fact that the output of the driver is bipolar (a mark is −3Vdc to −6Vdc, while a space is +3Vdc to +6Vdc) complicates driver design. Standard inte-

*Continued on page 68*

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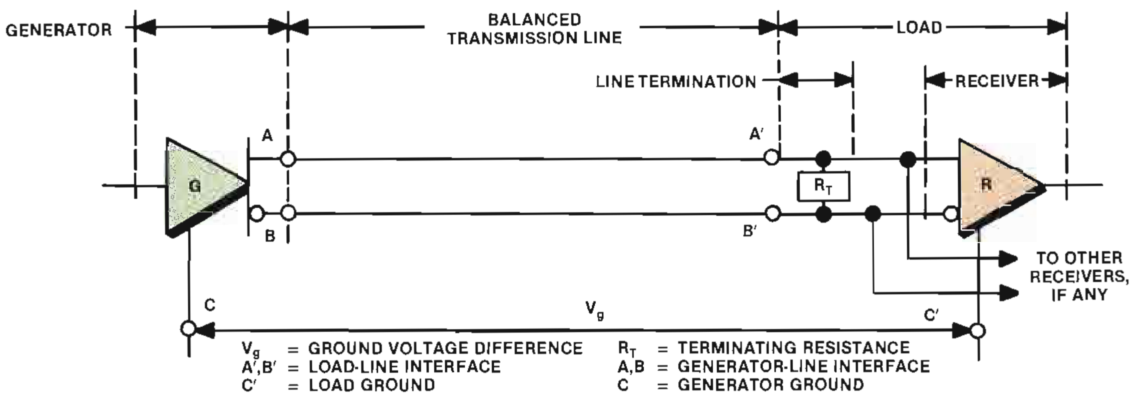


***Figure 9.*** *The RS-422 data link is ideally suited for use at a broadcast plant.*

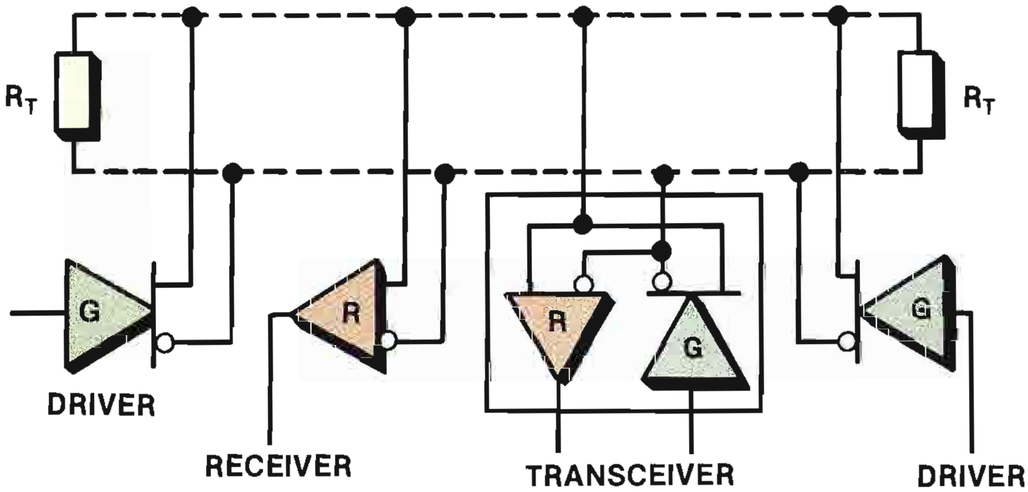


***Figure 10.*** *RS-485 is an EIA standard that addresses the party line environment.*

*Continued from page 64*

grated circuits are available for RS-232 and RS-422 drivers. This often negates any advantage gained by using RS-423.

Whenever electrically noisy environments are encountered, the RS-422 standard should be applied to the data link. This type of data link uses a balanced twisted-pair cable (one in which both lines are actively driven) that is terminated in its characteristic impedance (100Ω for most data cable), as shown in Figure 9. Although the output is specified at −2Vdc to −6Vdc for a mark and +2Vdc to +6Vdc for a space, driving both lines to opposite voltage rails allows the system to operate from normal 5V logic power supplies.

Because one line is at the logic "low" voltage, and the other line is at the logic "high," the net output between the lines is a bipolar signal that is twice the voltage present on either line. This configuration is extremely tolerant of external electrical noise. Any noise is equally present in both lines while the receiver monitors the voltage difference between the lines (±200mV is the monitored voltage band). This allows for RS-422 serial links to operate reliably at 100-kilobaud rates at distances of more than 1km and at 1 Megabaud up to 100m. These long cable lengths, high data rates and high noise

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immunity make RS-422 ideal for a high-speed serial data communications link.

According to the standard, RS-422 does not allow for more than one driver on a communications bus. This could be a major drawback. Many applications circumvent this limitation by using drivers that can be disconnected electrically from the circuit, thus allowing a party line data link to be implemented. A serious flaw with this approach is that if power is removed from a driver on the data link, the driver may short-circuit the bus and render the system inoperative.

As party line serial data systems have become extremely popular, the EIA has established the RS-485 standard, which addresses a party line environment (see Figure 10). This implementation is similar to an RS-422 application with several notable differences.

Multiple drivers and receivers may be connected to one data link (32 of any mix). Because multiple drivers present the possibility that more than one driver may accidentally be active at the same time, this type of fault will not destroy any transmitters. When power is removed from a transmitter, that unit is electrically disconnected from the data link. The party line is terminated at both ends in its characteristic impedance to prevent signal degradation, so an RS-485 driver is more robust than a corresponding RS-422 driver.

This standard is sufficiently popular that integrated circuits are available from several manufacturers to implement receivers, transmitters, transceivers and bus repeaters. In fact, a greater range of types of circuits exists for RS-485 than for RS-422.

### Transmission error detection

There are many sources of transmission errors in a high-speed serial data communications network. External or internal electrical noise spikes can mimic unwanted logic states. Faulty cables or connectors can cause bit dropouts or, in the case of a party line, multiple transmitters may be active at the same time.

There are three common techniques used in testing for serial data transmission errors: *parity*, *checksum* and *cyclic redundancy check*. Depending upon the probabilities of data transmission errors, these techniques can be used alone or in combinations.

The simplest error-detecting technique is incorporating an extra bit with each byte or work transmitted. This bit, called a *parity bit*, is used to set the total number of 1s in a bitstream to either an even amount (even parity) or to an odd amount (odd parity). Typically, if the data are transmitted as true binary bytes (all eight bits are significant), the parity bit is added to the datastream immediately following the related byte or word. If ASCII data are being sent, the parity bit traditionally is included as the eighth (most significant) databit of each transmitted byte.

The use of parity bits has the distinct advantage of determining a transmission error on a byte-by-byte basis, but this gain is offset by the added bit per transmitted byte. Another shortcoming of this technique is its failure to detect errors occurring in two (or any even number of) monitored databits.

When blocks of data are sent, a checksum can be added to verify proper transmission. A checksum is a byte determined by adding the equivalent unsigned value of each byte in the serial datastream. Unlike the parity technique, the checksum method can detect multiple-bit errors in a byte. However, errors in two or more bytes can cancel their effective contribution to the checksum and remain unprotected. This method, especially when used in conjunction with parity bits, usually reduces the possibility of undetected multiple-bit errors to an acceptable level.

When it is imperative that a trans-

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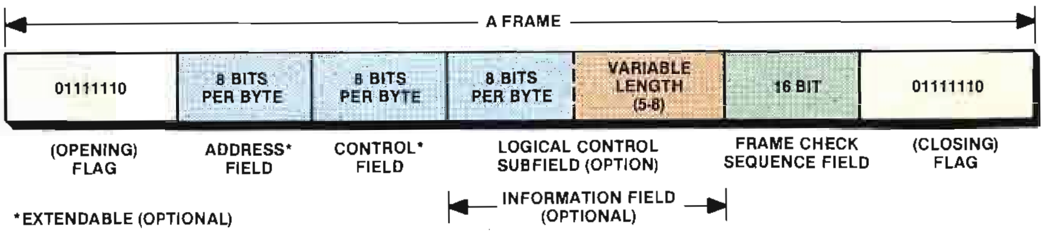



***Figure 11.*** *HDLC (high-level data link control)/SDLC (synchronous data link control) communications protocol.*

mission error be detected, a cyclic redundancy check (CRC) word rather than a checksum is appended to the datastream. This technique generates a binary word via a polynominal rather than simple addition. The possibility of an error remaining undetected using a CRC word is extremely small. Obviously, this check work is fairly complex to derive. It is fortunate that integrated circuits are available to automatically generate and verify the CRC. Many communications ICs incorporate this feature internally.

### Communications protocols

The key aspect of any serial data communications system is to deliver meaningful information from one point to another. The actual communications protocols determine how the individual units of the system will interact with the other units it operates. There is no firmly established, complete set of protocols, unfortunately, that addresses the needs of a high-speed serial data link as would be required by the broadcast industry.

There are several standards that specify what general format is to be followed and can be used as a guideline. As an example of some items that should be considered in a communications protocol, the HDLC/SDLC conventions are described as follows:

The HDLC (high-level data link control) and the SDLC (synchronous data link control) are effectively the same for this discussion and will be referred to as HDLC. The HDLC protocols specify only the data format of the serial data; they do not specify the electrical characteristics of the data link or the encoding technique, except that asynchronous encoding is inherently disallowed.

A typical HDLC datastream is shown in Figure 11. To indicate a valid datastream in progress, a *flag* byte is transmitted. This byte has a unique binary format of 01111110. The second byte of the stream is the address of the device being referenced. Following this is the byte used to determine the actual command involved. The specific additional data required are transmitted after the command byte. (Note: HDLC is a bit-oriented protocol and is adaptable to any data field width).

Completing the transmitted packet (called a frame) is a 16-bit CRC word. An additional *frame* byte is used to indicate the actual end of the data frame. To prevent transmitted data from mimicking a frame byte, any serial data sequence of five 1s forces a 0 to be inserted into the datastream. The extra 0 is automatically removed at the receiver. It is this zero insertion that makes HDLC ideal for NRZI encoding.

The HDLC protocol indicates the needed data in the order they would be used. The address field indicates which device must monitor the balance of the message. The command indicates the course of action that must be followed and the pertinent data follow with a powerful error-detection scheme incorporated in the transmission.


# The no hassle . . . . . broadcast telecine

## ADS 1
## Advanced Digital Scanner

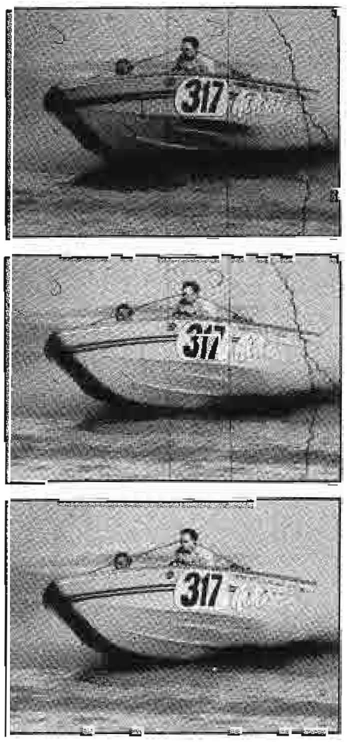
With ADS 1, Rank Cintel has applied its unique film-scanning experience to the specific needs of the broadcaster.

Developed in close co-operation with the British Broadcasting Corporation (BBC), this CCD multiplexed broadcast-telecine is designed for easy 'on-air' operation and transfer of film to tape prior to transmission.

The incorporation of solid-state imaging technology is an example of Cintel's continuing development philosophy.

Latest component technology, cost-conscious design and modern manufacturing techniques have been exploited, without compromising performance and reliability. The result is a telecine system which is technically advanced while at the same time being economical to operate. That is not all, ADS 1 also features a unique electronic dirt and scratch concealment system. Add all this together . . . . . . . . . . . . and you have the ideal broadcast-telecine package.

**Take the hassle out of film broadcasting — call us at 914-353-1914.**




**Rank Cintel Inc. East Coast**
New York 10994, U.S.A.
260 North Route 303, West Nyack,
Tel: 914-353 1914 Telex: 726441

Rank Cintel

**West Coast**
13340 Saticoy Street, North Hollywood,
California 91605, U.S.A.
Tel: 818-765 7265 Telex: 182694 RPI LSA
Fax: 818-765 3315

**Rank Precision Industries Inc.** 411 East Jarvis Avenue, Des Plaines, Chicago, Illinois 60018, U.S.A. Tel: 312-297 7720 Telex: 646998 Fax: 312-6990581

**Circle (52) on Reply Card**

# Remote control with the ESbus

By Douglas A. Hurrell

The broadcast industry has long been searching for a set of standards for the remote control of broadcast equipment. Now that digital control logic and microprocessors have become commonplace in broadcast equipment, it is no longer necessary to contend with relay closures and unusual voltage swings to remotely control a VTR or switcher.

These microprocessors provide each interface with a certain amount of "intelligence" of its own. This use of distributed intelligence offers a number of benefits to the broadcaster. Each set of broadcast hardware has its own idiosyncrasies and smart controllers can receive standard "vanilla" messages that will allow even vintage broadcast equipment the luxury of remote control. In addition, this distributed intelligence provides a high degree of resilience because failures generally are confined to one piece of equipment.

Manufacturers in increasing numbers started using serial RS-422 as an interface medium for remote control. Serial communications provided an easier method of remote control at generally lower cost with better error message response characteristics. Although RS-422 was a common hardware means of communication, everyone seemed to be talking a different language (protocol), and sometimes even at a different rate of speed (baud).

SMPTE created a committee in 1978 to work toward a remote-control standard. In 1979, the European Broadcast Union (EBU) undertook a similar task. In 1981, the two groups joined efforts and have produced a complete architecture for remote control of TV systems, known as the *ESbus.*

Hurrell is president of Alamar Electronics, Campbell, CA.

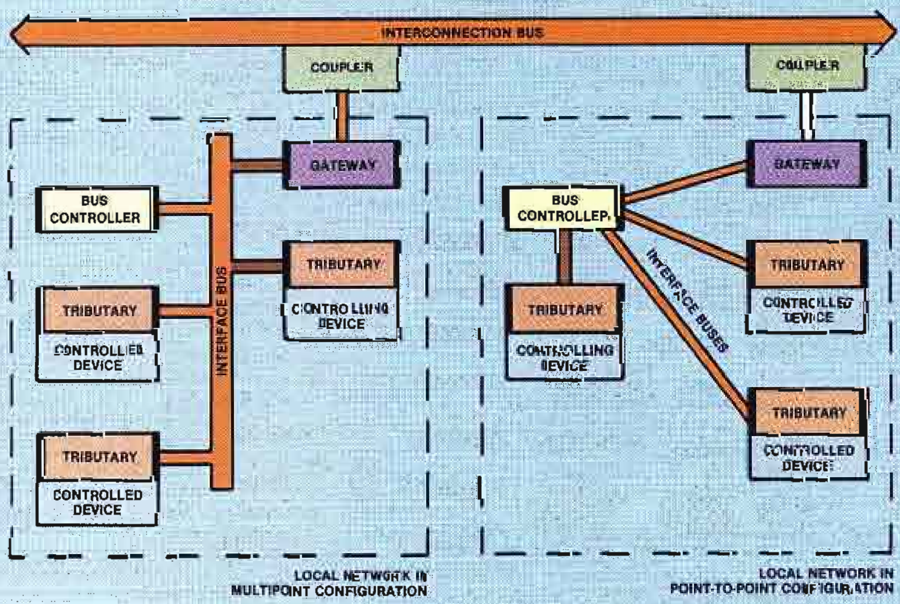
The ESbus is an applications-oriented bus that has gained wide acceptance within the broadcast community. It consists of a series of basic functional units that form a network. Each piece of broadcast equipment includes or is connected to a *tributary.* The tributary can be either a *controlling* device, such as a control panel or automation system, or a *controlled* device, such as a VTR or switcher. Each tributary has its own distinct address, and is responsible for detecting error messages and delivering control messages to and from the controlled equipment.

The *bus controller* supervises each tributary on a regular basis to determine whether any further communications are necessary. The *interface bus* is an RS-422 hardware interconnect that carries the messages between tributaries and the bus controller at 38.4kb/s. A *gateway* is available to interconnect each local network to the *interconnection bus* so that messages may be transferred among tributaries on different networks.

### The ESbus

The ESbus was structured according to the principles established by the International Standards Organization (ISO). Four layers are specified for the ESbus:

- *Electrical/mechanical:* The lowest layer specifying the electrical and mechanical characteristics of the commu-




*Typical ESbus interconnection does not specify couplers or controlled devices. Only the elements outlined in heavy lines are within the scope of the specification.*

nications channel.

- *Supervisory*: This layer provides access to the communications channel and guarantees error-free delivery of messages.
- *System service*: This layer provides routing of messages among tributaries, identification of the type of equipment connected to a tributary, and the blocking/deblocking of long messages.
- *Virtual machine*: This layer responds to control messages in a defined manner regardless of the type of physical equipment connected to the tributary. An important feature of this layer in the ESbus is the capability to execute control messages on a system time line.

Detailed information regarding these layers is available in the following documents from SMPTE:

- ANSI/SMPTE 207M—Electrical and Mechanical Specifications
- SMPTE RP-113—Supervisory Protocol
- SMPTE RP-139—Tributary Interconnect (system service)
- SMPTE RP-138—Control Message Architecture (virtual machine)

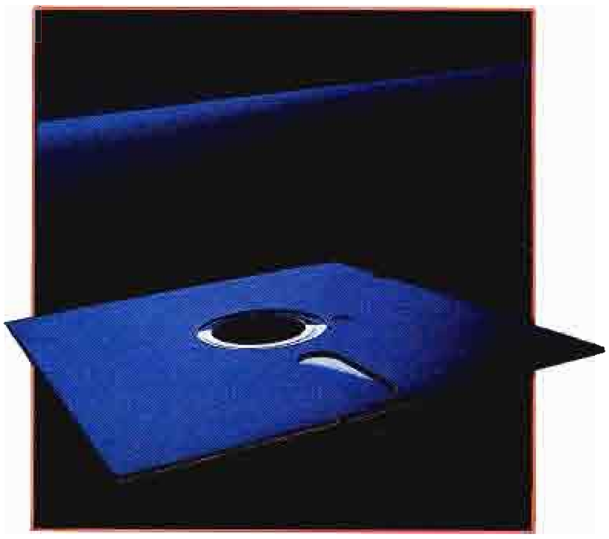
The EBU has approved and published a single specification for all four layers of the system, EBU Tech. 3245—Specification of a Remote Control System for Broadcasting Equipment.

Manufacturers have adopted a number of different technologies to address the issues of remote control and automation. The ESbus has received international acceptance with the inclusion of the EBU and Eastern bloc countries.

Broadcasters must carefully determine whether the control equipment (such as remote panels or automation controllers) answers the overall needs of their particular applications. The control bus determines only the way in which a command gets from point A to point B. The decision regarding implementation of a specific control bus is secondary to that of control equipment but has far-reaching implications regarding flexibility and the capability for future expansion.

As the manufacturing community closes ranks around this industry standard, more and more broadcasters are integrating with the ESbus.

[BE]



# Planning for engineering automation

By Joseph P. Geerling

**An electronic assistant may be the key to operating an engineering department efficiently.**

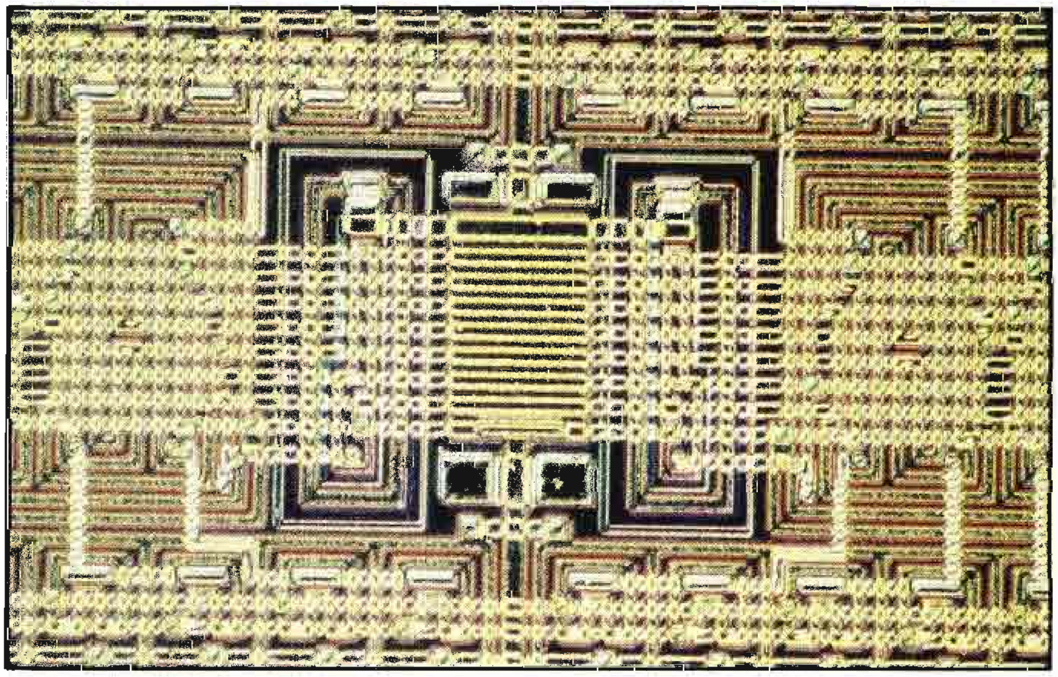


Photo by Timothy Schefter

*Few industries have affected the design of broadcast equipment more than the semiconductor industry. Integrated circuits have revolutionized broadcast hardware, making it smaller, lighter and more reliable.*

Most engineers probably would like to have an assistant. Convincing the station manager to hire one, however, is a completely different matter. After all, don't assistants cost a lot of money, occasionally call in sick, want vacations and even question your decisions? Believe it or not, an assistant may be available who has none of these shortcomings.

Bringing this new assistant to your station would be quite inexpensive, compared with what it would cost to keep most full-time personnel on the payroll. This assistant will not catch a cold, ask for time off or criticize your judgment. In fact, this assistant is almost guaranteed to follow your commands right down to the letter.

### High-tech help

By now you probably have realized that the assistant we're talking about is not another human being. Rather, many engineering functions can be met by a computer and appropriate software.

Today's engineer is faced with increasing time demands. The station manager wants a budget report. The program director wants to know whether it's possible to carry a live remote from a city 35 miles away. Finally, you have your own set of needs that might include correspondence, documentation on projects or even preparing graphs and charts.

Computers may be helpful for many of these everyday tasks. Computers can become a powerful typewriter, providing

Geerling is chief engineer at KWMU-FM, St. Louis.

printouts of reports, memos, graphs and mailing labels. They can calculate with lightning speed. When coupled with a spreadsheet program, computers can help examine any number of variables within a project. A database program provides storage and quick retrieval of information. Want the database sorted by fields? Need a special report consisting of only part of the database information? With today's programs, these tasks are easy to accomplish.

### Integrated programs

Computer application software is available in two general formats: stand-alone and integrated. A stand-alone program is designed to function by itself. It performs a task without trading information with other programs. In fact, it may not be able to easily exchange data with other programs.

Although many stand-alone programs may be feature-laden and low in cost, the inability to work in tandem with other programs can be a disadvantage. For instance, suppose you have developed a database of names and addresses and want to develop a form letter. If the database lacks a sophisticated word processor or cannot easily exchange the information with one, you may have to manually enter the data into the letters.

An integrated program offers several functions: word processing, spreadsheets, graphics and telecommunications together in the form of subprograms.

