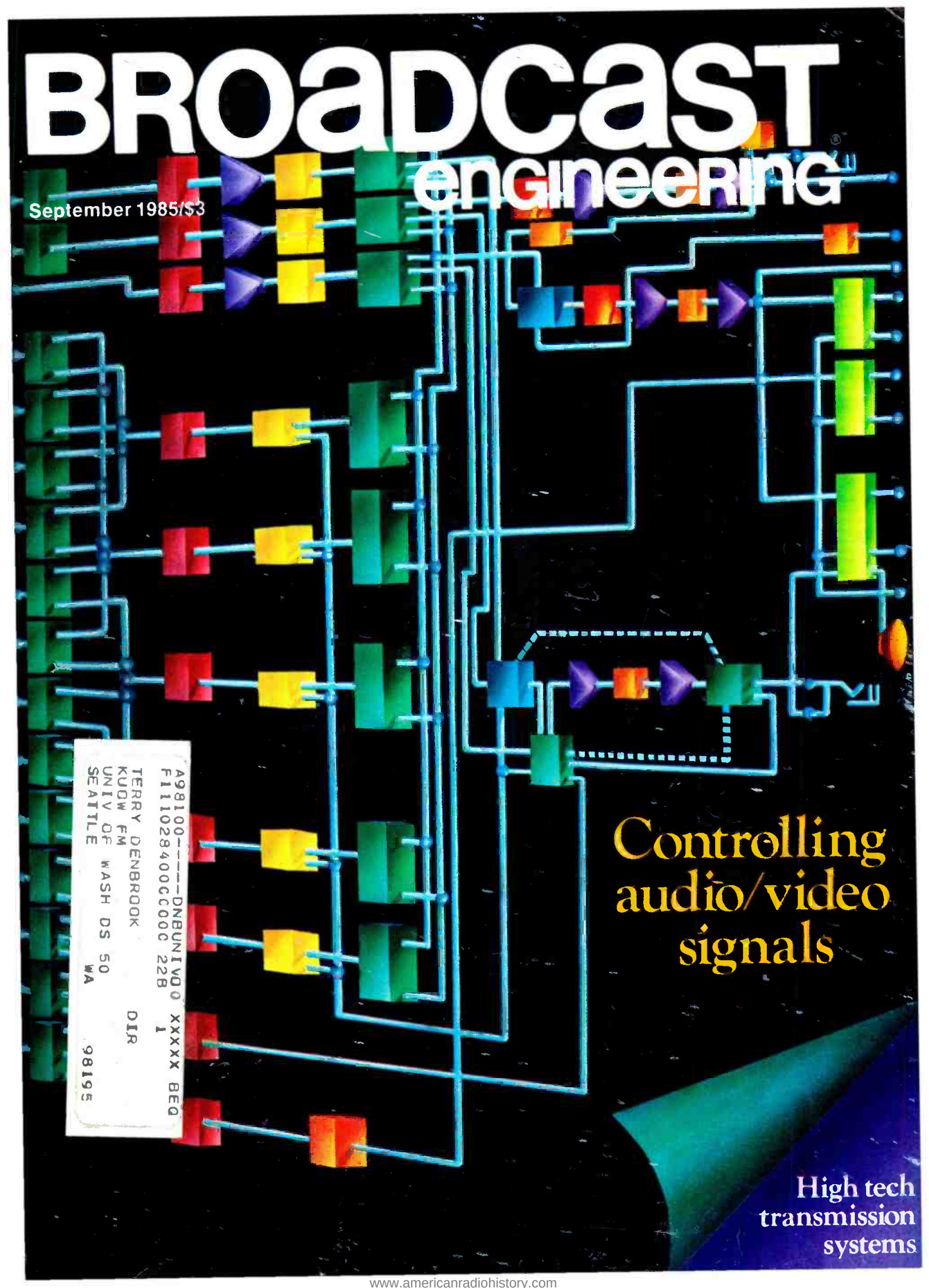
BROADCAST engineering

September 1985/$3



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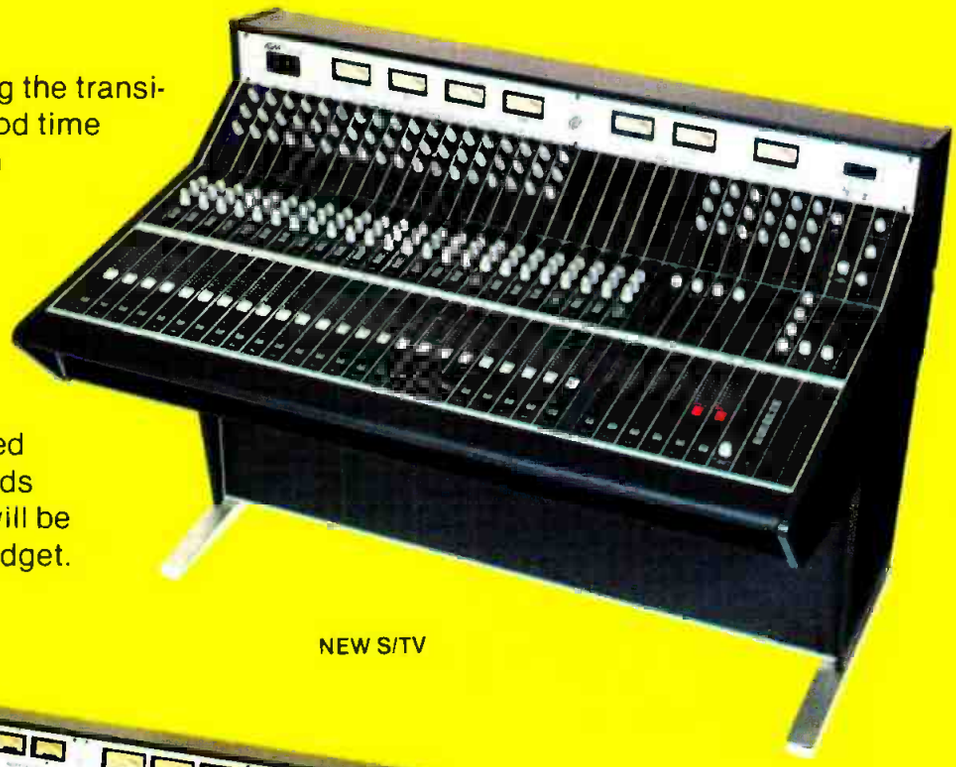

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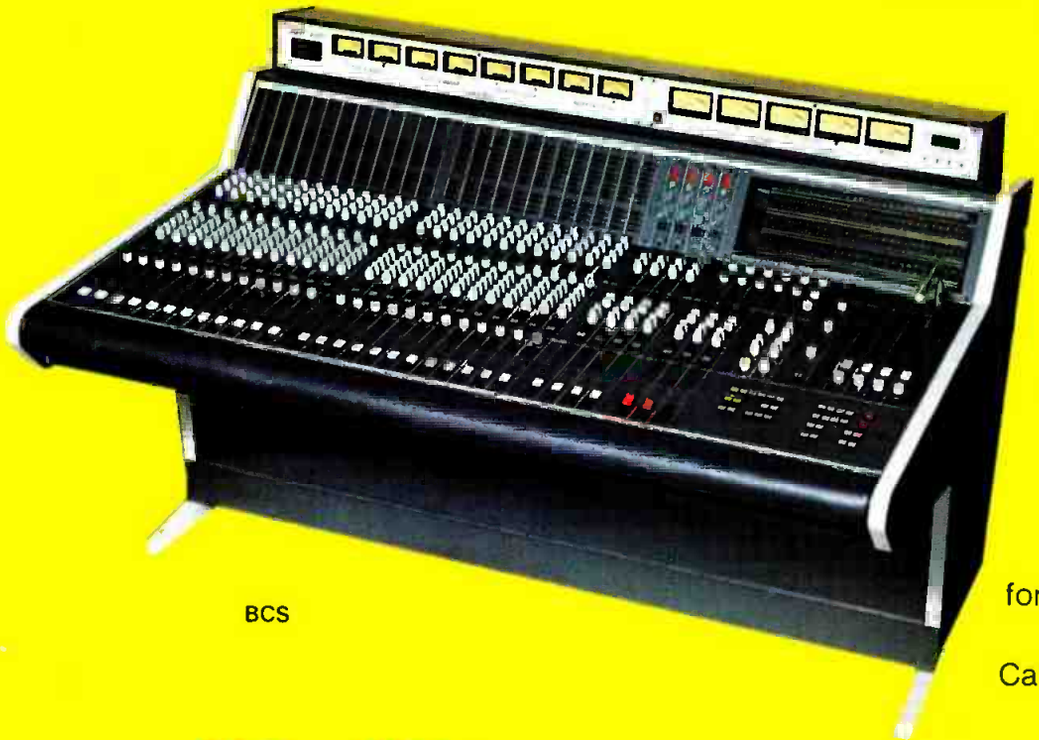

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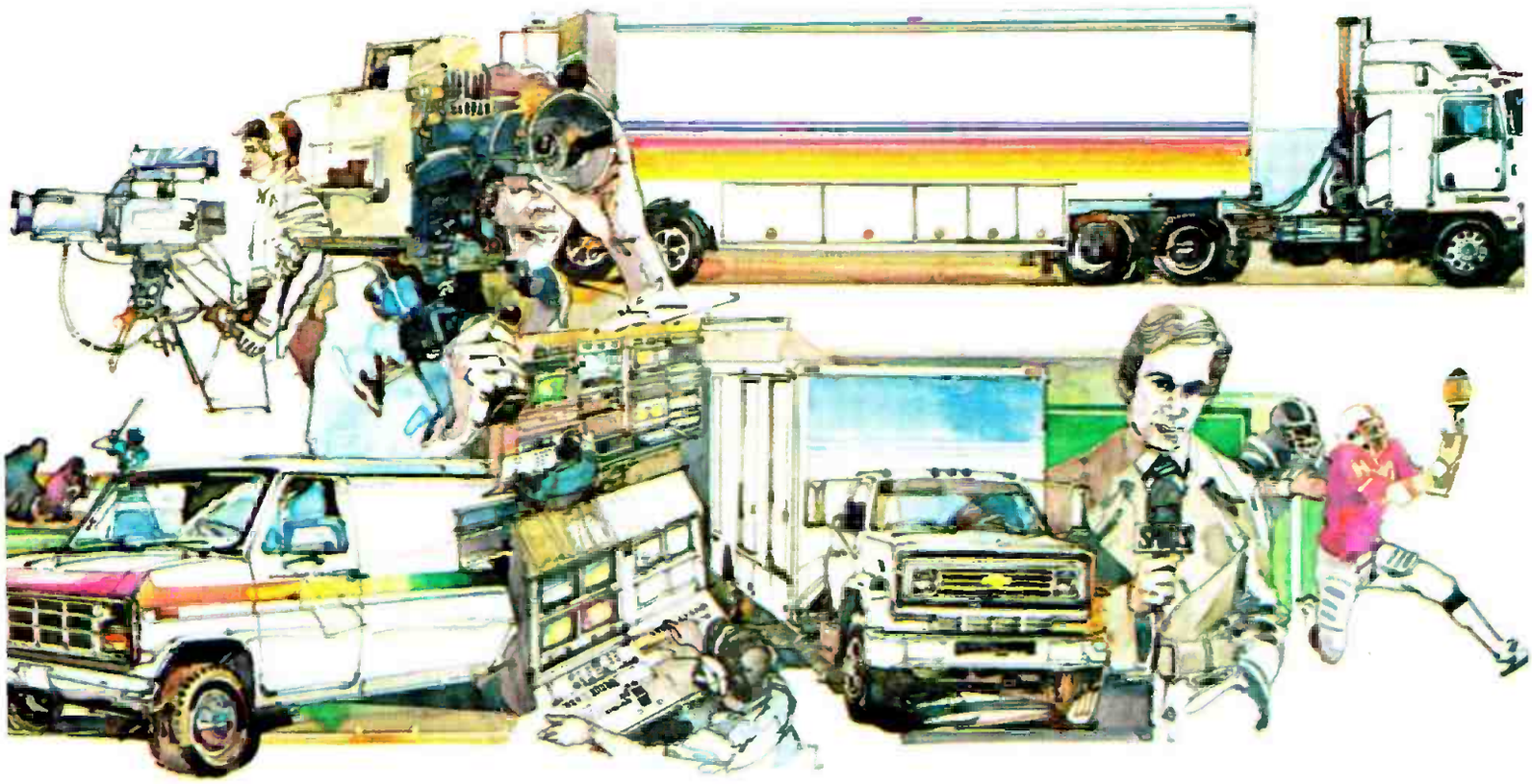

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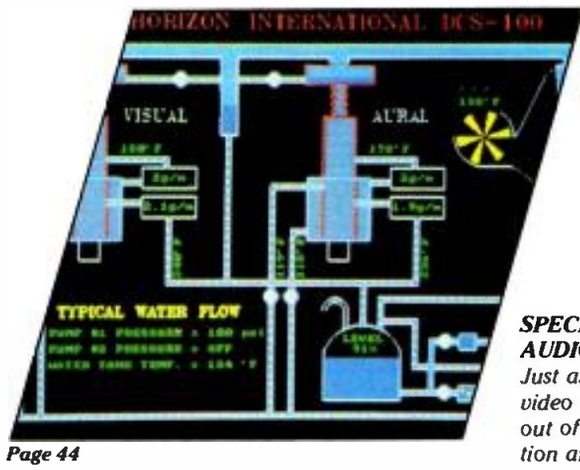
STUDIOS • POST PRODUCTION • MOBILE UNITS • MASTER CONTROL • MICROWAVE • FIBER OPTICS

Contents

September 1985 • Volume 27 • Number 9



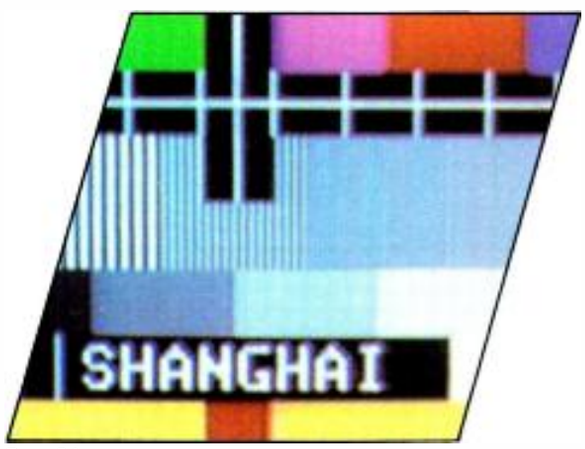
Page 44

BROADCAST engineering

SPECIAL REPORT:
AUDIO/VIDEO CONTROL EQUIPMENT

Just as the audio console is the heart of any radio station, the video switcher breathes life into a TV facility. To get the most out of your equipment, accurate planning and careful installation are required. We examine these aspects of facility design.

Page 76



Page 84

ON THE COVER
The move toward stereo television and AM stereo have focused attention on the need for high-quality audio production and control capabilities. Our cover this month illustrates the complexity of a modern on-air audio board. (The artist is Darla Buckley of BE's staff.)

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

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BREAKING SOUND BARRIERS

News

IEEE plans 35th annual Broadcast Symposium

The 35th annual IEEE Broadcast Symposium, sponsored by the Broadcast Technology Society (BTS) of the Institute of Electrical and Electronics Engineers, will be held Sept. 19-20, at the Hotel Washington, Washington, DC.

Engineering presentations are oriented toward the transmission aspects of broadcasting and in the past have attracted mostly consulting engineers and broadcast chief engineers. However, anyone interested in learning more about this side of broadcast engineering is welcome to attend.

Major topics of the symposium this year include radio engineering, broadcast interference, television engineering and non-ionizing radiation. The program of about 20 papers is spread over two days, with five papers presented during each of the four sessions. Luncheons on Thursday and Friday will feature guest speakers and an awards banquet will be held Thursday evening. Each of the technical sessions will address specific and major topics of interest to broadcast engineers. The papers are both timely and tailored to apprise the broadcast engineering community of important technical issues.

The symposium begins Thursday morning, Sept. 19, with the "Interference and Broadcasting" technical session chaired by Alan E. Gearing. Thursday's luncheon, jointly sponsored by the BTS and the Association of Federal Communications Consulting Engineers (AFCCE), will feature Michael Sherlock, NBC vice president for operations and technical services. The evening awards banquet includes award presentations for the previous year's best paper and outstanding engineer, and an address by former FCC chairman Richard E. Wiley.

The "Radio Engineering" technical session, chaired by John C. Kean, begins on Friday morning, Sept. 20. The speaker for Friday's luncheon will be FCC mass media bureau chief James C. McKinney. After the luncheon, the "Non-ionizing Radiation" technical session, chaired by Ralph H. Justus, will cover the subject of RF electromagnetic energy and how broadcasters will necessarily be involved in its measurement and control. In addition to four presentations on the subject, there will be a panel discussion with questions from the audience.

Formerly the Institute of Radio Engineers (IRE), the IEEE has evolved into the largest engineering standards organization in the country, and involves electrical and electronic engineers of all types. Its broadcast technology branch, the BTS, has more than 2,500 members worldwide, and publishes "Transactions," which contains many of the papers presented during the symposiums.

For more information, write IEEE/BTS Broadcast Symposium, c/o NAB, 1771 N. St. NW, Washington, DC 20036, or call 202-429-5346.

BROADCAST ENGINEERING

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INTERTEC PUBLISHING CORPORATION

Marketplace mania

The operation was a success, but the patient committed suicide.

We had heard great predictions about the marketplace philosophy of the FCC. It would get the commission off the back of the broadcast industry. It would allow rapid introduction of new technologies, such as AM stereo, into broadcasting. It would lead to increased competition and ultimately result in better service to listeners and viewers. But what has the much touted marketplace policy *really* given us? Not much.

The commission's marketplace philosophy has evolved over a period of many years, but most would agree that the cornerstone of the policy was the AM stereo decision. Pardon me, *indecision.* Because no one could agree on anything and everyone was prepared to sue everyone else, the commission saw a golden opportunity to try out its marketplace ideas in a big way. It was unfortunate that the experiment had to involve—and threaten—the future of AM radio.

When the commission declined to choose a single standard for AM stereo transmission, most industry observers expected a rather swift shakeout of the five competing systems. How long could the battle go on? One year? Two years? Certainly no longer than two years.

Guess again. In this, the third year of battle, there appears to be no early conclusion to the great debate. A debate that has undeniably slowed the introduction of AM stereo to the marketplace.

The inevitable loser in this fight is the AM broadcaster. Although about 400 stations are now estimated to be broadcasting in stereo, this is still less than 10% of the total number of existing AM stations. True, the major markets are represented among the ranks of the converted, but if a significant impact is to be made on the future of AM radio, many more stations will need to make the move.

Apart from the relatively small number of stereo stations is the long-term damage that delayed listener acceptance of the technology may have on the future of AM radio. It is no secret that AM has been steadily losing market shares to FM for more than a decade. Stereo was one of the methods that AM broadcasters saw as a way to regain lost ground. It is unclear what effect the lingering introduction of stereo may ultimately have on public acceptance of AM as a high fidelity medium. And AM *is capable* of high fidelity performance. Although the problems of the past may not have killed the chances for listener acceptance, the postponement has certainly hindered the effort.

On a positive note, the National Association of Broadcasters' AM Improvement Subcommittee has made significant strides in its efforts to improve the position of AM broadcasting from both a technical and marketing standpoint. This work is important and we applaud it. With enough effort, the subcommittee may be able to undo some of the damage caused by years of marketplace indecision and manufacturer infighting.

Contrast the introduction of AM stereo with the more recent introduction of multichannel TV sound. Given the commission's blessing about one and one-half years ago, stereo sound shows every indication of taking off and becoming an important factor in the TV industry.

The difference between the introduction of these two technologies is clear. AM stereo was launched in a frenzy of free enterprise. Every system for itself. Television stereo was launched under the umbrella of detailed technical examination by a respected industry organization (the Electronic Industries Association). This contrast provides a valuable lesson for the broadcast industry. We can no longer rely on the FCC to settle our problems for us. We can no longer afford to let each company go its own way. We can no longer allow the needs of the user to be secondary to the desire for product sales.

The marketplace eventually does work, but it is terribly slow. It is also a cold, cruel testing ground for competing companies and end users—stations in this case—that happen to pick the wrong system. AM stereo will surely become a significant force in the marketplace, but at the cost of years of needless delay and millions of dollars of wasted money.

The commission didn't create the marketplace theory; it merely implemented the policy. The marketplace is an ideal ground for determining user preferences for laundry detergent and canned soup, but it is a lousy place to decide technical standards. In the case of AM stereo, the broadcast industry has only itself to blame. Let's learn something from the lesson of marketplace mania.

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For years, sloppy tape transportation and handling have made the audio engineer's day much harder than it had to be.

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Professional Audio

Must-carry rules still a must

By Harry C. Martin

On July 19, the U.S. Court of Appeals for the DC Circuit ruled that the FCC's cable TV must-carry rules are unconstitutional. However, the rules will remain in effect until issuance of the court's *mandate* ordering the commission to delete them. Even if appeals of the decision are unsuccessful, the mandate may not be issued until late 1985. Cable systems must continue to carry all local must-carry signals until they receive word that the court's mandate is effective.

The commission, and the broadcasters who intervened in support of the commission, had until Sept. 3 to request rehearing *en banc* by the court or, alternatively, to notify the court that they plan to seek Supreme Court review of the decision. Regardless of the appeal route taken, it is likely that the Court of Appeals will stay the issuance of its mandate, permitting the must-carry rules to remain in effect until all appeal rights are exhausted. If the commission or the broadcasters file a petition for certiorari, and the Supreme Court decides to take the case, the must-carry rules would remain in place until the Supreme Court issued its final decision. Such a decision could take a year or more.

At this writing, it is difficult to predict whether the commission itself will appeal the July 19 decision. There is strong sentiment among the current commissioners that the must-carry rules are an anachronism and that the Court of Appeals' decision was correct. The commission has not moved ahead on its own to repeal the rules due to popularity of must-carry among politically powerful broadcasters.

If the commission decides not to challenge the court's decision, the broadcasters who support retention of the rules will have to go it alone to the Supreme Court. It is highly unlikely, however, that the Supreme Court would grant certiorari and hear the broadcasters' appeal without the commission's support and participation.

TV channel 6/NCE-FM interference rules

The FCC has adopted final rules governing permissible interference to channel 6 TV stations from non-commercial educational FM (NCE-FM) stations.

The new rules implement a compromise worked out between national organizations representing TV channel 6 and NCE-FM interests. The rules adopt power limitations for *new* NCE-FM stations, which are designed to permit interference to no more than 3,000 people. Up to 1,000 additional people may be included in the interference area if, for every additional person, the NCE-FM station provides for the installation of one filter. The predicted interference area is determined through the use of protection ratios that vary based on the field strength of the TV channel 6 signal and the proposed frequency of the NCE-FM station.

Several adjustments will be permitted to the ratio-based interference calculations. These include a 6dB allowance on the basis of TV receive-antenna directivity, guidelines for considering alternate programming from TV translators, satellite stations or duplicate network sources and a 10dB (16dB in rural areas) allowance for vertical antenna polarization. Further exceptions may be made in the case of extreme terrain conditions or if an NCE-FM station reaches agreement with an affected TV channel 6 station.

Existing NCE-FM stations are grandfathered and may continue to operate with their present facilities. Stations with construction permits also will be grandfathered except in situations in which objections have not been resolved.

The compromise rules also provide options by which existing NCE-FM stations can modify their facilities without being subject to the restrictions governing new stations. For example, stations may change facilities or locations if, for each person predicted to receive new interference, existing predicted interference to two people is eliminated. Existing NCE-FM applicants also may increase power in excess of that permitted new stations through the use of vertical polarization.

With the adoption of the new standards, the commission lifted its freeze, which was adopted last year, on the filing of NCE-FM applications and the processing of TV channel 6 applications. By Oct. 1, all pending NCE-FM applications must be amended to demonstrate compliance with the new rules.

Radio exempted from network contract filing

The commission has eliminated the requirement that radio licensees file copies of their network affiliation and transcription contracts. The filing requirement for TV licensees was retained, but was limited to affiliation contracts with the national networks.

The costs and burdens to the public outweigh the benefits of having the contracts filed, the commission said. Noting that there are about 3,400 radio stations affiliated with at least one of the more than 100 radio network organizations, the agency estimated that the time involved in paperwork to meet the filing requirement amounted to 2,500 work hours per year. This was found to be excessive. Furthermore, in the case of radio stations, the large number of networks minimizes the potential for any one program source to exercise undue influence. This obviates the need for a public disclosure requirement, the commission ruled.

Order your copy of the rules

The FCC rules are printed in four volumes of Title 47 of the Code of Federal Regulations (CFR). All broadcast stations must have an up-to-date copy of certain sections of the rules on hand. In general, the required rule parts are contained in Volume 1 (Parts 0 through 19) and Volume 3 (Parts 70 through 79) of the CFR set.

The latest edition of Title 47 of the CFR (revised Oct. 1, 1984) is now available from the Government Printing Office. The combined cost for Volumes 1 and 3 is $26. Contact the Government Printing Office, Washington, DC 20402; 202-783-3238.

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Circle (5) on Reply Card

Agitated electrons

By Carl Bentz, TV technical editor

The CRT in a monitor, receiver or oscilloscope includes a phosphor designator. For monochrome television, the number is P4; for color, P22. For oscilloscopes, P1, P7, P11 or P31 phosphors may be used, depending upon the instrument function and the manufacturer.

The designator indicates visual display characteristics of the tube, such as color(s) and relative persistence of the trace. (See Table 1.)

Phosphor	Color(s)	Persistence	Application
P1	Green	22ms	Oscilloscope
P4	Blue-white Yellow	<33ms	Monochrome TV
P7	Blue-white Yellow	Long	Radar
P11	Blue	2ms	Oscilloscope
P22	Red Blue Green	Medium Medium Short	Color TV
P31	Blue	Short	Spectrum analyzer

Table 1. *Visual display characteristics of a cathode-ray tube.*

Quantum mechanics

How light and color result from a CRT screen is explained by the subject of physics called *quantum mechanics*. Quantum refers to amount or level, and quantum mechanics deals with the interactions of energy and particles in atoms. Using mathematical models, quantum mechanics explains how atoms react to form molecules, how certain chemical elements show the property of magnetism and why every element can produce characteristic colors of light.

The term phosphor, when used in a discussion about cathode-ray tubes, is misleading. One might expect the element phosphorus to be involved. In reality, no phosphorus will be found in a CRT. Phosphorus glows in the dark if exposed to oxygen, because it is actually burning. Phosphorus is normally stored underwater to keep it away from air.

Phosphor refers to *phosphorescence*, one form of luminescence or light generation. It is closely allied with the effect *fluorescence*. Both types of light are based upon the absorption of energy and a subsequent re-emission of that energy by the atom within the visible electromagnetic spectrum.

The major difference between fluorescence and phosphorescence is time. Fluorescence occurs almost immediately when energy is applied and ceases when the source is removed. Phosphorescence also begins when excited, but the output glow persists even after the energy source is removed.

Fluorescent and phosphorescent light sources are cool, as compared to incandescent light. Incandescence occurs when energy heats an object to glowing. The thermal light process actually interferes with luminescence by upsetting fixed energy levels needed for phosphorescence.

To better understand the action of CRT phosphors, we must look at the electron(s) of an atom. The simplest is the hydrogen atom, with only one proton in its nucleus and one electron (per atom) orbiting around the nucleus.

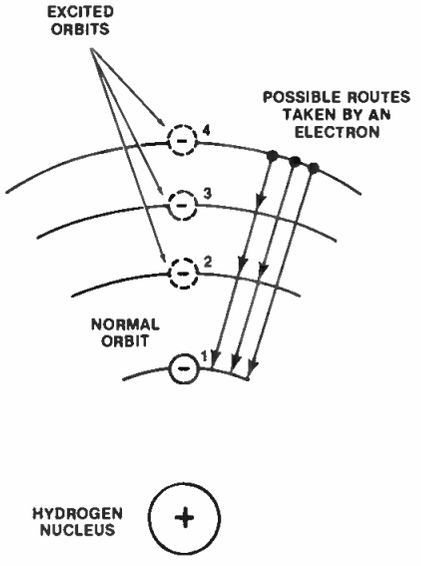

Figure 1. *In a hydrogen atom, the most stable electron energy level is the orbit indicated at 1. By exciting the atom, an electron may move to a higher orbit (2, 3, 4). As an electron falls to a lower orbit, the color of emitted light depends on the distance it falls and the path taken.*

Within the hydrogen atom, there are specific energy levels or *quanta* at which its lone electron may orbit. The farther the electron is from the nucleus, the greater the energy possessed by the electron. A simple analogy would be that an object 20 feet above ground has more potential energy than if it was lying on the ground. Normally, the electron spends most of its time in the lowest orbit, where it is most stable. In this stable condition, no light is emitted.

If we apply a high voltage potential to electrodes in each end of a tube containing hydrogen gas, we find the gas glows with a bluish light. The electricity has agitated the electrons of the hydrogen atoms, giving them more energy than they would normally possess. The energetic electrons jump to higher-level orbits in which they are not stable and cannot remain. To return to stable orbits, the electrons must release energy as *photons* of light. (See Figure 1.)

Chemical elements each emit characteristic colors as their agitated electrons fall to less energetic orbital levels. If we observe a luminescent substance through a spectroscope (prism), we can measure the wavelengths of emitted light. By knowing the colors involved, we may identify the glowing substance. By knowing the desired color of luminescence, we may select the substance.

In a CRT, electrons from the gun assembly bombard phosphor particles on the faceplate. Energy from beam electrons is transferred to electrons in the phosphor chemicals, which are forced to higher-level, unstable orbits. As the electrons return to preferred energy levels, light is emitted, which we see forming the image on the CRT.

Next month, the illusion of color TV becomes clear when we look more closely at red. |:-)))|

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Circle (6) on Reply Card

Sound of success isn't a snap

By Ralph Chambers

Whether you're ready or not, AM stereo is coming. There seem to be a few AM engineers who think that it will never reach their doorsteps, or that if it does, implementing it will be a snap. Nothing could be further from the truth.

Last month, we discussed several aspects of the implementation of AM stereo. Updating the transmission and monitoring systems is only the first of many steps that need to be taken if the station is to be successful in bringing quality AM stereo to its listeners. Assuming you have been able to resolve any transmission and monitoring problems, what next?

Phasing problems

The real key to consistent, quality sound lies in the production room. What emerges from the production room determines the station's sound. Those facilities that plan to use cartridges for their production and music should be mindful that the quality of their new stereo sound depends primarily on the quality of those carts.

In the early days of stereo FM, engineers had to learn a great deal about stereo phase and monaural compatibility. The early 2-channel open-reel recorders were susceptible to phase instability, much like today's cartridge machines. In those days, because most of the audience was listening in monaural, the quality of the FM station's sound was dependent upon accurate and stable stereo phasing.

The AM engineer of today faces a similar problem with the signal. Most of the receivers in the field are monaural, not stereo. Consequently, phasing problems are more noticeable. The AM station does have one advantage that FM stations didn't in the early days: AM receivers have such poor frequency response that some of the upper-end phase problems are not detected by the listener. That is no excuse, however, for not attempting to deal with the problem. After all, the quality of receivers is improving.

Stereo cart production

One of the more useful tools for maintaining good phase response for stereo cart production is a pink noise generator. Coupled with an oscilloscope (or even an L+R VU meter), the generator can be used to adjust the azimuth of the record

Chambers is chief engineer of WCMQ-AM, Miami.

head for best phase response. Make this adjustment while monitoring the output of the cartridge on the oscilloscope. The scope display should show a pattern of lines at 45° to the right. A single high-frequency tone can be used in place of the noise generator if necessary. The tone will produce a single line at 45° to the right on a properly adjusted machine. Some of the newer cartridge machines provide automatic adjustment of the record-head azimuth.

Once the azimuth has been set for best response, the cartridge is erased and the desired audio is recorded. This takes a few extra minutes, but the improved phase response is well worth the effort. Any station using cartridges for music playback is advised to go through this process.

Be aware that producing carts in this manner does not completely solve the problem. Remember, you still have to play the cart back on a different machine. In addition, if the cartridge is subjected to the normal wear and tear of a fast-paced on-air environment, it may well undergo unintentional *stress testing*. Stress testing occurs when the announcer drops, bounces or otherwise abuses the cartridge in an effort to keep the program going. When this happens, the mechanical stability of the cart may be impaired, and this can adversely affect the reproduced audio. The question now is: What can be done to provide and maintain quality reproduction in the air studio?

Phase correction

Two methods are used to electronically reduce playback phasing errors. The first method is to record the stereo signal in a unique format on the cartridge itself. The L+R signal component is recorded on one track of the cartridge and the L−R signal component is recorded on the other. The audio is converted to standard left-and-right signals only in the reproduce cartridge machine during playback.

Although this method works well in principle, it requires careful adjustment of the cartridge machine. The machine's frequency response, gain and delay characteristics must be carefully matched. A difference of as little as 1dB between tracks can produce as much as a 15dB loss in stereo separation. Common delay errors of several microseconds can also cause a loss in separation.

The second method of reducing playback phasing errors relies upon an audio delay scheme. Simply put, one channel of audio is delayed until the other channel catches up. A pilot tone is recorded on each channel of audio at the time the cart is produced. This tone is used in the decoder unit to control the delay process. The decoder examines the pilot tones from each channel and, if no phase difference is present, no action takes place. If, however, the decoder detects a difference in the relative phase of the pilot tones in the left and right channel, one of the audio channels is delayed slightly until the phase of that channel matches the other.

This method of correcting phase problems offers the additional advantage of reducing wow and flutter. Its major disadvantage is cost. However, because the decoder unit is equipped with an automatic sensor for the pilot tone, the station does not have to convert all of its carts at one time. If the unit encounters a cart without a pilot tone, it simply bypasses the audio without any processing.

Keeping the sound

An aspect of stereo cartridge production that remains to be addressed is that of maintenance. Although the newer models of cartridge equipment are more reliable, they are also more intricate. Automatic azimuth and erasing functions add to the cost and complexity of the equipment. In addition, the station probably will need to upgrade the quality of production cartridges used with the equipment. For best results, use premium cartridges, and only one formulation of tape. Optimize all machines for this particular combination of cart and tape, and stick with it. It is not possible to achieve a consistent quality sound if different types of carts and tape are mixed at random.

If a systematic approach is taken to prevent phasing problems, the station can be proud of the AM monaural and stereo sound that is achieved. With the current interest in AM stereo, it is more important than ever for engineers to become concerned with the sound of their stations. Don't wait for the competition to beat you to the punch. Plan now for AM stereo. [:-)))]

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Growing pains in the global village

By Carl Bentz, TV technical editor

On June 28, 1965, the *global village* was born and satellite communications came of age commercially, when former President Lyndon B. Johnson spoke with leaders of six European countries via the *Early Bird* satellite. The 85-pound spacecraft, launched by Communications Satellite Corporation (Comsat), permitted transmission of 240 simultaneous telephone calls or one TV channel.

The network expanded rapidly and today covers the globe, with satellites over the Pacific and Indian oceans as well. Intelsat (International Telecommunications Satellite Organization), with 110 member countries, uses more than 160 earth stations to form a system interlinking more than 170 countries and territories. Each Intelsat V satellite has a capacity of 12,000 simultaneous telephone circuits and two TV circuits.

Trouble in the neighborhood

A constant demand for more communications networks for voice, data and video by satellite has resulted in growing pains. Satellite uplinks and downlinks operate on some of the same frequencies as terrestrial microwave. In attempting to meet the demands, microwave communications has been enveloped in interference. In theory, the directed beams of terrestrial and satellite microwave signals should be able to operate relatively exclusive of one another, even though the two services use the same frequencies. In practice, however, downlink systems are often the victims of interfering terrestrial signals.

Many downlinks currently operating are already troubled by terrestrial links. Solutions to interference to these stations may be filtering, to reduce the effect of specific frequencies, or shielding, for more general problems.

Filtering can provide a workable solution for narrowband interference control, at least for short-term situations. Trapping undesirable signals with bandpass or notch circuits in the signal path is generally successful with out-of-band interference. Trapping in-band signals, however, inherently impairs reception of the desired signal from a satellite, and perhaps introduces other degradation factors in the process.

Building fences

Shielding can work in situations in which trapping doesn't. Earthen work barriers around the antenna site are often

effective, albeit expensive, in controlling the offending signals. If such methods are unacceptable, artificial shields may suffice.

Some artificial shielding may be done on the antenna itself. A shroud around the perimeter of the main reflector or a redesigned window on the feedhorn are both forms of shielding. The shroud is effective in deflecting interference coming at right angles to the main reflector.

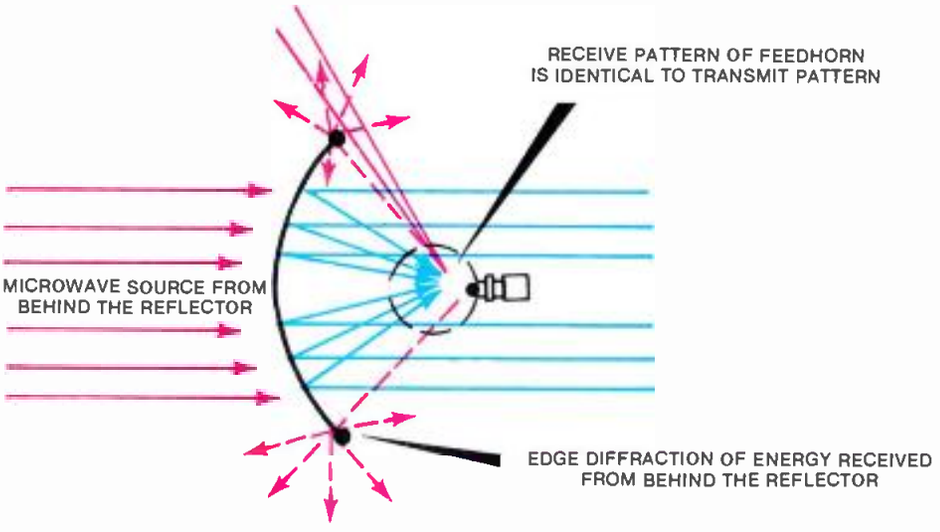

Figure 1.

Signals from behind the reflector encounter *knife-edge refraction* and may be bent enough to enter the feedhorn window. The shroud changes the angle of refraction, redirecting the interference away from the high gain receiving system. See Figure 1.

A shield approach alters the operating environment of the antenna. Metallic mesh screen, such as ¼-inch builder's hardware cloth, creates an effective block for 4GHz signals (see Figure 2). To appear opaque to the interference, the mesh openings should be less than 10% of the wavelength of the interfering signal. A wavelength for 4GHz is approximately 3 inches, so the ¼-inch mesh, slightly less than 0.3 inches, creates a relatively opaque wall. Such screens may form a surface covering, an internal strengthening material for plaster or cement structures or an in-the-open shield on a framework.

Perhaps an absorber on an existing wall will help. *Microwave resistors*, constructed of fibrous material covered with carbon, tend to reduce surface reflections of reradiations from diffracting edges. Research has also produced paints that absorb microwave energy.

Our use of microwave frequencies will increase. Ideally, we will be able to cooperate in our global village to achieve our communications goals with a minimum of interference. Still, just as fences make better neighbors, preventive shielding around your downlink installation will help you to more easily coexist with your RF neighbors.

(Art courtesy Microwave Filter Company)

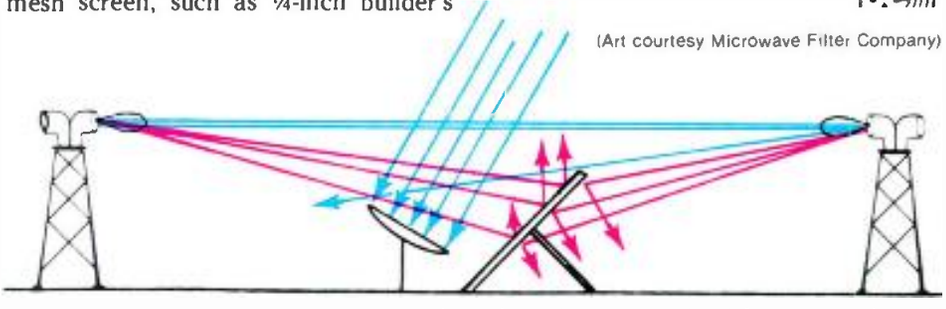

Figure 2. *An inclined metallic screen barrier reflects signals from the right downward, while signals from the left are deflected upward.*

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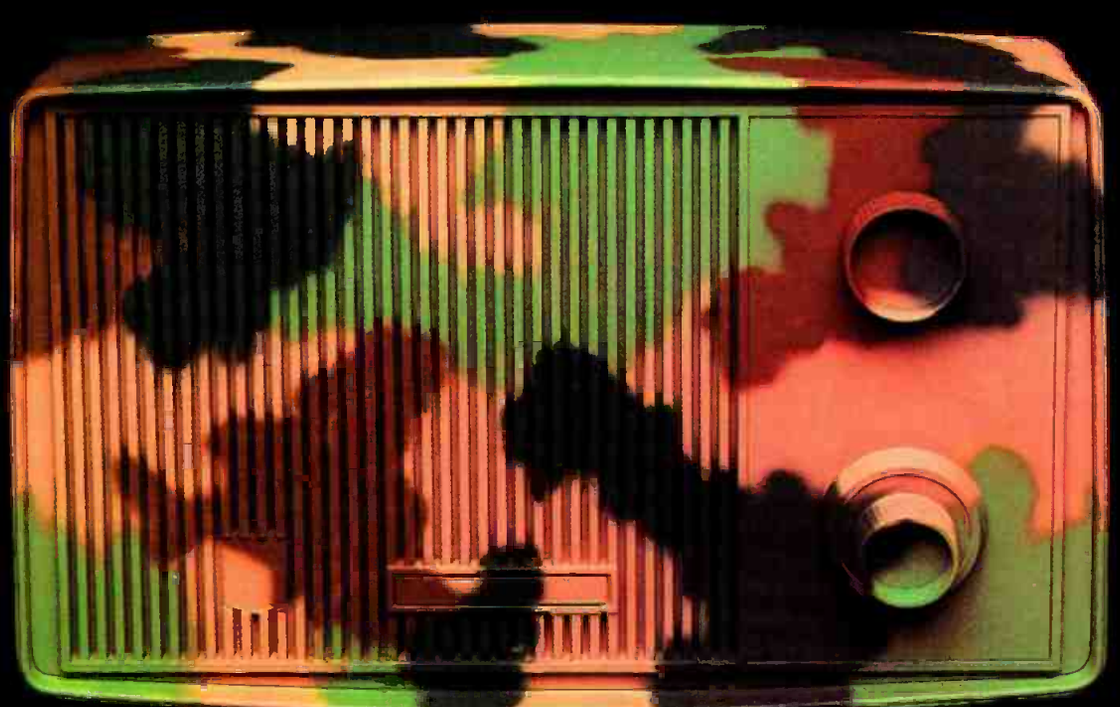

High-voltage power supplies

By Jerry Whitaker, editor

The most basic part of any broadcast transmitter is the high-voltage power supply. It is the section of the transmitter that produces the operating voltages for the PA tube and keeps you on the air. In order to keep the high-voltage supply working properly, you need a basic understanding of how it operates.

A number of circuit configurations may be used for the power supply. One, probably the most common, uses a 3-phase delta-to-wye transformer feeding a full-wave rectifier bridge (Figure 1). This configuration provides high efficiency and low ripple content. With a well-balanced ac input line, the ripple component of the dc output is 4.2%, at a frequency six times the ac input frequency (360Hz for a 60Hz input line). The dc output voltage is approximately 25% higher than the phase voltage, and each arm of the 6-element rectifier must block only the phase voltage. The RMS current through each rectifier element is 57% of the total average dc current of the load. The rectifier peak current is approximately equal to the value of the average dc output current. The typical power factor presented to the ac line is 95%.

Silicon rectifiers

Virtually all transmitter high-voltage power supplies use silicon rectifiers or special assemblies made up of groups of silicon rectifiers. Device parameters are generally expressed in terms of reverse-voltage ratings and mean-forward-current ratings in a ½-wave rectifier circuit operating from a 60Hz supply and feeding a purely resistive load. The three primary reverse-voltage ratings are:

Courtesy of Pacific Recorders

•*Peak transient voltage* V_{RM}

The maximum value of any non-recurrent surge voltage. This value must never be exceeded, even for a microsecond.

•*Maximum repetitive reverse voltage* $V_{RM\ [rep]}$

The maximum value of reverse voltage that may be applied recurrently (in every cycle of 60Hz power). This includes any oscillatory voltages that may appear on the sinusoidal supply.

•*Working peak reverse voltage* $V_{RM[wkg]}$

The crest value of the sinusoidal voltage of the ac supply at its maximum limit. Rectifier manufacturers generally recommend a value that has a significant safety margin, relative to the peak transient reverse voltage (V_{RM}), to allow for transient overvoltages on the supply lines.

There are three forward-current ratings that are of similar importance in specifying rectifiers for a particular application.

•*Non-recurrent surge current* $I_{FM\ [surge]}$

The maximum device transient current that must not be exceeded at any time. It is sometimes given as a single value, but often is presented in the form of a graph of permissible surge-current values vs. time. Because silicon diodes have a relatively small thermal mass, the potential for short-term current overloads must be given careful consideration.

•*Repetitive peak forward current* $I_{FM\ [rep]}$

The maximum value of forward current reached in every cycle of the 60Hz waveform. This value does not include random peaks caused by transient disturbances.

•*Average forward current* $I_{FM[av]}$

The upper limit for average load current through the device. This limit is always well below the repetitive peak forward-current rating to ensure an adequate margin of safety for the device and reliable equipment operation.

Rectifier maufacturers generally supply curves of the instantaneous forward voltage vs. instantaneous forward current at one or more specific operating temperatures. These curves establish the forward-mode upper operating parameters of the device.

Heat sink

Every high-voltage rectifier stack uses a heat sink assembly. Keeping a steady supply of cooling air directed toward the sink is critical to long-term reliability of the component. Likewise, it is important to keep the heat sink clean to maximize thermal transfer into the transmitter cabinet.

Because silicon junctions have a low thermal mass—much lower than their associated heat sinks—the sink assembly is effective only in dissipating heat generated because of the system's steady-state operating current. The heat sink will have little effect in preventing a catastrophic failure caused by a large transient overcurrent pulse. It can be shown, in fact, that in devices with a small junction mass, the temperature of the junction will follow the cyclic variations of current at the 60Hz power supply frequency. This factor is, of course, taken into account by the semiconductor manufacturer when determining typical operating parameters.

Next month, we will examine series and parallel rectifier stacks used in broadcast transmitters.

"Troubleshooting" this month examines how to repair high-voltage transmitter power supplies.

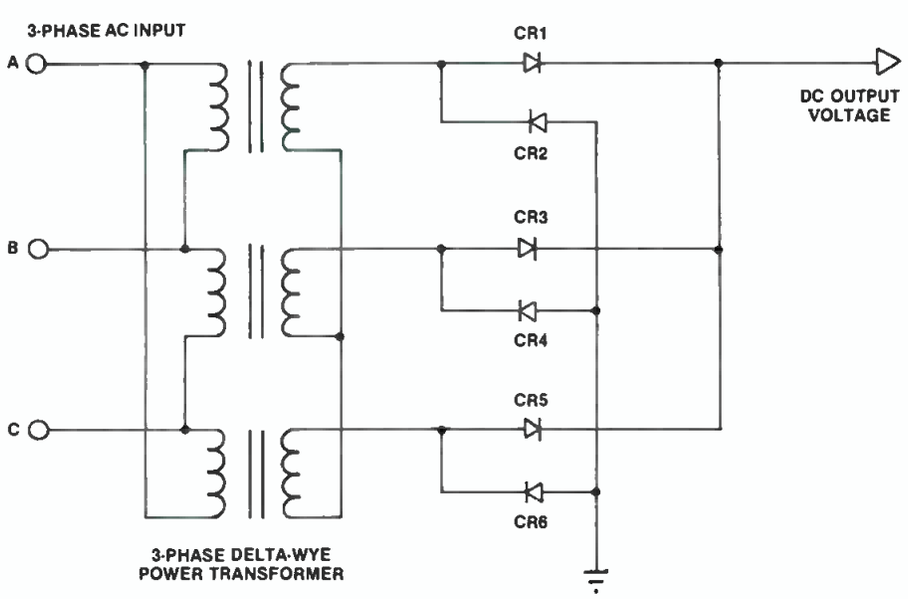

Figure 1. A typical 3-phase transmitter high-voltage power supply configuration.

Background information was obtained from the Howard W. Sams publication, "Reference Data for Radio Engineers," Sixth Edition.

Editor's note: "Circuits," a new column that will appear monthly in **Broadcast Engineering**, focuses on the theory of operation of broadcast equipment.

The most important part of a TV stereo generator isn't the stereo generator.

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Even so, the generator design itself should not be the prime criterion in choosing among manufacturers. The audio processor, more than any other element in the system, will dictate the sound you get.

Even if it sounds OK on some program material, a broadband compressor will sound pumpy and unnatural when processing material with heavy bass: Sophisticated multiband compression is needed to provide natural sound on high-quality stereo receivers with wideband audio sections.

In addition, stereo processors have to deal with filter overshoots that don't exist in mono. Advanced peak limiting and overshoot compensation are *required* just to achieve loudness equality with older mono processors.

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The design of such a processor is more an art than a science. It can't be done by a computer, no matter how powerful. It requires human taste, discrimination and, above all, *ears*. It also requires *time*. An audio processor rushed to market as an afterthought to a stereo generator design is not likely to serve well or long.

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Power supply failures

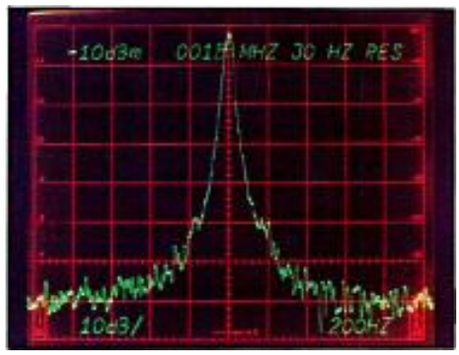
By Jerry Whitaker, editor

When you have a problem in the high voltage power supply of a broadcast transmitter, you know it. If you're lucky, the overload protection circuits will act fast enough to prevent any damage. If not, prepare for a long, involved and expensive repair job. By understanding how the power supply works and what failures can occur, downtime can be prevented, or at least minimized.

Figure 1 shows a high-reliability power supply of the type common in broadcast transmission equipment. Many transmitters use simpler designs, without some of the protection devices shown, but the principles of repair and maintenance are the same.

It is always easier and cheaper to prevent a problem than it is to correct one after it occurs. Careful observation of the power supply components can go a long way toward ensuring that any developing problems are caught early, before a catastrophic failure.

Every transmitter should be cleaned and checked on a regular basis. Thoroughly examine every component in the high-voltage power supply. Look for signs of leakage on the main filter capacitors (C1 and C2). Check all current-carrying meter/overload shunt resistors



(R1-R3) for signs of overheating. Carefully examine the wiring throughout the power supply for any loose connections or signs of overheating. Examine the condition of the filter capacitor series resistors (R4 and R5), if used, for indications of overheating. Excessive current through these resistors could spell a pending failure in the associated filter capacitor. Examine the condition of the bleeder resistors (R6-R8). A failure in one of the bleeder resistors could result in a potentially dangerous situation for maintenance personnel by leaving the main power-supply capacitor (C2) charged after the removal of ac input power.

Examine the plate voltage meter multiplier assembly (A1) for signs of resistor overheating. Replace any resistors that are discolored.

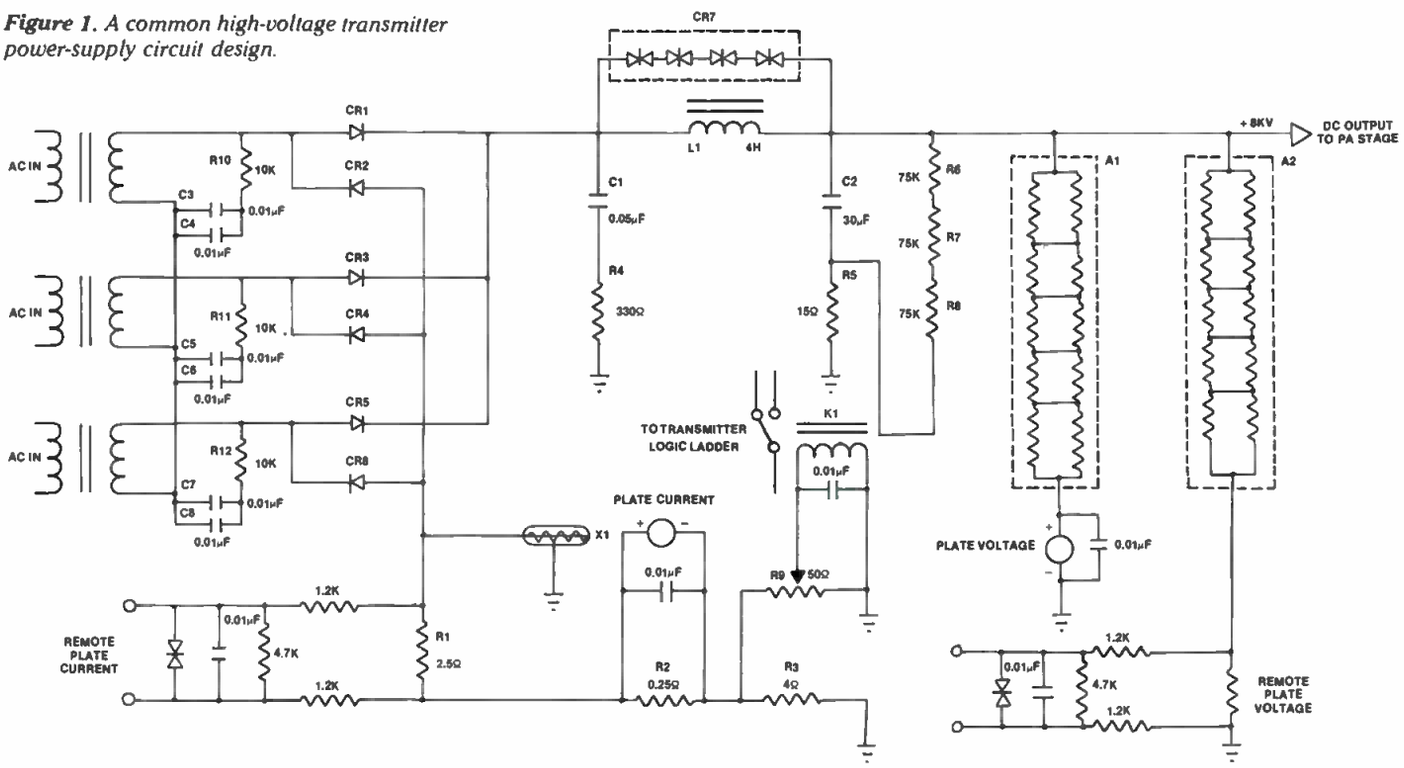
When changing components in the transmitter high-voltage power supply. be certain to use parts that meet with the approval of the manufacturer. Do not settle for a close match of a replacement part. Use the exact replacement part. This ensures that the component will work as intended and will fit in the space provided.

Metering

Proper metering is the best way to prevent failures in broadcast transmission equipment. Accurate readings of plate voltage and current are fundamental to transmitter maintenance. Check the meter for proper mechanical and electrical operation. Any meter that sticks or will not zero should be replaced. With most transmitter plate current meters, accuracy of the reading can verified by measuring the voltage drop across the shunt element (R2) and by using Ohm's law to determine the actual current in the circuit. Be certain to take into consideration the effects of the meter coil itself. Contact the transmitter manufacturer for suggestions on how best to confirm the accuracy of the plate current meter.

In "Troubleshooting," next month we will discuss maintenance and operation of specific components in the high voltage power supply. Figure 1 from this column will be referenced next month.

Figure 1. A common high-voltage transmitter power-supply circuit design.



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Designed to last

By Jerry Whitaker, editor

If you're getting ready to purchase and install a new audio console, be ready to make some decisions you can live with...for a long time.

Perhaps the hallmark of audio consoles is their longevity. How long was your station's last console in service? Ten years? Twenty years? More? I've been inside stations that are still using Western Electric and General Electric tube-type audio consoles. And they still work! Cart machines come and go, tape decks are improved, microphones are replaced and turntables are updated, but the console stays the same.