The difference between using an integrated program and using separate programs for each function lies in the ease with which data can be shared by the various subprograms. For example, with an integrated program, you can easily create a budget and play "what if" games to examine different possibilities. Portions of the information can then be graphed and included in a report. The entire document can be transmitted later to almost anywhere via the telephone. To accomplish the same task with stand-alone programs typically requires copying the information to each subprogram. Integrated programs eliminate this need.

### Choosing a program

There are five basic subprograms engineers should look for in an integrated software package. Each program plays a vital role. The *spreadsheet* or worksheet performs calculations and "what ifs." The *graphics* program translates the data into charts or graphs. The *word processor* creates letters and reports, which can include the charts or graphs. The *database* can sort and store huge amounts of information for mailings, diagnostics or reports. The *communications* program facilitates the transfer of information to other computer systems.

| Engineering Formulas and Conversions Worksheet | | | | | |
|---|---|---|---|---|---|
| Convert Power to dBk | Power in | dBk | | | |
| Enter Power in | 100,000 | 20 | | | |
| Enter dBk | 3,981 | 6 | | | |
| Wavelength | Frequency (MHz) | Feet | Meters | | |
| | 97.1 | 10.13 | 3.09 | | |
| Free Space Attenuation | Frequency (GHz) | Distance (mi) | Atten (dB) | Dist (km) | |
| | 0.9515 | 8 | 114.23 | 5.0 | |
| Coax Cable Attenuation | Tx Length = | 215 | Rcv Length = | 60 | |
| | | Tx Atten | Rcv Atten | Total | Efficiency |
| AT 950 MHz | LDF4-50 1/2" | 5.59 | 1.56 | 7.15 | 19.28 |
| | LDF5-50 7/8" | 3.23 | 0.90 | 4.12 | 38.68 |
| | LDF7-50 1-5/8" | 1.94 | 0.54 | 2.48 | 56.56 |
| | Tx Length = | 465 | Rcv Length = | 0 | |
| | | Tx Atten | Rcv Atten | Total | Efficiency |
| AT 100 MHz | HJ7-50 1-5/8" | 1.05 | 0.00 | 1.05 | 78.59 |
| | HJ8-50 3" | 0.70 | 0.00 | 0.70 | 85.16 |
| | HJ11-50 4" | 0.51 | 0.00 | 0.51 | 88.89 |
| STL Path Evaluation | | | | | |
| Tx Power Out (watts) | 10.00 | | | | |
| Tx Antenna Gain (dBi) | 22.00 | 6 foot grid | | | |
| Receive Antenna Gain (dBi) | 13.50 | existing | | | |
| TOTAL Gain | 75.50 | | | | |
| Tx cable loss | 3.23 | 7/8 inch | | | |
| Recv cable loss | 1.56 | existing | | | |
| Connector Loss | 0.50 | | | | |
| Path Loss | 114.23 | | | | |
| Other Losses | 0.00 | | | | |
| Grazing Factor | 1.75 | | | | |
| TOTAL Losses | 121.26 | | | | |
| | dB | μV | | | |
| Effective Received Signal | -45.76 | 1151.4 | | | |
| Min Sig for 60dB S/N | 74.95 | 40.0 | | | |
| Fade Margin | 29.18 | | | | |
| dB to μV | 71.47 | 59.7 | | | |
| μV to dB | 83.47 | 15 | | | |

***Figure 1.*** *A spreadsheet, such as the one shown here, can contain complex formulas and data. This one allows an STL path analysis to be performed in a couple of minutes.*

| Account | Description | January | | February | | March | |
|---|---|---|---|---|---|---|---|
| | | Budgeted | Actual | Budgeted | Actual | Budgeted | Actual |
| 1212 | Tube Expense | 0.00 | 0.00 | 1750.00 | 1732.00 | 0.00 | 0.00 |
| 1213 | Transmtr Bldg Maint | 75.00 | 68.00 | 75.00 | 68.00 | 75.00 | 68.00 |
| 1214 | Equip Parts and Supplies | 50.00 | 161.00 | 50.00 | 27.00 | 50.00 | 72.00 |
| 1215 | Tape Expense | 120.00 | 55.00 | 120.00 | 240.00 | 120.00 | 110.00 |
| 1218 | Publications | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 |
| 1220 | Computer Expense | 17.00 | 0.00 | 17.00 | 18.00 | 17.00 | 0.00 |
| 1223 | Tower Expense | 0.00 | 0.00 | 0.00 | 0.00 | 325.00 | 275.00 |
| 1224 | Paging | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 | 19.00 |
| 1229 | Misc | 50.00 | 65.00 | 50.00 | 32.00 | 50.00 | 78.00 |
| | | | | | | | |
| 1235 | Travel & Entertainment | 0.00 | 18.00 | 0.00 | 0.00 | 0.00 | 27.00 |
| 1236 | Conventions & Seminars | 0.00 | 0.00 | 0.00 | 0.00 | 600.00 | 575.00 |
| 1237 | Van Expense | 256.00 | 262.00 | 256.00 | 227.00 | 256.00 | 232.00 |
| | TOTALS | $615.00 | $676.00 | $2,365.00 | $2,391.00 | $1,540.00 | $1,484.00 |
| | | Deviation | 61.00 | Deviation | 26.00 | Deviation | (56.00) |

***Figure 2.*** *Budgets and financial reports are natural applications for spreadsheets.*

When selecting an integrated software package, the most important thing to keep in mind is the program's capability to perform your specific tasks. Your local computer dealer can suggest appropriate programs, and should be able to arrange for a hands-on software demonstration.

Perform a few simple tests. Try typing a short letter that will be merged with a mailing list. Then, using a database program containing multiple names and addresses, see how complex it is to create

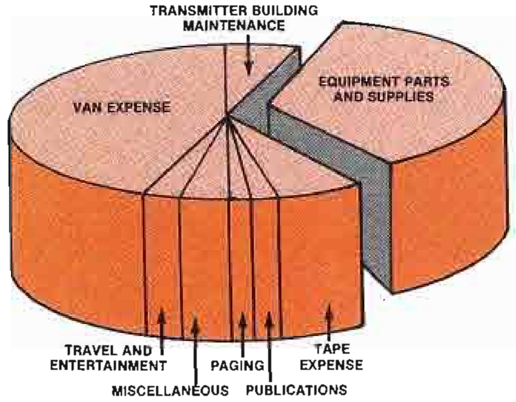



***Figure 3.*** *This pie chart pictorially depicts the data contained in the spreadsheet shown in Figure 2.*

customized form letters. Try entering numbers and calculations into the spreadsheet. Note how the spreadsheet recalculates the totals when one of the variables is changed. Finally, print out a copy of the spreadsheet, just to see how it looks.

Keep in mind that your computer system is a tool and must be viewed as a complete package. Just as a socket set is useless without its ratchet, an integrated program must have all the tools to do its job. An extra disk drive, a letter-quality printer with extra-wide paper capability and a modem may be required to take full advantage of the program's capabilities.

Purchasing an integrated program instead of separate stand-alone programs may save money and increase efficiency because of the ease of transferring data between the functions. Although integrated packages often require more memory and disk space than individual programs, the benefits usually outweigh these disadvantages.

The program's capabilities, not the brand of computer or software, are the critical considerations in choosing a system. Some programs can exchange database, spreadsheet and text information among different types of computers. This means that if your station already has a computer system, you may be able to share that information.

### Applications

Figure 1 shows a section of a spreadsheet used to evaluate an STL path. Formulas and figures are entered into each cell, and cells in the spreadsheet can be interrelated. Because the value of one cell can be dependent upon the values of other cells, many possibilities can be examined. For instance, what happens if you use a larger antenna and smaller coax? If you change the desired cell values (in Figure 1) for antenna gain and coax loss, within a second or two the program will recalculate the results based upon these new parameters.

Loan amortizations, budgets, load cal-

# Future remote-control systems

It's just starting to happen. Microprocessor-based remote-control systems are beginning to demonstrate their potential in the broadcast industry. Although today's remote-control systems may seem feature-limited, they already have come a long way toward providing expanded features in controlling broadcast sites.

### A wish list

Here is a list of additional features broadcast remote-control manufacturers might consider:

- It is unlikely that any single manufacturer could develop a comprehensive system that could not be enhanced by the addition of other vendors' accessories. Therefore, future remote-control systems must be complete systems. That is, these systems should possess all the components necessary to run a remote site, yet be expandable with accessories and software developed by independent vendors and engineers.
- Future remote-control systems should be able to communicate with a separate PC or dumb terminal using simple ASCII codes. Special terminals should not be required to send and receive data or to access subprograms.
- The remote control's communications interface should allow the station to use an auto-answer modem for periods when the normal control link is lost or when the system will be checked from other remote locations (such as an engineer's home).
- Future systems also should include security codes permitting only authorized access.
- Tone control and voice synthesis response are two areas that could be developed and improved upon by independent vendors.
- Tomorrow's control system must be able to take constant snapshots of all conditions and securely store the data in case of a failure. These readings should be stored in a non-volatile memory and be available for printout or transmission via modem.
- Status and analog channels should be expandable to fit the needs of many stations. Such flexibility could help reduce the concern a station might have about future growth.

Microprocessor technology is now capable of handling multiple monitoring and decision-making tasks. When broadcast remote-control systems begin taking full advantage of this technology, they finally will address the engineer's goals of reliable operation, positive control and comprehensive reporting.

| | | | | | | |
|---|---|---|---|---|---|---|
| FM Performance Data Sheet | | | | FM Noise | -72 | |
| Test Date: | Dec 8, 1985 | | | AM Noise | -50 | |
| All response data in dB | | | | L Ch Noise | -61.5 | |
| All distortion data in percent. | | | | R Ch Noise | -60.5 | |
| | | | | Tests by: | JG | |
| | | | | | | |
| Freq | Left Channel | | | | Right Channel | |
| 100% | Gen Out | Resp Dev | Dist | Gen Out | Resp Dev | Dist |
| 50 | 29.2 | 3.4 | 0.55 | 29.4 | 3.6 | 0.42 |
| 100 | 28.4 | 2.6 | 0.40 | 28.4 | 2.6 | 0.32 |
| 400 | 25.8 | 0 | 0.33 | 25.8 | 0 | 0.38 |
| 1000 | 26.7 | 0.9 | 0.40 | 26.7 | 0.9 | 0.50 |
| 5000 | 35.3 | 9.5 | 0.45 | 35.2 | 9.4 | 0.42 |
| 10000 | 42.5 | 16.7 | 0.70 | 42.1 | 16.3 | 0.80 |
| 15000 | 45.9 | 20.1 | 1.35 | 45.4 | 19.6 | 1.40 |
| | | | | | | |
| 50% | | | | | | |
| 50 | 36.2 | -3.7 | 0.46 | 36.4 | -3.8 | 0.42 |
| 100 | 35.3 | -2.8 | 0.41 | 35.3 | -2.7 | 0.40 |
| 400 | 32.5 | 0 | 0.30 | 32.6 | 0 | 0.30 |
| 1000 | 33.6 | -1.1 | 0.34 | 33.7 | -1.1 | 0.39 |
| 5000 | 42.3 | -9.8 | 0.63 | 42.1 | -9.5 | 0.68 |
| 10000 | 49.6 | -17.1 | 1.75 | 49 | -16.4 | 1.50 |
| 15000 | 52.9 | -20.4 | 1.50 | 52.3 | -19.7 | 1.70 |
| | | | | | | |
| 25% | | | | | | |
| 50 | 44.5 | -3.5 | 0.72 | 36.4 | -10.6 | 0.74 |
| 100 | 43.5 | -2.5 | 0.61 | 35.3 | -9.5 | 0.60 |
| 400 | 41 | 0 | 0.53 | 32.6 | -6.8 | 0.55 |
| 1000 | 42 | -1 | 0.62 | 33.7 | -7.9 | 0.57 |
| 5000 | 50.5 | -9.5 | 1.35 | 42.1 | -16.3 | 1.40 |
| 10000 | 58 | -17 | 2.55 | 49 | -23.2 | 2.50 |
| 15000 | 61 | -20 | >3 | 52.3 | -26.5 | >3 |

***Figure 4.*** *Proof-of-performance data entered into a spreadsheet can be used for written documentation or charts.*

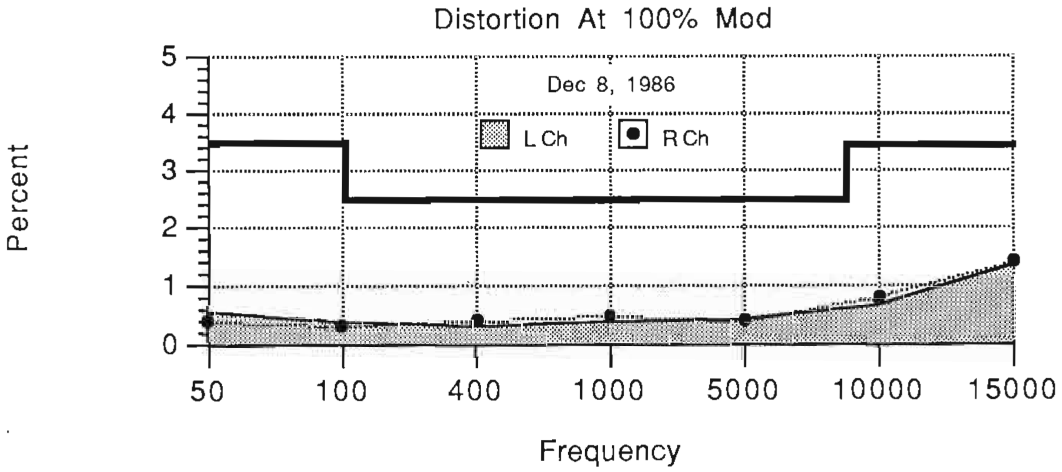
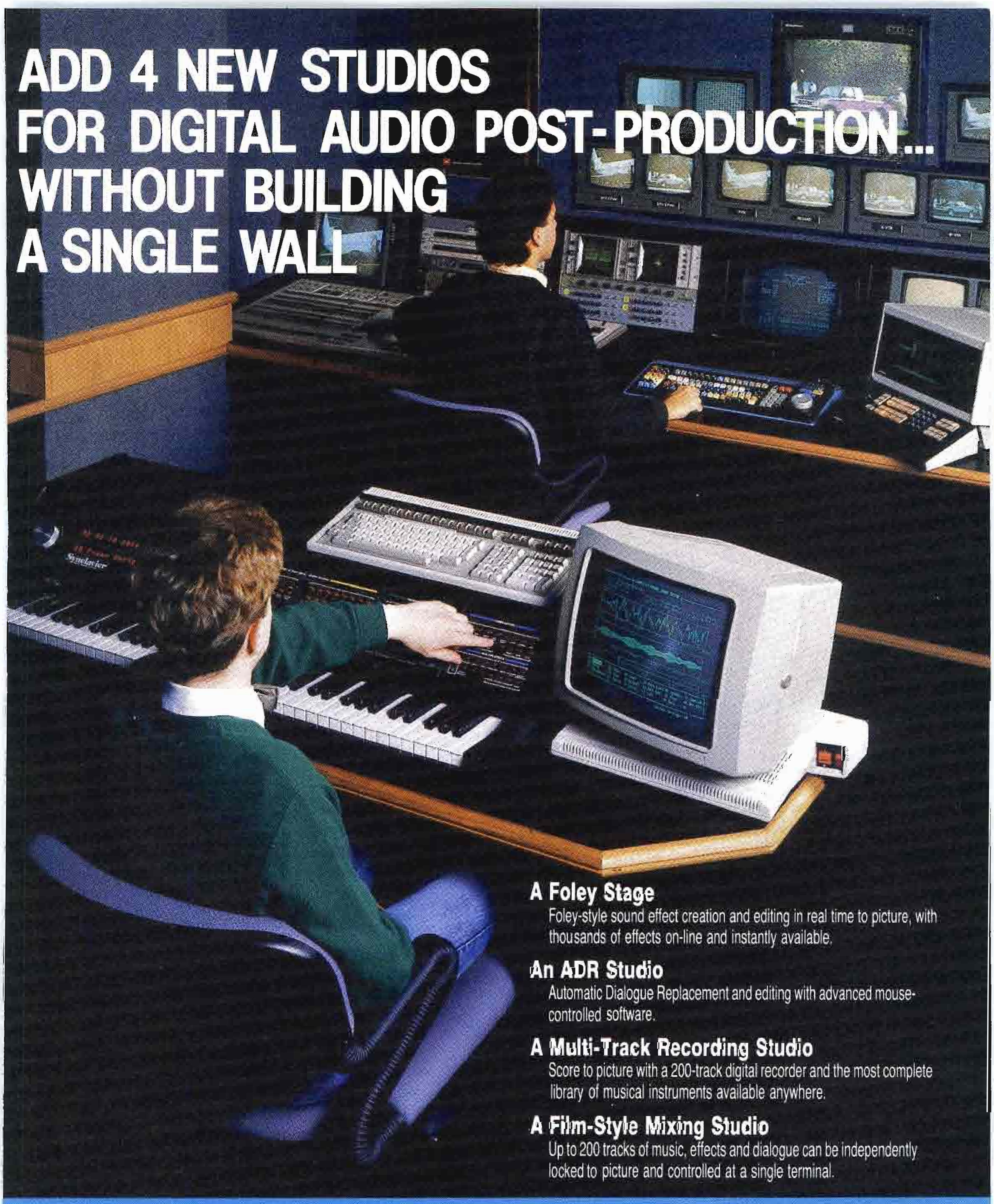



***Figure 5.*** *This graph was developed using the values from the spreadsheet in Figure 4. Such a chart has a great deal of visual impact.*

culations, distance between two coordinates and other routine engineering calculations can be included on one spreadsheet if desired. As you use the spreadsheet (often called a worksheet), you will discover new applications.

Figure 2 shows how monthly budgeted and actual expenses might be displayed on a worksheet. The pie graph in Figure 3 is based on the data in Figure 2. Graphs

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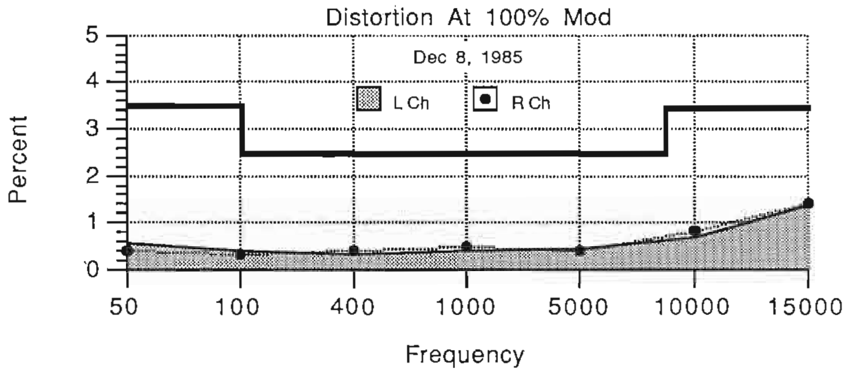
Dear Tom,

Below is the distortion graph from last year with the audio chain adjusted for normal operation. Their were no switches in bypass or proof. The distortion measurements were made with the KLTH test equipment consisting of the AT-51 test set and the model 691 monitor.




If you wish I could send you the results of the upcoming tests over the modem so you can review them before I leave on my vacation. I'll be out of town for five days. Randy and Marc will stand by for me.

You will also find the datasheets and serial number information on all the KLTH equipment enclosed.

Looking forward to your next visit.

Sincerely,

Joseph P. Geerling

***Figure 6.*** *Merging text and graphics can create professional-looking correspondence.*

are especially useful when they highlight good performance.

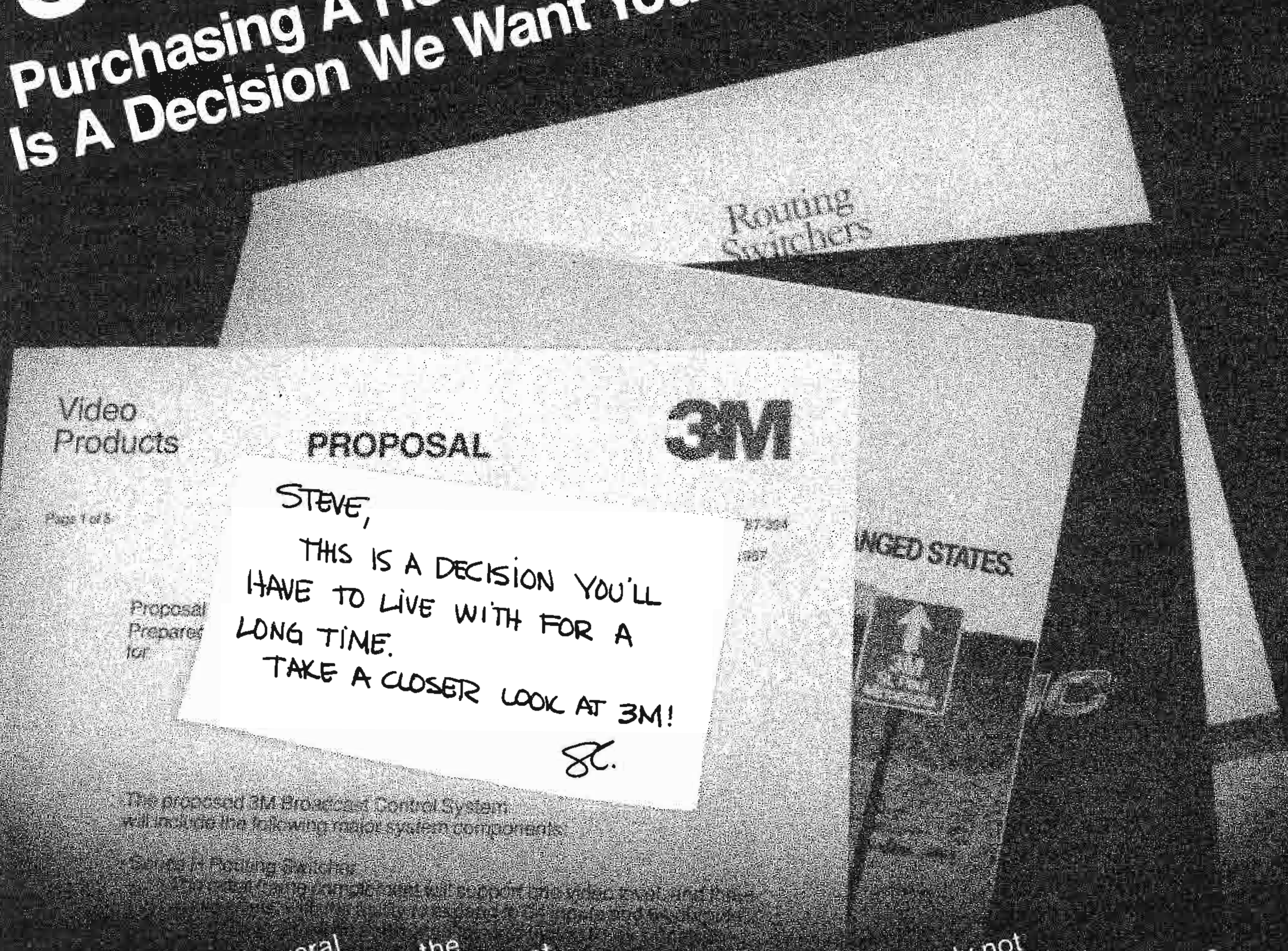
Another example is the spreadsheet data in Figure 4. In this case, the proof-of-performance results were entered into the spreadsheet. The graph shown in Figure 5, based on the spreadsheet data, was developed within a few minutes. Once you've produced a graph such as this, you can drop it into a letter or memo, as shown in Figure 6. In another three to five minutes you also could send a copy to your boss.