Audio consoles stay around so long for two reasons: (1) they work and (2) they are difficult to replace. Think about it. What piece of equipment in the air studio or production room would you *least* like to change? The audio console, of course. Most console replacement projects are accompanied by a total redesign of the studio. When the console goes, everything goes. Anyone who has changed an audio console while still trying to keep the studio serviceable knows that the project is a race against time. The effort is characterized by a Sunday night free-for-all in which the old board is taken out and the new one rolled into place. Then, the frantic rush begins to connect enough input and output lines to get the studio back on the air by 5 a.m.

The newer audio consoles that you find in radio stations today are vastly different from their predecessors. Think about the consoles in use a decade or two ago. They were generally huge, dominating the room. User preferences were normally limited to selecting a number of input channels. You could have six, eight or 12 pots. The ultimate flexibility of the system, therefore, was established at the time of purchase. Any improvements or modifications of console functions were handled with outboard elements. If you needed additional inputs, you added a *sub-mixer.* If you needed remote machine controls, you added a homemade control panel. If you needed to convert from mono to stereo, forget it.

Because the next audio console that you install is likely to be in service for a long time, the project should be planned in detail. Examine the equipment options. Identify the present needs and project future requirements of the station.

The audio board is the centerpiece of any radio production room or on-air control room. The console dictates the capabilities of the room and the possibilities for future expansion. It sets the pace for the facility. The console ties the studio together and has a major effect on operating efficiency. The importance of careful planning and installation of a new board cannot be overstated.

The planning of any major project begins with an assessment of the application. When the project is a new radio console, two major categories emerge: on-air and production. Each category has its own set of requirements that must be considered.

Assessing the needs

The audio board in an on-air control room is the hub of the station's programming. On-air boards are characterized by relatively simple, straightforward design. They have limited equalization capabilities and few, if any, special effects features. Machine control and status feedback capabilities are paramount, as are monitoring provisions. The function of an on-air console is to get program material on the air, not to do anything fancy with it.

Production boards are another breed. In the production room, the emphasis is on versatility and features. Production consoles usually have provisions for equalization on some or all input channels, special effects send/return and multiple-track (4- or 8-channel) tape recorder operation. A production board will take longer than an on-air board to set up, but it gives the user extensive capabilities to meet the creative needs of the station. As the creative needs grow, so do the requirements for a complex and versatile audio production board.

Many manufacturers offer both production and on-air versions of their audio consoles. Some use common modules in each design and add extra features as needed to tailor the console to the production environment. These options include equalizer, filter, compressor, studio monitor, effects send/return and slate/talkback modules. The station simply selects the types of modules required for each application.

An important aspect of any audio console purchase is the human element. A board that can perform every function under the sun is of limited value if it cannot be easily understood by operations personnel. Match the console to the application and to the operator's level of knowledge and experience.

The requirements of a production or on-air board will vary somewhat with the station's programming. A music format is probably the most demanding because it is usually production-oriented. A station with a music format generally relies on its in-house production staff to prepare commercials and promotional announcements. An 8-track studio is not uncommon in a major market music station because of the requirements for sophisticated production work.

An all-news station, on the other hand, has a different set of needs. Production work generally involves high volume, low complexity elements. All-news stations require extensive remote location interconnection capabilities to support field operations.

Talk radio stations have requirements somewhere between all-news and music formats. Because talk show studios are usually large—to accommodate the guests who come in to be interviewed—such facilities must have extensive microphone and telephone interface capabilities.

All of these considerations are predicated, of course, on the amount of money the station has available to spend on a new audio console. Stations seldom have the luxury of buying everything they want and some compromises must be made between the wishes of the operations and engineering staffs and the realities of the budget. An expandable, modular console with all the options may seem ideal, but not every station can afford one. Furthermore, it is questionable whether every station needs one.

Features and functions

Engineers designing an on-air control room or production studio today are blessed with the availability of flexible systems that make us veteran engineers wonder how we ever got by with stock console designs. Expandable configura-

tions have become standard practice among many console manufacturers, allowing installation of a custom-designed system that meets a station's exact requirements. Ultimately, the expansion limits are set by the mainframe size. Careful consideration must be given to selection of a mainframe that will meet future needs and lend itself to facility expansion. Mainframes are commonly available for 10 to 34 input positions, in a variety of steps.

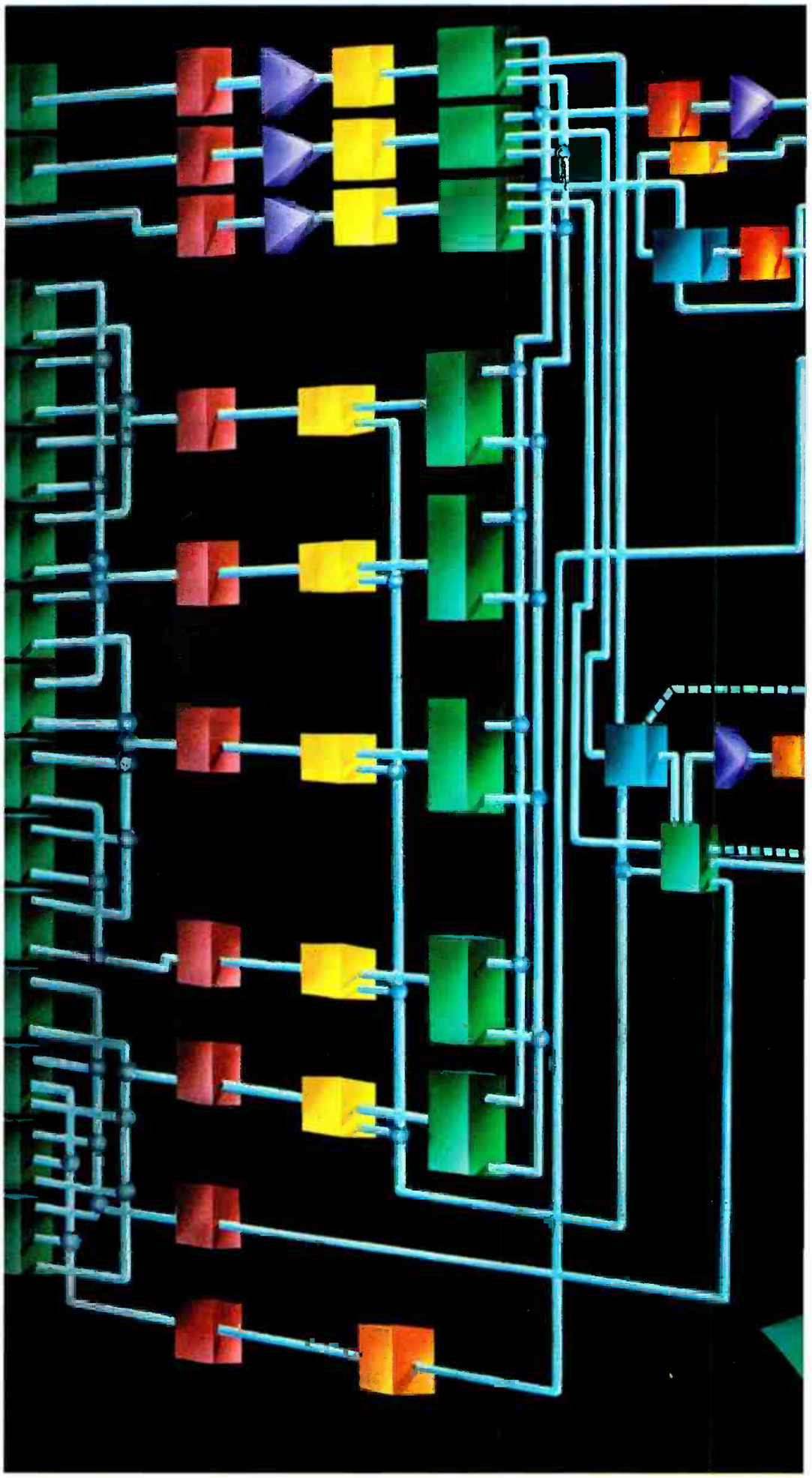
The functions of the console are dictated by the individual input, output, monitor and special-purpose modules. The channel elements vary in function and form from one manufacturer to another, but some generalizations can be made that apply to most units.

Features of a typical microphone/line input module for an on-air console (see Figure 1, page 26) include on/off push-button switches that control the audio signal flow and operate a machine control interface circuit. This interface may consist of a contact closure, low-voltage (5V to 12V) logic signal or open collector output. The console should provide for momentary or latched control, as determined by the requirements of the user. Lamps in the on/off buttons can be used for indicating signal flow status or external machine status in the case of a line amplifier input module. A console with extensive machine control features increases operator efficiency and reduces the potential for operator errors.

A cue button allows the audio source to be monitored without disturbing the attenuator setting. A number of options are available in the selection of an attenuator. User preference and field experience are your best guides. A pan pot provides the means to balance a stereo signal source or to position a mono signal in the stereo image, a feature typically used for announce or interview microphones.

Output routing switches on the input module allow selection of the program, audition or utility buses. Channel input selectors allow two or more inputs to be used. Modules that have provisions for external machine control should include logic that allows output commands to follow the input selector switches. Front-panel or internal gain trim controls are sometimes provided to allow convenient adjustment of input levels.

Carefully consider the maximum range of audio input levels for the console. Microphone channels should accept −60dBu to −40dBu and still remain within the manufacturer's performance specifications. (0dBu corresponds to an amplitude of 0.775V rms, regardless of the impedance of the circuit. It is the same voltage value as 0dBm measured across a 600Ω circuit.) Line-level chan-



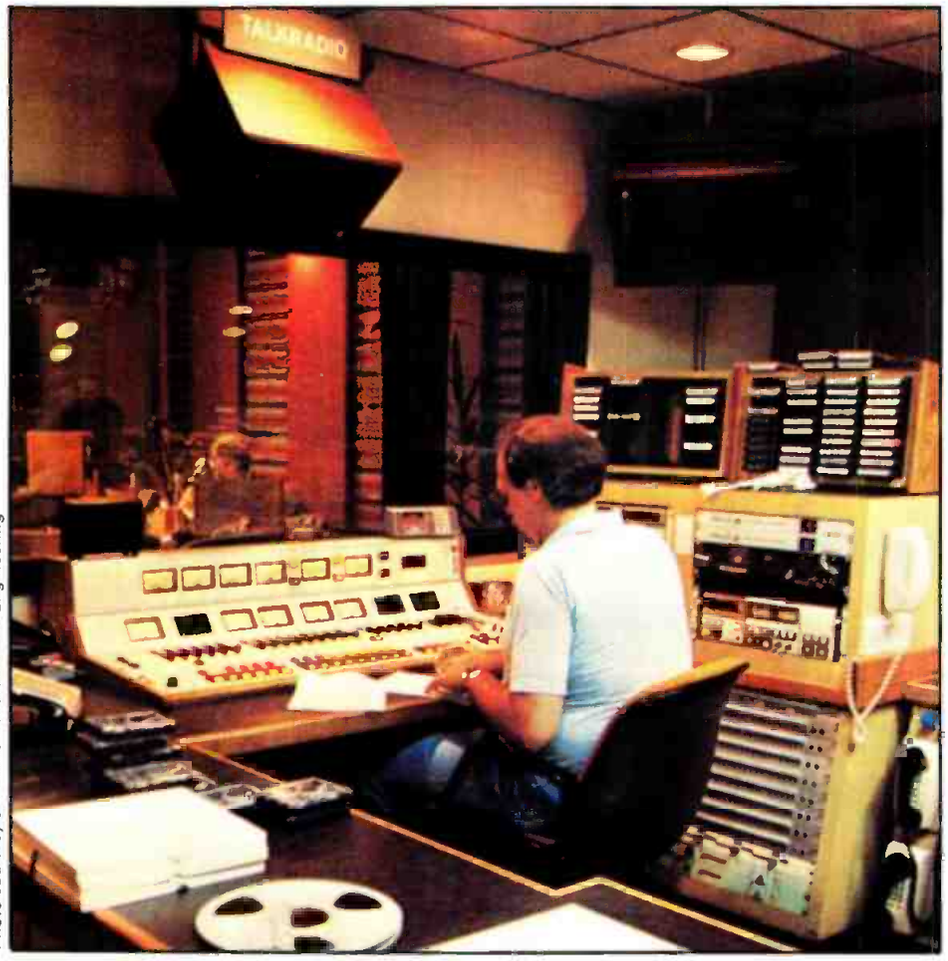


Photo courtesy of Pacific Recorders and Engineering

nels should remain within specs from −10dBu to +8dBu without external padding. Check the available input amplifier headroom at typical operating levels. Maintain a minimum of 20dB headroom before clipping throughout the audio chain. A minimum of 30dB headroom should be allowed on all line and microphone input channels of the board.

Carefully examine the input circuit design. Is it transformer-isolated, active balanced or (heaven forbid) unbalanced? What about the input impedance? Most inputs present a high impedance to the source, such as 1.5kΩ for a 150Ω microphone circuit and 10kΩ for a 600Ω high level circuit. A high impedance input (usually at least 10 times greater than the matching impedance of the source) ensures easy interface with various types of source equipment. Audio consoles manufactured today commonly use an active-balanced line-level input stage and a transformer or active-balanced mic-level input circuit. Some manufacturers offer transformers as options; others provide them as standard equipment.

Continued on page 26

When planning a studio redesign, attention to detail will result in a facility that will perform as required for years to come. Shown is one of the newly built studio and control rooms for KABC-AM, Los Angeles.

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Ikegami HK-322 automatic color cameras make Midwest picture perfect

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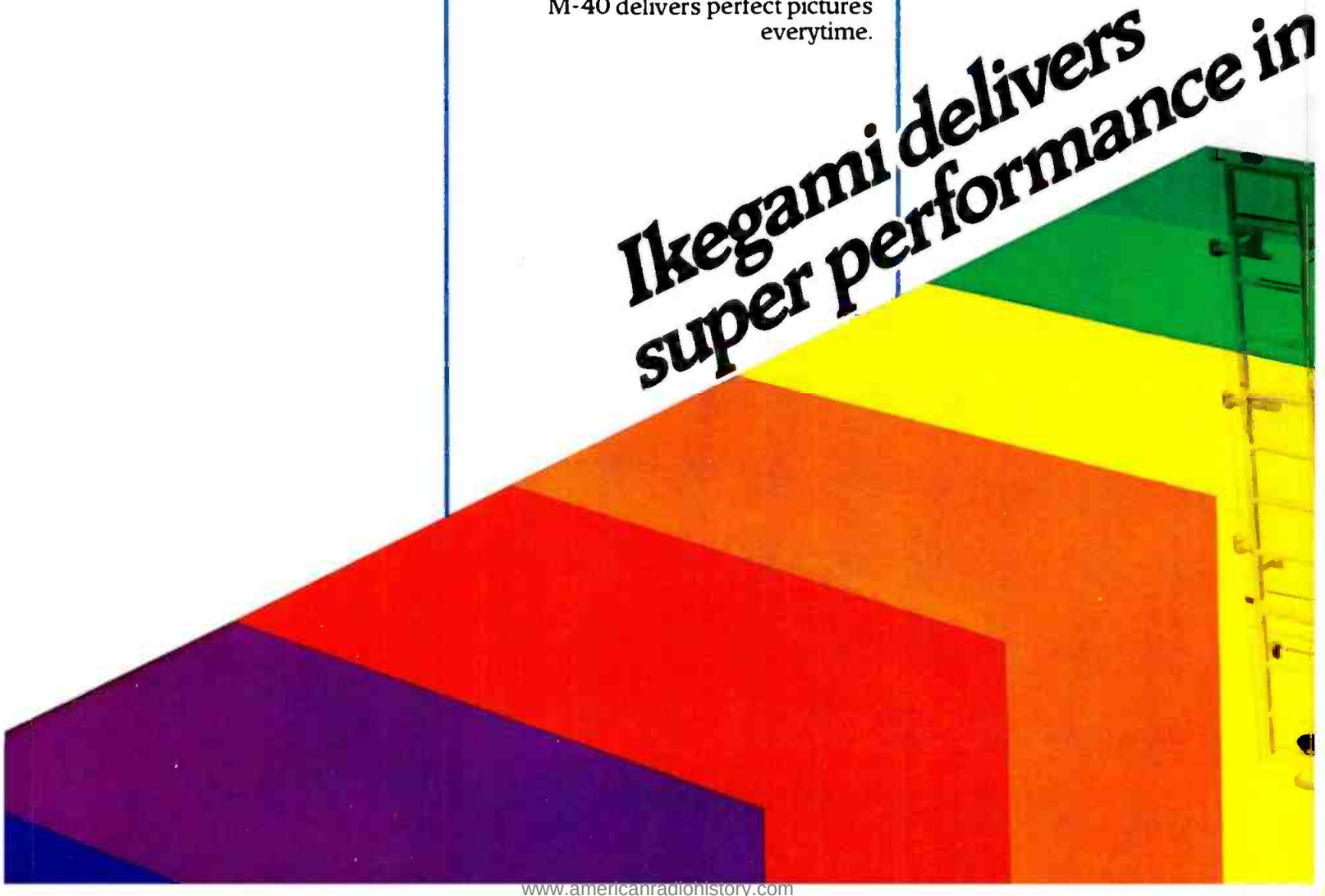
Ikegami HL-79E Series plays dual role for Midwest units

The Ikegami HL-79E Series camera was selected for use aboard the Midwest M-40 because it can handle two separate functions with superlative results. Although it's renowned as the perfect hand-held camera, the HL-79E Series can easily be converted into a field camera that produces higher quality images than many other manufacturers' top-of-the-line studio models.



Ikegami 9-Series color monitors give Midwest "true to life" pictures

Ikegami 9-Series Color Monitors are standard in the Midwest M-40 mobile unit because of their superb resolution and ability to reproduce colors that are amazingly life-like. This performance is unmatched by any other monitor in the world. Since the 9-Series monitors use In-Line Gun CRTs, they provide more than excellent colorimetry and

his exceptionally fine performance is due to Ikegami's painstaking tention to detail. Designed to meet e most rigorous performance standards, the HL-79E Series also offers ptional automatic set-up, either via s own set-up computer or by interface into the HK-322 set-up computer for total system integration. With the HL-79E Series, Midwest's M-40 offers you the versatility equired to produce network quality productions in any circumstances.

fantastic resolution. They also offer high stability, unit interchangeability, low power consumption, and convenient pull-out circuit panels. By using the Ikegami 9-Series, the Midwest M-40 can reproduce colors that are true to life.

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Continued from page 22

Do not overlook interface considerations when selecting a console. The price you may pay for such an oversight could be having to install outboard buffer amplifiers, isolation transformers, build-out resistors or loading resistors. Outboard hardware should be avoided whenever possible. Besides being expensive and time consuming, it can result in a system that looks as if it was designed and built by an amateur.

Figure 2 shows a typical input module for production room applications. Although the configuration is different from that shown in Figure 1, the module functions basically the same, with a couple of additional features. A multiband equalizer has been added to allow the operator to tailor the sound to fit the production requirements. In this particular example, a 7-band equalizer is used. Other designs offer 2- or 3-band equalizers and separate shelving or notch filters. An equalization in/out switch allows the production setup to be bypassed when not in use. An input mode control enables the operator to select stereo, mono, left or right signals for mixing. Other important features to consider include provisions for cue, solo, multitrack assignment and external machine control.

Figure 1. *The layout of a typical microphone or line-level input module for use in an on-air audio console.*

Output options

The output module for an on-air or production console is fairly straightforward. A master gain control may be provided for each of the three common buses (program, audition and utility). Individual gain trim pots may also be available on the modules for precise adjustment of channel balance and output levels.

When evaluating an audio console, examine the type of output circuit the manufacturer has used. Any console designed for broadcast applications should have a balanced output stage capable of at least +24dBm. A minimum headroom of 20dB (above the standard console output level of +8dBm) is recommended for the output circuit because of the relationship between the peak and average waveforms of typical program audio. Studies have shown that peak voltages can exceed the average values registered on a standard VU meter by as much as 20dB. To avoid clipping on program peaks, adequate headroom must be provided.

Determine whether the output stage uses a transformer or an active-balanced operational amplifier (op-amp) circuit to drive the load. Some op-amp designs will current limit and badly distort if connected to an unbalanced load. Some will even self-destruct (see Figure 3). When connecting an active-balanced dual op-amp driver to an unbalanced load, the inverting section of the stage is effectively shorted to ground. Configurations are available that are immune to this problem. The key phrase to look for on the specifications sheet is *balanced and floating.*

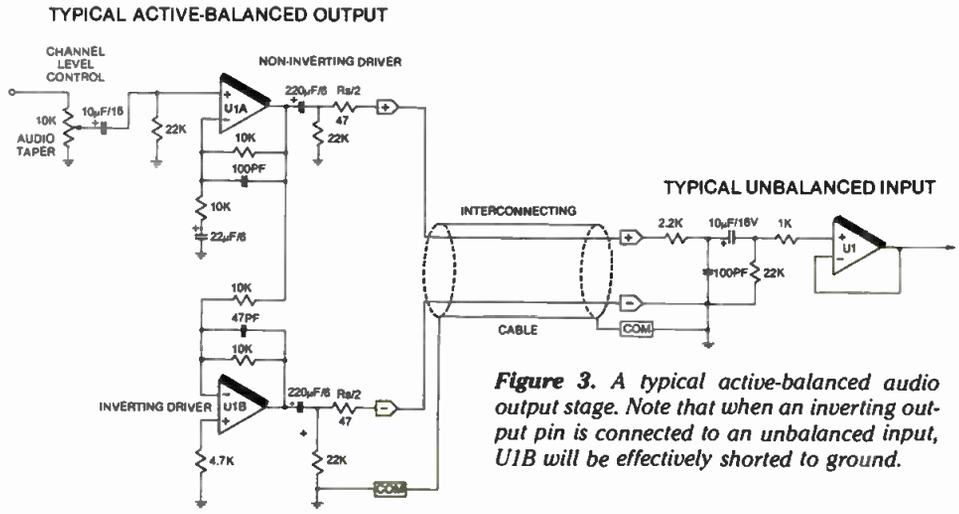

Figure 3. *A typical active-balanced audio output stage. Note that when an inverting output pin is connected to an unbalanced input, U1B will be effectively shorted to ground.*

Figure 2. *The layout of a mic or line-level input module for use in a radio production console.*

The foregoing does not mean that an active-balanced output stage such as that shown in Figure 3 should not be used. Rather, it means that the user must pay particular attention to how the console is installed and what types of equipment are connected to the outputs. Many console manufacturers use active-balanced input stages and transformer-balanced output stages. This provides for easy installation, high-quality performance and a cost-effective design. Because the performance of any amplifier using a transformer at the input or output will be determined primarily by the quality of the transformer, first-rate units should be used. The main specifications to consider for transformers are frequency response, low frequency distortion, rated output, square wave performance, common mode rejection and shielding.

Because the output of an on-air console usually must be distributed to several pieces of equipment external to the board, an internal distribution amplifier (DA) is a desirable feature. Complex distribution requirements, however, dictate the use of an external DA system.

Monitoring functions

The ability to monitor signals from various sources is of prime importance in an on-air application. Figure 4 shows a control room monitor module that provides the features desired in an on-air operating environment. Volume controls are provided for the headphones and control room monitor, cue and talkback speakers. A bank of selector switches allows the user

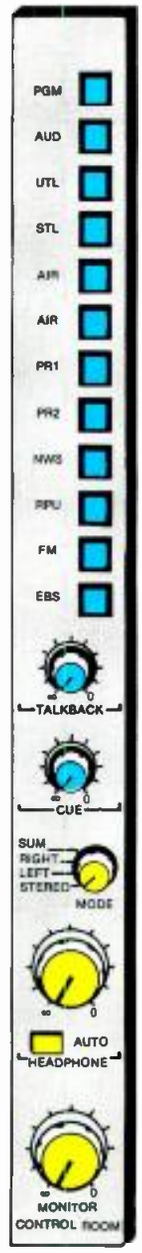

Figure 4. *The layout of a typical monitor speaker and headphone control module for use in either an on-air or production room application.*

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to hear the program, audition or utility channels, as well as any one of several external signal sources.

These inputs could include:

- Audio input to the microwave STL (or Telco loops)
- Air signal from the station's modulation monitor
- Air signal from a stand-alone off-air receiver
- Program signal from Production Room #1
- Program signal from Production Room #2
- Program signal from the newsroom
- Remote pickup unit (RPU) receiver audio output
- Air signal from a sister station (for combo operations)
- Output of the Emergency Broadcast System (EBS) receiver

The headphone feed may follow the monitor speaker signal, or be independently selectable. Provisions for switching the headphone input from stereo to left, right or mono mix also may be useful to the operator.

When shopping for an audio console, check the types of headphone and speaker outputs provided. Some units require external amplifiers to drive the control room or studio monitor speakers. Nearly all consoles provide dedicated headphone amplifiers. Check to be certain that the amplifiers will provide sufficient volume for your operators. In some applications, such as a talk show or an interview program, multiple headphone outputs may be necessary.

Metering for the console falls into two basic categories: the standard VU meter and peak program meter (PPM). The VU meter is more familiar to operators and is commonly used by networks and other program suppliers. The drawback of the VU is its average response characteristics. Short duration peaks can escape detection. The meter does, however, provide a dependable and easy-to-read display of average program energy content. If you select a VU meter for your console, make certain that it is a quality unit that meets the recognized ballistics specifications (American National Standard C16.5-1954). VU meters are available in standard analog (meter movement) displays and digital (bar graph) displays.

The PPM is an increasingly popular method of monitoring audio levels for broadcasting. The dynamic characteristics of a PPM are radically different from a VU meter. The PPM is designed to follow and display the peak energy of the audio waveform. The meter should be designed to conform with applicable standards (British Standard 4297:1968). Analog and digital displays are available. Table 1 compares the specifications for the VU meter and the PPM.

Probably the best method of monitoring the output level of an audio console is to use both VU *and* PPM meters. With this arrangement, the operator can regularly observe the VU meter for program level setting, and use the PPM to check for high level peaks that are not detected by the VU. Although this may be the ideal situation, it is probably asking too much of the operator to watch another set of meters. A simpler solution involves the use of a standard VU meter and a peak indicator lamp or LED set to a reference point below the level of amplifier clipping.

VU METER SPECIFICATIONS
(American National Standard #C16.5-1954)

Dynamic characteristics:
Upon application of a steady-state tone of 35Hz to 10kHz, the meter pointer shall reach 99% of the reference deflection in 300ms (± 10%). It shall then overswing the reference deflection by 1% to 1.5%. Upon removal of the tone the meter pointer shall fall to 5% of the reference reading within 300ms.

PPM METER SPECIFICATIONS
(British Standard #4297:1968)

Dynamic characteristics:
Upon application of a variable-length tone burst of 5kHz sinusoidal voltage, whose steady-state value will result in a reference reading, the following characteristics shall be observed:

Burst time	Scale indication
100ms	0dB
10ms	−2.5dB
5ms	−4dB
1.5ms	−9dB

The fall-back time for the pointer to drop from +4 to −20 after the removal of a steady-state 1kHz sinusoidal voltage shall be 2.5s to 3.2s.

Table 1. *A comparison of specifications for the VU meter and peak program meter (PPM).*

Other considerations

Additional features to consider for an on-air or production board include a test oscillator module for signal-quality checks, a telephone interface card for talk show applications, an effects send-and-receive module for special audio processing and a user-defined machine remote-control panel.

Because reliability is such an important aspect of an on-air console, consider purchasing a backup power supply (if the system is configured to accept one). Examine the construction of the console. It should be built to withstand the rigors of daily operation. It should also be resistant to degradation due to dust, dirt and coffee spills (the ultimate abuse).

Look for systems that are modular in construction. The active circuits on most consoles are divided into individual circuit boards that can be swapped with spares if a failure occurs. It makes little sense to attempt to troubleshoot an on-air console down to the component level. Stock a spare set of modules for each console at your facility. Most consoles must be switched off to replace circuit boards, but some are designed to allow *hot changes*. Never attempt this, however, unless the manufacturer specifically states that it may be done. The ability to hot change a module has obvious benefits for repairing an on-air board.

Consider the termination method used for the audio and control signals. Be certain that you are comfortable with the type of connectors or terminals used. Before the installation job is completed, you will have dealt with a lot of them.

Examine the possibility of radio frequency interference (RFI) into the board because of a co-located or nearby broadcast transmitter. The board should be shielded from RFI with a metal frame and extensive ground plane PC board construction. Ferrite beads also may be used on input lines to suppress RFI. The common mode rejection ratio (CMRR) of the input amplifiers will have a significant effect on the performance of the console in an RF field.