Perhaps you would like to send this memo to potential clients or fellow engineers. Using a program's sort feature, you can be as selective as you wish. Assuming the information is contained in the database, the letter could be sent to all managers and CEs at FM radio stations in the states of Missouri, Illinois and Kansas that don't have computers and have been in business since 1980. The program's sort feature will select only those records meeting the desired criteria. The program can then merge the letter with the selected database records, and personalized letters will begin print-

*Continued on page 86*

# STICKY DECISION?

## Purchasing A Routing Switcher Is A Decision We Want You To Forget




You probably have several important criteria for evaluating the routing switcher system that's going to get your approval; performance, reliability, control flexibility, size, expandability. Each is important now. Several will be important in the future.

The last thing you want to do is make a decision that will come back to haunt you.

At 3M, we think once you make the decision to use our products you should be able to forget it.

We design our products to work so well that you can take them for granted. Systems so flexible, they can grow in the ways you have planned, and in the unexpected directions that you can't plan for.

Frankly, we're probably not the first manufacturer of routing switchers to tell you these things. We have some solid competitors with good reputations. While at first glance their products may look similar, a closer look will show you why we have advantages *they* wish you would forget:

- The Series H Routing Switcher takes less than half the space of the leading monolithic and discrete crosspoint systems.
- Actual performance specs are better.
- The 3M control system is more versatile.

Now…are you going to make a decision you have to live with, or one you can forget?

**3M**

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Relax! We didn't meddle with a great format. But now that Ampex is delivering Betacam,™ you get a lot of things that make this great format even better, and your job a lot easier.

Our field service people will solve your problems *fast* wherever you are in the world. Reach us in the U.S. via our technical support hotline.

Our spare parts operation makes sure you get the right parts for your needs, and will advise you of any upgrades available.

Besides parts and fast service, Ampex offers pre-packaged repair kits. These simplify maintenance, insure peak performance, and reduce down-time. You can get kits and parts from 14 regional warehouses designed as a worldwide network, close to you wherever you are.

And if you need help in the training department, classes are taught by experienced Ampex instructors at reasonable rates.

It also is comforting to

# Ampex gives you

```
                                SITE 01-KLTH-FM        23-NOV-86 SUN 10:55:00

[--STATUS--]        [--------RELAYS---------]     [--------CHANNELS--------]
FIL ON 1     □      FIL OFF 1   ▒ ▒ FIL ON TX1     +09.23 KV PLT VOLT 1
OKT ON 1     □      PLT OFF 1   ▒ ▒ PLT ON TX1     +03.58 A  PL AMPS 1
FAULT 1      ▒      SPARE       ▒ ▒ SPARE          +0101  %  FWD PWR 1
EXT OL 1     ▒      PWR DOWN 1  ▒ ▒ PWR UP TX1     +0.038 KW REFL PWR 1
AUTO ON      ▒      LO PWR TX2  ▒ ▒ HI PWR TX2     -00.01 KV PLT VOLT 2
AUTO HOLD    ▒      PLT OFF 2   ▒ ▒ PLT ON TX2     -0022. A  PLT AMPS 2
NORM AC      □      SPARE       ▒ ▒ SPARE          -0021. %  FWD PWR 2
ANT > TX1    ▒      PWR DOWN 2  ▒ ▒ PWR UP TX2     -0.021 KW REFL PWR 2
IPA VSWR     ▒      FIL OFF 2   ▒ ▒ FIL ON TX2     -000.0 A  TOWER LTS
PA VSWR      ▒      AUD>BU EXC  ▒ ▒ BU AUDIO       +023.5 V  STL VOLTS
PA PLT OL    ▒      EXC> BU TX  ▒ ▒ BU EXCITER     +066 4 F  IN TEMP
PA SCRN OL   ▒      SPARE       ▒ ▒ AUTO CONT      +0144. F  EXAUST 1
AFC OL       ▒      SPARE       ▒ ▒ SPARE          +0034. F  OUT TEMP
STATUS  14   ▒      SPARE       ▒ ▒ AUTO ADV       +0119. V  PHASE A
EMER AC      ▒      AUTO HOLD   ▒ ▒ SPARE          +0120. V  PHASE B
ANT > TX2    ▒      AUTO RST C  ▒ ▒ AUTO RESET     +0118. V  PHASE C
                                                   +25.77 KW TPO TX1
MNT OVERRIDE. OFF       F/S OVERRIDE. ON           +102.4 KW ERP EST 1
PARTITIONS... 1         F/S RELAY.... ON           +00.17 KW TPO TX2
DATA BASE.... 1         TIME FNC..... ON           +000.6 KW ERP EST 2
FNC CTRL..... UPD STU
```

***Figure 7.*** *Many remote-control systems allow access via modems. With the appropriate software, an engineer can monitor a transmitter from almost any location.*

*Continued from page 82*

ing in a few seconds.

Perhaps the most interesting use of the computer involves the communications software and a modem. Some new remote-control systems have interfaces that can be coupled to an auto-answering modem. Through the use of a telecommunications program and a modem, telemetry and control data can be exchanged from almost any location. This technology makes it possible to use the microcomputer to access and adjust controls at a transmitter site from your home, office or even your convention hotel room.

At KLTH-FM in St. Louis, such a remote-control system is currently in use. Figure 7 is a printed view of the computer screen, using an off-the-shelf integrated software package. The computer, located in Oklahoma, called the transmitter site in St. Louis. The connection process took less than three minutes. The only expenses involved (excluding the required hardware) were the standard dial-up phone charges.

Computers are not the answer to every engineering function or problem. They can, however, provide valuable assistance to almost any technical department. One note of warning is in order. Learning to use any new tool takes time. Don't make the mistake of promising to automate the station or develop a database of thousands of names or even reduce costs in the first few weeks of operation. Computers and software are complex, sometimes feisty creatures. Give yourself time to become acclimated thoroughly and avoid making pie-in-the-sky commitments.

Today, broadcast engineers are called upon to be more creative, financially on top of things, organized and efficient. Hiring a computer as an assistant can make a lot of sense, not only for you but also for your company.



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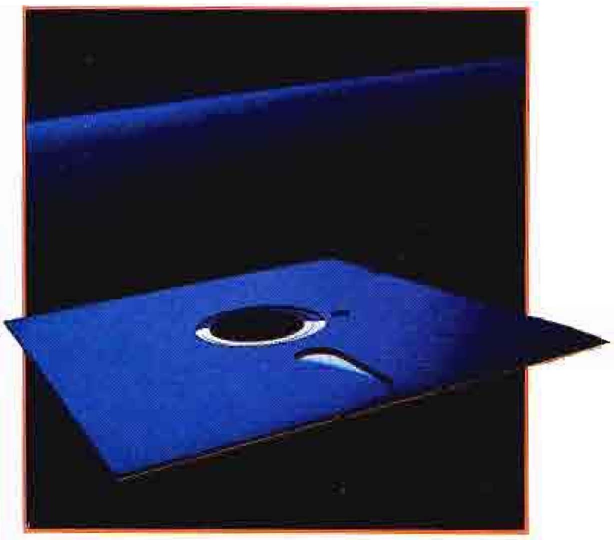

# Computer power protection

By Mark Hill

**Don't let your computer-driven broadcast equipment suffer damage from power-line disturbances.**

Pure, raw power. We all need it and use it every day. But more than any other external factor, the quality of power provided by the local utility determines how well a piece of electronic equipment will operate. Disturbances in the power line, no matter how brief, can cause improper operation, permanent circuit damage, excessive heating, data loss and shortened component life.

Unconditioned power from the local utility may run 5% or more above or below the stated levels of 120Vac and 240Vac. In addition to voltage variations, a given power line may suffer from a number of other disturbances. The seven deadly sins of ac power are electrical noise, spikes, voltage surges, voltage sags, glitches, outages and frequency deviations. To combat these problems, you must understand the cause of each type of disturbance and its effect on electronic equipment (see Table 1, page 97).

### Disturbances

Electrical noise generally manifests itself as hash or a series of spikes on the power line. Noise is usually much lower in amplitude than the single spike.

Electrical noise generally can be broken down into two types: *RFI* (radio frequency interference) and *EMP* (electromagnetic pulse). Any device that generates an arc or spark can radiate RFI ENER64. This interface often originates in motors and motor-control devices, switches, relays, static and atmospheric discharges and even automotive ignition systems. Broadcast transmitters also are possible culprits. Electrical noise is not as destructive as a sudden high-voltage spike, but it can cause poor performance, accelerated component deterioration and altered data in computer circuits.

Voltage spikes, or transients, are sudden, short-term increases in line voltage, typically lasting 100ns or less. They may reach an amplitude of thousands of volts, with frequencies in the kilohertz or megahertz range.

Spikes or transients may be generated from many sources, but usually result from some type of inductive "kick." Switching heavy loads onto or off of the power line can cause large transients. Even an electric typewriter, for example, when switched on and off can induce a 1,000Vac spike onto the power line. Power utilities often generate spikes when switching from one feeder line to another. Severe spikes can cause permanent component damage, erratic operation and lost or altered data in computers and security systems.

Voltage surges are increases in line voltage above the normal level for more than one-half cycle. Surges may last several cycles, seconds or minutes. They can be caused by removing a heavy load from a power line or switching feeder lines at the power utility station. Although a surge typically will not reach the magnitude of the single spike, surges can cause erratic operation, overheating, reduced component life and damage to input circuitry.

Sags usually are caused by switching heavy loads, either at the power utility station or within your own facility. Lightning also may cause short-term sags. The low voltage often causes power supplies within equipment to fall out of regulation, which in turn causes noise, improper operation or complete shut-

Hill is a technical service representative for International Tapetronics/3M, Bloomington, IL.

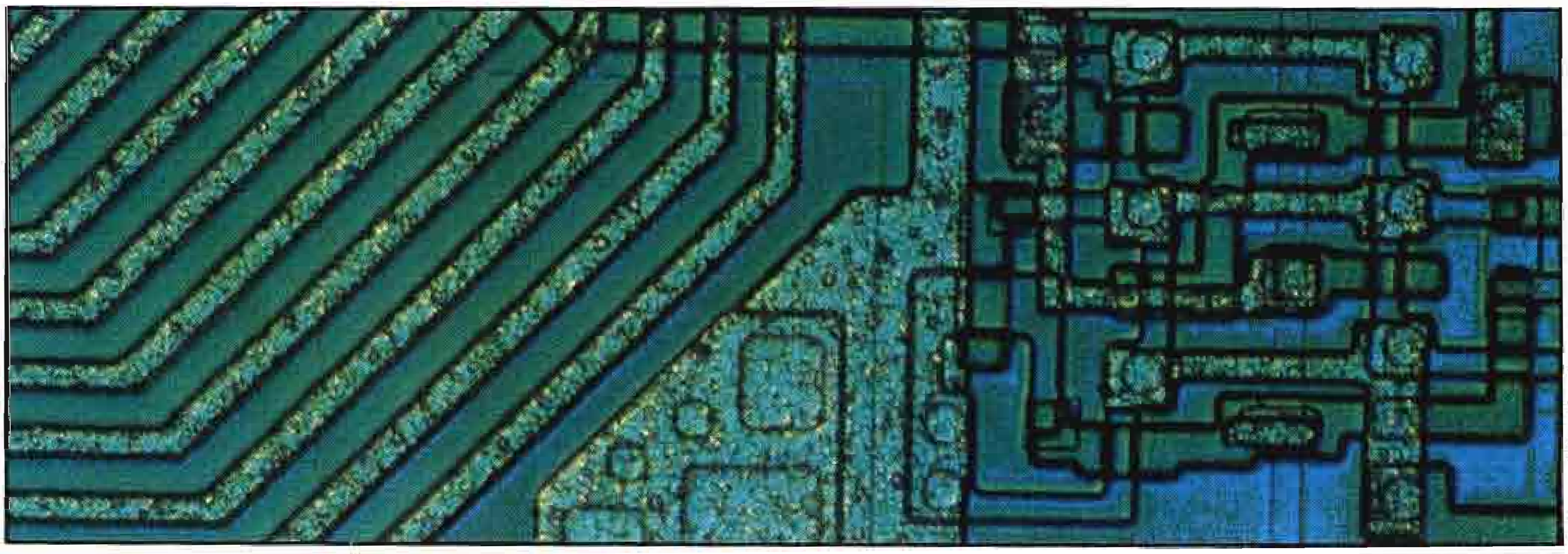

Photo by Timothy Scheffer

*The increased dependence on integrated circuits in broadcast hardware demands careful attention to suppression of transient disturbances on the ac power lines into a facility. Transient overvoltages represent the greatest single threat to proper operation of ICs and other sensitive components.*

*You said,*

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*and we said,*

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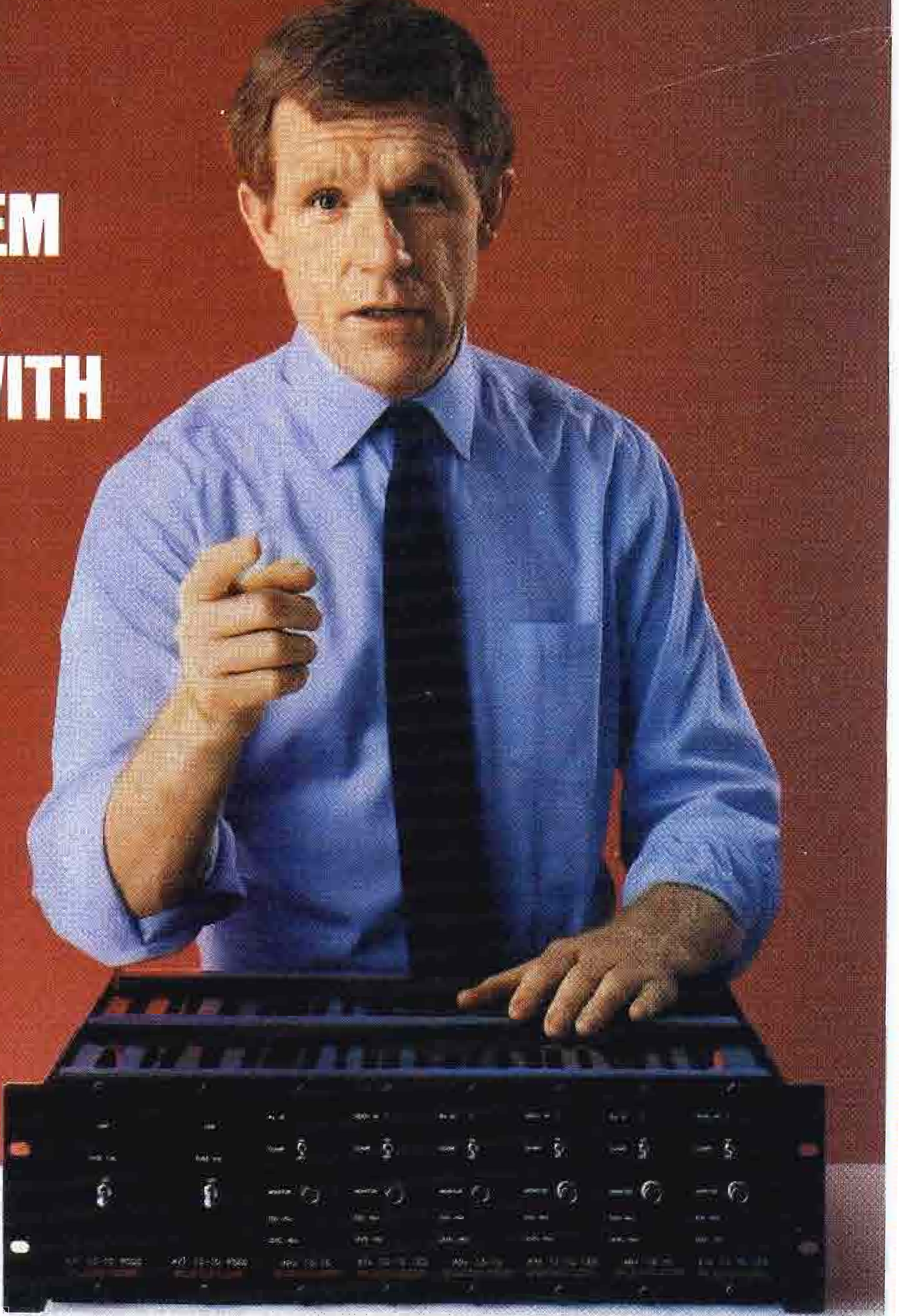

There are some things that just don't belong on live TV. Static in the picture from EMI or RFI contamination. Fuzzy electronic glitches. Or maybe you're having trouble teleporting the signal to other locations and you can't tell why.

If you want to eliminate problems like these, we have a suggestion. Get rid of that outdated coaxial or microwave equipment. And then get PlessCor's fiber optic analog video transmission system.

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down. Excessive heat probably is the most severe result of low-line voltage, in addition to lost or altered data.

Voltage sags, or *brownouts*, are defined as drops in voltage below the normal level for one-half cycle or more. In extreme cases, sag can last for several hours and cause permanent damage to electronic equipment.

The infamous *glitch* is actually a power outage or near-outage lasting less than one cycle. Glitches often occur when the power utility switches feeder lines. The glitch also may be accompanied by a voltage spike generated at the completion of the switchover. Glitches often result in data loss, injected errors in computer and security systems and possible head crashes on disk drives.

Although uncommon, a power outage, or *blackout*, can be the ultimate disturbance, resulting in an unplanned equipment shutdown. Many stations have emergency generators, but they take time to kick on, causing other problems.

Frequency drifts are uncommon on U.S. power lines, but are inherent to motor-driven generators. Line-frequency variations can cause improper operation, speed variations in motors, data alteration or disk drive shutdown.

You may be familiar with the effects of these disturbances in severe cases, but you may not be aware of the damage that can be done to equipment when it is exposed repeatedly to seemingly minor disturbances. Capacitors subjected to spikes can break down and short. Resistors can heat up from power sags and electrical noise, changing value over time. Semiconductors and ICs, although appearing to function normally, can deteriorate in performance and eventually fail completely. Clocked-logic systems sometimes become confused by glitches, spikes and electrical noise. In general, dirty power lines are detrimental to the operation of all electrical equipment.

### Monitor the lines

What can you do? Before running out to buy power-line protection, first determine your requirements. What types of disturbances are occurring at your facility? How frequently do they occur? Is your area prone to frequent outages, electrical storms or ice storms? A chart of the relative frequency of common power-line problems is shown in Figure 1.

You might contact your local utility company to inquire whether it will rent or loan you a chart recorder, which can be connected to the power line for a few days. A local computer service company also might have a power monitor for rent. This type of monitor provides a graphic indication of the types of disturbances present on that line.

Also consider what areas to protect, and the resultant cost of a power outage in those areas. A disturbance in the on-air studio may be catastrophic, while a shutdown of the traffic or sales department computer may just be inconvenient. Once you have identified the areas requiring protection, calculate the load requirements of each area. Consider more than just the present requirements. Try to project what the station's needs will be one or two years from now.

### Identify the noise source

Now that you have identified the types of disturbances and the areas needing protection, examine the situation carefully. There are several things to look for to help reduce the disturbances:

• *Grounding:* Proper grounding is essential. Many power-line disturbances can be reduced or eliminated by proper grounding. It is important to note that what may be an adequate ground for protection against electrical shock may not eliminate electrical disturbances. Voltage spikes and RFI can be capacitively coupled into equipment and improperly shielded audio or control lines.

Care should be taken to ensure proper

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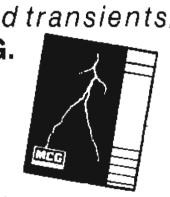


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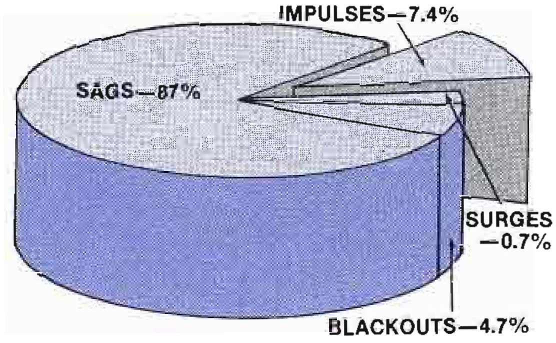



***Figure 1.*** *The pie chart depicts the average percentages of outages by category, measured in multiple locations over a 2-year period.*

grounding of equipment and all connecting audio and control lines. Contact the company's factory technical service representative for assistance on proper equipment grounding.

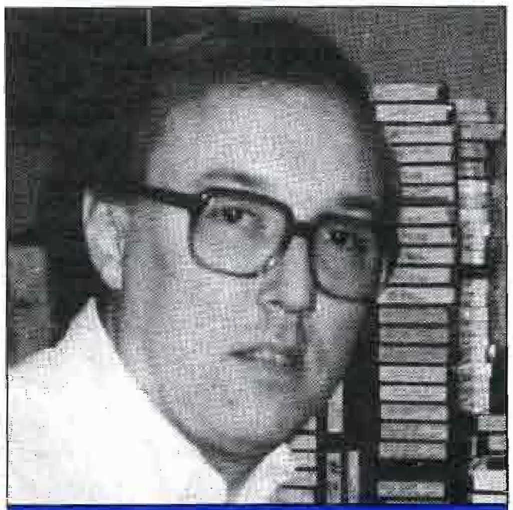
- *Line load:* Is the area requiring protection on a dedicated line? If not, what other equipment is on that line? Moving heavy inductive loads to different circuits may be necessary. Dedicated lines can be installed to protect an area, but this may provide protection only from *internally* generated disturbances.
- *Isolation:* Some pieces of equipment are, by nature, electrically noisy. Some use power in surges. Isolating this equipment with transformers may result in a significant improvement. Another alternative might be to isolate the offending equipment to one phase of the 3-phase supply, while running sensitive equipment from the opposing phases.
- *Peak demand:* If power disturbances seem to occur at the same time every day, try to identify the source of the disturbance. Usually a little detective work will lead you to the cause.

### Install protection equipment

Once you identify the source, you can be relatively confident about the steps to take toward solving the problem. A wide range of power protection systems and devices is available. Most of them fall into one of five categories:

- *Surge suppressors*, or spike clippers, shunt voltage spikes that exceed the clamping voltage of the device (see Figure 2). Typically this is set at 200Vac on a 120Vac line. Surge suppressors offer no protection from spikes less than 200Vac or from voltage reductions or electrical noise.
- *Isolation transformers* electrically isolate equipment from the power line. They protect against electrical noise and short-term voltage spikes. However, isolation transformers offer little or no protection against longer duration spikes, glitches or low-voltage conditions.
- *Voltage regulators* generally provide no isolation, but merely regulate the supply voltage. Regulation usually is accom-

**Larry W. White**
Chief Engineer
KOAM-TV, Pittsburg, KS



**James L. Sorensen**
Chief Engineer
WJQY-FM, Fort Lauderdale, FL

**Daniel S. Bruck**
Telecommunications Specialist
Channel 25, Beverly Hills, CA

# How 3 Broadcasters Solved Their Power Problems

**LARRY W. WHITE**
**3 KVA FERRUPS Uninterruptible Power Supply**

EQUIPMENT SUPPORTED: IBM System 36 with two workstations, two IBM-PC XTs, 3 printers.

WHITE'S STORY: "Pittsburg, KS, has 'soft' power. We are at the end of a long leg from a rural electric company. If a farmer down the road turns on an arc welder, we see a drop in power. Just turning on a gang of lights in the studio drags the line below 108 volts. We lose power completely to thunderstorms in the summer and snowstorms in the winter.

"All these problems—outages, soft power, brownouts—played havoc with our computer, which runs day and night doing traffic, payables, receivables, administration.

"Since installation of the FERRUPS in May, 1986 to support the computer, we have not had a single glitch. I'm real happy with the FERRUPS."

**JAMES L. SORENSEN**
**7.5 KVA FERRUPS**

EQUIPMENT SUPPORTED: IBM System 36 with 3 terminals and 3 printers; microwave transmitter, 2 IBM-PCs with printers, telephone system, satellite down-link equipment.

SORENSEN'S STORY: "We were plagued by large voltage swings, outages and surges, which our utility considers 'acceptable' power. All crashed our computer and shut down the microwave transmitter. We installed a 350 KVA diesel generator. There was a 12-second gap between power failure and generator coming on line. Twelve seconds is a disaster in radio.

"In the first 2 months after installation of the Best FERRUPS, we experienced 43 power problems that would have crashed our systems. Protected by the FERRUPS, everything just hummed on. FERRUPS closed the generator gap."

**DANIEL S. BRUCK**
**1 KVA MICRO-FERRUPS**

EQUIPMENT SUPPORTED: Electronic billboard (specialized character generator), sync generator, frame store synchronizer.

BRUCK'S STORY: "The smallest power glitch would cause the unattended 24-hour-a-day character generator to go down, leaving us with a blank screen. When the character generator crashed, memory was lost. It took 3 hours to restore messages. These glitches also affected synchronization between other devices necessary for stable signals. These power problems occurred twice a month.

"Since installation of Best's unit in early 1986, we have not had a single power problem with any equipment. And the character generator works better because of the line conditioning provided by the MICRO-FERRUPS, in addition to uninterruptible power."

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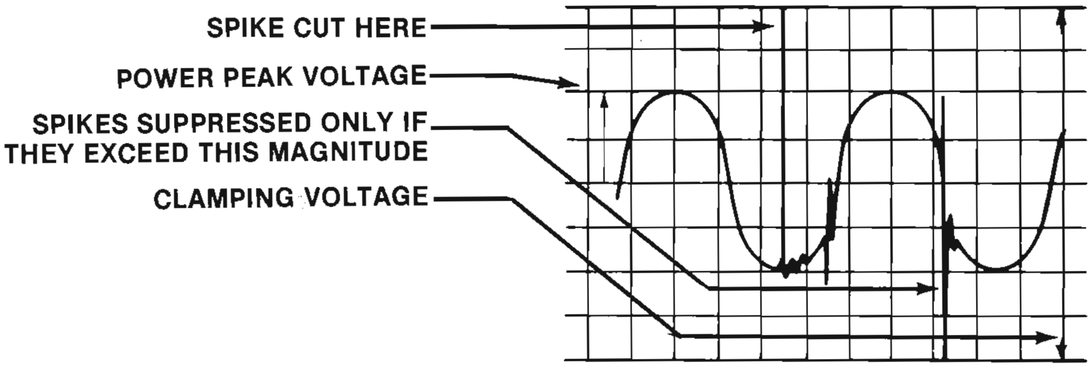


***Figure 2.*** *Spike clippers suppress only voltage spikes that exceed the clamping voltage, which is customarily set at approximately 200Vac for a nominal 120Vac power line.*



plished by electronically switching taps on the transformer's primary winding. Equipment is left exposed to spikes and sags that occur too quickly for the regulator to react.

- *Isolators/regulators* combine the protection of an isolation transformer with a voltage regulator. This combination provides effective protection against most disturbances. There are two types of devices commonly available: tap-switching and ferroresonant. Tap-switching devices, like the voltage regulators, fall short in protecting against longer duration spikes and require one to three cycles to correct voltage fluctuations. Neither type can protect against power outages.
- *Uninterruptible power supply* (UPS) systems offer the utmost in power-line

*Main story continues on page 97*

# UPS vs. standby

Selecting the type of power protection to use requires careful consideration. Many broadcast applications rely on computer-based equipment, which is less forgiving of power-line disturbances than some other devices. In many cases, the importance broadcasters now place on computers may demand that the computers never suffer a brownout or power outage.

If this applies to your station, a UPS or standby power system may be required. Both devices rely on an inverter to convert dc voltage from a battery into 120Vac for power during an outage. There are, however, distinct cost and performance differences between a UPS and a standby system.

A standby system consists of an inverter, battery, battery charger and high-speed transfer switch. When not activated, the inverter is at rest and the primary ac power passes straight through to the load. When the ac voltage drops below a preset threshold, the load will be transferred and the inverter switched on to supply ac power. When the ac returns, the load is switched back to the ac line, the inverter is switched off and the battery is recharged.

The standby system is sometimes called an off-line UPS because during a power outage there is a lapse during the switching process from ac to dc power. The switching time for a standby power system is typically from 2ms to 10ms. Standby systems protect only against blackouts; they do not protect against line voltage problems such as surges and sags.

### UPS

The UPS system is similar to the standby power system, but doesn't have a transfer switch. The load is continuously supplied power developed within the UPS. The line ac is con-

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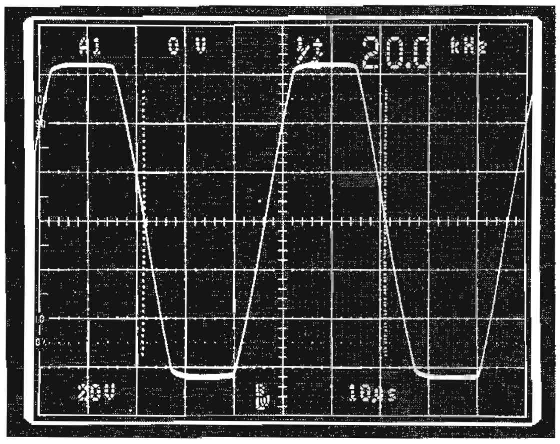


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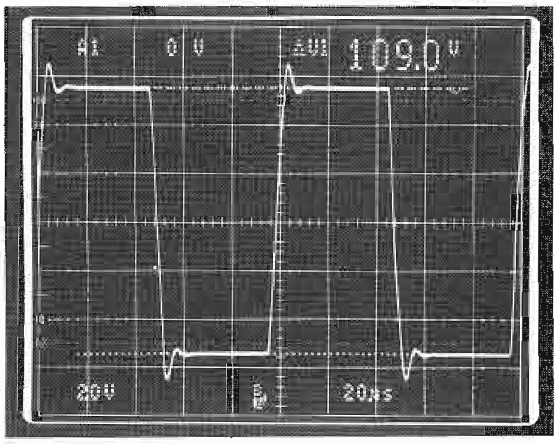


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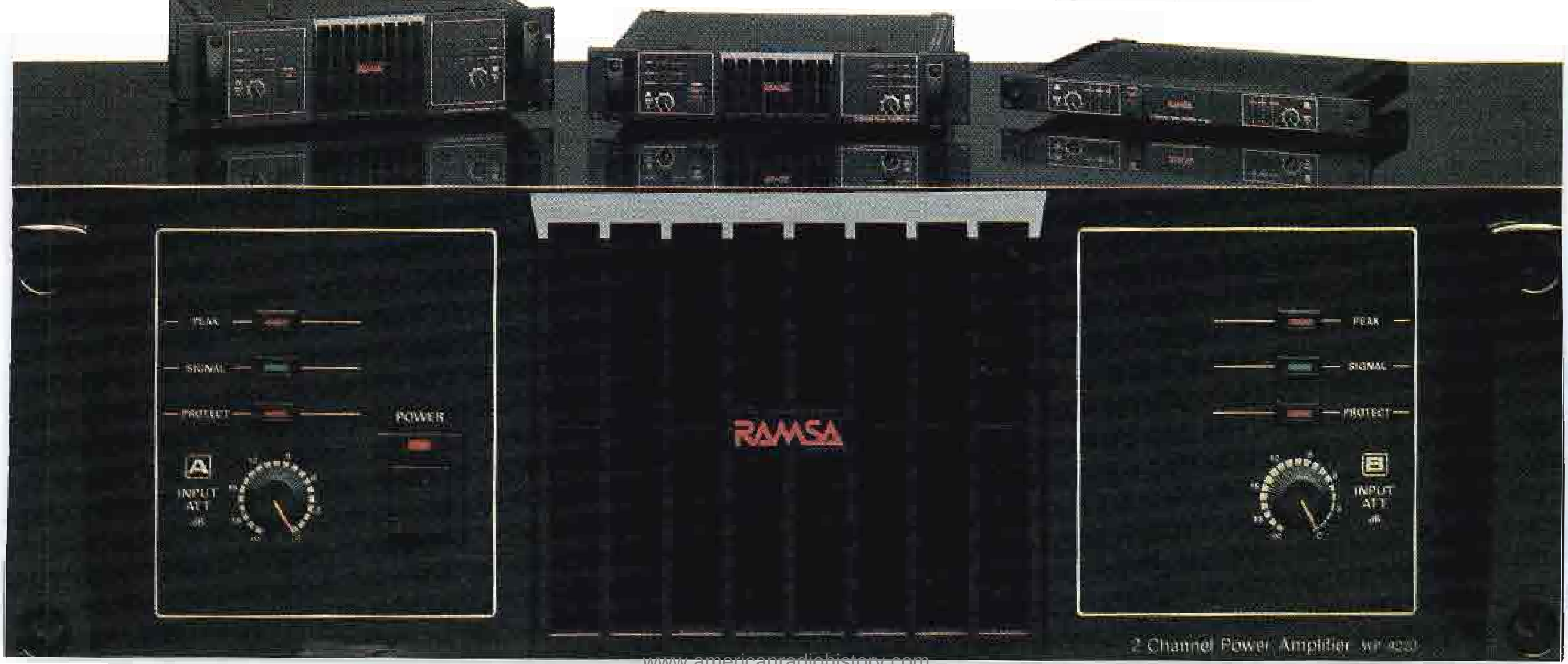


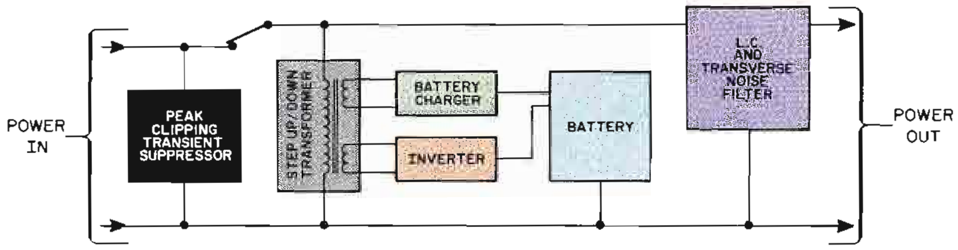
verted to dc to charge the battery and power the inverter section. The inverter converts the dc back to ac, which powers the load.

A drop in the ac line causes the battery charger's dc output to decrease, but the battery automatically compensates and continues to supply dc power to the inverter. The inverter's ac output to the protected load continues with no interruption.

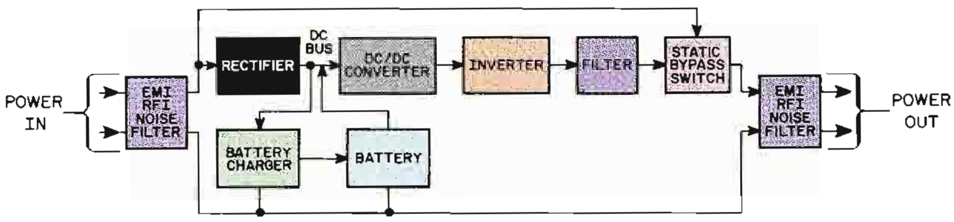
In addition to providing blackout and brownout protection, the UPS also serves as a power conditioner. Low voltages, spikes, surges, noise and most other power-line problems can be eliminated by a UPS. A UPS has the advantage of no switching time; the unit is always on-line. This feature is important for many computers that cannot tolerate the momentary outage produced by a standby system.

### Other factors

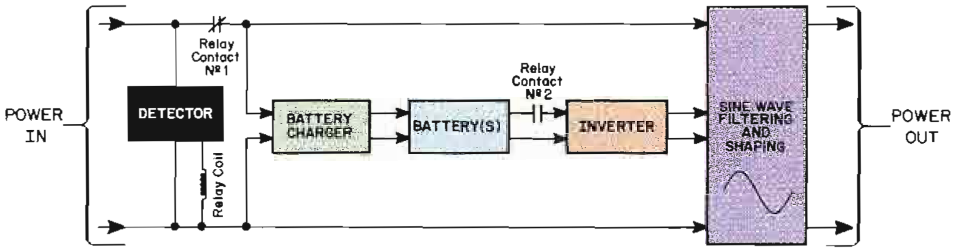
The standby system often is less expensive than the UPS. The standby system can be useful for equipment that can withstand the switching time during an outage without suffering malfunction or component failure. More sensitive and sophisticated equipment may require the continuous operation provided by a UPS. In both systems, the length of time you can operate off-line depends upon battery capacity and load current requirements.




*The typical standby power system protects only against blackouts. Also, the transition time between modes can create problems for computer-based equipment.*




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




*In addition to providing standby power protection, some power supplies also provide line-voltage regulation and noise filtering, while operating in the normal on-line mode.*

| | Disturbance | Causes | Effects |
|---|---|---|---|
| | Electrical Noise | Atmospheric conditions<br>Radar, Radio signals,<br>Arcing equipment<br>Switching apparatus | Individual data bits changed, data altered |
| | Spikes | Lightning<br>Power line feeder switching<br>Power factor capacitor Switching<br>Turn-off of heavy motors | Data altered, wiped out<br>Circuits damaged |
| | Surges | Sudden load decreases<br>Switching of feeder lines | Data altered<br>Equipment shuts down |
| | Sags | Lightning<br>Turn-on of heavy loads | Data altered<br>Equipment heats up excessively, leading to early failure<br>Computer shuts down |
| | Glitches | Power line feeder switching<br>Circuit breaker re-closing<br>Brief short-circuits | Disk heads crash<br>Data altered<br>Equipment shuts down |
| | Outages | Accidents involving power lines<br>Transformer failures<br>Generator failures | Disk heads crash<br>Data altered<br>Equipment shuts down |
| | Frequency Deviations | Generator instabilities<br>Huge load changes | Data altered<br>Disks shut down |

***Table 1.*** *These seven disturbances account for most of the power-line-induced damage to equipment.*

*Continued from page 94*
protection, guarding against all forms of interference, including power outages. However, depending on type and battery capacity, a UPS system can cost several times more than an isolator/regulator of comparable capacity. UPS systems are invaluable where a clean, steady and uninterrupted power supply is critical.

Countless hours are spent by engineers nationwide, tweaking and tuning equipment to achieve the utmost in performance. All too often, the power being supplied to that equipment is taken for granted. Power protection requirements vary greatly, and require a careful analysis of each facility.

The cost of protecting your station could vary greatly, depending on the facility's size, the magnitude of the power problems and the level of protection required. In nearly every case though, the cost of power-line protection is small compared with the cost of repairs and dead air these problems can cause. Carry your good engineering practices right down to the power line, and you are almost guaranteed success.

# Field report

## Media Touch 2005 control system

**By Larry Vidoli and Jim Oliver**

When WEEI-AM wanted to automate its overnight broadcast operation, it was decided that the same system might be used to ease the daytime anchor's job. Using the system that evolved, it is now possible for a dual anchor morning drive team in an all-news format to run combo.

The Media Touch 2005 was selected to perform the complex switching and live-assist tasks. The system provides a control network that allows fingertip control via a touch-sensitive color CRT screen. Simply by touching the CRT screen, an announcer can control all aspects of the broadcast operation. Through the system, the anchor can control live-remote audio feeds, cart machines, Instacarts, reel recorders, on-air telephone lines and the delay system. We can eventually control digital audio sources such as a CD multiplayer or audio sources such as computer hard disks.

The automation system also communicates directly with the station's traffic and billing computer and the newsroom NewStar computer. The integration of on-air operations with the business side of the station has proved extremely useful.

A local area network is the heart of the system of IBM XT computers. An IBM AT computer acts as the file server for the entire system. Each work station consists of an XT computer, which can access and change any of the information stored on the file server. The LAN essentially allows all of our computers to communicate with each other. The traffic computer sends the daily log information to the network. The work station with the touch screen, OPLOG, reads the log information and controls the various equipment associated with our on-air operation.

The editor's work station allows direct communication with the OPLOG work station and last-minute changes to the program log. The server computer has 20Mbytes of disk storage. The large amount of storage allows us to also have word processing and database programs available on-line for use by the other work stations.

The OPLOG computer is primarily dedicated to its own set of functions. It converts the matrix output from the touch screen to RS-232 data and feeds the updated information to the CRT. The touch screen is composed of a standard 19-inch color monitor with a capacitive touch-sensitive overlay. This screen provides the human interface to the OPLOG computer.

The touch screen allows access to normally scheduled log events and gives the anchor complete control over all audio sources that would enter a typical console. The anchor can turn sources on or off and fade them by touching or wiping a finger across the computer screen.

In addition to controlling all live and recorded events, the touch screen also controls live copy. When a live commercial is required, the copy automatically appears in a screen window. An optional 13-inch, large-letter copy monitor is available, which allows scrolling and paging of commercials, PSAs, tags and other copy.

The OPLOG station is connected to four intermediate controllers: an audio switcher, five Instacarts, an electronic switcher and an automation decoder. All of the interface units are controlled via an RS-232 databus.

A second XT added to the network provides an editor's position. This work station is located in the newsroom and allows last-minute changes to the log and non-invasive access to the announcer. During call-in programs, the show producer screens the calls from this location and enters the information into the computer. As soon as the caller's name, town and telephone number are entered into the computer, they also appear on the anchor's screen. To place the call on the air, the anchor simply touches the screen. This work station also acts as the interface to the traffic department's large computer.

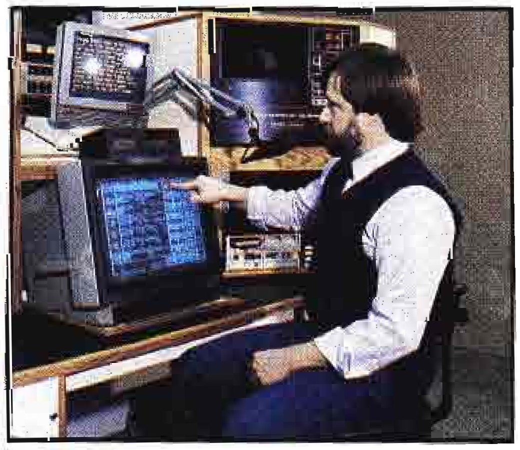
### Audio switcher

The audio switcher is a module consisting of three major components: a serial-

*Continued on page 102*

***Performance at a glance***

- *Provides automated or live-assist features to a radio or TV station*
- *The touch screen provides the announcer with easy control of audio sources*
- *Audio sources controlled via an RS-232 databus*
- *Capable of linking with billing and traffic computers, providing integrated accounting and control*
- *Standard audio input/output configuration: 32 x 6*
- *THD + noise 0.008% at +8dBm*
- *Hum and noise −88dBm at +8dBm*



*The modified color TV monitor provides control and feedback information to the operator. All control takes place by pressing the CRT screen.*


*Program log and tag-copy appear in windows, which overlay the current information. The windows for a variety of information can be recalled or removed by touching the screen.*

Vidoli is director of technical operations and Oliver is maintenance engineer at WEEI-AM, Boston.

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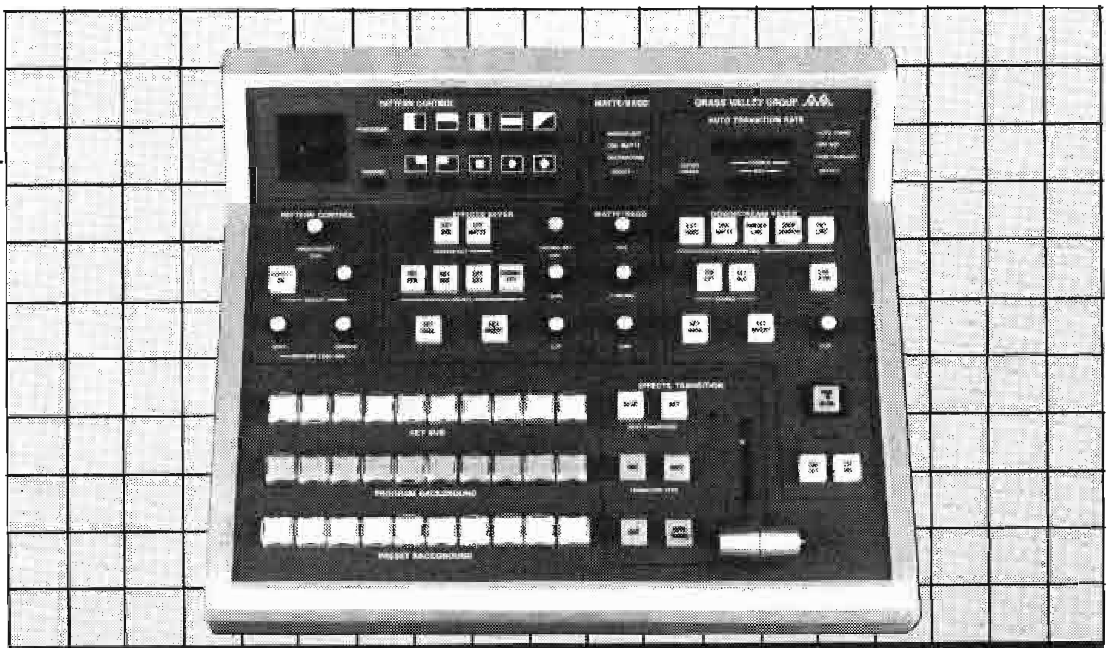

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Circle (75) on Reply Card

# Automated CDs simplify use

As compact discs become more popular, music stations are experiencing a need to be able to quickly cue and play selected cuts. DJs used to tossing a record on a turntable, locating the cut and pressing play, often find using the CD a bit more complicated.

The announcer now has to know the cut number before a CD can be played. Also, because the CD players used in many stations are consumer decks, durability may pose a maintenance problem.

Some stations elect to solve these two problems by dubbing the CDs to cart. Unfortunately, when this is done, the sonic advantages of using a CD may be lost.

The final problem with the use of CDs lies in their cost. The loss or damage of even a few CDs can quickly mount into a sizable replacement bill.

### Automated solution

Stations that rely on large numbers of CDs can help solve these problems through the use of an automated controller and a CD multiplayer. The computer provides the control and the CD player provides security. The equipment combination provides the announcer and the station with quick access to the records, a controlled play list and secure storage.

The CDs are mounted in a CD multiplayer, which typically holds up to 100 discs. If more storage is desired, the players can be chained together for prompt access to hundreds of CDs.

The key to effectively using such a large CD library lies in computer-assisted automation. The CD title, artist, timing and category information for each listed song is stored in the computer. The air personality can select any song for air play, providing the programming department has authorized the song's use. The software can even control at what times during the day any song can be played. If a particular song does not fit the rotational clock, it can't be played in error. Also, because all of the events taking place are recorded in the computer, a program director can receive a print-out of all of the cuts played and the time they were aired. This type of information can make sophisticated programmatic reviews possible.

### Operation

To select manually or to automatically cue or start the song, the DJ simply touches the screen. The selected block instantly changes color, providing positive confirmation of the desired action.

Any number of CDs can be programmed in any sequence for automatic playback. This feature allows the announcer to preprogram a segment, providing relief for other duties.

Because the entire system is software-controlled, additional features can be easily built in. For instance, pop-up notes can appear on the screen, either automatically or at the press of a square on the CRT. This feature might prove useful in music programming for noting important facts about a particular artist or song about to be played.

Live-assist automation can, for some stations, provide that useful link between human and machine. Today, full automation may not be the answer to a station's unique needs. Partial automation may, however, be a useful tool. This idea represents another way in which computers can improve the productivity of a broadcast station.