It is more than a little disturbing to install a new console and power it up only to find that the station's broadcast signal comes booming through on one or more of the input channels. To avoid such problems, purchase a unit with good shielding and RFI protection, maintain balanced input and output lines throughout the facility and provide a proper ground system for the console and each piece of equipment.

Specifications

Because of the complexity of audio consoles today, it is difficult to determine how well a unit will meet a station's needs simply by examining the manufacturer's specifications sheet. Specs can be measured in a variety of ways, resulting in as many different readings from the same piece of equipment. The manufacturer's reputation, your personal observations and the recommendations of fellow broadcasters can be a great aid in translating specifications into a real world experience.

Specifications are important in the selection of any piece of broadcast equipment, and audio consoles are no exception. Carefully examine the measured performance of the unit for both

Continued on page 32

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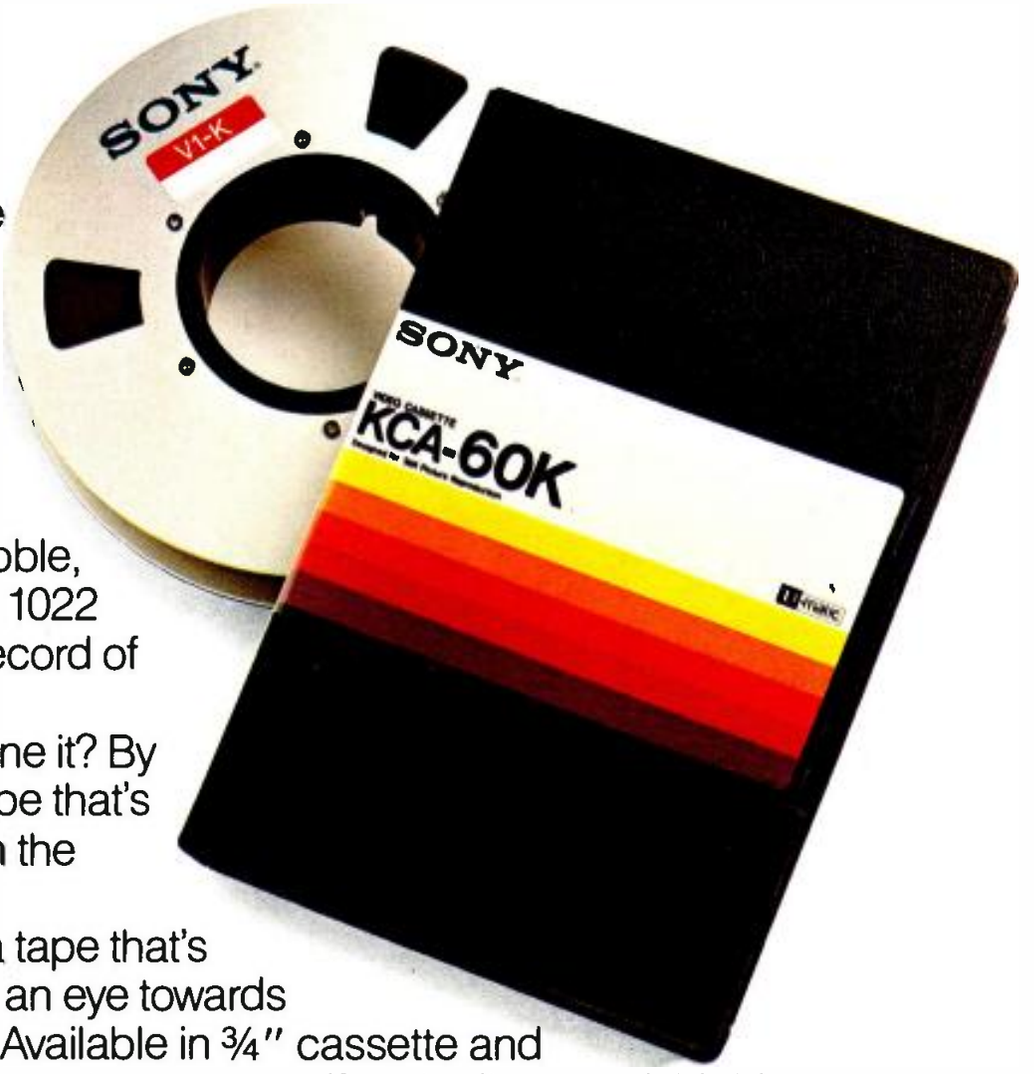

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Continued from page 28

microphone *and* line level inputs. Pay particular attention to the reference levels specified for the measurements. Carefully read the notes and test conditions on the spec sheet. Virtually all audio consoles manufactured for broadcast applications have excellent specifications across the useful audio spectrum. The following specs can be used as minimum performance targets for an audio console today:

- Frequency response flat to within 1dB, 20Hz to 20kHz, mic or line input, 0VU output.
- Total harmonic distortion (THD) less than 0.1%, 20Hz to 20kHz, mic or line input, 0VU output.
- SMPTE intermodulation distortion (IMD) less than 0.05%, mic or line input, 0VU output.
- Interchannel crosstalk at least −70dB, 20Hz to 15kHz, 0VU output, any input to any output.
- Signal-to-noise ratio at least −70dB, referenced to 0VU output, mic or line input, 20kHz bandwidth.

These specifications provide a reference point to judge a console, but they do not begin to tell the whole story. Further investigation is required by the potential buyer. When shopping for a console, ask questions. A company that is proud of its product is willing—and usually eager—to talk about its gear. Consider asking the following questions:

- *Although the frequency response looks good out to 20kHz, what happens beyond that point?* Response should extend well past the usable audio range. Even though the transmission system will filter out everything above 15kHz, all components of the system up to the transmission equipment should be selected for transparent performance. The 3dB point for the console, input to output, should extend to at least 40kHz. Input and output transformers, if used, will have a significant effect on this parameter. The internal bandwidth of the console (the system minus any transformers) should extend to beyond 100kHz.

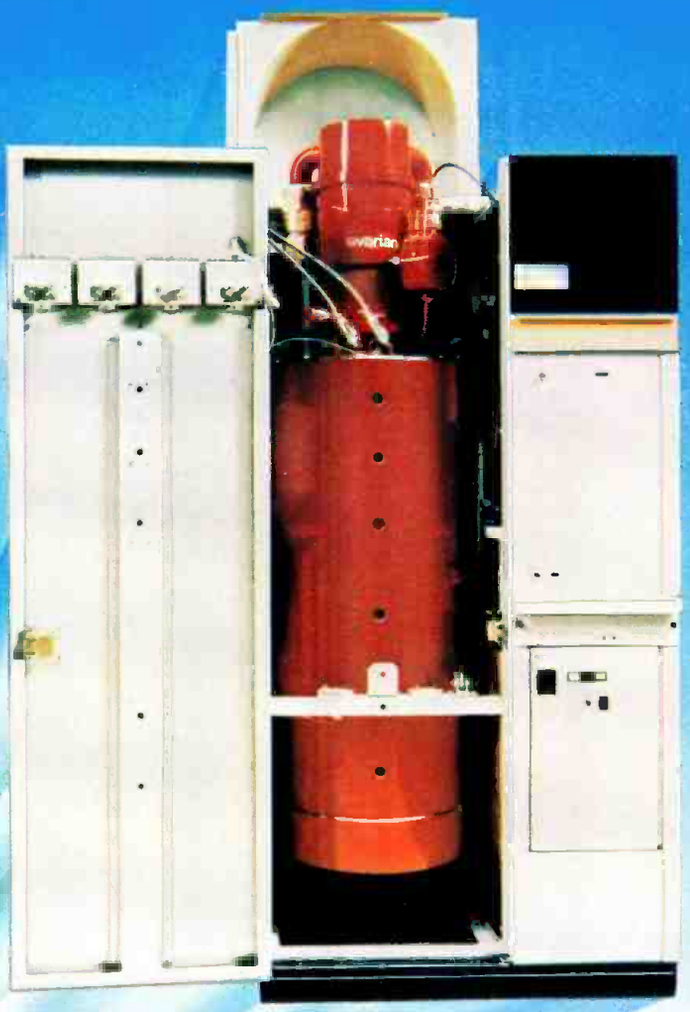
As a rule of thumb, integrated circuit op-amps used in the station's audio system should have a gain bandwidth product of at least 10MHz. To assure adequate overall bandwidth, no single amplifier stage should be operated with more than 40dB voltage gain.

- *How is crosstalk measured? Is the specification shown a typical value, or a worst case value?* The crosstalk performance of a console with a poorly regulated power supply will be degraded when more than one channel is driven.
- *What is the expected transient response of the overall system?* The square wave performance of the board will become increasingly important as high-quality digital audio material is integrated into daily operation.
- *What type of ringing and overshoot performance can be expected from the input or output transformers used in the console?* Poor quality transformers can seriously degrade program material containing steep wavefronts, as found in some music selections that are reproduced on a compact disc player.
- *Is the console equivalent input noise (EIN) specified, and how is it measured? What are the mic and line reference input levels? What is the input impedance and measuring instrument bandwidth? Are any weighting curves employed?* Noise is perhaps the most difficult parameter for the manufacturer to measure comprehensively, and for the user to understand. Special attention should be given to this area.

Shop around

Because an audio console will be used for many years—perhaps decades to come, selection of the unit should be made with care. Allow yourself adequate time to evaluate the performance, features, expandability and price of various consoles. Do not rush into a decision about a new audio console. You may be living with it for a long time.

Acknowledgement: The assistance of Dave Evans of Broadcast Audio and Jack Williams of Pacific Recorders and Engineering is appreciated in the preparation of this article.



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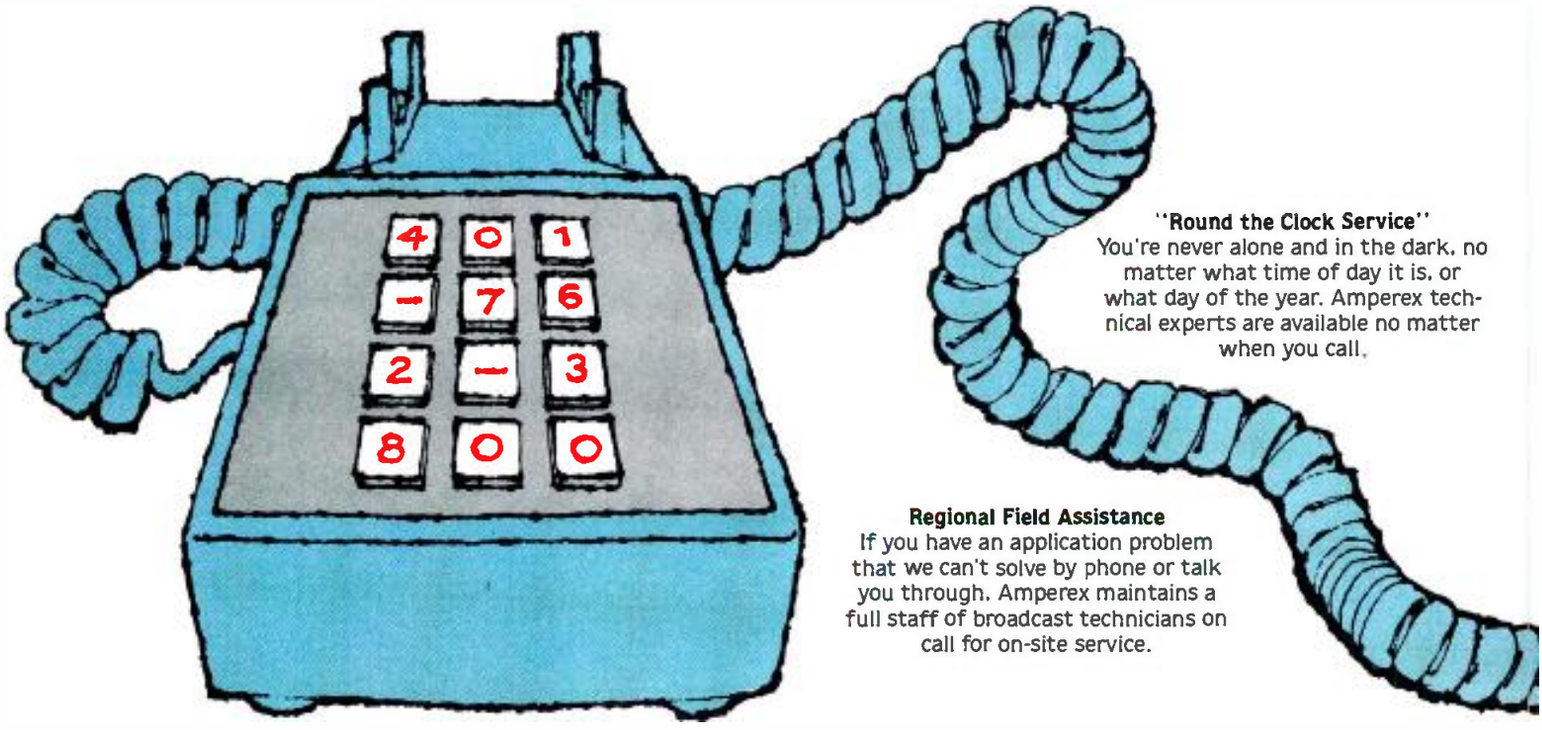

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Switching to the future

By Carl Bentz, TV technical editor

How many crosspoints can your station have? To meet the prospect of tomorrow's TV control needs, you'd better start counting.

Television is no longer just a picture combined with sound, as we have come to know it. Today's digital techniques can process video into images that are far beyond the dreams of yesterday's TV engineers. Noise reduction brings outstanding clarity to both luminance and chrominance video. High-definition TV, a pending reality, promises to paint images on screens that are much larger than the ones we've been using.

The advent of stereo television has kindled a general interest in upgraded audio equipment. Although stereo operation results in real (and perceived) improvements in fidelity, it demands equipment that can be adjusted to control the inherent threat of noise and distortion. The inclusion of Second Audio Program (SAP) and professional (pro) subchannels on aural carriers will call for even more critical control settings.

Automation proposes to change the way a TV station operates. Ironically, the key to simplification is sophistication—of

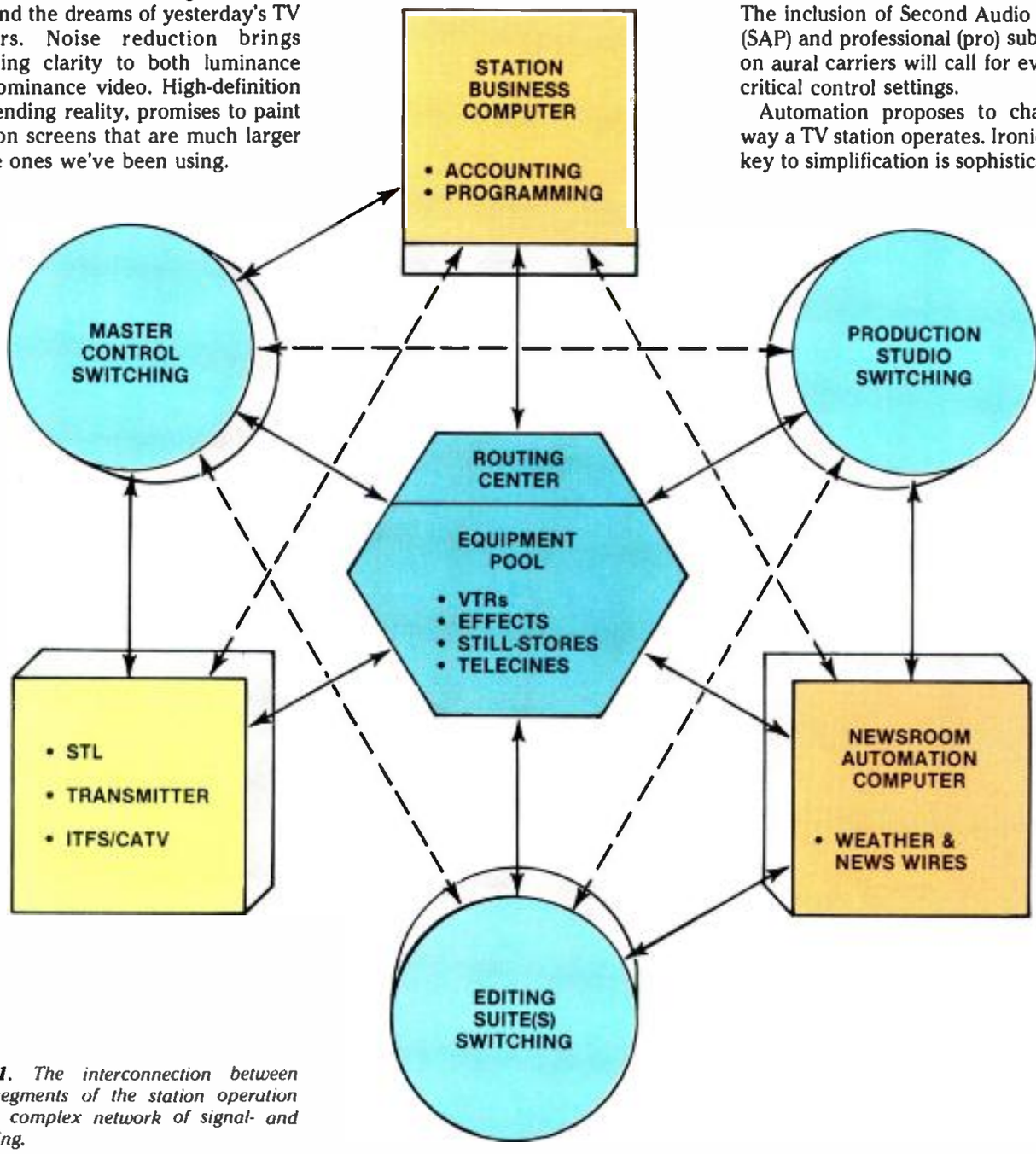

Figure 1. *The interconnection between various segments of the station operation creates a complex network of signal- and data-routing.*

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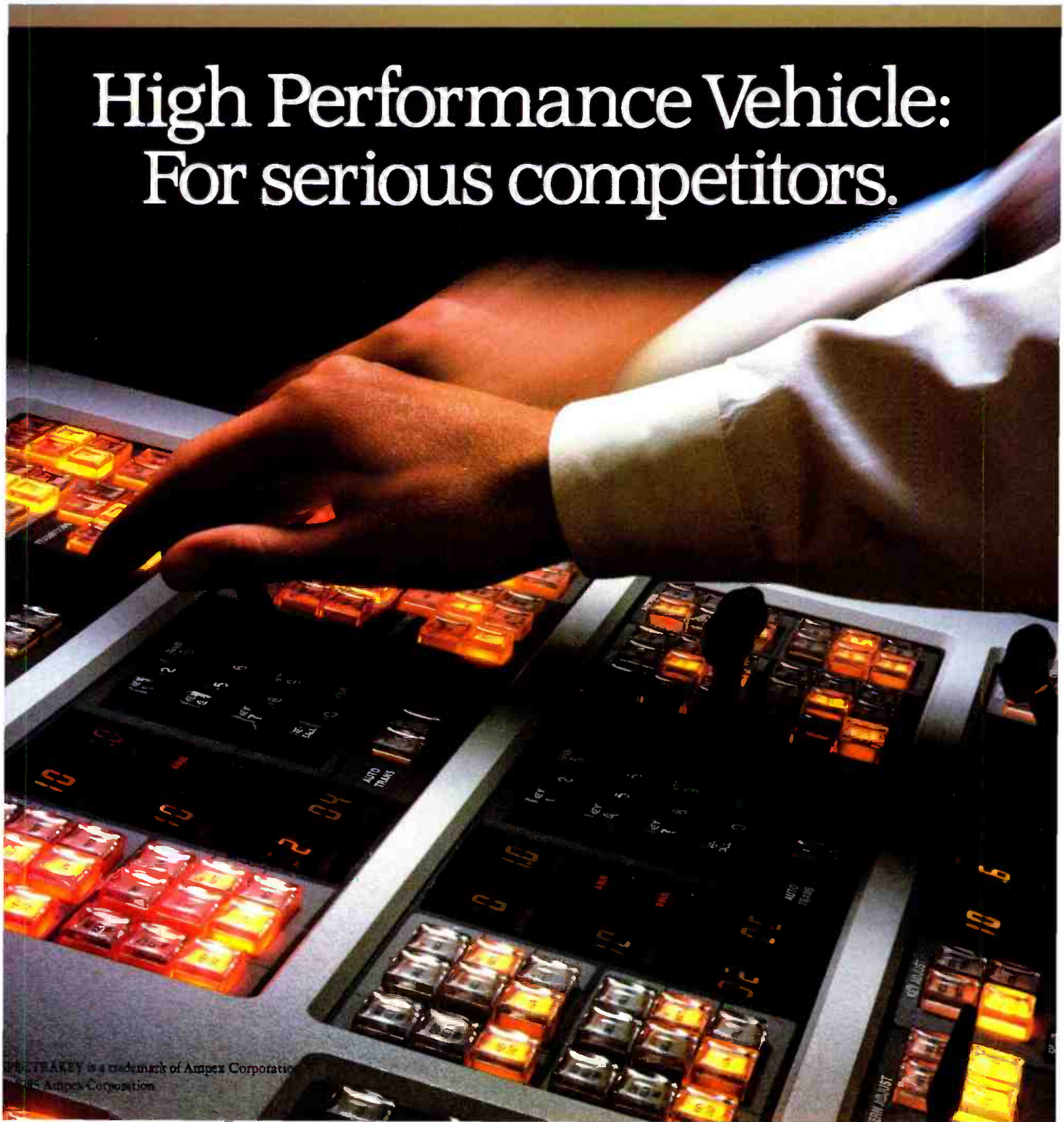

the equipment and those who operate it. It is predicted that daily operation of the newsroom, business accounting and master control will all fall under the control of the station's master computer network. In some operations, ITFS and special CATV channel programming may be automated, in addition to the standard TV channel switching. Figure 1 illustrates the interconnection requirements of a typical TV facility today.

Switching directions

For most stations, preparing for enhanced television will mean new switching networks. Audio equipment and cabling may require updating, but implementing multichannel sound (MCS) will impact video switching as well, particularly in routing systems and the area of master control. There are limits to how many ways and how many times old equipment can be modified. Signal-handling quality of newer systems should also be considered, in terms of noise levels and control flexibility.

Some audio control functions in the studio production switcher might be advantageous. Undoubtedly, any major stereo audio studio production will go through several rehearsals. During those sessions, mic switching and levels to coordinate with camera angle changes could be worked out. Then, at the actual taping session, those cuts between mics to follow the visual presentation could be controlled electronically by the technical director. Accurately matched audio control in a production could mean the difference between success and mediocrity.

Count your crosspoints

If a station chooses not to expand its video equipment inventory, then the matter would be limited to audio system changes. For example, stereo requires *left* and *right* audio, and perhaps a *monaural mix*. Information to be transmitted on the SAP carrier need not be related to the visual program, but could be used for dual-language purposes. Similarly, the pro channel may or may not be related to the visual program, but it could involve audio signals as cues to a remote crew, for continuing education programming or even data bit streams. As such, the pro channel could become a source of revenue for the station.

As we contemplate the additional control features and functions of tomorrow's systems, we should consider SMPTE LTC and VITC codes, RS-232 and RS-422. Implementing automation will require some communications network to operate throughout the studio complex. Unrecognized services could be provided if these protocols were transmitted on VBI lines. Other control protocols and data signals may converse to the home TV receiver for functions such as captioning, screen text displays and personal message services. Back in the studio, embedded characters in the newsroom script could control some of the video switching for keys, VTR prerolls and takes.

Not only are we looking at more than five levels of audio control in various portions of the TV complex, we may also be dealing with multiple video signals as well. The interest today in video is analog components; tomorrow it will be digital components. Accordingly, video switching may need to handle at least three layers of video components, and probably more. Just modifying the switchers so they can tackle all of these requirements poses a major project.

Avoiding trauma

Primary equipment failure is a traumatic event for any station, particularly a commercial operation. Almost equally as harrowing is the process of upgrading switching and control capabilities to add new equipment.

To avoid constant upgrade projects, you should prepare now for the next several years. Project the future of your operation and try to make realistic predictions. Will your switching needs change within five years? Will the station convert to stereo? Do plans include automation that will link to engineering

Continued on page 42

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HITACHI PUT AUTO SETUP EXACTLY WHERE IT BELONGS.

"Not only does the SK-970 have complete auto setup, but it's a genuine studio camera that's lightweight enough to send into the field."

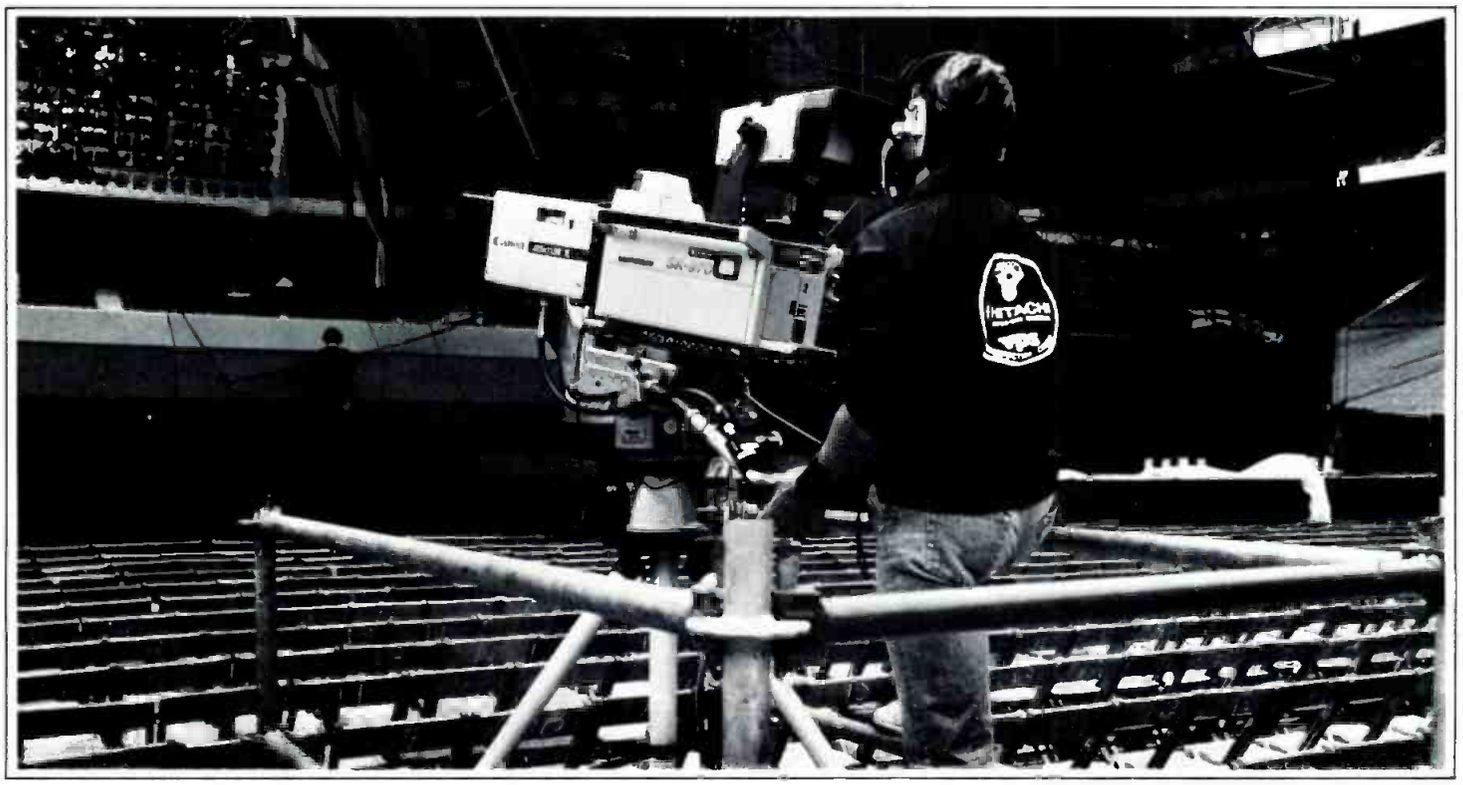
I. Jay Azimzadeh, President
Video-Pac Systems, Ltd.
Hollywood, CA

The largest producer of live concert videos in the U.S., VPS requires lightweight, low-maintenance broadcast cameras it can put on the road for long stretches.

Azimzadeh considers the SK-970 the only studio camera with 2/3-inch mobility and EFP handling. So it can meet the demands of often makeshift stadium facilities, while delivering the broadcast images that are needed for larger-screen multiple projection.