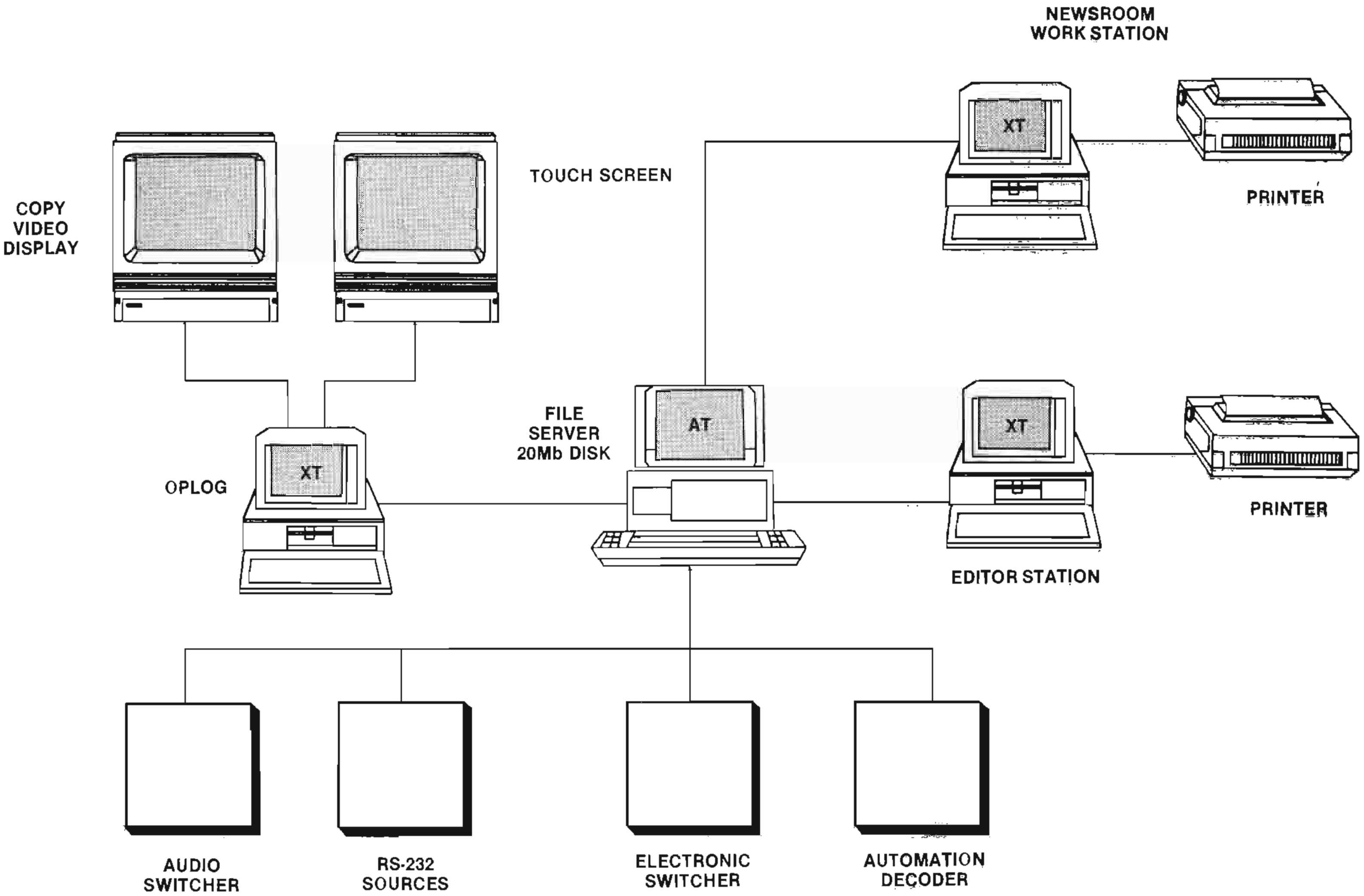


***Figure 1.*** *the heart of the Media Touch system is the software residing in the file-server computer. This computer controls the RS-232 bus and directs data between the other devices.*

*Continued from page 98*
to-parallel converter and two audio switcher assemblies. The audio switcher provides 32 inputs and eight outputs. All of the assignments are software-controlled via the touch screen. The switcher outputs are assigned to the transmitter, mix-minus for private-line news exchange, recording feed line and two level-adjustable feeds. The announcer can control the volume on these two lines by wiping a finger across the CRT screen.

The audio switcher inputs rely on op-amp circuitry and take levels ranging from −60dBm to +8dBm. This allows us the flexibility to patch anything from a microphone to a cartridge machine directly into the switcher. Measurements show the crosstalk to be quite low, at −70dBm.

There are two inputs that are not controlled by the computer: the announcer's microphones and the combined audio feed from three cart machines. These devices are located in the studio next to the operator's position. In the event that the touch screen fails or the system needs rebooting, on-air operations can continue without interruption.

### RS-232 interface

The RS-232 interface module ties all of the control lines together. At our station, the RS-232 sources include the audio switcher and five Instacarts. A music station could easily use this control line to access CD players or other RS-232-controlled audio sources.

The electronics switch provides a software-controlled switch to ground when any channel is activated by the audio switcher. This ground can be used for controlling ancillary devices such as tape machines, telephone lines and delay systems.

### Automation decoder

The automation decoder is designed to decode tones from any network source. The decoder takes the information, which is usually a simple relay closure, and converts it to RS-232 data. This data, in conjunction with secondary cue tones on cartridges, allow the system to operate in full automation during the overnight shift.

### Performance

Because the system is 90% software, there is little possibility of mechanical failures. In just a little more than a year of continuous operation, we have experienced about one hour of down time.

The worst thing that can happen is that the touch screen freezes, not allowing the anchor access or control. If that happens, the anchor can read a PSA or play a recorded segment from any of the three cart decks, which bypass the automation system. The entire system can be rebooted in about 15 seconds.

The initial operator resistance was quickly overcome by the system's user friendliness. A glance at the touch screen shows how easy it is to operate. In fact, what isn't self-explanatory is explained through system help menus that guide the operator through the operation.

### Installation and maintenance

Installation of the system took about the same amount of time as it would to install a control board. The key steps were the installation of the audio switcher and the connection of the LAN.

Routine maintenance is simple, much like that conducted on any automation system and far simpler than for a combo board. Most of the system consists of software, and the main audio feeds are handled electronically. We do not miss having to clean spilled coffee from console pots and switches.

This level of automation and control may be new to many radio stations. For some engineers, the lack of hardware and the required computer interfaces may result in some hesitancy to embrace

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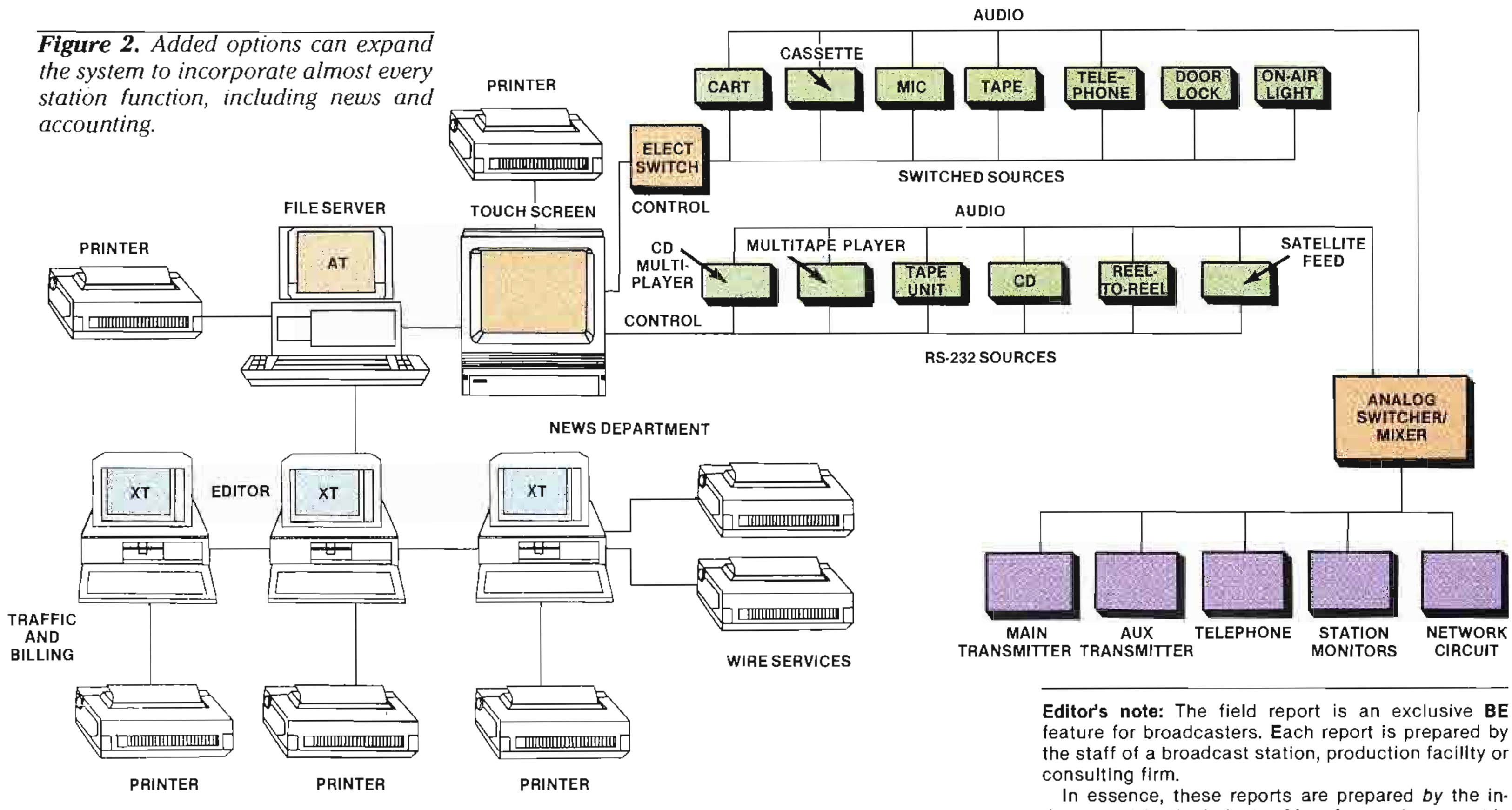


***Figure 2.*** *Added options can expand the system to incorporate almost every station function, including news and accounting.*

the technology. However, the step into the world of computer-controlled broadcast studios is inevitable, to some degree.

At WEEI-AM, the Media Touch 2005 control system enabled us to not only automate the overnight operations, but also make the daytime anchor's job easier. The integration of on-air control with the station's traffic and billing computer makes a great deal of sense, not only from an operational standpoint, but also from a business standpoint.

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

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

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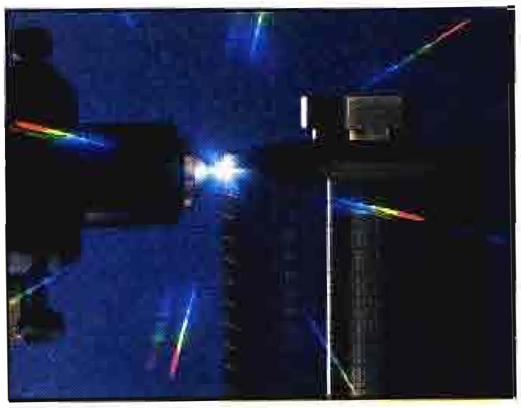

## Control via Dynabus

**By Carl Bentz, special projects editor**

Designers face a technical problem in interfacing equipment into a system. Remote-control schemes, although generally an equipment feature, often differ according to the manufacturer. A simple switch closure starts and stops the VTR or puts it into record mode. The same cue steps a character generator to its next sequential message or initiates a new signal path through a routing switcher. Some type of feedback, usually an indicator lamp, shows the operator that the desired event has occurred. And all of this costs only one wire per function per machine.

The genre of today's systems is oriented to microprocessor control, possibly with a human assistant as overseer. In this regard, one design goal is to derive a method by which various devices (production equipment, switchers, character generators, business systems and transmitter monitoring/control equipment) can talk to one another through a common, single-pair communication link. The concept goes well beyond simple machine control.

With microprocessors, programmable, intelligent devices can be designed. Such equipment not only responds to tape motion commands, for example, but also can generate a status report of its operation. That status can show a VTR to be in play mode, and it also can signal at least some malfunctions within the monitored circuitry, providing alarms to alert the operator. Conceivably, feedback from one device can trigger the central automation computer to reassign the task to another device.

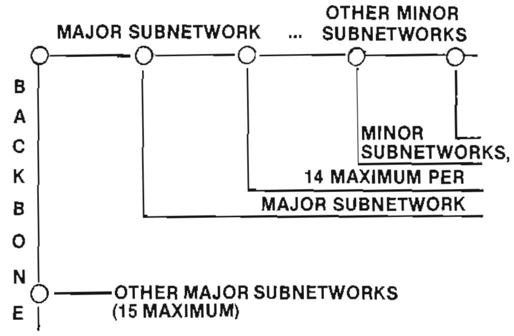


***Figure 1.*** *Node controllers, represented by 0, control the passage of information from one part of a network to another.*

### A language defined

Over a period of several years, representatives of manufacturers around the world met repeatedly to formulate a common control system that could be implemented at any facility. The results of those efforts evolved into the EBU-SMPTE or ESbus control standard. The ESbus follows the theoretical, 7-layer open system interconnection (OSI) structure derived by the International Standards Organization (ISO). Successful demonstrations of this network with various manufacturers' products have been presented at recent trade shows. Those involved in its development should be given credit for their accomplishment. A difficult part of that network remains to be solved—convincing all manufacturers to design equipment to match the network or to provide interfacing units.

There is concern regarding some parameters of the ESbus. One is the use of one central processor to maintain system control. If that processor fails, then a second processor with appropriate, automatic-alarmed switchover provision is needed for system reliability. The cost of an additional processor can be great.

Another concern is the data rate specified for ESbus—38.4kbaud. The trend to more digital equipment and the desire to create a communication path through a common machine control network suggests a need for several multiwire buses routed to each machine and control panel to handle the possible data flow. If the central control processor must deal with additional buses, an inevitable reduction of operational speed results.

Disconnecting a device from an ESbus system requires a multibus, loop-through, detachable connector, containing either a complex splitting network or several bypass relay circuits. The connector is needed because removal of a device from the network must not affect the reliable operation of other devices on that network.

### Searching for solutions

As the Utah Scientific engineering staff began development of a machine control system, they considered various network structures that existed or would soon be available. Various LAN (local area network) concepts were examined. Token passing systems were rejected, because in the systems, the failure of a single device will usually lead to immediate system failure. Polling systems also fell by the wayside for failure mode reasons.

Instead, a system was sought that would be reasonably priced, operate at a high data rate, be reliable and immune to single-point failures. The requirements were filled by CSMA/CD technology (carrier sense, multiple access with collision detection). Dynabus is the design that evolved.

The system structure does not revolve around a central processor, and no single active device is essential to successful network operation. Data buffers isolate each drop cable to a controlled device from the network bus. A bypass relay automatically disconnects the device transmit chip from the bus when a tap is disconnected or if power is removed from the device. A transformer detects high transmitter output current that results when data collisions occur, rather than seeking the absence of an ACK (acknowledgment) signal from an intended recipient to detect a transmission failure.

The system operates at a sufficiently high data rate that numerous devices and systems may be connected to the same network, including edit suites. The network allows random machine assignment from a central equipment pool, eliminating inefficiency that is inherent to dedicated equipment, cross-patching or control cables.

The network is managed from a simple computer terminal, which serves as the user interface. In addition, the computer allows diagnostics to analyze the system, providing the capability to detect insidious failures and to reconfigure potential problem areas. A printer tied to the computer records events.

### The system structure

First, the network links equipment through 150Ω twinax cable, segments of which should not exceed 1,000 feet. Several controlled devices may connect to each segment and communicate with one another through this rudimentary network link. Segments may interconnect through repeaters.

Two networks join at a node. A node controller tackles the movement of messages from one network to the other at the node point.

Typical broadcast stations will probably use only a single network, but the system topology supports as many as 226 interconnected networks. These would be arranged as a backbone or spine, with up to 15 nodes or major subnetwork links. Each subnetwork may in turn contain a maximum of 14 node controllers, leading to minor subnetworks. Controlled devices connect to the minor subnetwork portions of the system. (See Figure 1.)

Each segment can support a maximum of 100 devices, while each network can address as many as 32,767 devices. For a complete system implementation (15 major subnetworks, each with 14 fully loaded minor subnetworks), a maximum of 6,881,085 devices could be addressed by a single network.

### Addressing

In a control network, a means to direct messages to individual devices is necessary. That is, each device has a unique 16-bit address, which is assigned by the user with a DIP switch at each device. Devices on other subnetworks may have identical addresses because they are separated from one another through node controllers.

Two restrictions are placed on address assignment. The least significant bit must be a 0, leaving all addresses as even numbers. Also, address 0 (or 0000) is reserved from routine device assignment.

Sending a message to a specified device requires that the major and minor subnetwork addresses are known. This is encoded in a single byte with the four most significant bits indicating the major subnetwork and the least significant four bits specifying a minor subnetwork.

Every device on a Dynabus system has one or more group addresses, allowing a machine to communicate with a group of devices in one communication sequence. Each device may belong to any of 32,767 different groups. A group address uses the same two bytes as individual addresses, but they differ in the least significant bit being a 1. All odd-number addresses are valid except FFFF.

Message routing and handling is determined largely by a node, or most significant, address byte. If the node address (NA) byte of a destination address (DA) matches the current subnetwork, the message moves only along the originating network. When the least significant four bits are 1s (mmmm1111), and the most significant four bits match the originating major subnetwork, the message is distributed to all minor subnetworks linked to the originating major subnetwork. If the most significant four DA bits are 1s, the data is directed throughout the system or to selected minor subnetworks, according to the least significant four bits.

A global address also is available to send data to all devices on the system. The global address is 16 1s. Routing of global messages is determined by the most significant address byte, according to group addressing.

An address consists of 24 bits, as illustrated in Figure 2. The first eight form the node address. The next 16 bits form a local device address (LDA). Messages must contain both designation address (DA) and source address (SA) fields, each consisting of NA and LDA segments. Note that Dynabus differs from IEEE specification 802.3, which calls for either two bytes or six bytes for each address.

### Group addresses

The machine control system is assigned to the first two global (odd) addresses. Control sources are group number 1, while command execution units are group 3. A control source is any station that needs to know machine status. A status change at any machine is transmitted to group address number 1. Stations capable of executing advanced machine control functions belong to group 3. A next event command transmitted to group 3 addresses suggests that multiple commands execute simultaneously.

The routing switcher claims group addresses 5 and 7. Group address 5 is the destination address of router status messages. Router commands are directed to group address 7 because multiple control cards may exist for the routing switcher.

The current time is available to all stations listening to group address 9. The current time of day is periodically transmitted to group 9.

Other addresses are available.

### Message construction

Messages must conform to a generalized format. The structure consists of a preamble (P) field, a start-of-frame delimiter (SFD) field, a DA field, an SA field, a message ID (MID) field, a data (D) field and a frame-check sequence (FCS) field. Frame-check sequence is synonymous with cyclic redundancy check (CRC) used in conjunction with error correction.

The P field synchronizes the phase-locked loop of all receiving devices to the incoming data and clock stream. It acquires use of the local network for transmit procedures. A duration length (usually three bytes) is determined by the longest network attached to the system.

The duration must be sufficient for all devices to see the P field before its transmission is completed. In this field is a repeating sequence of 1s and 0s, which must begin with a 1 and end with a 0.

An SFD field signals the end of the P field with the unique bit pattern [10101011]. The 1-byte-long field also signals the beginning of the following destination address field.

In the DA field, three bytes provide addressing for the destination of the message to a device or group of devices. It is followed by the 3-byte SA field to allow a receiving device to determine the source of the message and to permit quick 2-way communication.

The MID field defines the message type as system or DA-specific. The most significant bit indicates the type. The seven least significant bits represent a message type selector.

All devices connected to the network must receive and respond to all system messages, of which there are 127 possibilities. Each specifies certain requirements for the format of the D field.

Messages directed to specific DA addresses are applicable only to that device. The format of the remaining seven bits will be defined by the manufacturers of devices intended to communicate through this system.

The D field contains a cue for the receiving device to make sense of the message. The format of the D field is defined by the MID field. DA-specified D fields are described in the protocol definition from the device manufacturer. No minimum number of bytes is required in the D field, but it cannot be longer than 256 bytes.

The purpose of the FCS field is to check data integrity. The contents of an FCS field are generated by the transmitting device and checked by the receiving device. If field values match, data is accepted as correct. Calculations of the FCS value begin with the first byte of the DA field and end with the last byte of the D field. The value fills the 2-byte FCS field.

A standard CCIT HDLC polynomial determines the FCS value, transmitted as the 1s complement of the sum of the remainder of:

$$X^k \times (X^{15} + X^{14} + ... + X^2 + X + 1)/(X^{16} + X^{12} + X^5 + 1).$$

In this relationship, $k$ is the number of bits in the frame existing between, but not including, the SFD and FCS fields and the remainder after multiplication by $X^{16}$ and the subsequent division by the generator polynomial $X^{16}+X^{12}+X^5+1$.

The FCS value is normally calculated by the LAN controller chip. Because the 2-byte length of the Dynabus FCS specification differs from the IEEE 802.3 specification of a 4-byte length, the 2-byte FSC

**24-BIT ADDRESS FIELD**

| 8-BIT | 16-BIT | 8-BIT | 16-BIT |
|---|---|---|---|
| NODE | LOCAL DEVICE | NODE | LOCAL DEVICE |

***Figure 2.*** *The structure of all address fields contains node and local device regions.*

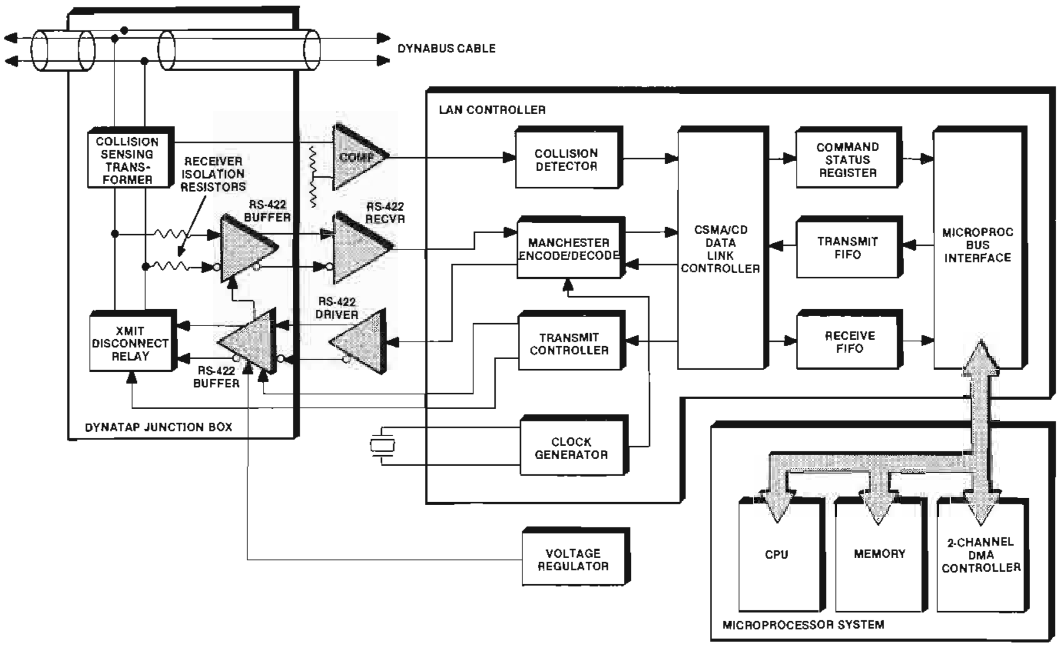


***Figure 3.*** *Block diagram of the Dynabus interface.*

is not supported by available LAN chips.

**System messages**

An orderly application of a communications protocol can occur only if system messages are coordinated with other users. Without coordination, failure or confusion of the desired and actual communication results. Ten system messages are currently specifically defined as follows:

- Message 0: Final Response

A final response message results from some other system message. The D field data format is specified by the system message initiating the response. This response is identified by 0s in the seven least significant MID field bits.

- Message 1: Intermediate Response

An intermediate response message contains data as a response to other system messages, if the requested data cannot be contained or transmitted in one message. This interim format is used until only the few bytes remaining to be transmitted can be contained in a single final response message. The receiving station is responsible for concatenating (combining) a series of individual blocks into the complete message.

- Message 2: Report Errors

The report errors requests a receiving

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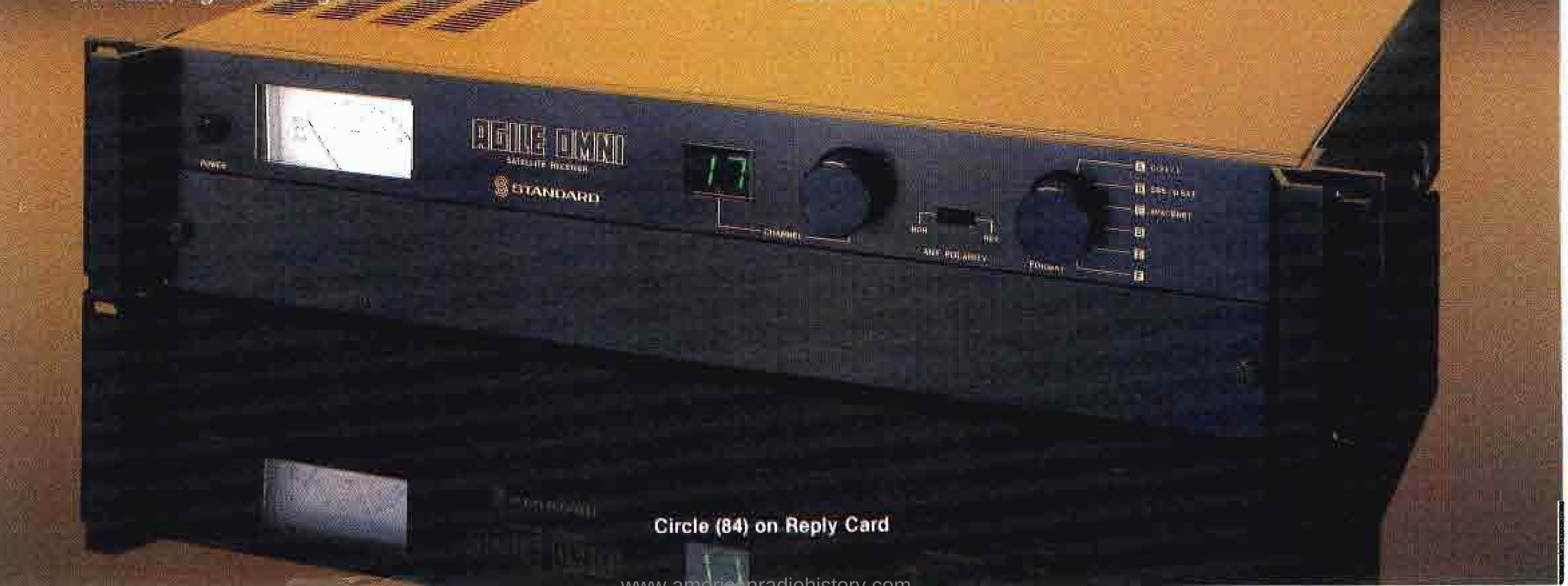
*Format control enables selections of desired satellite system. Direct-reading channel selector displays transponder-assigned channel. Second selectable subcarrier and space for optional third subcarrier or descrambler modules.*




Circle (84) on Reply Card

device to read and respond with the contents of its internal errors counters. This message is identified by an empty D field, with the FCS field immediately after the MID. A special organization of response information is initiated, as noted in Table 1. Error registers or counters are separately cleared to zero by a command from the system terminal (user's interface diagnostic panel).

- Message 3: Report Transmissions

A report transmissions order initiates the receiving device to respond with a number of messages sent following the last reset command. The D field of the response contains a binary representation of the number of messages, transmitted as two bytes, in low-byte, high-byte order.

- Message 4: Report Name

At a report name command, the device identifies itself with its designated name as a string of ASCII characters. The 32-byte D field of the response is padded with 0s (hexadecimal) for names fewer than 32 ASCII characters.

- Message 5: Receive Name

A receive name command stores a new name designator in the receiving device name buffer. The D field of the command is 32 bytes in length, padded if required, with 0s (hexadecimal).

- Message 6: Roll Call

When roll call is taken, the device responds by indicating its presence on the network.

- Message 7: On-line

The on-line message informs the receiving station that the transmitting station is on the line and prepared to receive messages. No response is generated for this system message.

- Message 8: Set Station Time

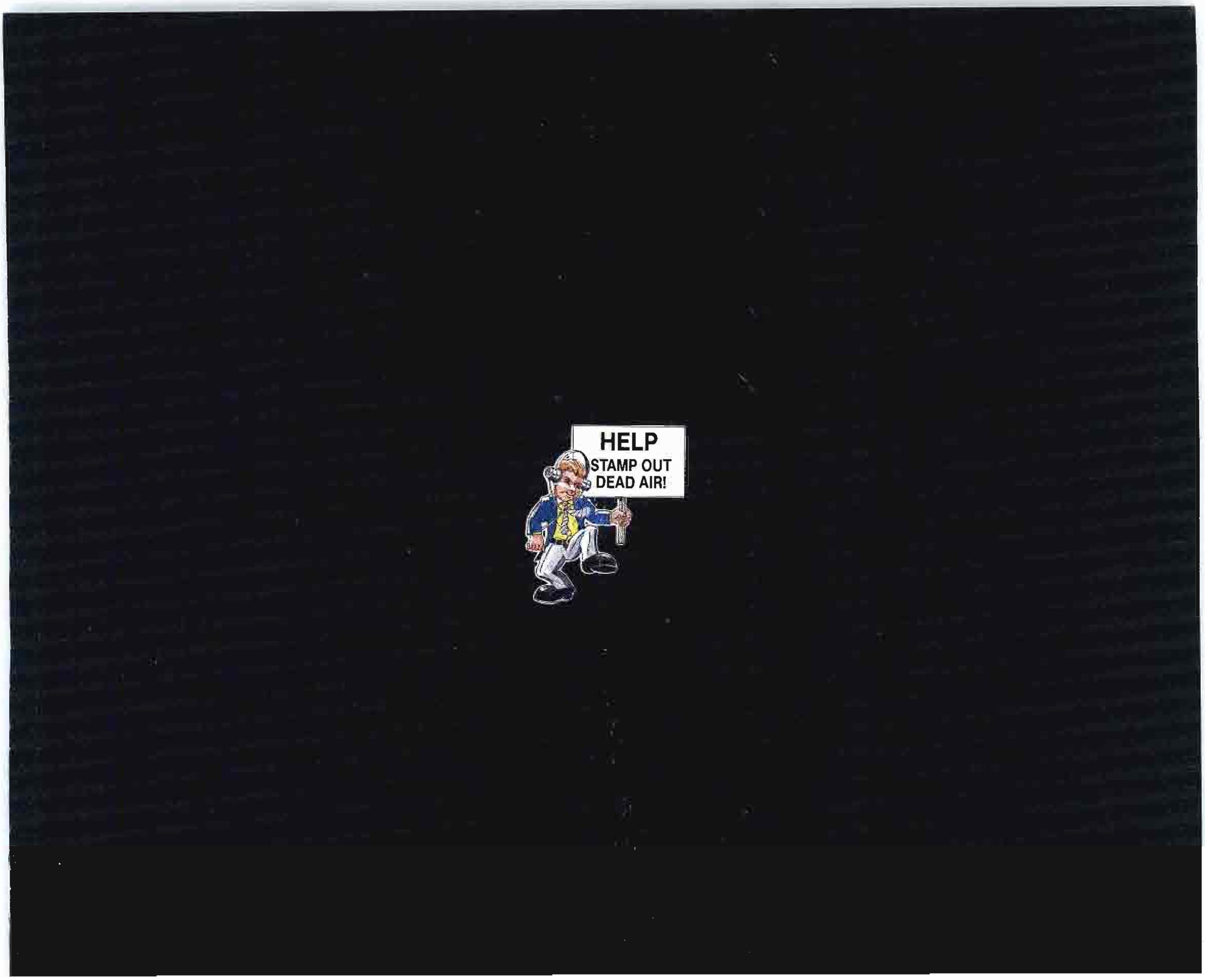
Internal real-time clocks are instructed to set the station time in response to the network system clock. A 7-byte D field contains month, day of month, hours (0-23), minutes (0-59), seconds (0-59) and hundredths of seconds (0-99), all as binary representations.

- Message 9: Reset Counters

At a reset counter message, the device clears all internal error and statistics registers to 0. No response is generated.

The design of Dynabus was formulated primarily for use in the broadcasting environment, providing fast and reliable communication for various control and data functions. Although it does have many similarities with LANs offered by the computer industry, the realistic needs of broadcasting have played a major role in the development process.

**Editor's note:** This examination of Dynabus is based upon documentation provided by Utah Scientific. It is used with permission.

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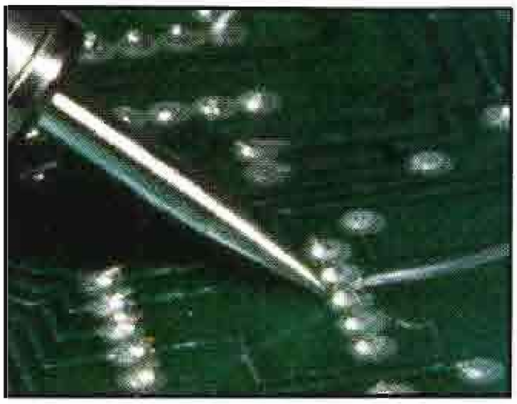


# Using the phone for remotes

By Jack Cunkelman

Using a telephone for remote communications and program feedback seems to be more popular than ever. Being able to communicate between the remote site and the studio is critical to effective production when using ENG and SNG equipment.

At WLWT-TV, providing return audio to reporters and trucks in the field has become an everyday task. To make the return link as foolproof as possible, I built a simple, yet reliable, device for non-technical operators. Although several companies can provide such equipment, building it myself saved a fair amount of money. The device is straightforward and provides excellent audio quality.

## Operation

Most IFB and COM lines operate over automatically answered telephone lines. In the case of satellite feeds, the return audio is usually a mix-minus IFB signal. All the remote reporter or truck operator needs is a standard telephone with a detachable handset.

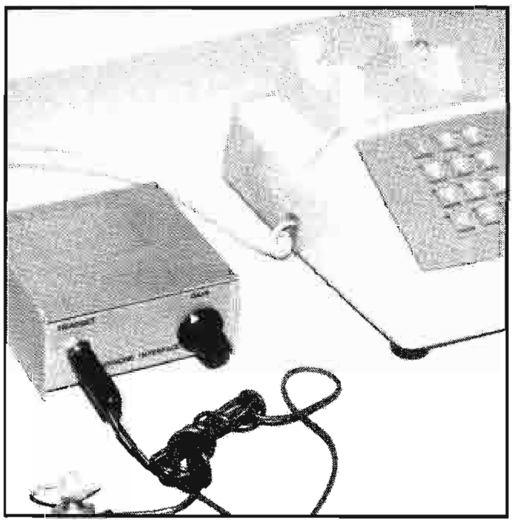
After contact is established between the studio and remote site, the telephone handset is disconnected from the telephone. The custom amplifier box is then connected in place of the handset. The reporter can then adjust the volume to a comfortable level and begin operating.

It is important that the reporter not replace the now-disconnected handset back on the telephone cradle. To do so will immediately cause a telephone disconnect and the call will have to be replaced.

Cunkelman is manager of engineering maintenance at WLWT-TV, Cincinnati.

## Construction

The entire unit is housed in a small metal chassis. A plastic box can be used if you think it will stand up to your particular environment. Mount small rubber feet on the bottom of the unit to help it remain stable if located on a desk or tabletop. Don't assume anything. Label all jacks, connectors, knobs and switches.



*The interface replaces the telephone handset when in operation.*

The amplifier uses a readily available LM386 power amplifier IC chip. The chip is capable of 500mW of audio output and uses an easy to obtain 9V battery. Although this power level won't drive a low-impedance headphone to ear-splitting levels, the volume should be enough for most earphones, even in a noisy environment. A fresh battery provides about 12 hours of continuous use, which should be enough for most applications.

The schematic is shown in Figure 1. The IC amplifier chip gain is fixed at 20. Adding R1 provides a simple volume control. Resistor R3 and capacitor C3 prevent the amplifier from oscillating.

When the device replaces the telephone handset, a 600Ω resistor is connected across the telephone microphone wires. This load is needed to help keep the telephone hybrid balanced.

When constructing the amplifier box, remember that the modular handset jacks are not the same size as modular line jacks. The modular line jacks are larger, allowing for as many as six connections. The handset jacks are sized to permit only four connections.

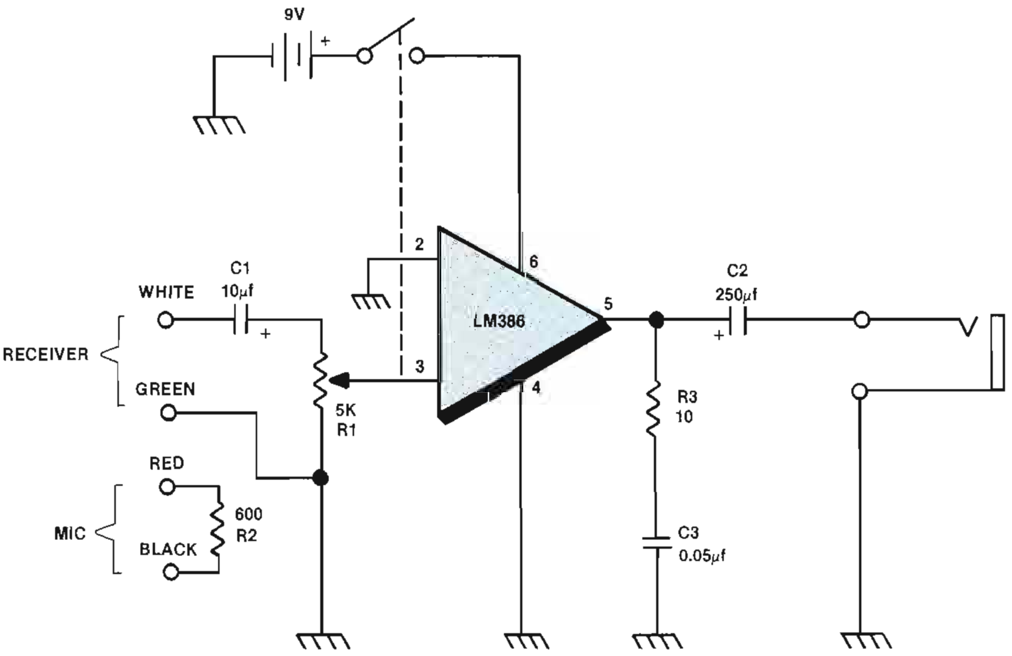


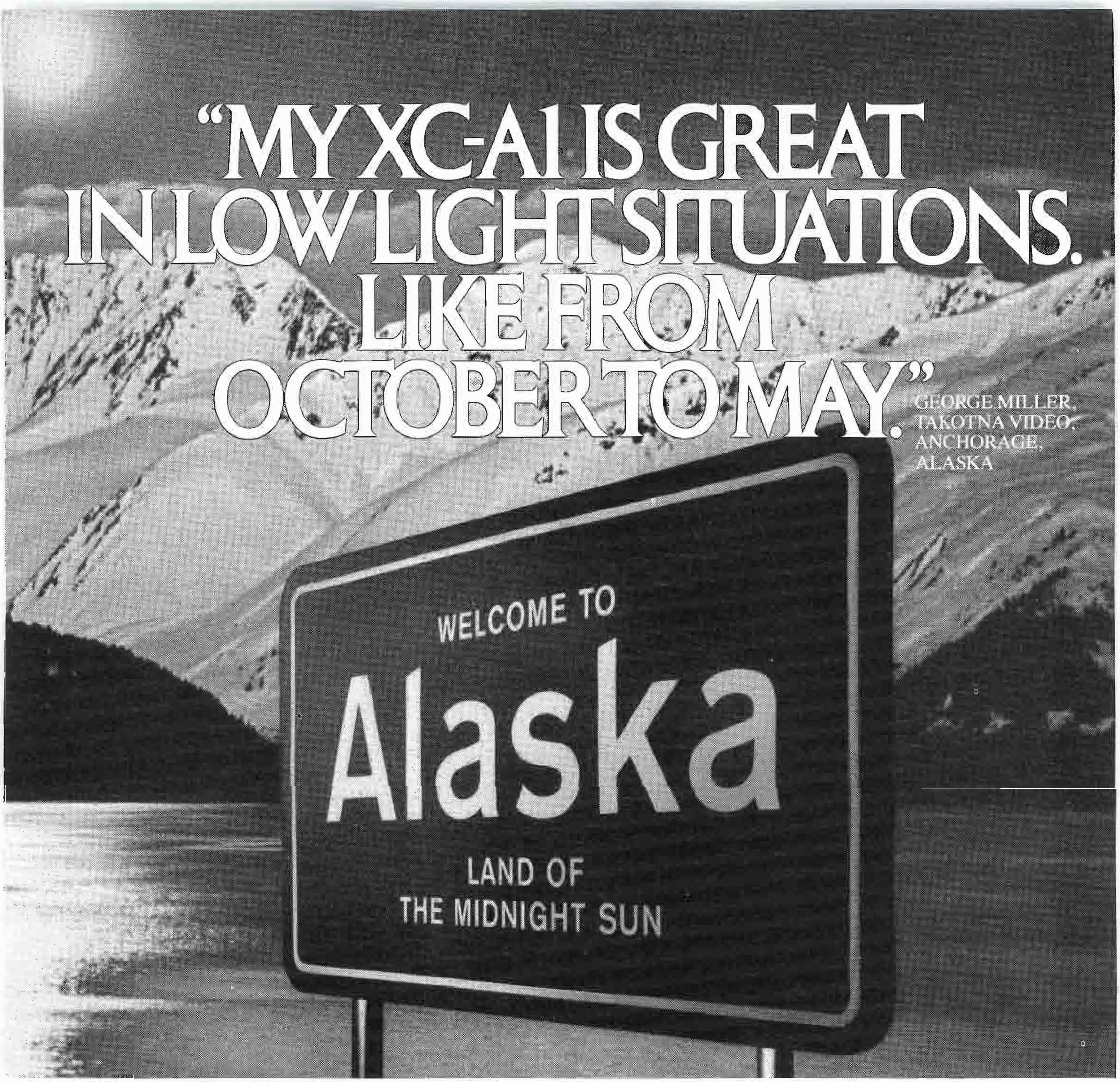

***Figure 1.*** *Schematic for the IFB telephone interface.*

## Optional features

The amplifier box, as described, will accomplish its assigned task. It does a good job and is inexpensive. The design is, however, easily changed and other optional features can be added.

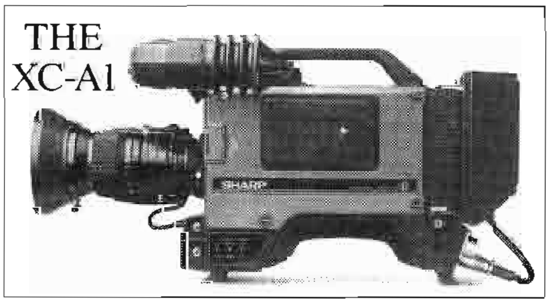
One useful addition might be a connector and switch to allow the handset to go on-line with the flip of a switch. This would make using the telephone more convenient.

The number of additional features is limited only by your imagination and budget. Now that the telephone industry has been deregulated, you are no longer limited to features provided by the phone company. Today, if you can build it, you can probably use it on your telephone line.




George Miller lives in Alaska and shoots documentaries. So half the year he's shooting at night.

That's why he replaced the camera he was using with a Sharp XC-A1. The picture is amazingly quiet. Even when he goes to 18db gain.




And thanks to all the information the XC-A1 displays in the viewfinder, George's job is a lot easier. Step-by-step instructions coach him on what to do, then disappear or move to one corner automatically.

Of course, George realizes that the XC-A1 can't do everything, so he still keeps the camera he replaced with it for one very important job—he uses it to anchor his boat.

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# SBE Update

## Look ahead to 1987 national convention

**By Bob Van Buhler**

The SBE welcomed the support of four new sustaining members at the last executive board meeting. They include: Jampro, Sacramento, CA; Pacific Recorders and Engineering, San Diego; Richardson Electronics, East Rutherford, NJ; and Utah Scientific, Salt Lake City.

### 1987 national convention

The 1987 SBE national convention and **Broadcast Engineering** conference promises to be even bigger and more exciting than last year.

Joint radio-TV engineering sessions begin at 10 a.m., on Tuesday, Nov. 10. Attendees can begin their day with a cash continental breakfast in the convention center prior to the sessions. The morning sessions conclude at 12:30 p.m.

After a 1-hour lunch break, the afternoon sessions continue until 4 p.m. At that time, a reception will be held in the exhibit hall to celebrate the opening of the 1987 SBE national convention.

Wednesday activities kick off with a cash continental breakfast available in the convention center. The separate radio and TV sessions begin at 8:30 a.m. The radio sessions will break for lunch at 11:30 a.m. The TV sessions will continue an hour longer and break for lunch at 12:30 p.m. Each of the sessions will resume after a 1-hour lunch break and conclude at 6 p.m.

On Wednesday, the exhibits open at 8:30 a.m. and run concurrently until 7 p.m. Those who have a break in their sessions will want to tour the exhibit hall.

Thursday marks the final day of the conference. The morning period will be devoted to touring the exhibit hall. The exhibit hall opens at 8:30 a.m., after a cash continental breakfast. The exhibit hall will remain open until 3 p.m.

A 12:30 p.m. engineering luncheon will highlight the Thursday activities. As in last year's conference, the luncheon will feature an important industry leader.

The convention's final engineering sessions resume at 2 p.m. and conclude at 4 p.m. The convention has been planned with the attendee in mind. Thursday's schedule will allow you time to enjoy all the activities and still have time to return home, if desired. The national SBE event will again be held in the Cervantes Convention Center in St. Louis.

SBE and **BE** are once again planning to publish the conference *Proceedings*. The *Proceedings* were a big hit last year. They are especially important when you cannot participate in all of the desired sessions. The *Proceedings* also provide the only way to obtain the graphs, charts and other visuals so important to many of the presentations.

In order to accommodate all of the expected exhibitors, the amount of hall space has been expanded to 525 booths. If you need additional information on booth reservations or other convention matters, call the St. Louis convention secretary at 314-928-6780.

### 1986 convention review

The 1986 national convention was a great success. Anyone who attended the event can attest to the enthusiasm and excitement that was generated. The hard work of the St. Louis SBE chapter and many others resulted in proceeds of $36,745, which were donated to the Ennes Foundation and Scholarship fund.