Since each of the four SK-970s and two SK-97s in the travelling package has complete self-contained auto setup, a separate box isn't needed. And any potential problems are confined to one head.

Although VPS earmarks two SK-97s and SK-970s for studio use, the ability to use both wherever they are needed is a welcome economy. Still, the greatest asset of the SK-97 and SK-970 is rockbottom reliability. To Azimzadeh, concerts are just like live TV—no one can afford any slip-ups, or an equipment failure.

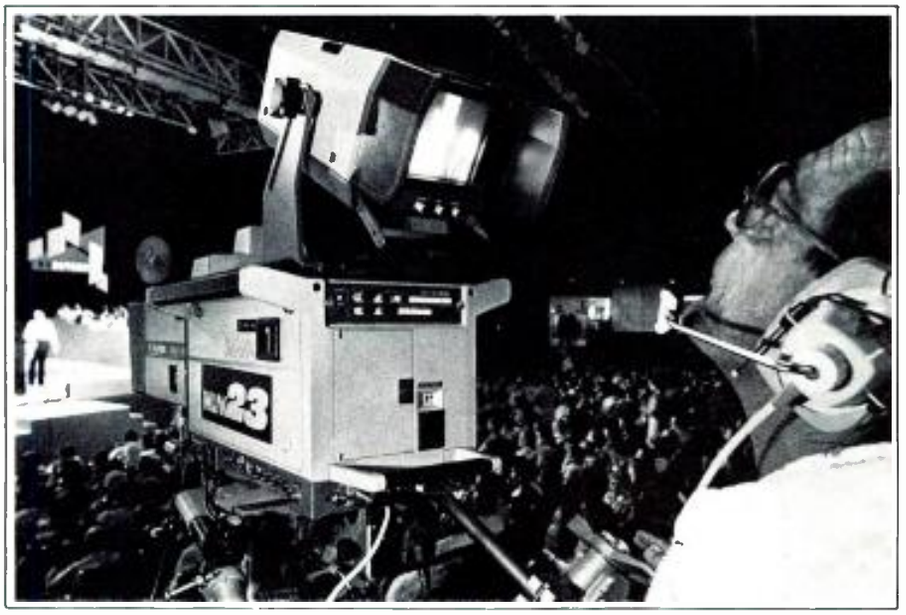


"Since each SK-97 and SK-970 has its own on-board computer, I can set everything up at the same time automatically."

Terry McIntyre, Remote Supervisor
F&F Productions, Inc.
St. Petersburg, FL

As a mobile production facility covering sports and large outdoor events for local and network TV, F&F needs broadcast quality on location.

They also need fast, independent setup. So they keep three handheld SK-97s and four compact studio SK-970s permanently stowed on one of their trucks. And with complete computerized auto setup on-board each camera, the crew can set all of them up at the same time from parameters stored in memory without having to worry about drift or last minute adjustments.



The SK-97 and SK-970 also perform superbly under low-light conditions. As a result, notes Chief Engineer Dennis Lusk, both can use very large lenses. And with real-time registration compensation automatically correcting for any changes throughout the travel of zoom lenses, the cameras are ideal for the demands of sports coverage. Resolution and colorimetry are also unsurpassed, according to Bill McKechnie, another Remote Supervisor. In fact, the SK-97 is often run by F&F as a "hard" camera, in place of the SK-970. Location recording is done on two Hitachi HR-230 1-inch VTRs.

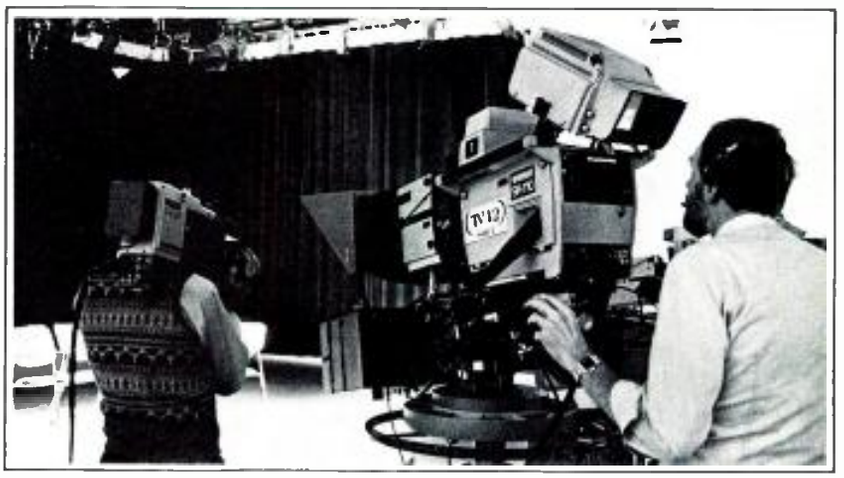
Most important, however, is the almost complete interchangeability of both cameras. Not only are they easy to work with, but they are also easy to link up. And so similar electronically, a single set of spares can cover any potential emergency.

"The SK-97 is a real mini-cam that can be completely integrated into a total studiowide auto setup system."

Bill Weber
Vice President for Engineering
WHYY Television
Philadelphia, PA

WHYY has extensive production facilities at Independence Mall and more studios on the drawing board. To plan for this rapid growth, WHYY sought a family of broadcast cameras that was as flexibly integrated as it was advanced.

While evaluating computerized camera systems, Bill Weber and his staff found that the Hitachi SK-110 studio unit and the portable SK-97—with the same basic complete auto setup—were so perfectly matched in colorimetry and resolution that pedestal and handheld work could be combined without a hitch. And because the SK-97's auto setup is also completely self-contained, both cameras are as electronically independent as they are geared toward common console control.



Staffers like Senior Video Engineer Bob Miller consider the SK-97's auto setup easy-to-use, as well as accurate and reliable. And the on-board lens and scene files give operators instant-filter and color correction at each camera head, in addition to the console. So the staff looks upon the Hitachi SK-97 as a studio camera that they can shoulder.

As facilities grow, WHYY's Weber knows that he will have the flexibility to configure and reconfigure SK-110s, SK-970s, and SK-97s to meet production requirements of most any complexity without encountering technical snags. In fact, with Hitachi cameras at other sister stations in the Eastern Educational Network, joint productions can even be assured of a common look.

For a demonstration of the SK-97 and SK-970 in your studio, contact Hitachi Denshi America Ltd., Broadcast and Professional Division, 175 Crossways Park West, Woodbury, NY 11797; (516) 921-7200, or (800) 645-7510. Canada: Hitachi Denshi Ltd. (Canada), 65 Melford Drive, Scarborough, Ontario M1B 2G6; (416) 299-5900.

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Continued from page 38

equipment in any way? What about expansion of editing or production facilities and operations? Would expanded production needs overload the present switching equipment? Your answers to these questions will help you predict the video and audio networks you will need tomorrow.

Switcher planning should include ways to achieve redundant versatility. You must determine how many video inputs will be required for the production switcher, the master control switcher, and the editing suite switcher(s). Think about how you will handle contingencies of needing output signals from various equipment at more than one switching location. In case of master switcher failure, could the production system be pressed into master duties, or vice versa? Making each switching center in the station an independent, but interrelated and functionally comparable work area definitely increases system complexity, but the alternative is downtime—and that's expensive.

Are new or expanded digital effects practical in your video future? If so, it would be a good idea to directly interface the switchers in production, editing and master to the preferred effects system. Prudent scheduling for all three centers to use the same effects unit may be tricky, but the concept of versatility suggests that such a tie should exist. The station computer system can be requested to optimize still-store or effects use on air, if that equipment is needed for studio production.

Also consider the trends in video components. Analog components without subcarriers have shown that significantly better image quality is possible. We can expect digital components to bring additional improvements. The compatibility of new switching systems with these modern techniques is essential.

Phase to phase

Developing multiple switching centers will ensure redundancy, but it will require special attention to phasing between video and audio equipment. One approach is to place a pool of production equipment in one location to serve all operating centers of the station. Placement of all equipment in a central location simplifies some of the phasing problems. The introduction of multiple switchers and links between them, however, could pose some unusual situations. (See "Keeping in Step," page 28 in the July 1985 issue of **Broadcast Engineering** for a discussion of solutions to phasing problems.)

Strict observance of RS-170A would allow any switcher system to relieve another system in case of failure or unusual scheduling of the facilities. The result is that viewers would not detect a change if the transfer occurred without horizontal positioning shifts or hue changes. This takes the terror out of equipment failure for station personnel.

As the fully phased complex is planned, consideration should be given to signal sources arriving from the outside world. Frame synchronizers, driven by the station's master sync generator, can almost guarantee the ENG segment, the remote production project or the network feed will be properly timed. Even the reliability of network by satellite is improved through the use of synchronizers, because you no longer have to rely on gen-locking to the remote source for elements such as effects and titling. There is no graceful recovery of the studio equipment when a gen-lock source drops out, then unexpectedly returns.

Don't wait

The production and transmission system capable of serving the station of tomorrow will not be planned or built in a day, but a piecemeal approach is not advisable. Give it the time and attention it deserves. Start today to determine what you must have and what you'd like to have in terms of capabilities. Look for equipment that fits those requirements practically, and allows room to grow.

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Implementing transmitter diagnostics

By Will Bruner and Tim Armour

A diagnostic/control system for transmission equipment is not just a futuristic fantasy: It is possible, as well as practical, now.

The technology of computer-aided systems diagnostics has been developed over the years for industries that deal with goods and services such as nuclear power generation, military products, space equipment and medical life-sustaining apparatus. The research and development investment in diagnostics totals in the millions of dollars. These technologies are only now beginning to make their way into the broadcast industry, providing increased reliability for major systems such as transmitters.

The state-of-the-art

Traditional remote-control equipment has been around for many years. It provides the means for controlling and displaying status information from one or more remote locations. In more sophisticated microprocessor unit-based (MPU) systems, alarms can be sounded or a control event can be initiated based on an input status condition. The primary feature lacking in current remote-control systems is the capability of actively assisting the operator or maintenance engineer when a problem, or the potential for one, arises.

In many broadcast facilities today, the person operating the transmitter is not necessarily the one who maintains it. When a failure occurs, information regarding the problem and the corrective actions to be taken must be communicated from the operator to the maintenance engineer. The details and exact sequence of actions are often forgotten or overlooked in the haste of a crisis. This situation can be frustrating to maintenance personnel because it makes the job of diagnosing the failure that much more difficult.

Sophisticated status and control features eventually will be incorporated into transmitter designs. Although most transmitters in operation today were not configured with built-in intelligence capabilities, such features can be implemented in an existing system. To accomplish this, a number of custom transducers and sensors are needed. Placement of these devices is critical for a reliable and cost-effective system. Although some transducers and sensors are not readily available, they do exist.

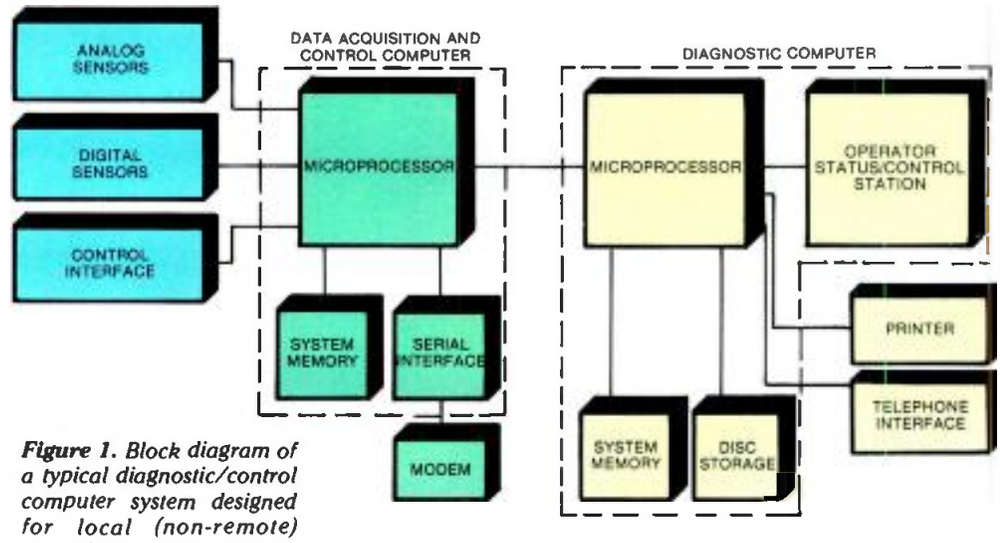

Figure 1. Block diagram of a typical diagnostic/control computer system designed for local (non-remote) operation.

Monitoring points

How many points need to be monitored to enable reliable diagnostic capability? The number varies according to the size and type of transmitter. As an example, consider a common high-power UHF TV transmitter (the RCA TTU-55). For such a unit, 60 analog points and 180 carefully chosen digital points should be monitored for detailed diagnostic capability. Some of the required analog monitoring points are:

- Mod-anode voltage for data concerning efficiency and aging of the klystrons. With trend analysis capability, tube life expectancy can be predicted.
- Temperature sensors at the elbows and flanges of the transmission lines for an indication of pending failure before actual burnout occurs.
- Air flow sensors to monitor cooling through the klystron's cooling tower (or main amplifier cabinet on a VHF transmitter).

Bruner and Armour are with Horizon International, Phoenix, AZ.

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- Coolant conductivity and clarity sensors to monitor water quality and detect possible contamination.
- Water flow and pressure sensors to identify any failures within the cooling system.
- Water temperature samples at various points in the system for determining overall cooling efficiency.

Extensive monitoring of digital (or on/off) points throughout the transmitter gives vital information on the system's current operating status. Points within the control ladder logic and power tree provide the information necessary to analyze and to specify a problem area.

Additional points to be monitored include tower safety and building integrity. Sensors that measure ice on the tower, oscillating guys and excessive sway provide a detailed picture of the condition of the structure. If the transmitter site is at a remote location, data concerning the environmental parameters is also essential. By monitoring the building's security alarm system, the presence of water on the floor, excessive snow load on the building, outside temperature, wind speed and wind direction, it is possible to make an accurate assessment of the transmitter site building status.

Handling the data

A major step in implementing real time transmitter diagnostics involves improving the speed of data transfer between the transmitter and the monitoring location. With many of the current status and control systems, it may take 16 seconds to 60 seconds to get a full status report on a transmitter. An operator who makes a change in the system must wait the same amount of time for a complete update. By implementing multiple microprocessor (*multiprocessor*) technology, data acquisition and manipulation tasks are distributed more efficiently. This enables faster data acquisition and transfer to the diagnostic computer, a prerequisite for sophisticated real time diagnostics. In this configuration, multiple diagnostic computers and stand-alone terminals can be supported by the system.

Hardware considerations

All data points between the transmitter and interface system should be optically coupled to ensure reliable data acquisition by isolating the monitoring points from the computer circuitry. A/D conversions for analog data can be performed in groups by microprocessors, with data held in buffers and readily available on command.

A CMOS-based data acquisition computer is ideal for such an application because of its low power requirements and high-RF immunity. All of the digital points can be read by the data acquisition computer and stored in a memory buffer, along with a time stamp. This system status *snapshot* is typically recorded in less than 1ms. With such detailed information, any failure—including a catastrophic one—can be recreated from the stored data. The computer takes care of all initial checks by comparing the current data with previous data. After an initial download of information, only the data that has changed is sent to the diagnostic computer.

Many state-of-the-art systems are

Figure 2. Bar-graph display with transmitter parameters out of tolerance. Red represents power out of range. Yellow represents a cautionary condition.

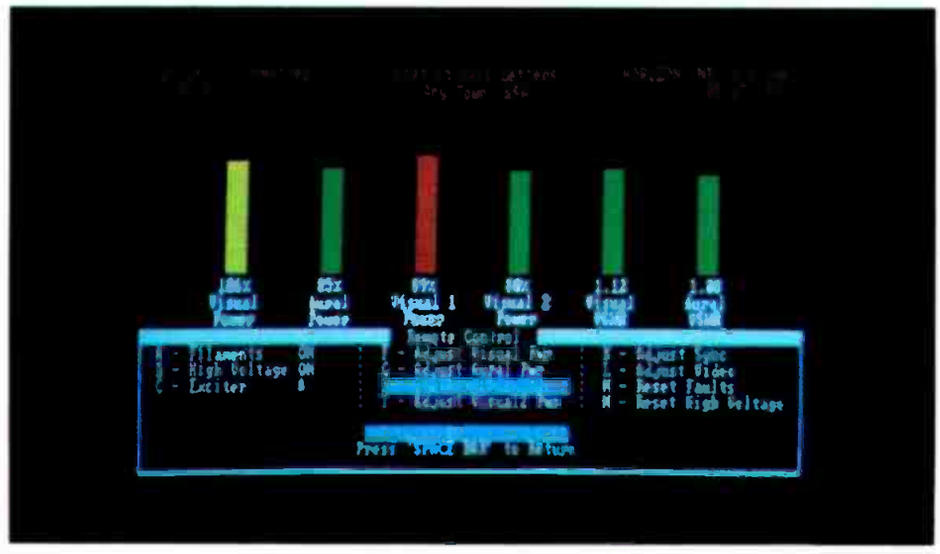

Figure 3. Bar-graph display with power out of limits and control options displayed in the lower part of the screen.

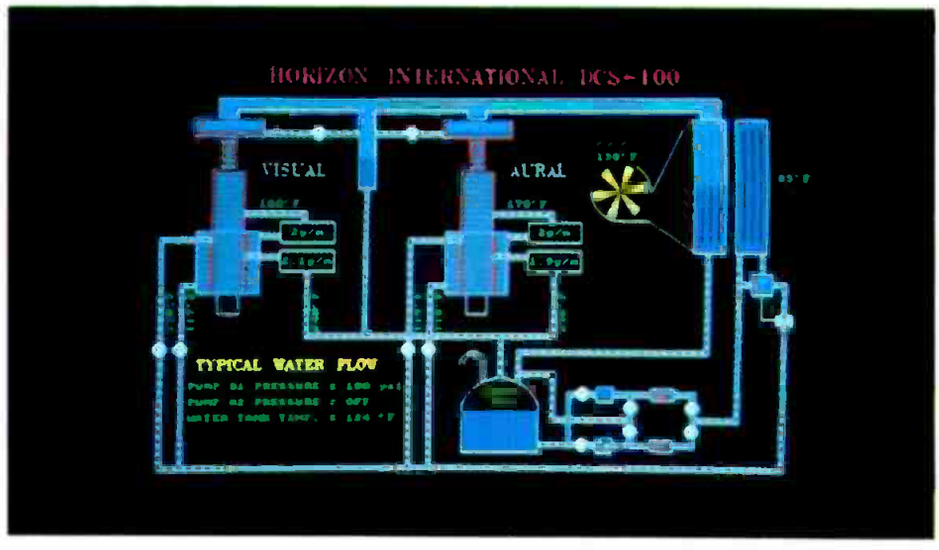

Figure 4. A cooling system diagram display for a typical UHF transmitter. Shown are the water flow, temperature and water levels.

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available to the user who is choosing a computer for graphics and diagnostic processing. The manufacturer's commitment to support, availability of parts and options and pricing are all important considerations in this choice. The options necessary to implement a diagnostic system should also be readily available off the shelf from various manufacturers.

Human interface

The diagnostic computer is the operator interface to an advanced transmitter-control system. In the typical installation, this computer is located at the transmitter (see Figure 1). If the transmitter is located at a remote site, a second computer is installed at the studio and tied to the data-gathering computer via an SCA channel or Telco line.

Under normal conditions, what data does the operator need to monitor and how should it be displayed? These important questions must be carefully addressed when designing a display format.

Most operators have many duties that do not allow them to sit in front of a display screen all the time. By using bar graphs, all vital transmitter information is displayed and can be checked by the operator with just a glance from across a room.

One method of displaying bar-graph readings is to scale each bar individually so that the nominal condition on all bars rests at the same level across the screen. As the value of a monitor point changes, the bar representing that point changes in height. The color of the graph can also be made to change from green, to yellow, to red at user-defined points to represent cautionary and danger levels. Individual bars of different height and/or color stand out when compared to the other bars that are operating within the nominal range. An example of this display is shown in Figure 2. This approach to status display is supported by aviation tests that prove such bar graphs have a high degree of instant intelligibility.

With one computer screen, it is impossible to display all monitored parameters of a typical broadcast transmitter simultaneously. A decision, therefore, must be made on which parameters to display and in what format. The bar graphs most likely would display power and VSWR status, but not necessarily. When asked the question, "What are the six most important parameters to monitor from the operator's standpoint?" everyone we talked to had a different preference. And here is where the flexibility of a software-based system comes into play. With the addition of a few more bytes of code, the bar-graph display can be made selectable. Each site can select the parameters best suited for its operation and its particular type of transmitter.

Although it is impossible to display all parameters at one time, the system must be capable of continuously monitoring all parameters and conditions. If the parameters and status conditions are blocked into groups, a similar bar-graph method can be implemented to represent the condition of a general area of the transmitter. This allows the status of a section of the transmitter, such as RF flow, cooling or control ladder, to be depicted in a status block on the same page as the bar graphs. The operator can

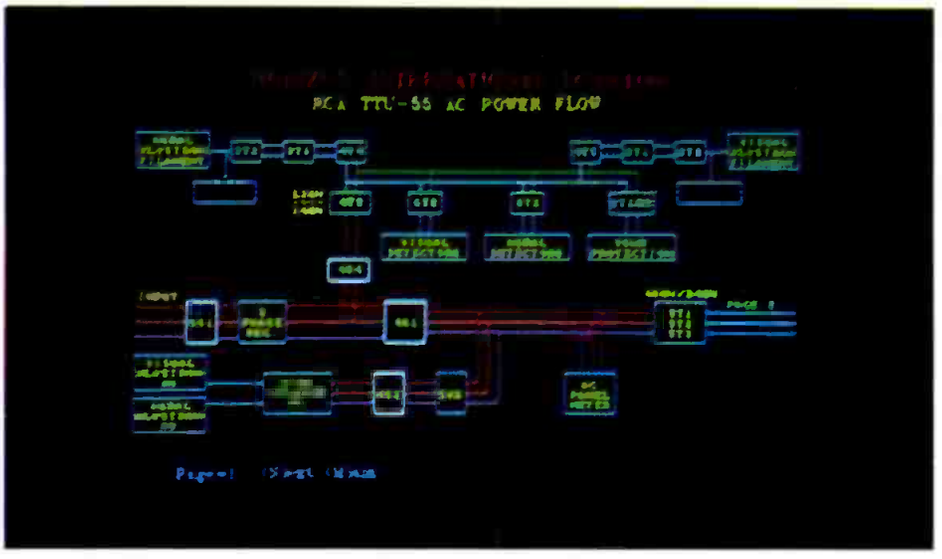

Figure 5. *CRT display showing the ac block diagram for the cooling system illustrated in Figure 4. Shown are switches, relays and interconnections.*

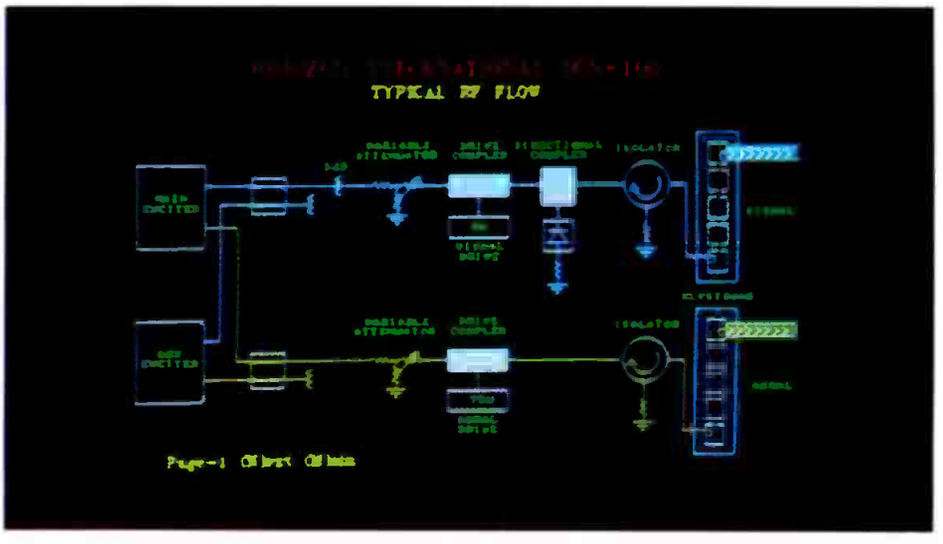

Figure 6. *CRT display showing primary monitoring points for the transmitter low-power RF path.*

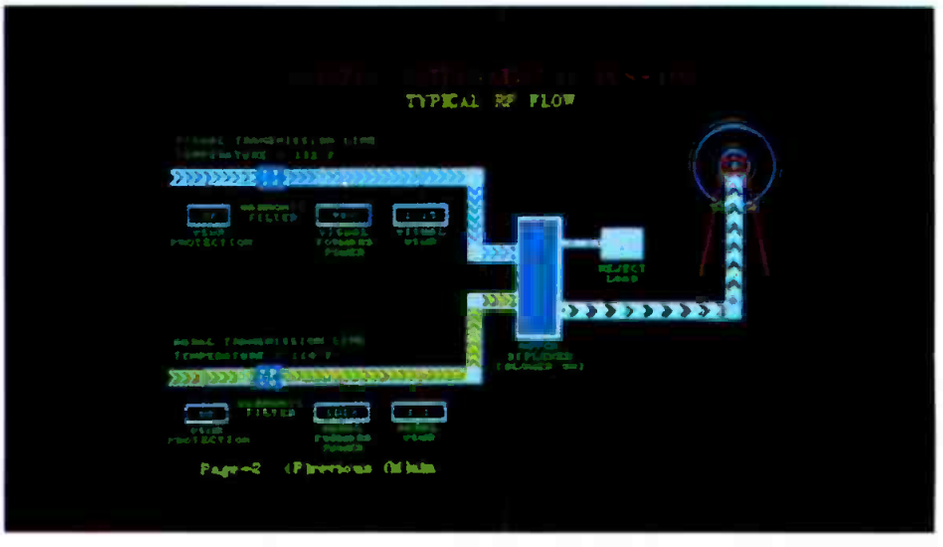

Figure 7. *CRT display showing primary monitoring points for the transmitter high-power RF path.*

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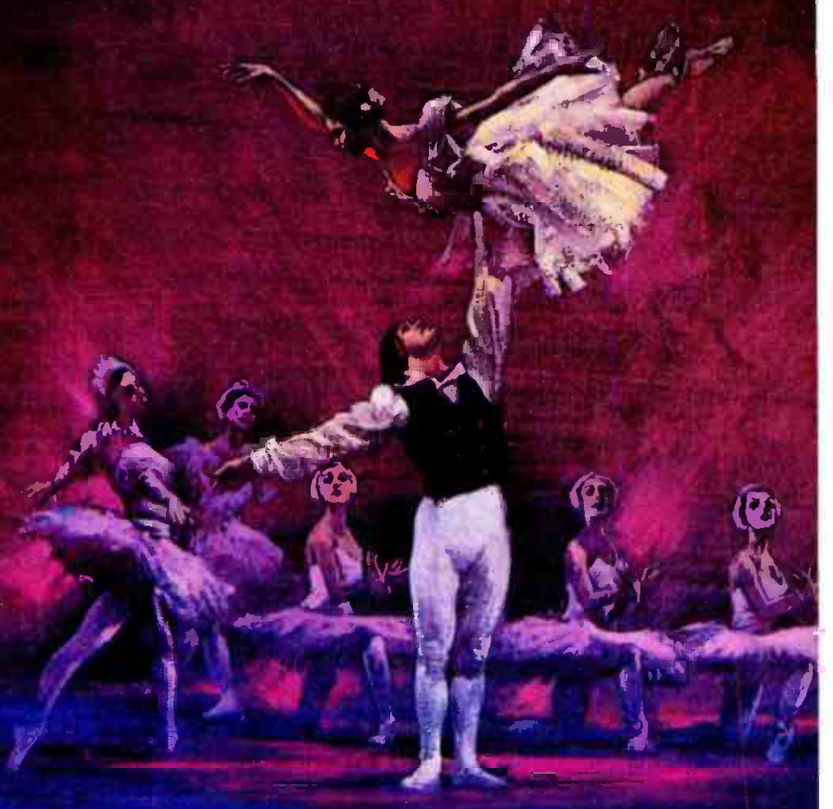

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see, at a glance, whether the transmitter is operating within specified conditions. (See Figure 3.)

If a problem occurs, the status box representing the particular group turns yellow or red, depending on the severity of the out-of-tolerance condition. This prompts the operator to the appropriate graphics screen for more detailed information. By using a graphic depiction of a part of the transmitter, the problem can be seen and understood more quickly.

If the transmitter indicates a fault in the water-cooling system, for example, the initial indication may point to a loss of water pressure. (See Figure 4.) The reasons for this failure could be numerous, but with the computer's diagnostic capabilities, the problem is quickly isolated to the loss of one phase of ac power to the water pump. The ac flow graphic diagram indicates which power phase was lost, at what point and when (see Figure 5). Examples of RF flow from the exciters to the antenna are shown in Figures 6 and 7.

Voice feedback capabilities can also be implemented in a diagnostic system. This enables the computer to telephone authorized personnel with a report on the status or condition of the transmitter. With a security code, authorized personnel can initiate a call from a touch-tone phone and inquire about the system status. This adds significant flexibility to the diagnostic control computer.

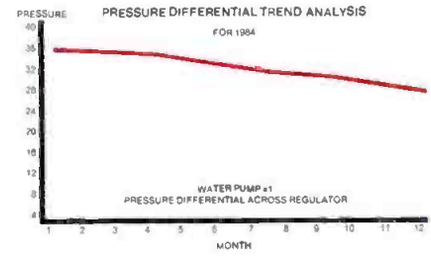

Figure 8. A trend analysis graph display of differential water pump pressure over a period of one year.

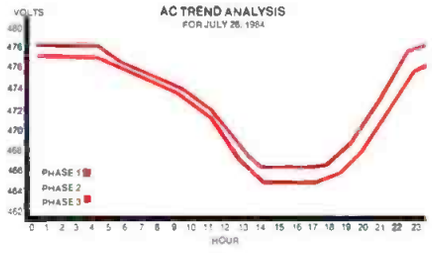

Figure 9. A trend analysis graph display showing 3-phase power fluctuations over a 24-hour period.

An MPU-based diagnostic system allows a number of transmitters to be monitored and controlled from one central location. This feature is convenient for group-owned stations that have a centralized technical support center or use outside engineering services on a regular basis.

Improved efficiency

Sophisticated capabilities can and will save time for the maintenance engineer, as well as assist the operator in times of trouble. Such systems also allow the qualified engineer or technician to troubleshoot a transmitter without having extensive RF experience or training with the particular make and model.

MPU-based transmission systems offer intelligent control capabilities that ensure that an improper sequence of events cannot be executed. This prevents an inexperienced operator from inadvertently causing damage to the transmitter.

With trend analysis, equipment performance can be recorded and repair or replacement can be initiated before a failure occurs. Two examples of trend analysis are shown in Figures 8 and 9.

The cost of major transmitter components are high now and are likely to become even more expensive. The value of on-air time is also climbing at an ever-increasing rate. The difficulty of recruiting, training and keeping competent RF and transmitter engineers is well-known in our industry, and more and more stations are staying on the air for longer hours. It is time for our industry to address these problems. One approach is to give the broadcast professional the diagnostic control tools that have been available in other industries for many years and, perhaps, elevate the state-of-the-art even more.

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Understanding MTS equivalent mode

By Eric Small

To properly adjust a TV transmission system for stereo operation, you need to know what equivalent mode is, and how it should be used.

Stereo sound is bringing an exciting new dimension to the TV industry. It is also providing TV engineers with a new bowl of alphabet soup to be digested—BTSC, OST-60, MTS, SAP, pro—and a new set of parameters that need to be measured and understood. Probably the most confusing new term is *equivalent mode*, sometimes called *equivalent 75μs mode*. To gain an understanding of equivalent mode, examine the block diagram of the Broadcast Television Standards Committee (BTSC) encode/decode system shown in Figures 1 and 2.

MTS vs. FM

What sets multichannel television sound (MTS) apart from conventional FM broadcast stereo is the BTSC (dbx) noise-reduction encode/decode circuit in the L−R channel. It is this noise-reduction system that makes possible buzz-free stereo operation with intercarrier sound detection. Unfortunately, the presence of a compressor and expander in the L−R channel that is not duplicated in the L+R channel creates a host of test and measurement problems that do not exist in conventional FM stereo.

FM stereo broadcasting is much simpler than MTS because the FM system is linear throughout. The BTSC encoder and decoder each add a phase shift (time delay) to the L−R signal that must be compensated in the L+R channel to maintain stereo separation. This delay compensation can be tricky, because some implementations of the encode/decode circuits produce a delay that is gain-dependent.

Another challenge is maintaining the absolute accuracy of the encoder/decoder parameters, both static and dynamic. The compression and expansion ratios are 3:1 and 1:3, respectively, at high frequencies and 2:1 and 1:2 at low frequencies. An error of 1dB in the encoded channel will result in an error of 3dB in the final output. The total allowable error budget—input to output—on the L−R channel is ±0.1744dB for 40dB of stereo separation and ±0.550dB for 30dB of separation. It is easy to see why professional encoders and decoders use 0.1% tolerance components.

Level-setting accuracy is one more area of major concern. For the encoder and decoder to track one another correctly, they must have a common reference. That common reference is the absolute deviation of the transmitter. A review of the setup procedure for an actual stereo generator will help clarify this point.

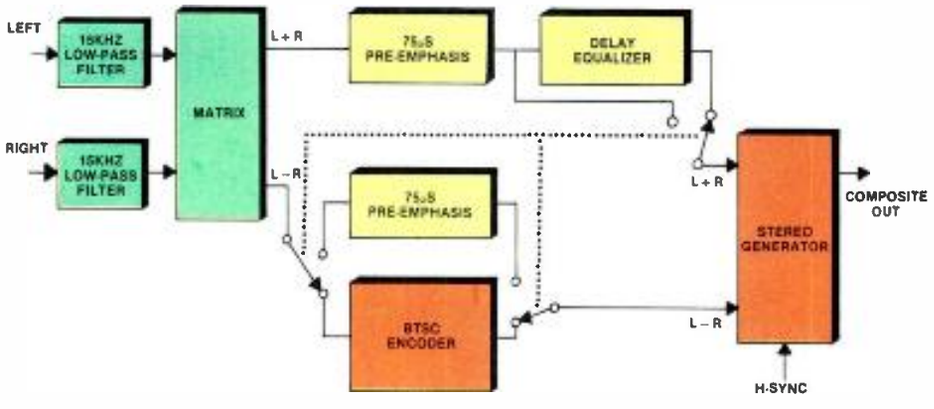

Figure 1. An MTS stereo generator switched to the BTSC mode (the normal operating mode).

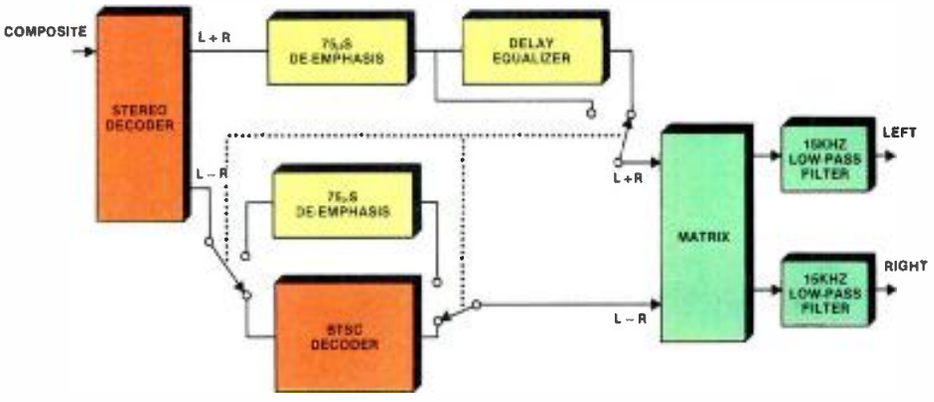

Figure 2. An MTS stereo decoder switched to the BTSC mode.

Small is vice president for engineering at Modulation Sciences, Brooklyn, NY.

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Setup

The generator is placed in a test mode and a 10,396Hz signal is fed to it at the generator's exact 25kHz deviation reference level. This odd frequency is the first Bessel null frequency for 25kHz deviation. At this modulating frequency, the aural carrier will disappear at exactly 25kHz deviation. The accuracy of the level setting achieved with this procedure is excellent, amounting to an error of plus or minus only a few hundredths of a percent of modulation. (The major limiting factor is the harmonic content of the 10,396Hz test signal.) The stereo generator must have a precise level-indicating circuit (accuracy ±0.03dB) to allow setting the 10,396Hz tone to the exact 25kHz deviation reference of the BTSC encoder.

The calibration procedure is to first adjust the level of the 10,396Hz signal until the stereo generator shows 25kHz deviation reference level, and then adjust the modulation of the aural transmitter until the carrier nulls out. Accuracy counts: a 1% error in either the generator reference level or transmitter modulation sensitivity would limit the maximum stereo separation to about 40dB. A 3% error would limit it to less than 30dB.

In discussing MTS broadcasting, we must use the term *100% modulation* with caution. In traditional monaural TV sound, 100% modulation means 25kHz deviation. With stereo, the pilot is deviated 5kHz, L+R (mono) is deviated 25kHz and the L−R subchannel up to 50kHz. However, the maximum total deviation for stereo operation is 55kHz, because the L+R and L−R subchannels are expected to interleave. If a separate audio program (SAP) channel is used, it may deviate 15kHz. And if the professional (pro) channel is used, it is allowed 3kHz of deviation.

The maximum deviation of a TV aural transmitter is set at 75kHz by the FCC in a new revision of rule 73.682. So what is 100% modulation? Is it 25kHz, 55kHz, 70kHz, 73kHz or 75kHz deviation? With much wisdom, the BTSC did not try to define 100% modulation, and generally refers simply to *deviation*. In the few instances in which BTSC does refer to percentage modulation, it is usually in connection with the L+R (main) channel. For example, 50% modulation of the L+R channel means a deviation of 12.5kHz. The 100% reference is the maximum allowable deviation of L+R channel, 25kHz.

While we're on the subject of modulation, it is important to remember that because the BTSC encode/decode system is non-linear, its performance may vary significantly with L−R modulation. BTSC specifies the separation of the system at 10% L+R modulation resulting from modulating one channel, left or right. This is a reasonable mean value. However, typical broadcast audio can have an electronic dynamic range (the range between the noise floor and the clipping point) of up to 78dB for digital source material. If the noise-reduction encoder does not track over this range of input levels, separation will suffer. (See Figure 3.) To best verify on-air performance, a family of separation plots must be run at 10dB below 10% (3.2%). 10% and 10dB above 10% modulation (32%).

We can now better understand why MTS stereo system performance depends almost entirely on the performance of the noise-reduction encode/decode system. But where does this leave adjustment and calibration of the rest of the MTS stereo system? If the BTSC separation does not come up to specs, why not? Is it the stereo generator alignment, an exciter problem or just the BTSC encoder/decoder out of alignment by a fraction of a decibel?

Equivalent mode

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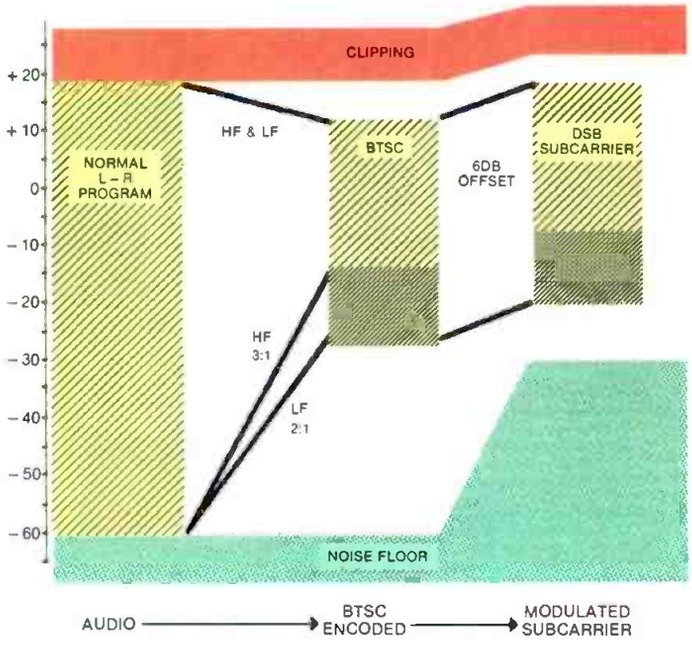
code/decode circuits from everything else in the system, the BTSC made provisions to remove the encoder/decoder from the system and to replace them with precision 75μs pre-emphasis/de-emphasis networks, identical to those in the L+R channel. When the BTSC noise-reduction system is removed from the stereo encoder/decoder, the need for absolute level tracking is also removed. Thus, equivalent mode does not demand precise level calibration to produce valid separation data. The system is now linear and nearly identical to a conventional stereo FM system. This allows for precise alignment of the transmission chain and is especially useful for measuring the effects of major system components, such as the aural/visual diplexer, on stereo separation. All crosstalk and noise measurements are made in the equivalent mode, and except for BTSC mode stereo separation and harmonic distortion, all measurements specified in the FCC's OST-60 report are made in the equivalent mode.

The BTSC mode measurements are, of course, important too. They determine how the system will actually operate in the real world. They are, however, dif-



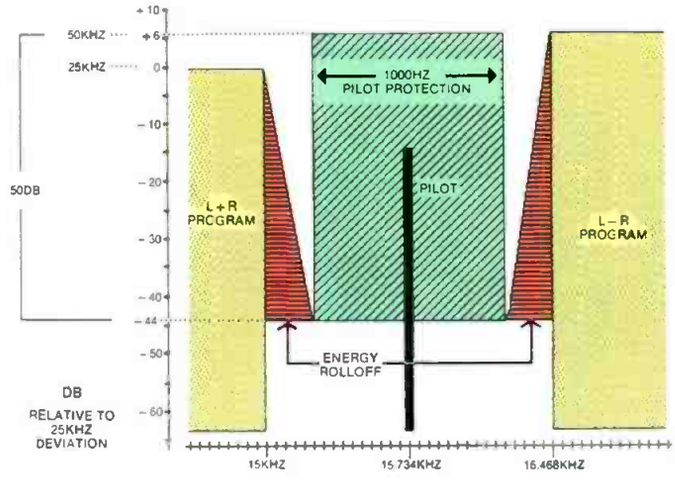


Figure 4. *Above, the MTS pilot frequency protection requirements. Note the steep rolloff above 15kHz.*

Figure 3. *At left, the gain structure of the L – R BTSC encoding system. Note that the high-frequency compression ratio is 3:1 and the low-frequency compression ratio is 2:1.*

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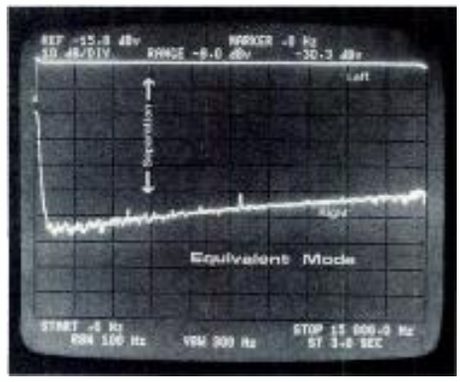
ficult measurements to make accurately and they demand that the rest of the transmission chain be adjusted to near perfection. Such performance can only be achieved with the equivalent mode.

Performance

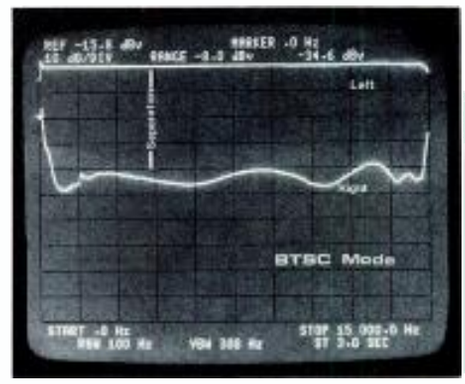
Most of the specifications for a stereo generator or professional decoder will be in the equivalent mode. In such back-to-back tests, separation of 55dB or greater should be achieved, aiming for through-the-transmitter performance of greater than 40dB across the audio range of 50Hz to 14kHz. The measured BTSC separation should be greater than 40dB, with expected system performance of 35dB at all normal modulating levels. The photos above show equivalent and BTSC mode respectively. These measurements were made with pre-emphasis on and low-frequency modulation set at 10%.

It's interesting to note that although the frequency response of the BTSC system is specified to 15kHz, separation is specified only to 14kHz. This is because audio filters have to be designed and built by mortals. With the pilot at 15,734Hz and protection specified at ±500Hz, the L+R pilot protection area begins at 15,234Hz. This leaves only 234Hz between the program and pilot protection areas. (See Figure 4, page 56, for a graphic representation.)



Typical separation performance of a stereo generator switched to the equivalent mode of operation. Separation exceeds 50dB across the audio band (50Hz to 14kHz). The equipment used in this test: a Modulation Sciences TSG stereo generator and SRD-1 stereo decoder and a Hewlett-Packard 3585A low frequency spectrum analyzer/tracking generator.

When we add the requirement that the filters must be a matched pair with phase tracking to 1°, the result is a filter that can be realized only with advanced digital technology. To create a filter that can be built with analog components, the phase-tracking specification was relaxed by the BTSC to require near-perfect tracking to 14kHz, instead of 15kHz. The frequency response remains good to 15kHz, only the separation is relaxed in the "last kilohertz."



Typical stereo separation performance of a generator switched to the BTSC mode of operation. Minimum separation is approximately 40dB from 50Hz to 14kHz. (See photo at left for a test equipment list.)

Examine the specs

Both equivalent mode and BTSC mode performance data play a vital role in specifying MTS stereo. BTSC separation should be used to evaluate the stereo generator, because the BTSC encoder is clearly the hardest element to make work. However, when evaluating the rest of the transmission system—the exciter, transmitter, diplexer and other elements—equivalent mode separation is the parameter of choice. This mode will readily show any transmission system degradation. Be certain to differentiate between these two modes whenever you are evaluating a manufacturer's equipment performance claims.

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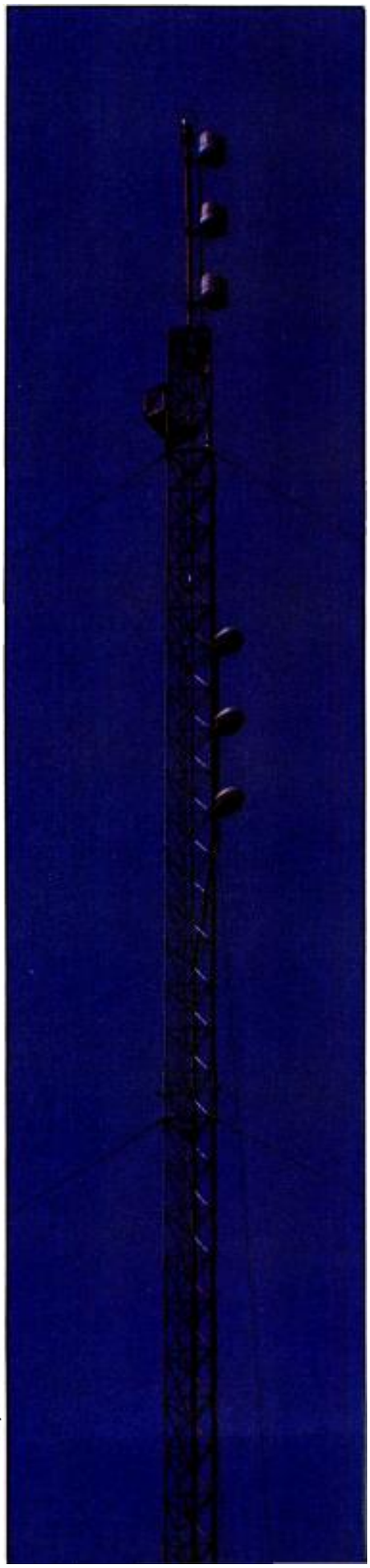


Photo by D. W. Fearn

By Douglas W. Fearn

A customized transmitting antenna can improve your FM signal where it really counts.

Soon after WKSZ made its debut in November 1982, we became aware of signal-strength problems in certain directions. What we learned in the process of improving our signal may benefit other stations experiencing similar difficulties.

WKSZ is a Class B FM facility licensed to Media, PA, a suburb of Philadelphia. Our license requires the use of a directional antenna. We are required to protect a co-channel station in Washington, DC, 110 miles southwest of our transmitter site. We also wanted to maximize our signal over the Philadelphia metropolitan area, 14 miles from the transmitter. (See Figure 1.)

Signal problems

Within days we began to receive reports of signal problems, primarily to the northeast. Station personnel confirmed these reports by driving through the affected areas. Terrain profiles were checked, but nothing was found to explain the problems.

We then asked our consulting engineers to provide us with field-strength measurements at 12- and 25-mile distances from the transmitter on radials from 0° to 150°. These measurements indicated the signal was about 10dB below the predicted strength on bearings between 40° and 140°. It is likely that similar deficiencies existed in other, less populated areas, but because we received few complaints from them, they were not measured.

Our 3-bay, circularly polarized antenna was pole-mounted with the bottom bay near the tower top plate. This proximity was suspected as being a major cause of the trouble.

The 3-bay WKSZ directional antenna installed atop its 500-foot transmitting tower. The 3-bay antenna mounted below is a standby unit.

Fearn is chief engineer, WKSZ-FM, Media, PA.

Directional FM antennas

FM antennas do not usually exhibit the omnidirectional radiation predicted in theory because, in the real world, there is often a significant amount of steel of unpredictable configuration within the antenna aperture. This can cause anomalies in the antenna's radiating pattern.

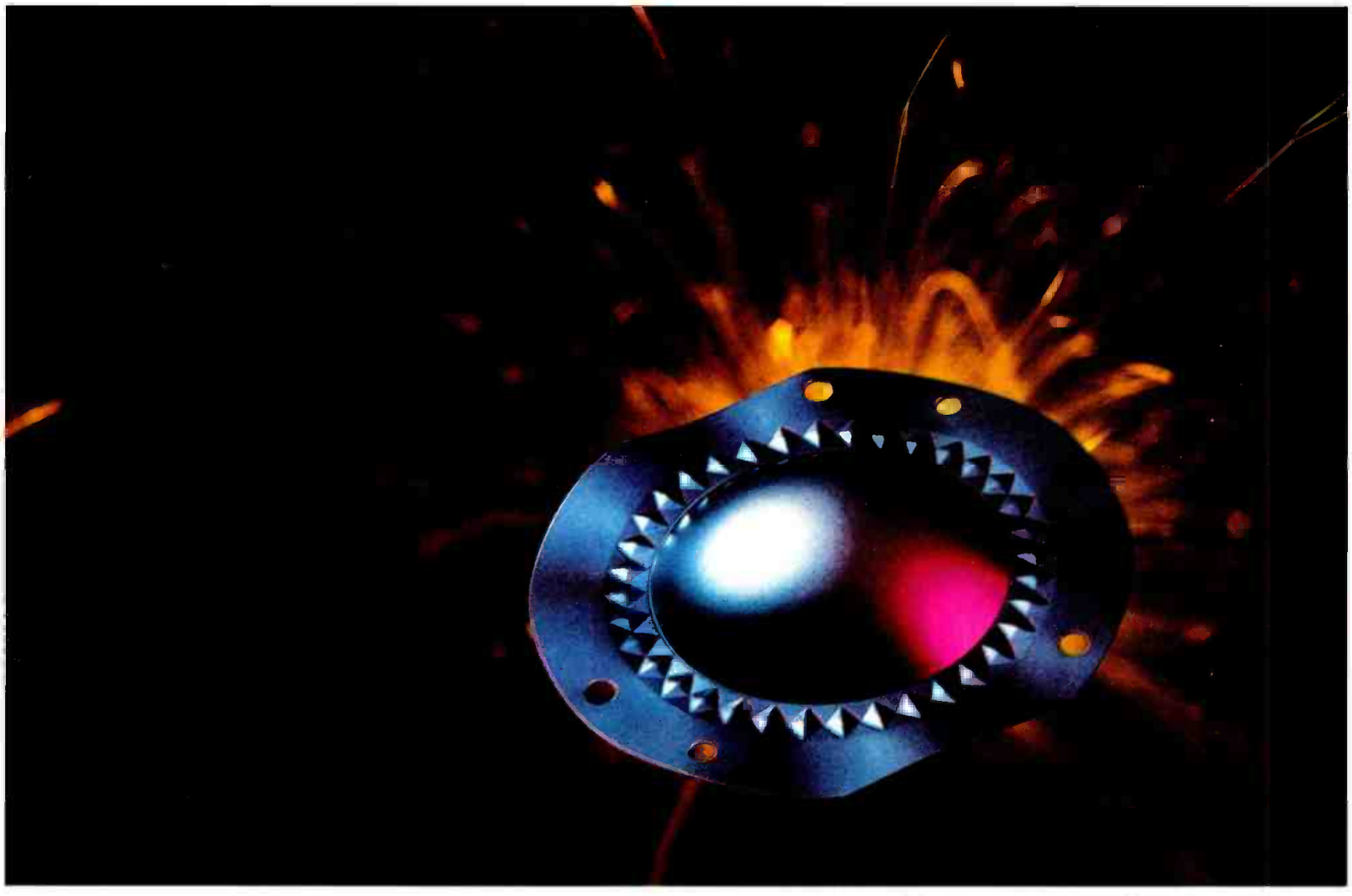
Sometimes, however, the pattern may be made non-circular intentionally. This might be done to obtain the required pattern in the case of a directional station. If it is made non-circular to provide more signal in a particular direction, this is sometimes called *pattern optimization.* It allows a station to concentrate radiation in certain directions, providing more signal in heavily populated areas and less signal where there are few listeners. (There are FCC limitations on the amount that the pattern can deviate from omnidirectional.)

The radiation pattern of an FM antenna can be modified by adding parasitic elements, either horizontal, vertical or both. If a truly omnidirectional pattern is desired, an antenna usually can be designed to compensate for the effects of the support structure.

In our case, we needed an antenna incorporating the required directionality to fulfill our protection requirements, while also providing more signal in a specific area.

Unlike AM directional stations, FM directional operations are not required to make periodic field-strength measurements to prove that the radiation pattern is correct. Instead, it is necessary only to measure the pattern of the proposed antenna on a test range. The results of these measurements must be submitted to the FCC as part of the license application. These measurements are usually performed by a consultant or by the antenna manufacturer. Directional FM antennas have proved to be quite stable.

It is fortunate that field measurements are not necessary, because the required equipment and procedures are much



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more complicated than those used for AM field-strength measurements.

Measuring the pattern

One way to measure a pattern is to construct a full-sized antenna with all the bays, and install it on an antenna test range. The antenna is then connected to a receiver with an accurate method of measuring signal strength. A horizontal or vertical dipole antenna, placed some distance away, is fed from a low-power transmitter on the antenna's operating frequency. The test antenna is rotated and the received signal strength is plotted. The transmitting antenna is then switched in polarization, and the measurements repeated. Alternatively, the test antenna can be used as a transmit antenna, with the dipole connected to a receiver.

A second method relies on the assumption that a multibay antenna will have a radiation pattern essentially identical to that of a single-bay version of the same antenna. (Obviously, the vertical angle of radiation will differ, but that is not important in this case.) Only a single bay is measured, regardless of the size of the final antenna.

Full-sized FM antennas are rather large and must be supported well above the ground and away from other objects. These factors make it difficult to measure multiple bays. Neither of the measurement methods discussed usually takes into account all the effects of the mounting structure (pole or tower), because duplicating the supporting structure is impractical in many cases.

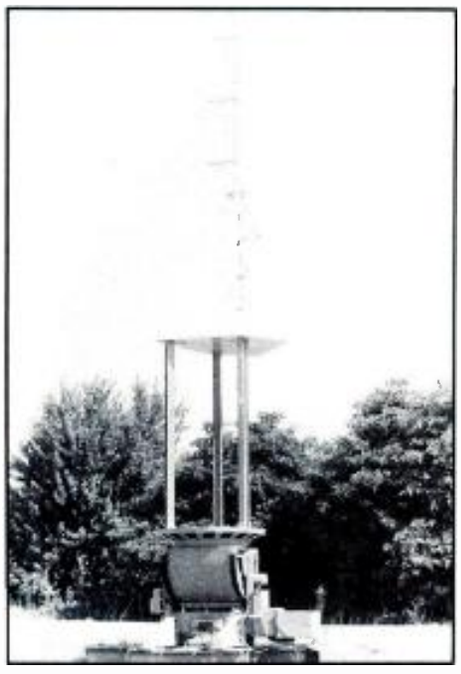
A third method of antenna testing, which allows practical measurements of all the bays as mounted on the tower, uses a scale model of the antenna and a portion of the supporting structure. Typically one-fourth of the actual antenna size, this model is fed with an RF signal four times higher than the intended operating frequency.