In addition to the praise from attendees, the convention also received wide acclaim from the broadcast industry. Copies of the 1986 convention *Proceedings* are available from the national office for $10.

### New SBENET system operator

Chuck Kelly, board member, has assumed the task of assistant SysOp for the CompuServe SBENET. He will be responsible for coordinating and posting SBE-related information within the SBENET area. Chapters and individuals may direct their files and questions to Kelly either on CompuServe or at ITC/3M.

Kelly assumes the duties from Gerry Dalton, the society's first CompuServe SBENET SysOp. Dalton will remain active in the SBENET area and messages can be directed to him there. He also has been responsible for the installation and maintenance of most of the national office computer hardware and software.

### Election ballot

The 1987 annual election is an especially important event for the membership. The bylaws revision proposal, which will appear on the ballot, may determine the quality of the national board members for many years.

Because of the way the original bylaws are constructed, large-scale changes cannot be adopted with a single vote. Rather, each bylaws revision requires a point-for-point vote. If you have questions on how the proposed changes might affect you and the organization, contact the national office, an SBE officer or board member. Additional information on the proposed changes will be presented in *Shortcircuits*, the *SBE Signal* and in BPForum on CompuServe.

### New treasurer

Wally Dudash, long-time SBE member, officer and board member, has retired from Group W, creating an opening for SBE treasurer. Richard Rudman, SBE president, recently appointed Bill Harris, Duffy Broadcasting, Denver, as interim secretary. Harris will serve the remainder of Dudash's term and run for treasurer in the next election.

The society will miss Dudash's valuable participation at the national level. He served the society in yeoman fashion for many years and we all wish him a long and happy retirement.

### Update on coordinators

James Lies, chairman of the Northern Indiana/Southwest Michigan frequency coordinating committee pointed up a change in the coordinator list that appeared in January's "SBE Update" column. Lies advised **BE** that his group recently took on additional areas beyond the South Bend perimeter. If you need coordinating help in the Northern Indiana or Southwest Michigan area, call Jim at 219-293-5611.

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

# Triple Play


## Videotek's new combo monitor gives you more inputs, more output and more memory for less money.

Only Videotek's TVM-620 waveform monitor/vectorscope gives you three selectable inputs for multiple viewing combinations, a roster of other winning features *and* the economy of a two-in-one unit.

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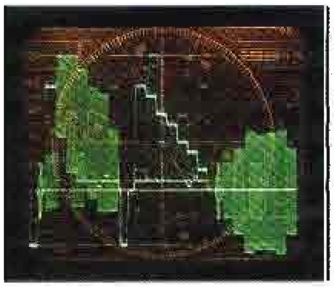

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# People

**Tom Nielson** has been appointed vice president in charge of marketing for Spectra Image, Los Angeles.

**David Burns**, national sales manager, Allied Broadcast Equipment, Richmond, IN (medium audio); **Ed Youskites**, marketing manager, broadcast products, Grumman Electronic Systems, Great River, NY (small video); and **John Phelan**, marketing manager, professional products, Shure Brothers, Evanston, IL (small audio), have been elected to the 9-member Exhibitors Advisory Committee. They were elected by companies exhibiting at the NAB convention.

They will serve 3-year terms that began March 31, the closing date of the convention. They represent audio and video exhibitors occupying small and medium areas of the exhibit floor.

Committee representation is based on type (audio, video and outdoor exhibits) and amount of exhibit space: small (100-400 square feet), medium (401-1,600 square feet) and large (more than 1,600 square feet). The committee was organized in 1985.

**Henry Lasch** has been appointed to the newly formed position of national sales manager for Cubicomp, Hayward, CA. He is responsible for the company's domestic sales force, with all U.S. regional managers reporting to him. He is a former Eastern regional sales manager for the company.

**Erich Friend** has been appointed lighting specialist for the Dallas region at Victor Duncan, Irving, TX.

**David Ray** has been appointed as the national manager for Monster Cable Products, Professional Products Group, San Francisco. He also will head up the OEM and government sales divisions.

**Bob Webb,** Grass Valley Group's national sales manager, has been chosen as vice president of marketing for GVG subsidiary, Dubner Computer Systems, Paramus, NJ.

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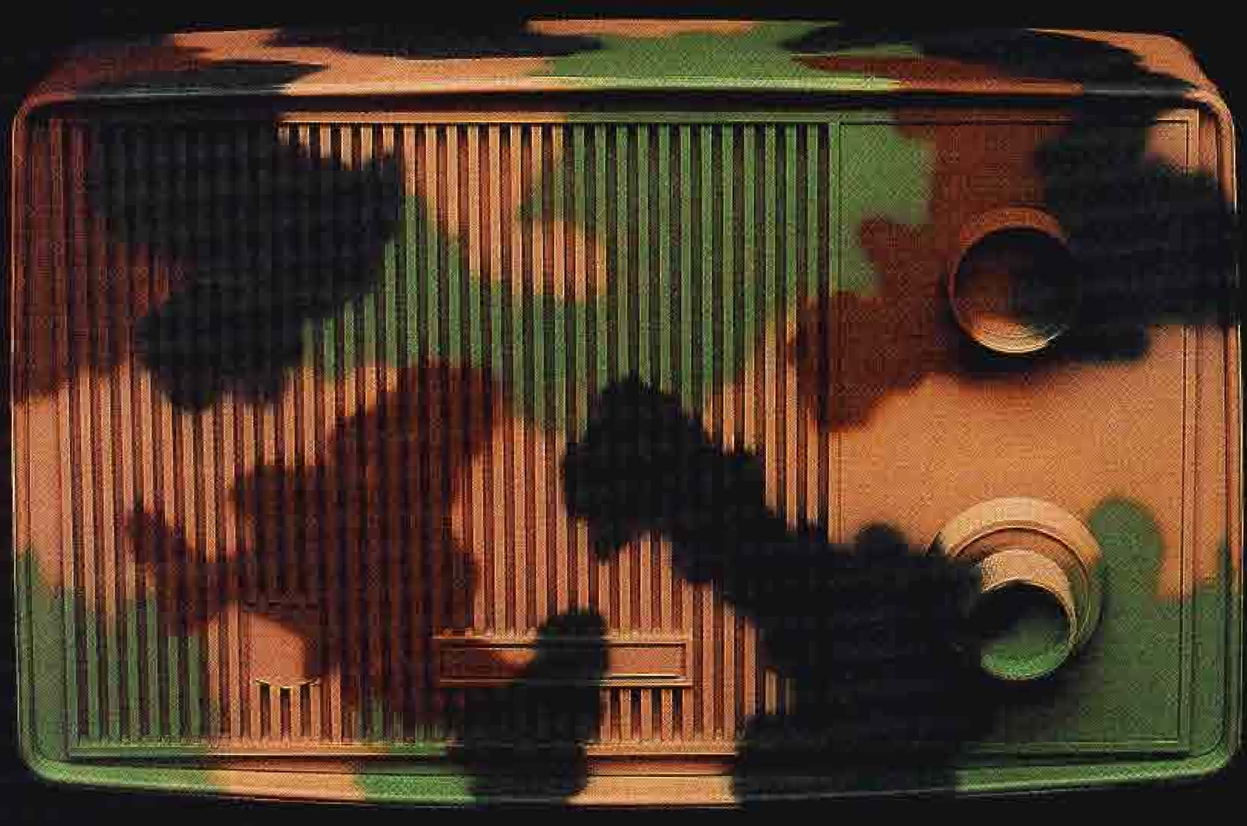

*Continued from page 4*
to Dollie Hamlin, program coordinator, SMPTE, 595 West Hartsdale Ave., White Plains, New York 10607, by June 15.

Frank J. Haney, Capital Cities/ABC, and Edward J. Burns, Eastman Kodak Company, have been named program chairman and program vice chairman.

## DBS comes to England

**By Howard T. Head**

Direct Broadcast Satellite (DBS) service opened in England on Jan. 30. Known as Super-channel, the new service operates on a Ku-band transponder on the Eutelsat (European Organization of Telecommunications by Satellite) satellite ECS-1.

In its first phase, Super-channel expects to reach most of the more than five million European homes that already have cable connections. This initial coverage will include cable systems in Holland, West Germany, Belgium, Switzerland and the United Kingdom. Programs also can be received with parabolic antennas in these countries as well as Spain, Luxembourg, France, Denmark, Ireland, Sweden and Finland.

Program variety is the great attraction of DBS transmissions in Europe. Most TV broadcasting in European countries is under tight government control, and some programs fall short of public tastes. Videotapes, both legal and pirated, are widely viewed.

The new enterprise also has attracted attention to its business structure. Financed by a consortium of public and private British TV companies, it has the backing of the British government.

## Master antenna systems are legal in Spain

Videotape and film producers and distributors in Spain have reacted angrily to a decision by the Supreme Court of Spain, which held that community videos are not TV broadcasting and, therefore, not subject to government regulation. A community video is a master antenna system, but with two twists—it doesn't carry air signals, but runs movies from noon to midnight.

The great mass of TV viewers in Spain are dissatisfied with the broadcast programming; VCRs are proliferating at the rate of about 600,000 per year, and video stores and rentals are springing up like mushrooms. Any additional programs are eagerly sought, and community videos are one way of filling the gap.

Although the law provides for copyright protection for videotapes, getting it is another matter. Pirating of tapes is widespread, and there also is a shortage of legal titles. The producers and distributors want the government to step in in the hope of getting protection, but the new court ruling makes it look as if the government can act only under the guise of establishing technical standards for interference protection.

Head, **BE**'s European correspondent, is a consulting engineer based in Madrid.

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*Photo shows 8600 STL System (Model 8600 Transmitter) as a single link with redundant receivers (Model 8601 × 2).*

**Based on available price information 6/86*

## Ampex sells equipment; demos AVC series

NBC affiliate, WMAR-TV, has purchased Betacam ENG equipment to upgrade its news department, from *Ampex*, Redwood City, CA. The purchase includes: 11 CVR-105 camcorders, four CVR-25 portable recorder/players, two CVR-21 portable players, four CVR-10 studio players, three CVR-15 studio players with AST tracking, 12 CVR-40 studio recorder/players, an AVA-3 video graphics system and various accessories. The station has also ordered an Ampex PictureMaker 3-D modeling and animation system.

Ampex demonstrated its AVC Century series of high-end video broadcast and post-production switchers to editors, technical directors, facility operators and other members of the Hollywood production industry during an open house, Jan. 14, 15, 16 and 19, at the Sheraton Universal Hotel. The series provides keying, key masking and memory capabilities, and interfaces with any editing system, enabling facilities to upgrade their switchers without replacing existing equipment.

## BTS expands U.S. activities

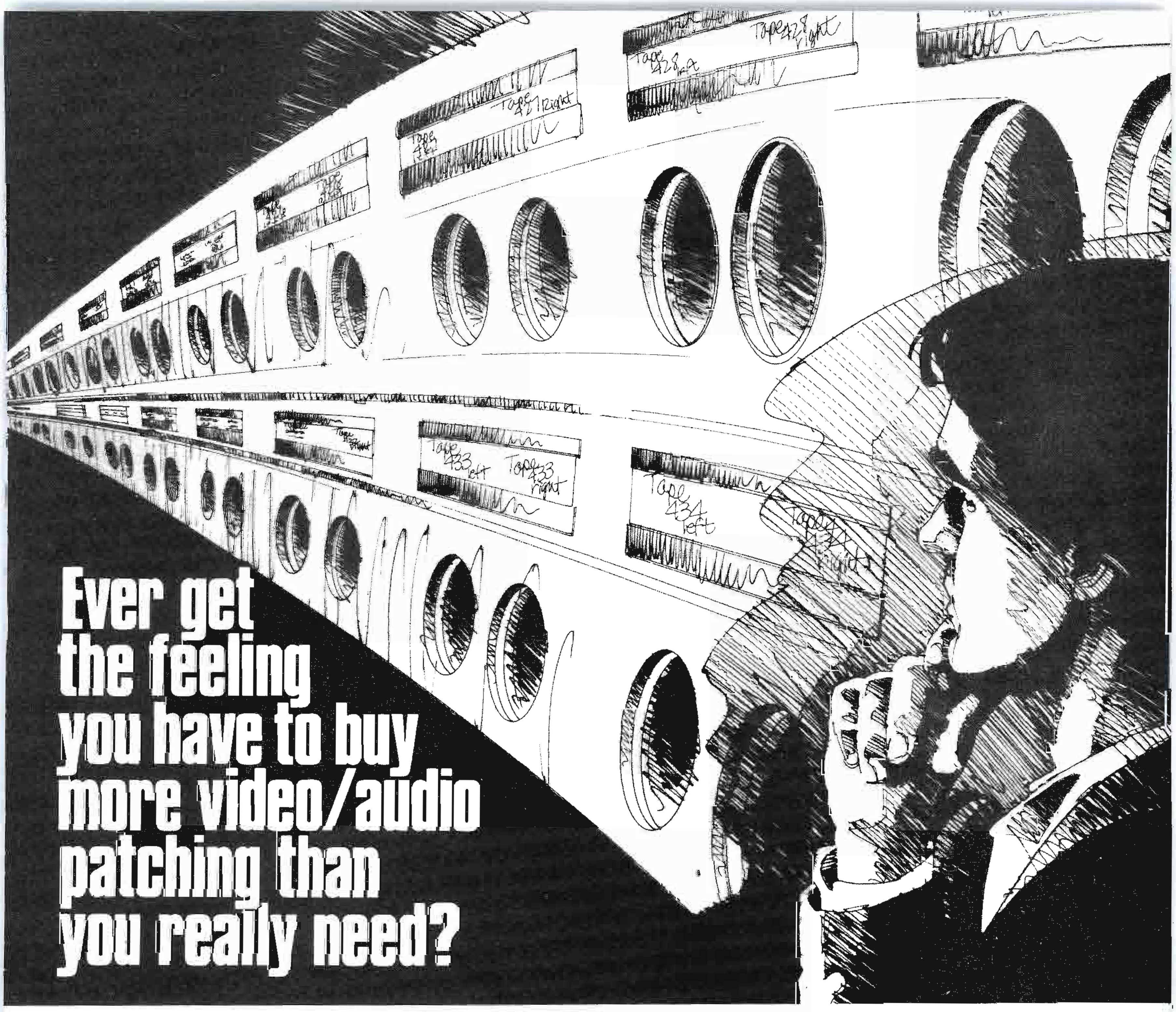
The *BTS Broadcast Television Systems*, Salt Lake City, is expanding its graphics product range by adding the Vidifont/Viditext product line from Thomson CSF Broadcast. Product development, production, sales and field service will be handled by BTS, a subsidiary of BTS Broadcast Television Systems GmbH, Darmstadt, Federal Republic of Germany.

## Tek Media Supply Company formed

RTI and Schmidt Audio Visual have formed a new company to market their film and video accessory products. *Tek Media Supply Company*, Lincolnwood, IL, offers a line of professional film and video care and storage supplies and equipment. Products include the RTI brand film and video storage racks, film cleaning/conditioning chemicals, film splicers, splicing tapes, viewers and sound readers. Also offered are blank and custom-printed film leader, Academy leader, along with storage, shipping and carrying cases for videotape and film, audio visual carts and furniture. Tek Media also will distribute the Tuscan unplastic reels and cans. The company is located at 4700 Chase, Lincolnwood, IL 60646; telephone 312-677-3000. For toll-free ordering call 800-323-7520.

## Gannett receives Wheatstone consoles

The Gannett News Service facility in Washington, DC, is scheduled to receive A-500 on-air consoles from *Wheatstone*, Syracuse, NY. The consoles will be installed in the main news production studios. The consoles are based on the standard 28-position model and will include several options, one of which is the MXM-500 module.



# Ever get the feeling you have to buy more video/audio patching than you really need?

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VAMP audio modules feature ADC's exclusive QCP punchdown insulation displacement contacts for fast, durable terminations with no soldering or wire-stripping. Video modules come with ADC's SJ2000 self-normalling jacks or a pair of CJ2011 single coax jacks. Each VAMP chassis holds up to 20 modules; mix or match audio and video modules to suit your needs.

For flexible audio and video patching with no wasted space or unnecessary costs, revamp your system—with ADC's VAMP.

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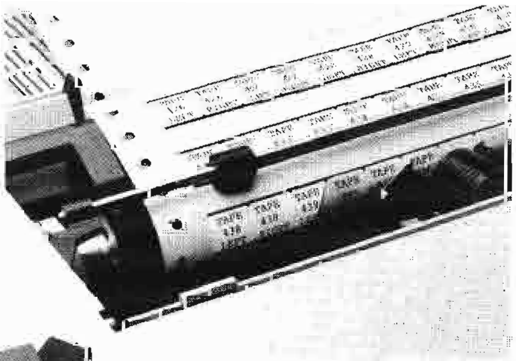

SAILS are over ½" wide, providing ample room for circuit designation.

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The HK-322 with 1" or 1¼" tubes remains the ultimate production camera in the industry, with specialized functions not found on any other camera. These include 6 vector color corrector, scan reversal with memory, negative video, out-of-bands horizontal aperture correction, scene files with extensive memories, dream effect and much more. For complete flexibility, the hand-held HL-79EP is available as the companion camera.

For field/studio operation, the HK-323 1" and ⅔" cameras, recently introduced by Ikegami, are quickly gaining acceptance with the networks as the market leaders in this segment of fully automatic micro-processor controlled, lighter weight broadcast cameras. The HK-323 is available with the optional hand-held companion, the HK-323P, which operates off the same base station.

Once again Ikegami is right where the marketplace expects us to be; with a commitment to excellence and our assurance of the best.

For a demonstration of the Ikegami HK-323 and HK-322, contact us or your local Ikegami dealer.

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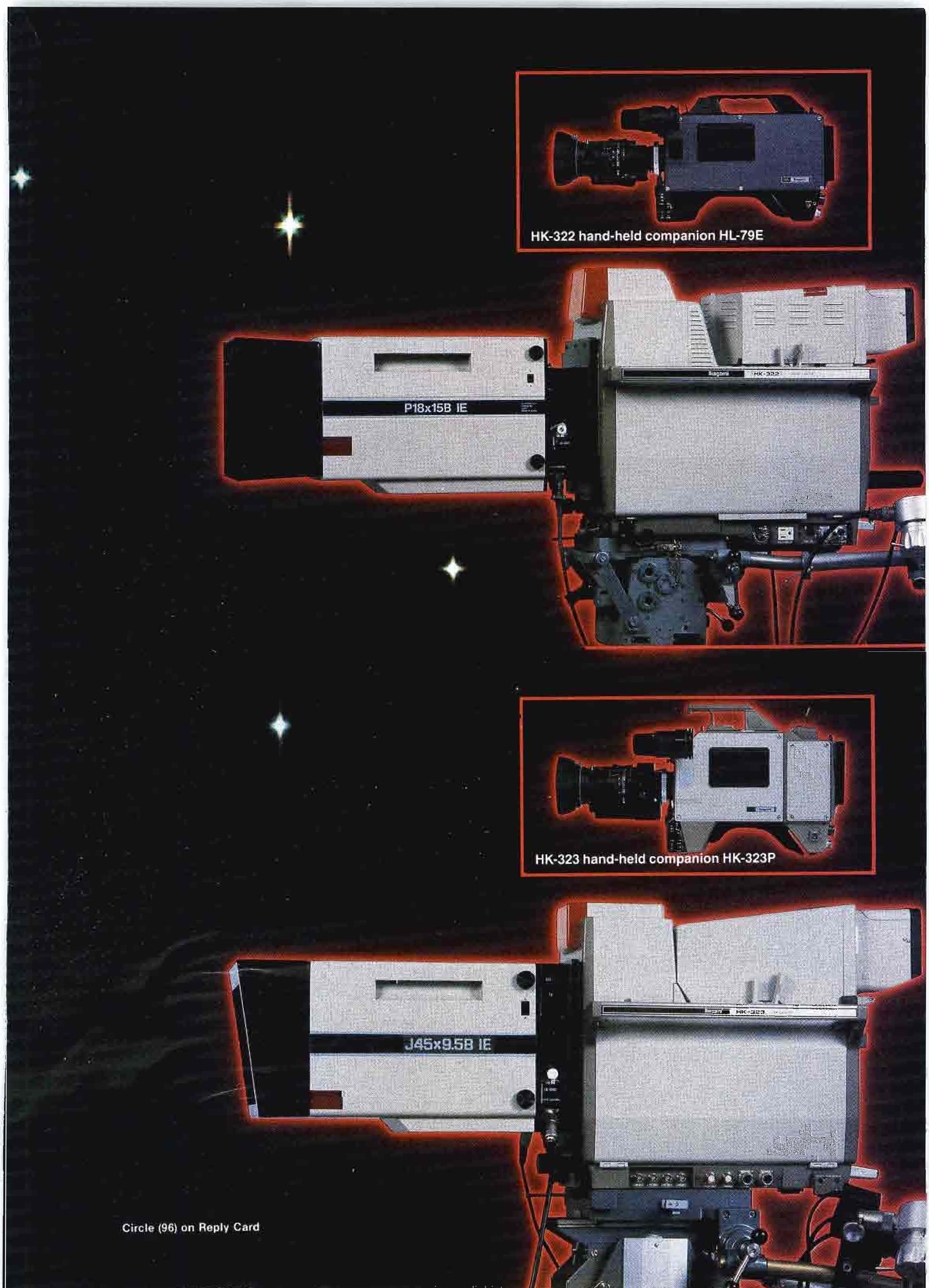
HK-322 hand-held companion HL-79E
P18x15B IE
HK-322
HK-323 hand-held companion HK-323P
J45x9.5B IE
HK-323
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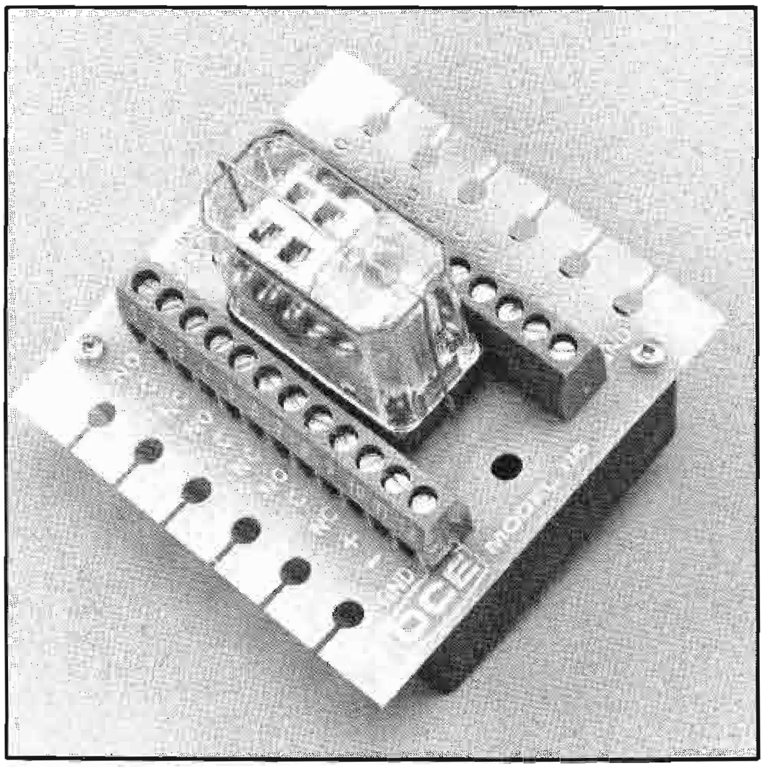
# New products

## Automation system, interface devices

*Allied Broadcast Equipment* has announced the following products:

• The Over-Nite automation system uses two Audiometrics multi-CD players with two SMC carousels and a system controller to allow unattended operation for overnight programming. Also provided are 48 random-access tape cartridge tray locations and two single-play tape cart players. The system is CRT-based and includes a stereo monitor amp with provisions for an external off-air signal, a silence sense alarm, VU test meters, fiber-optic connection between CPU and keyboard, dual CRT driver, real time clock, printer driver and equipment rack.

• Four relay interface devices that include the model 115 and 116. The model 115 contains one relay and can be ordered with 2, 4 or 6 form C contacts. The model 116 has four separate relays each with two form C contact arrangements. The relay contacts are rated at 2A with a supply voltage required of 24Vdc that can usually be from the remote-control system, the transmitter or a small separate supply. Wire attachments are by isolated screw terminals that require no crimp lugs and no soldering.



Relay interface device

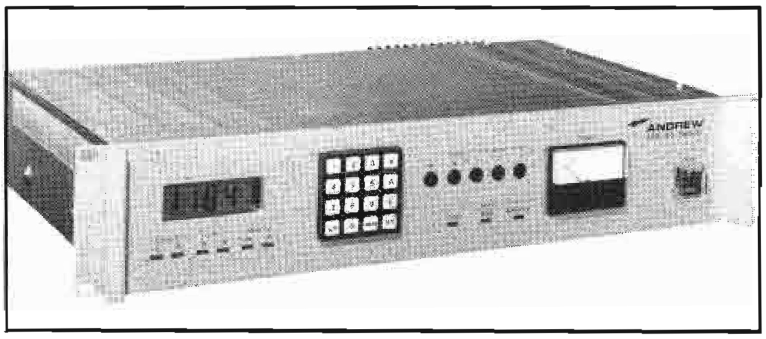
**Circle (350) on Reply Card**

## Satellite video receiver and grounding strap kit

*Andrew* has announced the following products:

• The ASR300 dual-band satellite video receiver. It operates in both C- and Ku-bands, and provides video performance that meets the EIA RS-250B standard. The receiver has dual RF inputs, frequency-agile RF tuning in 1MHz steps and two selectable IF filters with independent output level adjustment. Additional features include a frequency-agile audio subcarrier demodulator, two fixed-tuned audio subcarrier demodulators and a clamped composite output with clamp defeat. Alarm and control capability is provided in the receiver and includes loss of carrier, loss of video and power supply fault. The receiver may be controlled via a serial RS-422 or TTL compatible interface.

• A solid copper, preassembled grounding strap kit for use with Heliax coaxial cable and elliptical waveguide. It is corrosion resistant and is shipped fully assembled. It includes a strap tool for tightening a 2-part tape system and stainless steel hardware for mounting the grounding cable to the down conductor.




ASR300 dual-band video receiver

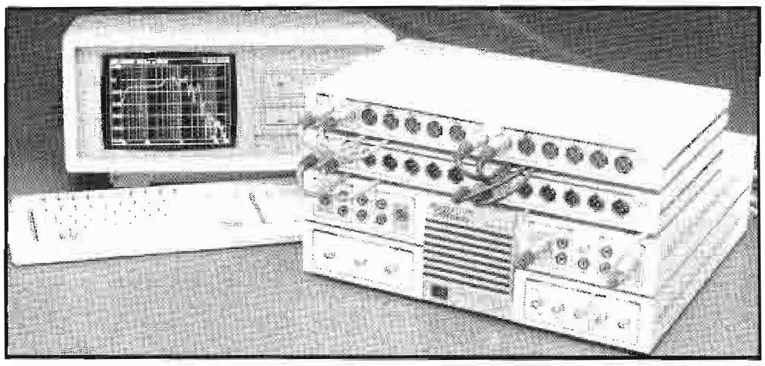
**Circle (351) on Reply Card**

## Character generator with added features

*Aston* has introduced three features for its A-4 character generator. They are the LogoMaster graphic/logo compose facility; Shades, an additional plane with comprehensive shaded background capabilities and the Hard Disk facility. LogoMaster allows creation of displays ranging from multicolored logos, symbols or special characters at sizes of 10 TV lines upward to full screen graphics. It is controlled from the keyboard and can be fed from any video input. The Hard Disk capability allows for an integral 25Mb disk, with a capacity equal to 16 floppy disks.

**Circle (352) on Reply Card**

## Audio test system



*Audio Precision* has introduced the A version of its System One audio test system. It makes simultaneous amplitude measurements on two channels, permitting stereo response measurements at twice the speed. Both channels can be displayed simultaneously as analog bar graphs or decibel difference between the channels can be displayed for balance adjustments. Crosstalk and stereo separation can be displayed as the amplitude difference between the two channels.

**Circle (353) on Reply Card**

## Transport cases

*Andiamo* has introduced the line of Aerospace transport cases. They can be used to transport video gear, sensitive electronic instruments, optical and mechanical devices and computer disks. All cases come with a lifetime warranty. The cases' exteriors are made of impact-resistant engineering plastic. Custom, dust-repellent foam interiors safeguard against damage to any equipment that's shipped or carried. The cases also are chemical- and scratch-resistant and feature a tongue and groove seal that makes them airtight and watertight. An interlocking mechanism enables the traveler to connect dissimilar-sized cases. The cases can be carted on two wheels, dollied on four or stacked horizontally.

**Circle (354) on Reply Card**

### Microphone windshields

*Audio Services Corporation* has introduced several windshields for stereo microphones. One series looks like the conventional windshield, but has larger diameters for larger stereo microphones. The Rycote Ball Gag houses two remote capsules in either M-S or X-Y stereo configurations. Windjammers are available for all stereo windshields.

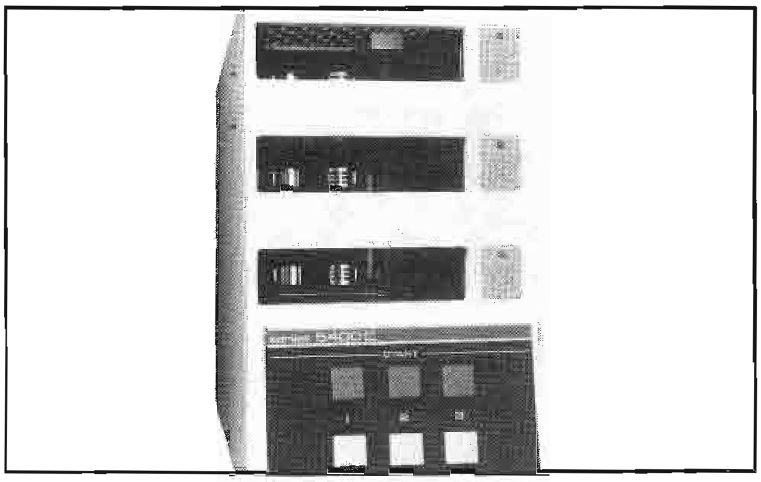
**Circle (355) on Reply Card**

### Teleprompter program

*Beacon Software* has introduced the AUTOPROMPTER+, a microcomputer-based teleprompter program for the Apple II series computers and compatibles. It is a full-featured, menu-driven program that supports video or paper-based portable or camera-mounted prompter systems and offers a range of features for text entry and electronic teleprompting. The program features smooth scrolling text; adjustable scrolling rate; on-line help screens; 1,350-line text display; program for minimum of 128k computers; built-in word processor; and story list management.

**Circle (356) on Reply Card**

### Cart machine



*Broadcast Electronics* has introduced the model 5400C 3-deck cart machine. The Phase Lok V head assembly is a key feature of the machine. It uses a locking azimuth control that is independent of the height or zenith adjustments. Also included is a cartridge guidance system that provides positive positioning for all accepted cartridges. Features of the cart machine include the air-damped solenoid in each deck assembly and a torodial transformer in the primary power supply. A non-repeat function flashes the stop indicator to let the operator know that the cartridge has played through completely or has stopped before recuing.

**Circle (357) on Reply Card**

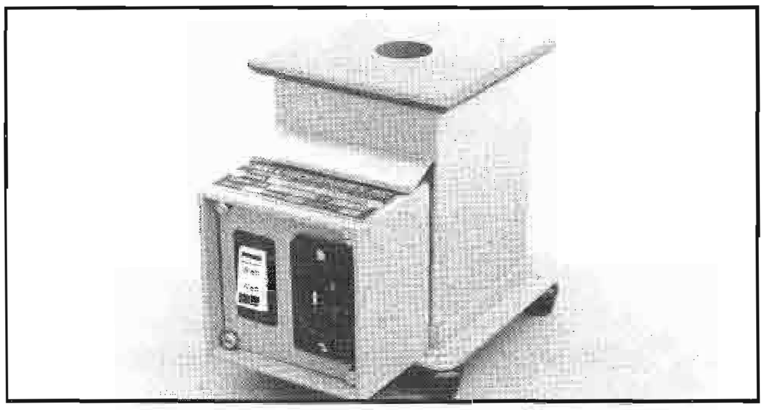
### Tower strobe models

*Broadcast Communications* has introduced the following products:

- The model SB-2001 Brighter Idea strobe beacon is designed for tower applications where a 20,000 candela strobe is used for daytime lighting and red flashing incandescent lights are used for night. The beacon is housed in the upper half of a 300mm code beacon. The bottom glass fresnel lenses are red and house the two 620W incandescent lamps. An internal photocell senses the external light level and changes from daytime strobe to night red flashing lamps.
- The model SH-2001 is a self-contained strobe housed in a glass fresnel lens system. The base, hinges and top are all cast aluminum and mount in place of an incandescent beacon using the same mounting holes. The beacon operates from 120V, 60Hz power using 2-wire No. 12 or larger.
- The alarm model AL-1001 provides an audible alarm and NO/NC contacts for remote-alarm alert to the studio. It mounts in a standard 19-inch rack panel. The panel contains an audible alarm as well as normally open/normally closed dry contacts to send an alarm to a remote-control point.

**Circle (358) on Reply Card**

### Solder pots, contact preservatives




# The only Character Generator that can display these kinds of figures.

Dubner's 10-K includes 4 anti-aliased typefaces and 30 standard fonts for $15,500. Designed to meet the demanding requirements of broadcast, teleproduction, corporate and industrial video users, the system also features: 16 million colors; embossed and 3-D edges; full screen help menus; playback effects: tumble, fade, wipes and pushes; sequencer; built-in sync generator/encoder/keyer; 5 ¼" floppy disk.

For a little more, the 20-K offers all of the 10-K features with a 10 megabyte disk and direct compatibility with our CBG, Texta and DPS-1 Painter System.

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**Circle (101) on Reply Card**

*Caig Laboratories* has introduced the following products:

- Cramolin products are anti-oxidizing solutions that clean, preserve and lubricate all metal surfaces including gold. When the preservative is applied to metal contacts and connectors, it removes resistive oxides and also forms a protective molecular layer that adheres to the metal surfaces and maintains electrical conductivity. It can be used on switches, potentiometers, relays, connectors, batteries, faders, interconnecting cables, gold-edge connectors, plugs and jacks.
- Solder pots are manufactured in round or rectangular, shallow or deep, low or high watt densities and cast-iron steel or stainless steel materials. Most sizes also are available with full heat operation, thermostat controls or accurate SCR time proportional controls.

**Circle (359) on Reply Card**

## Audio automation

*BC Engineering* has introduced the AC 400. It features four channels with two controls: one to set the rate of change and the other to set the amount of gain reduction. The four channels may be used separately or coupled for stereo. Additional features include variable rate fades; variable gain reduction; versatile interface; balanced inputs/outputs; stereo coupling switches; and crossfade capabilities.

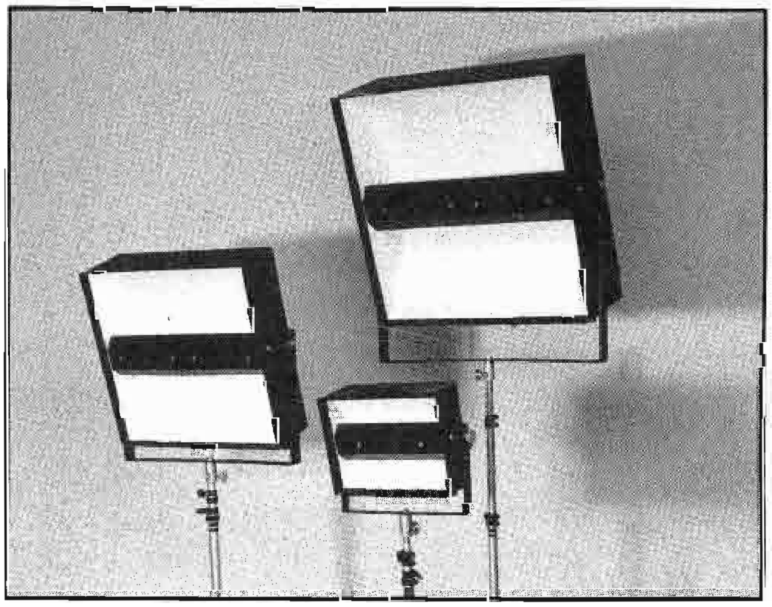
**Circle (360) on Reply Card**

## Jackfield cleaner

*Canford Audio* has introduced two products to clean jackfields. The Canford jackfield burnisher is machined from tool steel, treated to create a fire-burnishing surface and then chrome-plated. To clean contacts, insert the burnisher, twist lightly and remove. There is no need to dismantle equipment. The jackfield solvent injector cleans switch contacts. It has a channel drilled lengthwise through the tool with an additional perpendicular channel at the top. Insert the tool into the jack, the switch contacts are opened, and by inserting the plastic tube of a solvent aerosol into the back of the tool, the cleaning fluid can be injected directly onto the contacts. When the tool is removed, the movement of the switch contacts completes the cleaning process.

**Circle (361) on Reply Card**

## Softlights



*Comprehensive Video Supply* has introduced a family of SOFTOUCH softlights. They provide a flexible, indirect light source. The fixtures are softlights that reflect the direct rays of a lamp off a reflective surface. The chip-resistant, non-yellowing white paint on the reflector reproduces the Kelvin color temperature of any bulb used. The light's center lamp support swivels around for easy relamping. The lights are available in five sizes and two kit configurations.

**Circle (362) on Reply Card**

### Broadcast encoder

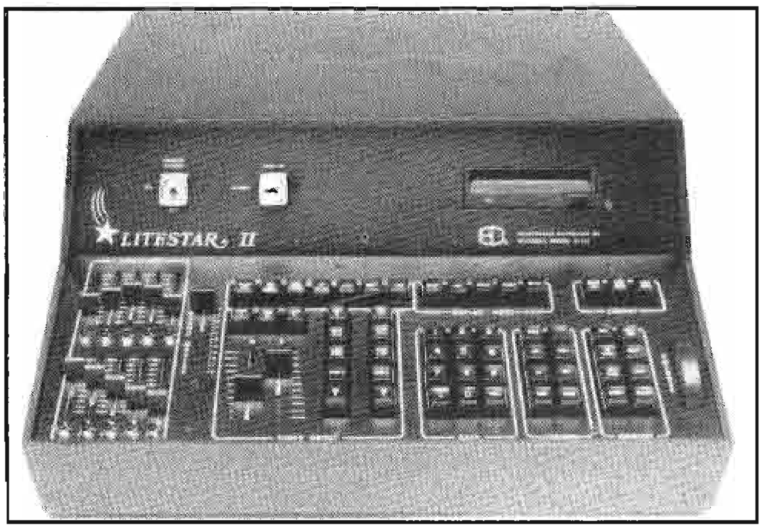
*Crosspoint Latch* has introduced the model 6051 broadcast quality encoder. It accepts RGB signals from graphics and character generators and converts them to encoded signals that can be inserted into video switchers or displays them on projection TV systems. The encoder gen-locks to any color signal or blackburst. It does not require any external drives. It has front-panel horizontal and subcarrier adjustments.


**Circle (363) on Reply Card**

### Memory controller and control board

*Electronics Diversified* has introduced the following:

- The Litestar II memory controller allows up to 1,000 dimmers to be controlled by 120 control channels. Features include 100 memories, 10 inhibiting submasters, two electronic crossfaders and a manual crossfader. Output is USITT standard serial digital, with analog backup. Shows may be linked to disk drive and color video monitor.
- The Troubadour Plus can control up to 1,000 dimmers with 96 control channels. Up to 100 cues may be stored. Features include 1,000 dimmer proportional patch, 10 inhibiting submasters, X and Y crossfaders, independent master with timers, full 2/4-scene manual mode and an RGB color monitor. Output is USITT standard serial digital, with 1-channel analog backup. Information is protected by a 10-year lithium battery.




**Circle (364) on Reply Card**

### MTS stereo TV multiplexer and modulator

*FM Systems* has announced the FMT633 second-generation MTS stereo TV multiplexer and modulator with a built-in DNR dynamic noise reduction system. The stereo modulator is compatible with the BTSC TV stereo transmission system and provides up to 14dB improvement in audio signal-to-noise ratio. The modulator accepts stereo or mono signals from audio baseband sources or demodulated subcarrier and converts them to 4.5MHz or 41.25MHz MTS compatible stereo. A built-in stereo synthesizer converts monaural TV audio to synthesized stereo so that all TV channels can be received by the stereo TV sets. The output is connected into a cable TV modulator, providing MTS compatible stereo on cable systems for all TV channels.

**Circle (365) on Reply Card**

### Automatic voltage regulator

*Hipotronics* has announced the Peschel automatic voltage regulator. The regulator uses the patented Peschel variable transformer and is available in medium to high power. Input voltage is available from 240V to 13.8kV in ranges of +9% to −14% or ±20%. Output capacity is available from 40A to 2,000A.

**Circle (366) on Reply Card**

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**FOR SALE—EQUIPMENT:** AFC/Microdyne 4.3 Meter Conical Horn Satellite Antenna with Motor Drives and MAPS controller. Call KRIV-TV, (713) 626-2610, Wendell Wyborny, VP/CE. 4-87-1t

**FOR SALE—EQUIPMENT:** RCA TCR-100 with TR-60 Master Machine, TCR-100A with SP-100A both machines refurbished with 200D cartridges, Winder, Spare Heads, Parts and Central Air System. Call KRIV-TV, (713) 626-2610, Wendell Wyborny, VP/CE. 4-87-1t

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**HELP WANTED—TECHNICAL: ASSISTANT CHIEF ENGINEER**—KRIV-TV, Fox Television, is seeking a qualified Assistant Chief Engineer. Must have minimum of 5 years television broadcast experience. Must have supervisory experience and be familiar with studio equipment, maintenance and UHF transmitter. Must also have good communication and budgeting skills. FCC license and SBE certificate required. Send resume to: KRIV-TV, P.O. Box 22810, Houston, Tx. 77227, Attn: Wendell Wyborny, VP/CE. 4-87-2t

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**VT EDITOR.** International television news agency in New York. 1" BVU 800's & convergence exp. Satellite knowledge a plus. Some maintenance experience or willingness to learn. Salary history and resume to Broadcast Engineering, Dept. #677, P.O. Box 12901, Overland Park, KS 66212. 4-87-1t

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## HELP WANTED (CONT.)

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- AM & FM station ☐ 23
- TV & AM station ☐ 24
- TV & FM station ☐ 25
- TV, AM & FM station ☐ 26
- CATV facility ☐ 27
- Non-broadcast TV including closed circuit TV (CCTV) ☐ 28
- Recording studio ☐ 29
- Teleproduction facility ☐ 30
- Microwave, relay station or satellite company ☐ 31
- Government ☐ 32
- Consultant (engineering or management) ☐ 33
- Dealer, distributor or manufacturer ☐ 34
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- Community ☐ E
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- Recommend make or model to be purchased ☐
- Have no part in specifying or buying ☐

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   - 24 ☐ TV & AM Station
   - 25 ☐ TV & FM Station
   - 26 ☐ TV, AM & FM Station
   - 27 ☐ CATV Facility
   - 28 ☐ Non-Broadcast TV including Closed Circuit TV (CCTV)
   - 29 ☐ Recording Studio
   - 30 ☐ Teleproduction Facility
   - 31 ☐ Microwave, Relay Station or Satellite Company
   - 32 ☐ Government
   - 33 ☐ Consultant (Engineering or Management)
   - 34 ☐ Dealer, Distributor or Manufacturer
   - ☐ Other ______ *(Please specify)*
3. **If you checked 20 through 26 above, which of the following best describes your over-the-air station: (Check only one.)**
   - A ☐ Commercial
   - B ☐ Educational
   - C ☐ Religious
   - D ☐ Campus Low Frequency
   - E ☐ Community
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   - C ☐ **Operations & Station Management/Production & Programming**—VP Operations, Operation Manager/Director, Station Manager, Production Manager, Program Manager, News Director and other Operations Titles
   - D ☐ **Other: Specify** ______
5. **IMPORTANT: Check the statement that best describes your role in the purchase of major communication equipment components and accessories.**
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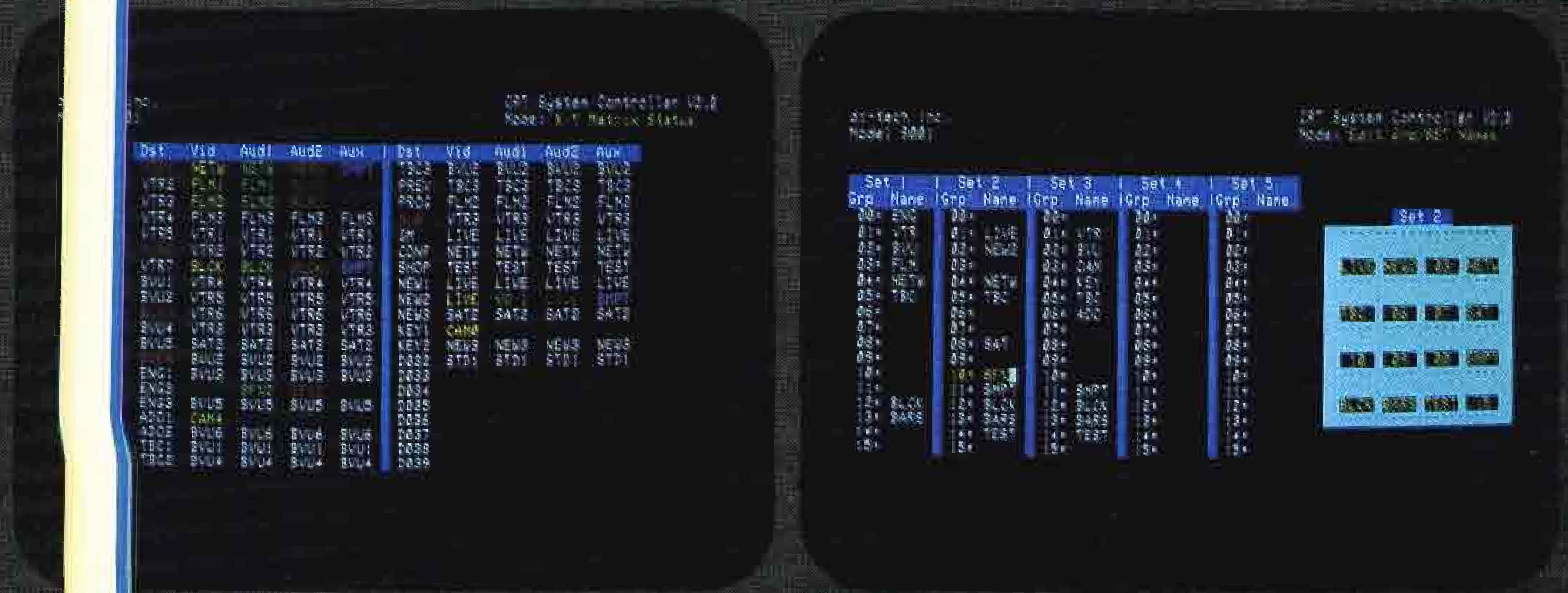

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