The model approach may use a single bay, all the bays or strike a compromise, often using three bays for large antennas. The accuracy of this testing method has been proved by test-range measurements on corresponding full-sized antennas, and actual field-intensity measurements on installed antennas. Terrain and local influences can, of course, affect the actual measured pattern, but the model method appears to offer a reasonable, cost-effective prediction of coverage.

When an antenna is made directional for the purpose of protecting another station, technically (according to FCC regulations), only the horizontal component is required to be attenuated. However, it is often stipulated that the vertical component must not exceed the horizontal in any given direction. The specific requirements are spelled out in the station's construction permit.

Opting for the model method

After investigating the various methods, we decided to use the model approach to design a replacement antenna. Two factors influenced our decision. First, the WKSZ antenna is pole-mounted atop a 500-foot tower. The pole is only 27 feet long, somewhat short for the 3-bay antenna we planned. By necessity, the bottom bay is quite close to the tower top—less than one-half wavelength. Secondly, the tower has a large face dimension, of 4 feet, which also happens to be about one-half wavelength. We suspected that the tower was having an influence on the pattern, and we wanted confirmation that a new antenna would perform as required. We wanted measurements to be made with all three bays, and to fully account for the tower and pole influences.



The antenna model in place for measurement. The bottom section of the support is fiber glass. The model tower and pole are mounted above. The climbing cage can be seen on the right side of the tower.

A number of companies are equipped to make the measurements we needed. We chose one located nearby so that we could participate in the development process. The actual antenna was fabricated elsewhere.

From the tower blueprints (which indicated accurate azimuth bearings), the pattern-study contractor built an aluminum scale model of the top 25 feet of the tower and the entire antenna pole, as shown in the photo above. This detailed model included all cross members, the climbing ladder, feedlines and the climbing cage mounted on the side of the tower at the top. (This cage allows a climber to go safely from the inside ladder to the outside climbing rungs on the antenna pole.) All three bays of the proposed antenna were modeled at the same scale of 4:1. The antenna elements were constructed of brass.

The actual antenna pole was fitted with steel climbing rungs, but these were not modeled. The test-range engineer concluded that their effect was negligible, as proved by various tests made in the past.

Antennas mounted on tower legs or faces may have guy wires, passing within a few wavelengths, that can affect the radiation pattern. It is advisable to either move the antenna up or down on the tower to distance it from the guys, or to use non-conductive guy wires in the vicinity of the antenna. This was not a problem in our case because the nearest guy wire was many wavelengths away.

The measuring process

Because most of the WKSZ audience is in a direction ranging from due north to due south of the transmitter site, with the greatest population situated on a line due east, we felt that the pattern shown in Figure 1 would give us the coverage we wanted. This pattern still would provide the necessary protection to the southwest, while not compromising coverage of the city of license.

In our pattern study, the model antenna was used as a receive antenna. The transmit antennas were cavity-backed dipoles—one horizontal and one vertical—that were fed low-power RF at four times the station's operating frequency (about 400MHz). The transmit antennas were located approximately 60 feet from the model antenna, or about 25 wavelengths. To prevent ground reflections from affecting the measurements, RF absorbers were placed on the ground between the two antennas. Figure 2 shows the test range with the model antenna in position for measurement.

The tower section and antenna were mounted on a fiber-glass support structure about 20 feet high that rested on a rotating platform. The entire assembly could be tilted 90° so that work could be performed on the antenna from the ground. The platform was rotated by servo motors that were controlled from an equipment shack about 50 feet away.

To make a pattern measurement, the model tower and antenna were turned and the resulting radiation pattern was drawn by a polar plotter synchronized with the rotation. The polarization of the transmit antenna was then switched, and a second plot of the antenna was made.

Initial measurements showed the interaction of the antenna and the support structure. In our case, the support pole had a significant effect on the vertical component. When the bays were appropriately oriented in azimuth (with the antenna boom pointing east), the natural pattern was similar to the desired pattern. The horizontal component was not affected in the same way, however. The tower corners had a significant effect on

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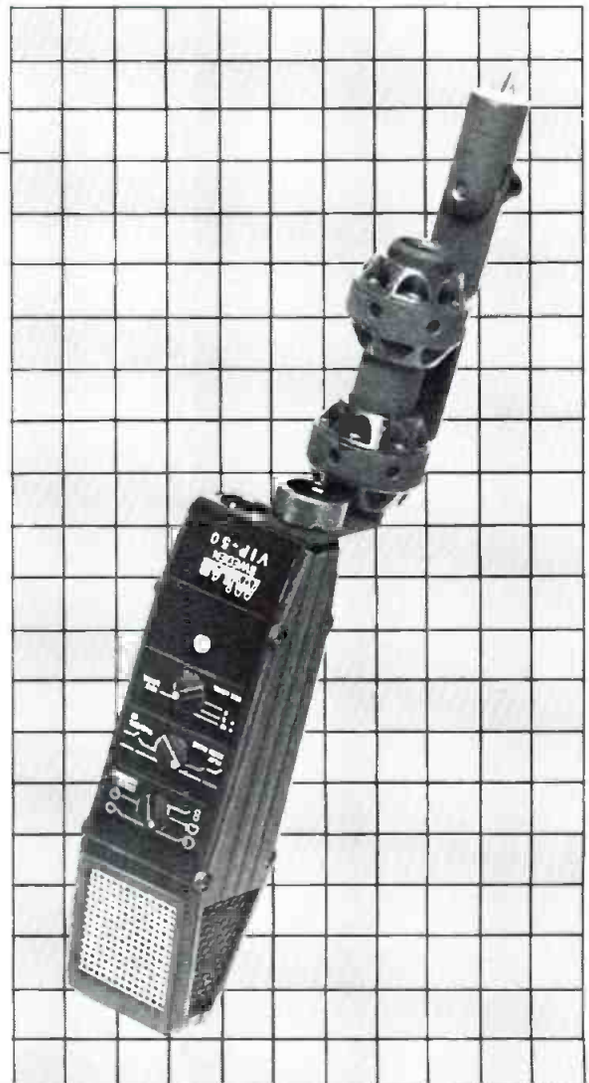

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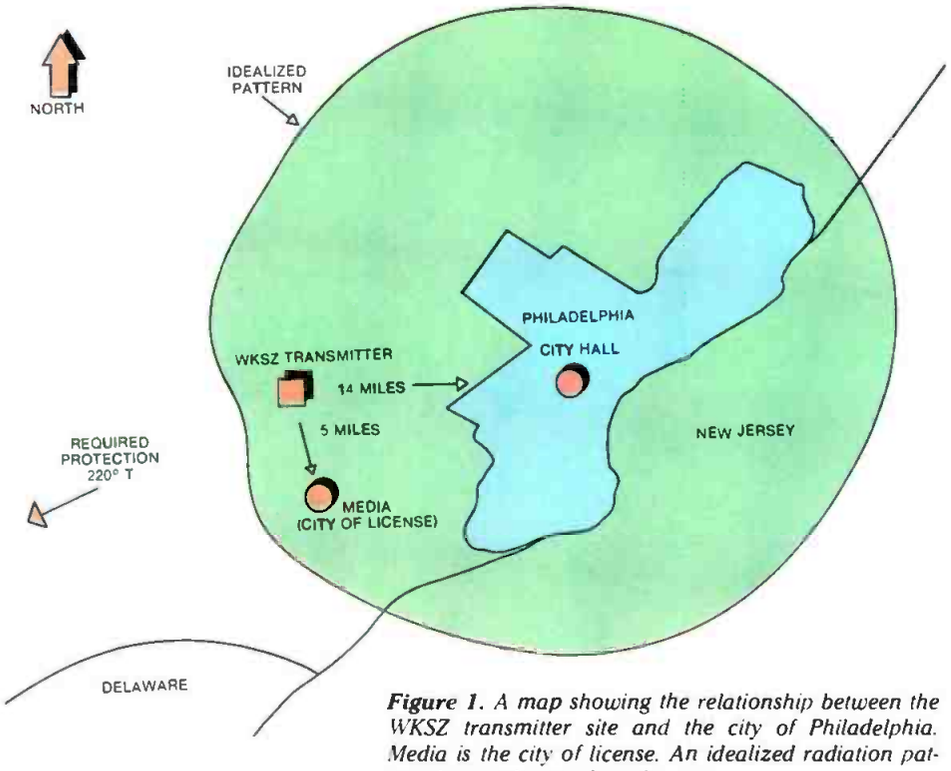


Figure 1. *A map showing the relationship between the WKSZ transmitter site and the city of Philadelphia. Media is the city of license. An idealized radiation pattern is superimposed on the map.*

pattern was obtained rather quickly, in about three working days. Our antenna required only one horizontal parasitic per bay. The support pole provided the necessary vertical-pattern modification.

Antenna impedance adjustment

Generally, it is not possible to predict the impedance of the full-sized antenna from the model antenna. The small size of the model elements and the higher frequency involved make impedance measurements unreliable. It is, therefore, necessary to construct a full-sized antenna to determine the impedance.

For our antenna, a full-sized single bay was first adjusted to the dimensions determined in the model-pattern study. The parasitic element was cut to size and mounted in proper relation to the bay. The impedance measurements were made on an elevated wooden platform located away from buildings, wires and fences to minimize external effects on the antenna.

The bay was mounted on a fiber-glass pole, as shown in the photo below. An

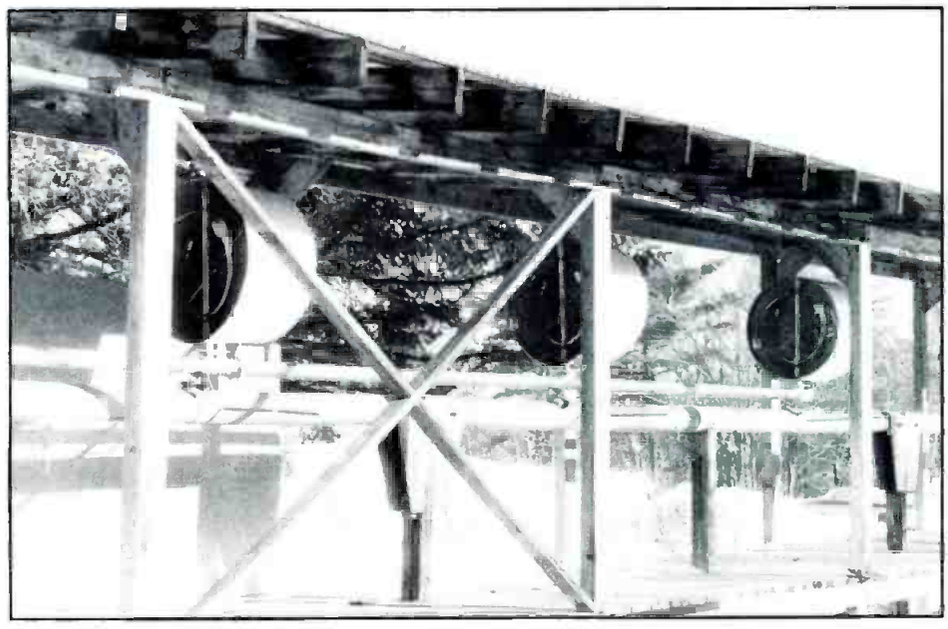
Continued on page 68

the horizontal pattern, and the climbing cage introduced asymmetry. The natural horizontal pattern was roughly omnidirectional, with nulls of a few decibels in the direction of the three tower legs, and a significant reduction in the direction of the climbing cage. (See Figure 3.)

In some cases, when proofing an antenna, it is advisable to measure individual bays to gauge the influence of the mounting structure on each bay. We felt it was important for us to make individual bay measurements because the bottom bay was so close to the tower top. It was obvious, from the measurements on the bottom bay, that it was affected by the tower far more than the other two bays were.

In order to modify the horizontal pattern, horizontal parasitic elements were mounted between each antenna bay and the support pole. The length of each element and its distance from the bay affected the pattern and changed the impedance of the antenna as well. Parasitic elements are typically about one-half wavelength, or 4 to 6 feet long on the full-sized antenna.

A variety of parasitic-element lengths and spacings were tried until the pattern was as specified. In our case, the desired



The photo above shows the full-sized antenna mounted on the test bench for impedance determination.

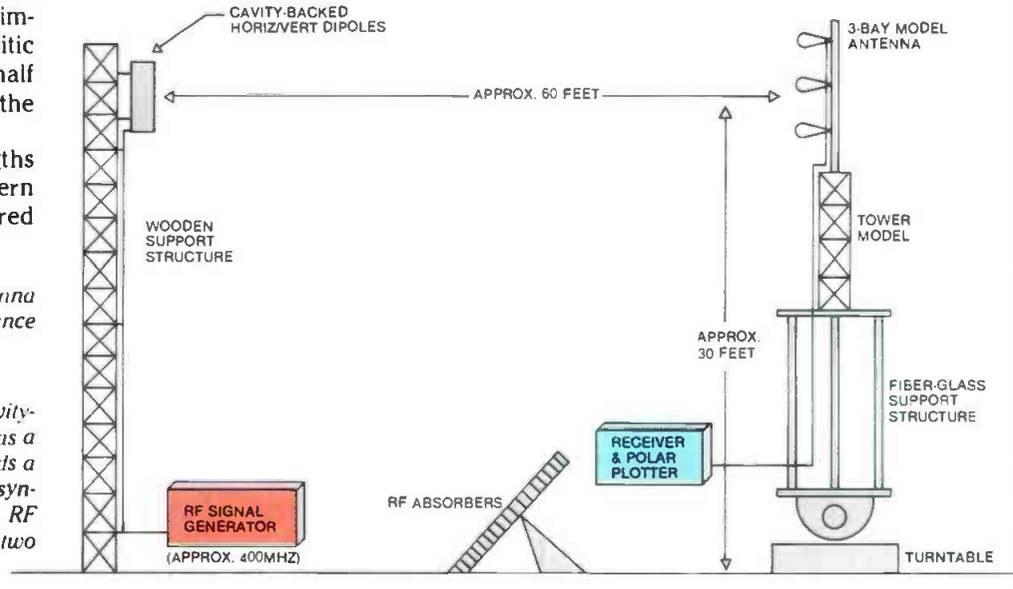


Figure 2. *The test-range setup. The cavity-backed dipole antenna on the left is used as a transmit antenna. The model antenna feeds a receiver and polar-chart recorder that is synchronized to the rotation of the turntable. RF absorption material is used between the two antennas to eliminate ground reflections.*

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☐ technical/engineering ☐ I approve console purchases.
☐ producer/user

Please check the description that applies to your studio:
☐ television broadcasting ☐ jingles/commercials
☐ video production ☐ film
☐ video post production ☐ multitrack recording

Audio Operations Personnel:
☐ all staff ☐ all freelance
☐ staff & freelance

Number of console inputs required:
mono (mic/line) _____ stereo (line) _____

Number of console outputs required:
stereo _____ mono _____ AUX/FB/cue _____
multitrack (TKS) _____

Console Operation Format:
☐ mono ☐ stereo ☐ multitrack
☐ all of above

Need Automation? ☐ Yes ☐ No

Current Mixing Console(s) (please list): _____

Please Check:
☐ Yes, I wish to buy a new mixing console. When? _____
☐ Yes, I would like a free analysis about my studio's console needs.
☐ Send info for file only.

My Budget for a New Mixing Console is Approximately:
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☐ $50,000–75,000 ☐ $150,000+

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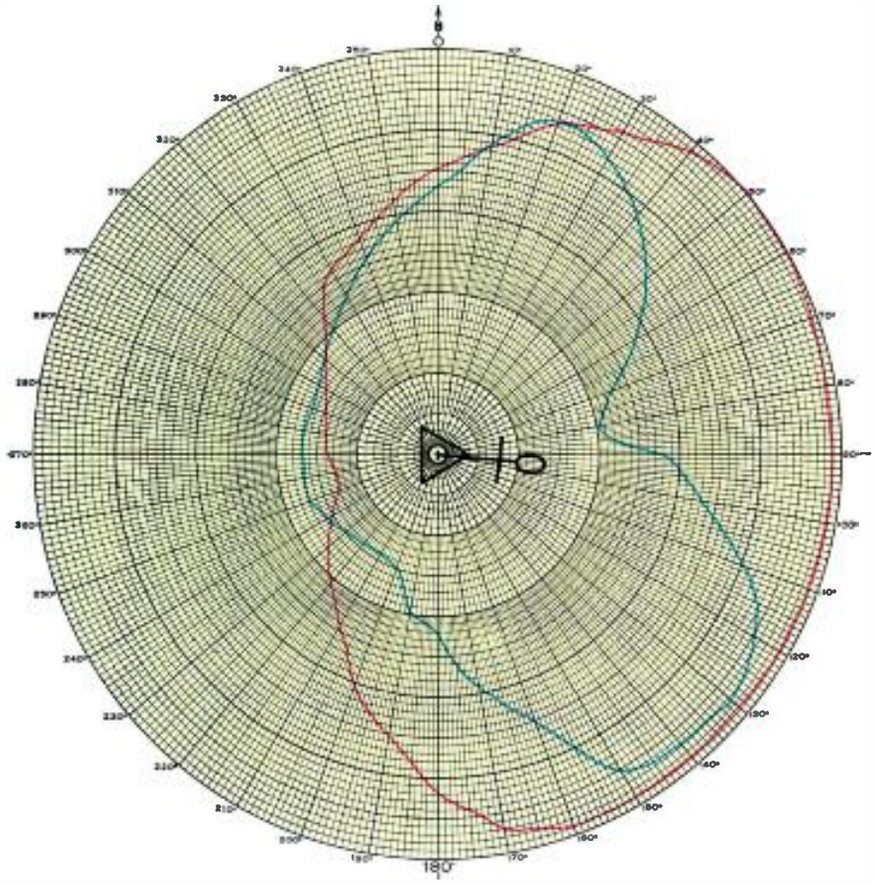

Figure 3. *The unmodified radiation pattern of the 3-bay antenna, pole-mounted, as shown in the photo on page 62. The tower and antenna are shown schematically in the center. The vertical pattern is shown by the red line, and the horizontal pattern by the blue line.*

Continued from page 64

impedance plotter, connected between the antenna and the signal generator, provided an X-Y output for an oscilloscope, which displayed impedance vs. frequency in a Smith chart format. An exact impedance match was made by varying the diameter of a short section of the inner conductor of the transmission line. (This line is a permanent part of the antenna.)

If the impedance falls outside a range that can be reasonably matched, it is necessary to go back to the model-test range and try a different configuration of the model antenna. The element-feed point, the pitch of the helix and the length and positions of the parasitic elements can all be varied.

In our case, it took three attempts before both the impedance and the pattern were within limits. The ability of the antenna engineers to anticipate various interactions is vital to efficient design work.

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Construction and testing

It was critical that the physical dimensions of the model antenna were accurately measured, because any error would have been multiplied four times in the final antenna. The antenna was constructed from stainless steel. The large knobs on the element ends, as seen in the photo of the full-sized antenna, were designed to prevent corona discharge inside the fiber-glass radomes.

All three bays, with the parasitic elements, interbay feedlines and supporting hardware, were assembled on the same outdoor wooden test bench that was used to determine the antenna impedance. The actual impedance of the entire antenna was determined, and appropriate matching sections were inserted to provide the best match in a simulated free-space environment. In this step, the antenna again was mounted on a fiber-glass pole. To compensate for the anticipated impedance change that would occur when the antenna was mounted on the steel pole, an adjustable transformer was used between the feedline and the antenna input. The final antenna pattern is shown in Figure 4.

A surveyor was hired to help properly orient the antenna in azimuth. For directional FM stations, a surveyor's affidavit is a necessary exhibit in the application for license. In the case of a pattern optimization, it ensures that the antenna will perform as planned.

The surveyor placed a large orange marker on the ground about 600 feet from the tower in the proper direction. The riggers used this marker for rough aiming, and a transit set at the marker was used to make final adjustments. After installation, the antenna was again checked by the surveyor for his affidavit.

The overall gain of a directional FM antenna is considered to be the gain at the point of maximum radiation. In our case, the gain was 2.48, as opposed to the usual 1.5 for a 3-bay circularly polarized antenna.

We switched over to the new antenna with no problems. The non-adjusted VSWR was under 1.1:1. Trimming of the matching transformer brought the VSWR down to well below 1.1:1.

The total time, from the beginning of the pattern study until final installation, was about five months. Because several time-consuming steps must be performed outdoors, weather can be a major factor in the length of such a project.

Performance

We incorporated several changes with the new installation: the actual type of antenna, the bearing and, of course, the parasitic elements. It is, therefore, difficult to determine the effects attributable to each variable. Although superficially similar to the old antenna, which also had a single horizontal parasitic element per bay, the performance of the new system is vastly different, and appreciably improved.

There are still some problems, most of them caused by terrain, that we had expected would remain. Most of the Philadelphia FM and TV transmitters are located on one antenna farm about 12 miles from our site. A major expressway passes within a mile of the farm, and in the same area, a large cliff looms over the road in our direction. Most car radios suffer from severe front-end overload in this region and, because our signal is well-shielded by terrain, reception along the expressway is quite poor for a couple of miles. The new antenna helped the situation, but did not totally solve the problem.

In the troublesome northeast direction, however, there has been a big improvement, which tends to confirm our initial theory that the old antenna was being adversely affected by the tower.

As evidence of the improvement, the station received numerous unsolicited calls from listeners who said that reception was improved. We had provided no advance publicity of the change. The signal to the east has been improved significantly, with reception possible in

Continued on page 74

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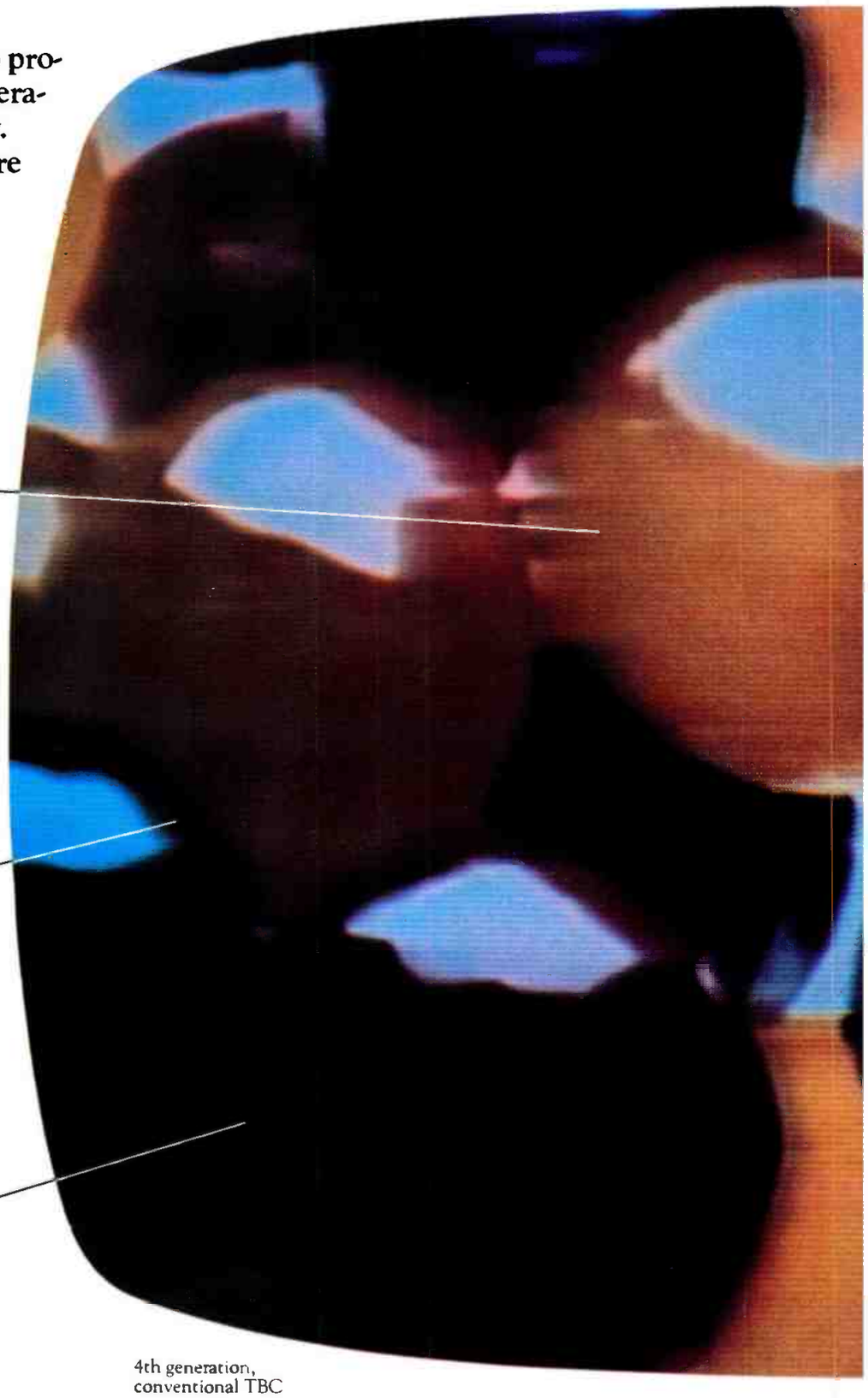

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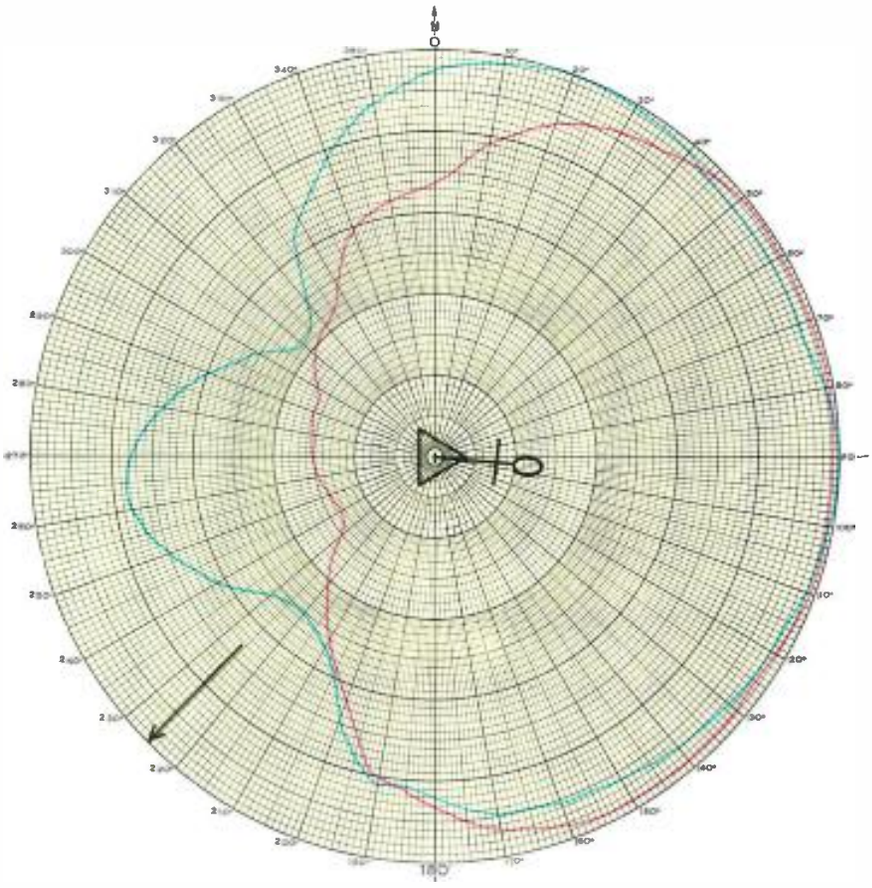


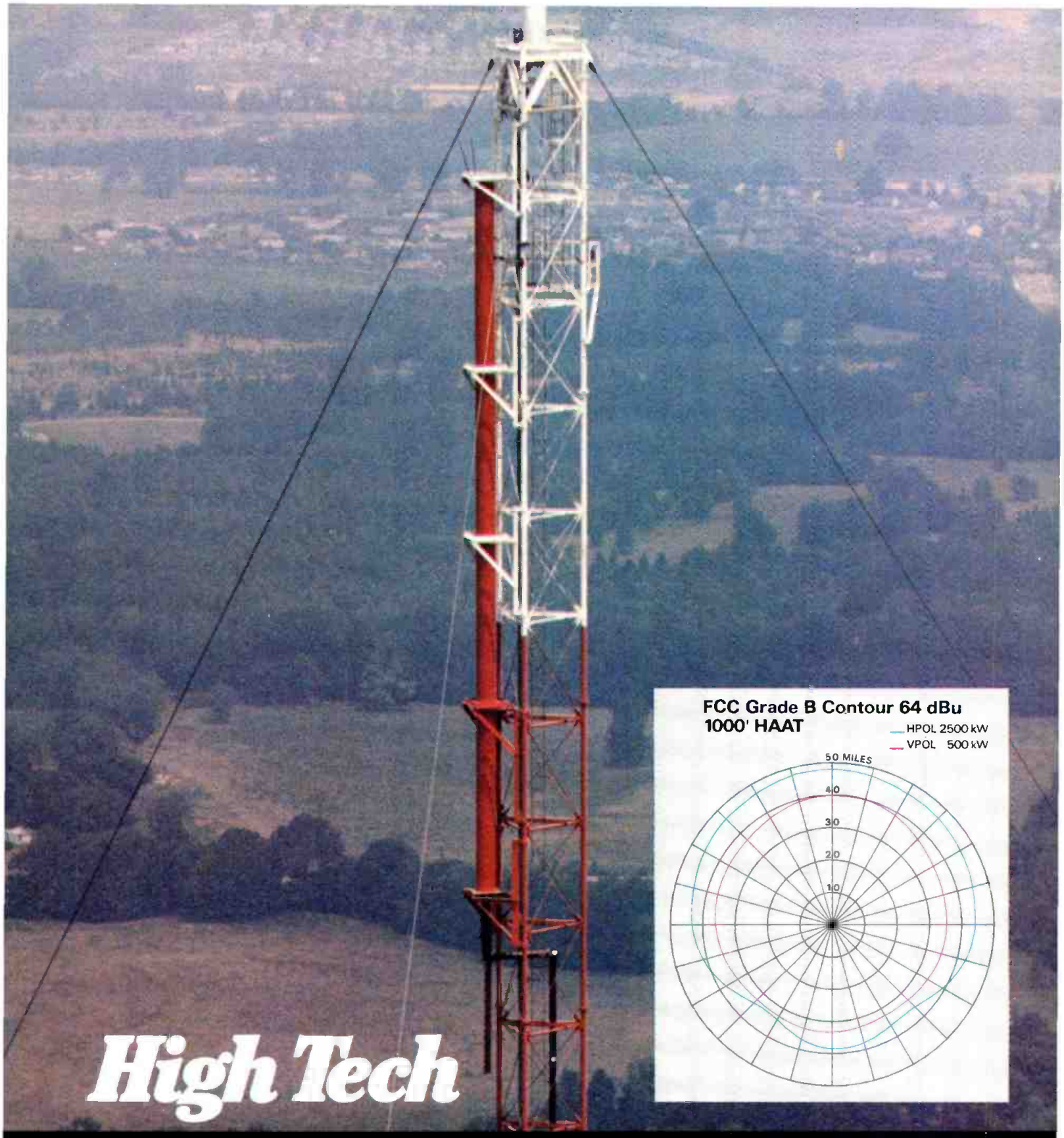
Figure 4. *The final pattern derived from the model measurements. The vertical pattern is shown by the red line and the horizotnal pattern is shown by the blue line. The required protection on a bearing of 225° is noted.*

Continued from page 70

Atlantic City and at other New Jersey shore points about 70 miles away. Even to the west, there appears to be little or no loss, with shopping malls 45 miles away carrying the station on their PA systems.

We have not repeated the field-strength measurements to determine exactly what improvements have been achieved, but the reaction of our listeners seems to confirm that the new antenna is providing a significantly better signal. We feel that the model-pattern study—with all three bays, the tower top and pole—provided us with an accurate way of ensuring top performance from our new antenna.

Editor's note: The author acknowledges the help of Wally Warren, Lauris Waterhouse and Bill DeCormier on this project.



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Selecting broadcast microphones

By John F. Phelan

When preparing for an in-studio broadcast or remote-location shoot, don't grab just any microphone.

Choosing the right microphone for a particular broadcast application may seem as easy as falling off a log, but it is a decision that deserves considerable thought. Just as no two radio or TV production sessions are alike, the microphone requirements for those sessions are varied also.

Microphone manufacturers offer a selection of units to match almost any application. With a good working knowledge of the various microphone designs, choosing the right mic for the job becomes easy. This education process begins with a look at some of the microphones commonly in use today.

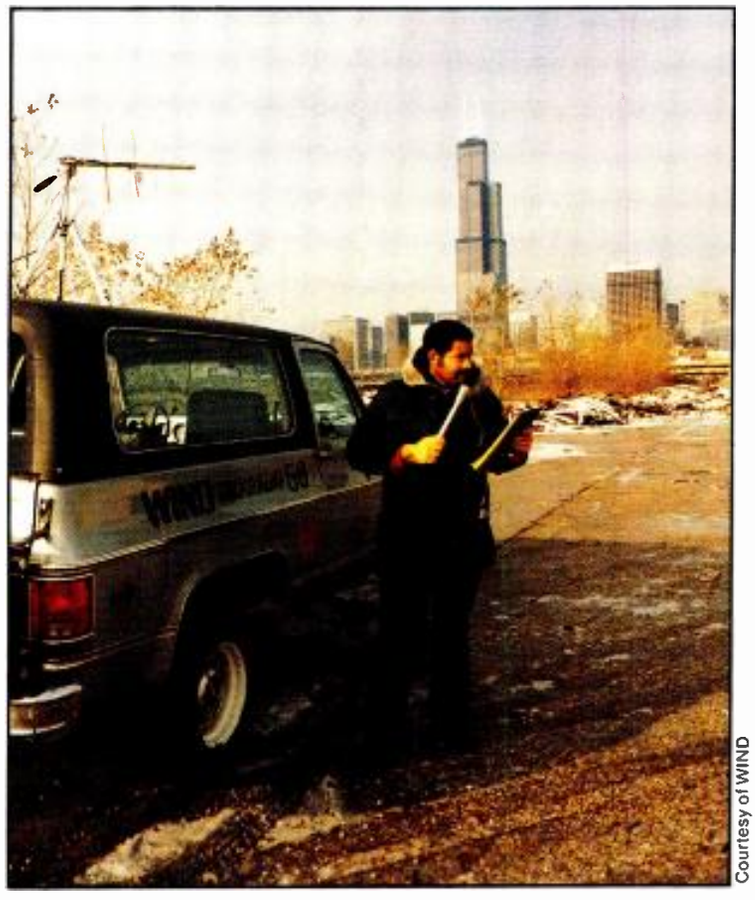
Lavalier microphones

The lavalier microphone is in high demand. Its small size and wide frequency response offer the broadcaster what appears to be the best of all worlds. Small size translates into minimum visual distraction on camera. Wide frequency response assures good audio quality. There are other points to consider, though, before a lavalier microphone is chosen for a shoot.

Examine the unit's polar pattern. The smallest lavaliers available are omnidirectional. This makes the talent's job easier because staying on mic is no problem. However, extraneous noise from the surrounding area has no problem staying on mic either. The omnidirectional lavalier microphone can pick up unwanted sounds just as easily as it captures the talent's voice. In an indoor, controlled environment, this is usually not a problem, but take the same lavalier outside and the ambient noise can make the audio track unusable.

Directional lavaliers are available, but they too have performance trade-offs. The most obvious is size. In order to make a lavalier directional, a back entry must be added to the housing so that sound can reach the back of the microphone. This translates directly into a larger housing for the microphone capsule. Although not as large as a hand-held microphone, a unidirectional lavalier is noticeably larger than its omnidirectional counterpart. In order to keep size under control, shock mounting of the directional capsule is usually kept to a minimum. This results in a microphone that may exhibit more handling noise than a comparable omni. This point should be carefully considered because what you eliminate in background noise can be drowned out by handling noise.

Windscreens for lavalier microphones are a must on outdoor shoots. Even a soft breeze can cause the audio track to sound as if it was recorded in a wind tunnel. The culprit is turbulence, caused by the wind hitting the grille or case of the microphone. The sharper the edges, the greater the turbulence. The more turbulence, the more noise. A good windscreen helps to break up the flow of air around the microphone and reduce turbulence. It works best when fitted loosely around the grille of the microphone. A windscreen that has been jammed down on a mic only serves to close off part of the normal acoustic



Courtesy of WIND

When preparing for a remote broadcast, consider the types of microphones that will be required. The motto of the ENG/RENG engineer should be: "If in doubt, bring it." By packing a variety of microphones and accessories, unexpected changes in the remote or shoot will not result in poor audio pickup. Shown here is reporter Larry Langford of WIND-AM, Chicago. (Photo by Dave Gibson.)

Phelan is marketing manager of professional products for Shure Brothers, Evanston, IL.

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path from the sound source to the diaphragm. The end result is attenuated high-frequency performance and reduced wind protection.

Hand-held microphones

The hand-held microphone—probably the most popular type—is available in many shapes and sizes. Manufactured in both omnidirectional and unidirectional versions, the hand-held microphone provides wide frequency response, desirable handling-noise characteristics and a wide choice of *sounds*. Because adequate space is available, a shock-mount system is incorporated into most professional hand-held microphones. Just holding a microphone or dragging the cable across a floor can cause low-frequency noise to be transmitted to the cartridge. A shock-mount system minimizes such noise. A hand-held microphone without a suitable shock mount should not be used for broadcast applications.

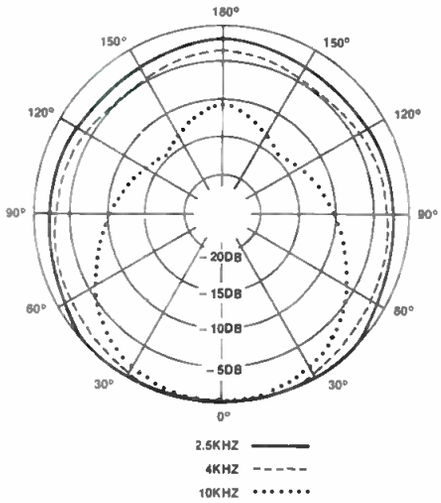
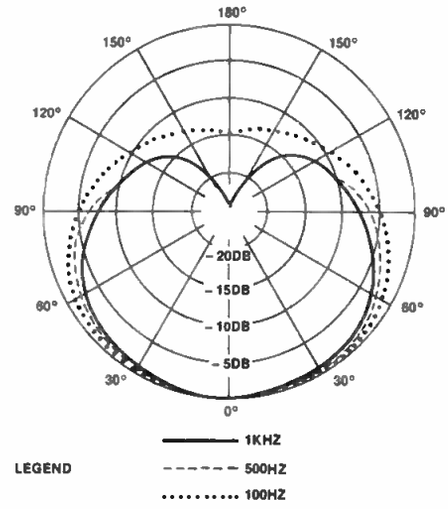


Figure 1. The typical polar pattern for an omnidirectional microphone at three discrete frequencies. (Data shown is for a Shure SM63L.)



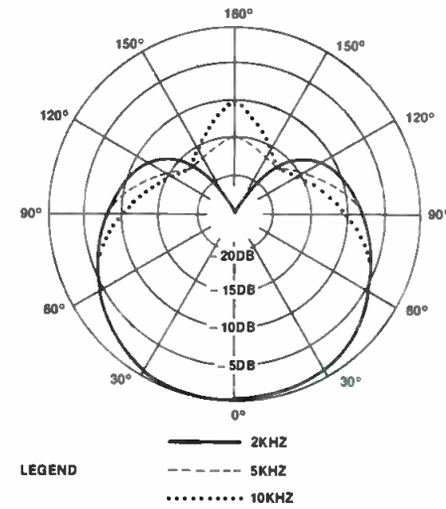


Figure 2. The typical polar patterns for a unidirectional (cardioid) microphone at six discrete frequencies. (Data shown is for a Shure SM81.)

The same polar characteristics that affect the performance of lavalier mics apply to the hand-held microphone as well. An omni will pick up sounds from all angles; a unidirectional will discriminate in favor of sounds arriving at the front of the microphone. (See Figures 1 and 2.) Hand-held microphones also offer tighter pickup patterns than most directional lavaliers.

The *cardioid* is a standard unidirectional microphone. In fact, the two terms are often used interchangeably. *Supercardioid* and *hypercardioid* microphones have even tighter patterns and reject more background noise than a cardioid. This allows a cleaner audio track with

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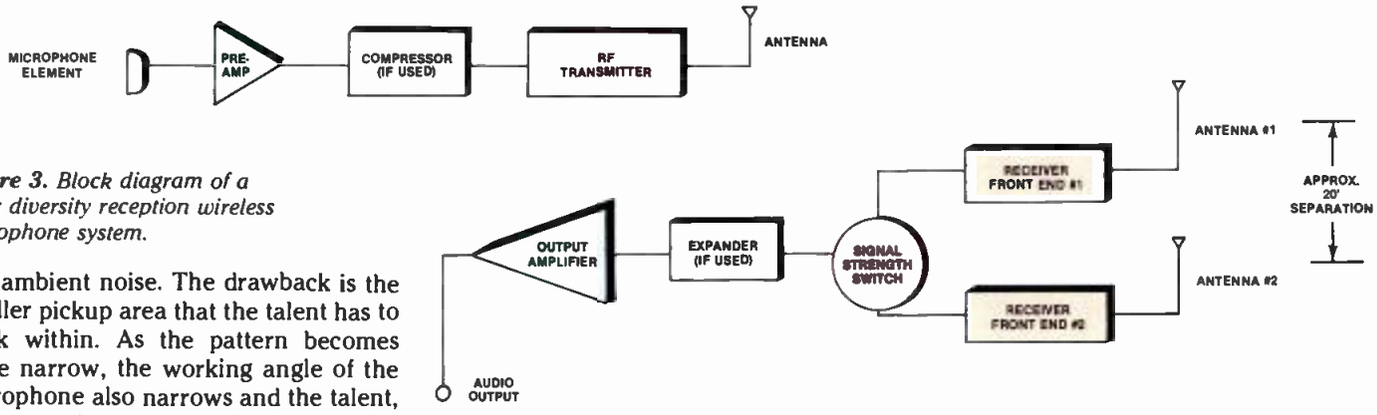


Figure 3. Block diagram of a basic diversity reception wireless microphone system.

less ambient noise. The drawback is the smaller pickup area that the talent has to work within. As the pattern becomes more narrow, the working angle of the microphone also narrows and the talent, consequently, must remain closer to the microphone pattern center. If the talent strays too far off axis, the microphone will assume that the talent is part of the background noise and attenuate the sound accordingly.

Shotgun microphones

A special version of a unidirectional microphone, the shotgun microphone offers an extremely tight polar-response pattern. Although shotgun mics seem to reach farther than a normal cardioid microphone, the truth is that they simply reject background noise better. The shotgun can pick out sounds at a distance, while ignoring ambient noise around the shoot. Because it has a narrow working angle, the mic must stay on axis. The closer the talent is to the shotgun microphone, the more attention you must pay to microphone placement.

There is a rule of thumb in the world of shotgun microphones that says the longer the mic, the more directional it will be. Within working constraints, this is true. A short shotgun will not be as directional as a long shotgun. You could, however, build an enormously long shotgun microphone only to find it unusable in most applications. Today's shotgun microphones feature a combination of cartridge tuning and interference tube tuning to achieve a smooth frequency response and polar pattern. Compromises of the tuning factors dictate what the microphone will sound like and how it will behave.

Wireless microphones

Although wired microphones are cost effective and microphone cable is relatively cheap, there are times when the talent simply cannot be tied to the camera or recorder. When it's a question of mobility, the obvious answer is a wireless microphone.

The wireless mic offers the user freedom to move about the studio or remote location without dragging along a mic cable. This may sound like the ideal situation for all broadcast users, but the wireless microphone is not without its own set of trade-offs.

In general, any microphone type may be used with a wireless transmitter. The two more popular types are the hand-held and lavalier. Most manufacturers of wireless microphones offer a version of each in their product lines. A body-pack transmitter, on the other hand, can be made to accommodate almost any microphone simply by using the proper cable. Shotgun, hand-held, lavalier and headset mics all can be turned into wireless units with the correct interface.

The wireless world brings with it a whole new set of factors that must be taken into account when planning an inside or outside shoot. The most important is frequency selection. With the radio spectrum becoming more crowded each day, finding a frequency that is not in use is, at best, more an art than a science. A frequency that works well in the studio may not work at all on location. News crews face the added problem of covering events at which they could end up on the same frequency with multiple users. A good working relationship with engineers in your area helps to prevent such problems. Another solution is to carry several transmitters adjusted for operation on different frequencies. This allows a backup unit to be used in case of frequency overlap.

In addition to frequency-coordination considerations, the possibility of multipath cancellation of the RF signal at the receive antenna must also be anticipated. To avoid problems, follow a few simple rules. Keep the transmission path as short as possible and free of obstacles. You wouldn't give the talent a 500-foot-long microphone cable when 25 feet would do, so don't position the wireless microphone 500 feet away if a 25-foot distance will suffice. Maintain line of sight between the transmit and the receive antennas. Anything that gets between the antennas increases the possibility of a dropout. This includes sets, cameras, lights and people.

A *diversity receiving system* can be used to reduce the threat of multipath cancellation problems. A diversity arrangement uses a single transmitter (microphone) and two receive antennas. Depending on the particular design, the antennas feed either a single receiver or two separate receivers. Internal circuitry senses which antenna has the higher received signal strength and locks onto it. (See Figure 3.) Diversity microphone systems are used in locations that are subject to multipath cancellation problems, such as the interiors of buildings. The receive antennas are generally about 20 feet apart.

Audio compression at the transmitter and reciprocal expansion at the receiver is often used in wireless microphone systems to improve the S/N.

A wireless system, when used correctly, allows the talent freedom to move about without the fear of cable entanglement. It gives the production team the same mobility.

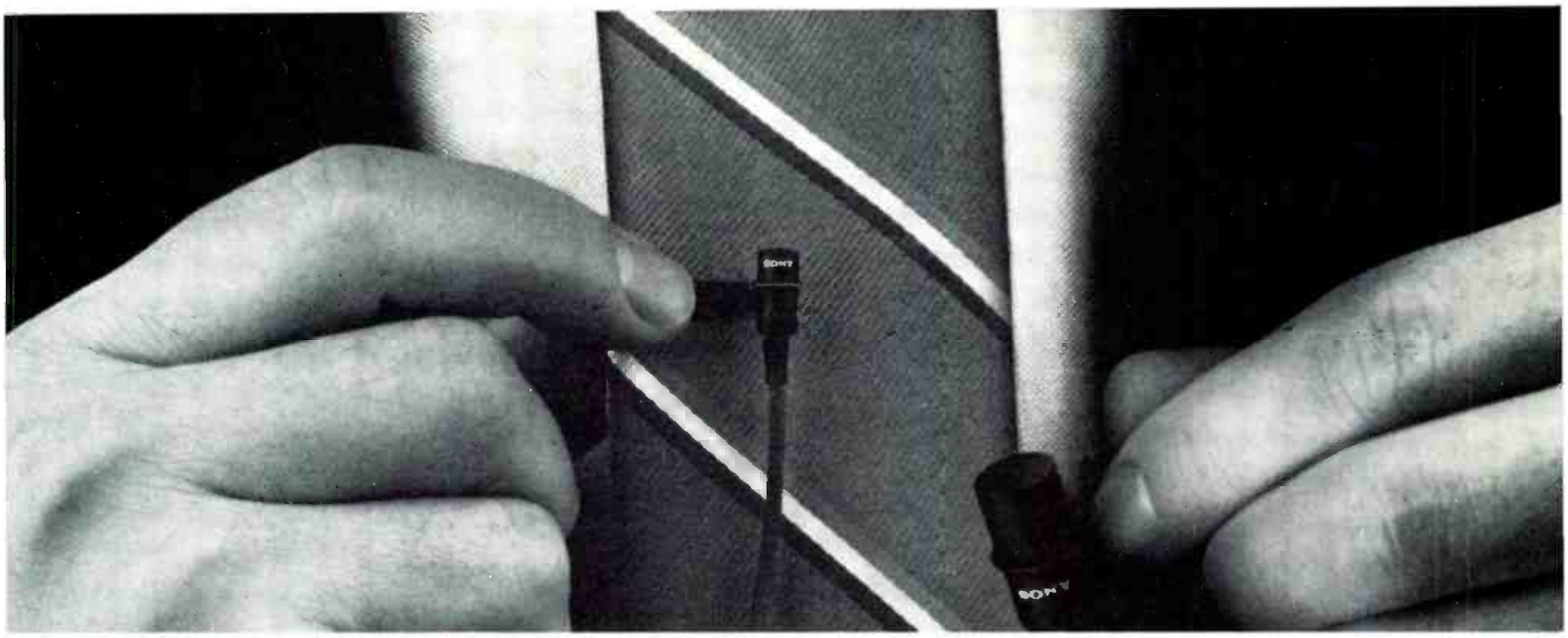
Special-purpose microphones

No matter how many microphones you have in your stockroom, there will come a time when you need a special unit and nothing else will do. Although you might be able to rig an existing one to partially cover the need, the fact remains that special-purpose microphones have a place in the broadcast world.

For long cable runs that make it difficult to use a wireless microphone, a microphone with a line-level output is an ideal solution. The high-level output allows the microphone signal to be boosted before it is sent over a long cable run. This eliminates the hum and noise pickup to which long cables are susceptible. Because the microphone signal is amplified approximately 60dB, it is that much higher than the noise floor.

If you do not have a line-level microphone, there are mic-to-line preamps available that allow you to turn any microphone into a line-level unit. Although it is another item on the list of equipment you have to carry, a mic-to-line pre-amp can be a lifesaver in an emergency. It also eliminates any concern that the normal microphone and line-level microphone will sound different. Because you are using the same microphone, the sound will be the same.

Parabolic microphones are another breed of special-purpose devices. Used primarily on sports shoots, they allow the audio operator to zero in on a player or a particular area of the playing field. A parabolic microphone functions in much the same way that a satellite dish works:



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Sony lavalier microphones operate on either a single AA battery or phantom-power. You also have a choice between black or satin-nickel finishes; and XLR, pigtail or Sony wireless-compatible output configurations.

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It concentrates the acoustic energy at the focal point of the parabola, which is where the microphone is mounted. Compared to a shotgun, which provides directivity and wide frequency response, the parabolic microphone is even more directional. However, the directionality is achieved at the expense of frequency response.

The low-end response of a parabolic microphone is limited by the diameter of the parabolic dish. The larger the dish, the lower the cutoff frequency. Because most parabolic mics are hand-held, a small dish is used. Response below 300Hz is minimal. A larger dish would yield a better low end, but holding and steering the dish would be a problem. A windy day would make matters worse.

Microphones that may be hidden from view make up another category of special-purpose devices. Hiding a mic has basically the same effect on performance as hiding a wireless system antenna. It may look good on camera, but the audio performance suffers. As with RF, anything that comes between the microphone and the sound you are trying to pick up will degrade the audio signal. Although microphones have successfully been hidden in plants, sets, news desks and walls, such installations require a lot of trial-and-error positioning and equalization.

Microphones are also available that are designed to be mounted at or near a reflecting surface, and they work well if mounted properly. However, placing a standard hand-held or lavalier microphone on a reflective surface would destroy the unit's high-frequency response. Manufacturers of *surface-mount* microphones take this effect into account during design of the units. Use a microphone for the specific purpose for which it was intended and engineered.

Stereo microphones

As TV broadcasting now turns toward stereo, some thought must be given to the manner in which stereo audio will be produced. Quality stereo is not twice as hard to achieve as quality mono. It is *10 times harder.* Phase relationship, spatial aspect and mono compatibility all are factors in recording stereo audio. It is not enough to throw two microphones out there and hope for the best.

There are a number of ways to achieve stereo with two microphones. Among these are the mid-side (M-S), coincident pair and X-Y methods. Each has its proponents and each attains its own stereo sound. The scope of this article does not allow a discussion of various stereo microphone techniques. However, it would be well worth your time to study the methods available before you send a crew out to shoot in stereo. While studying the stereo image problem, ask yourself these basic questions:

- How will it sound to the viewer at home?
- Will the audio match the picture?
- Will the dialogue match the picture?
- Will the dialogue be center and only the effects (for instance, crowd noise at a sporting event) spread out to the left and right?
- Will the dialogue be spread out in the same proportion as the talent?

These questions and others will have to be answered before a *standard* format is adopted for stereo TV broadcasting.

FM stations use a variety of methods to handle stereo in the studio. Some use a single microphone and send out the announcer audio as mono to both channels. Others use two microphones and let the announcer's voice wander between the two. Still others use a stereo synthesizer for the announcers, with only the music and commercials in true stereo.

What will you do? There are many fine books on the market that deal with stereo microphone techniques. Most microphone manufacturers also have literature available that should be helpful to the radio or TV engineer.

No matter what your audio needs—in mono or stereo—the time you spend learning about microphones and the techniques to use them properly will be a wise investment. The improvement to your on-air sound could be dramatic.

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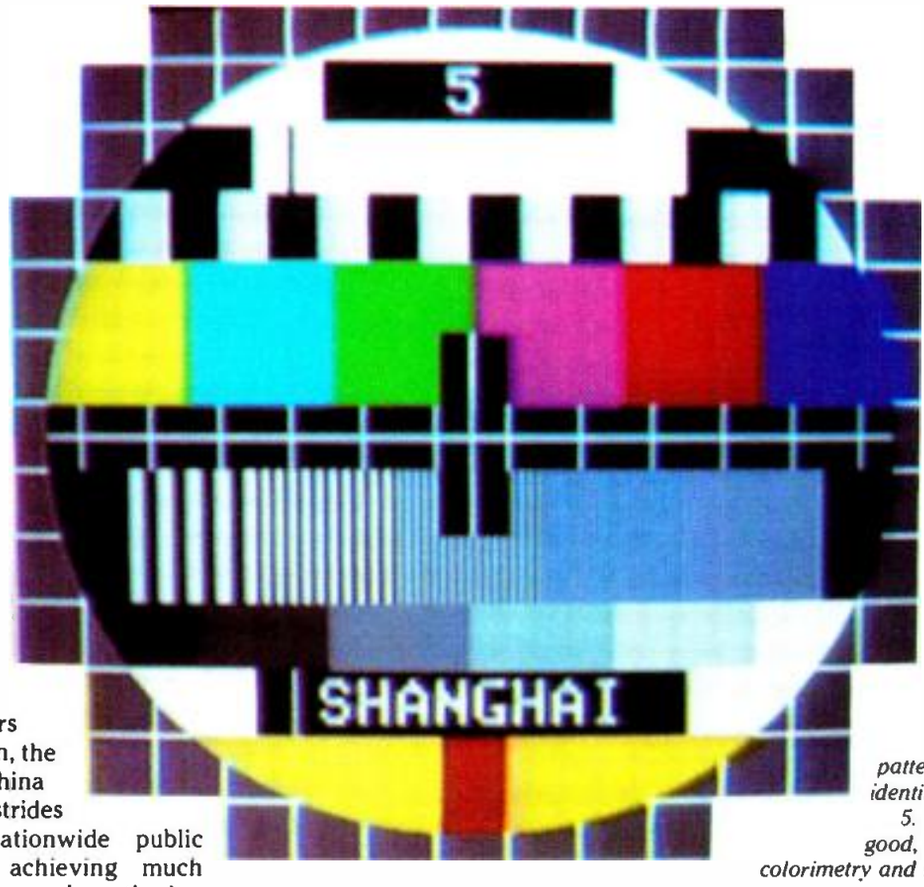
Circle (71) on Reply Card

The state-of-the-art in China

By Joseph Roizen

The rapid growth of TV broadcasting in the People's Republic of China heralds new opportunities for the U.S. broadcast industry.



The Shanghai TV test pattern with English language identification on VHF channel 5. Off-air quality was quite good, as you can see from the colorimetry and multiburst reproduction.

In the nearly five years since the decade began, the People's Republic of China (PRC) has made giant strides in implementing nationwide public television services, achieving much greater coverage area and vastly improving programming. This was the consensus of a group of TV executives from the United States, the United Kingdom and Australia who recently completed a **BE**-sponsored technical tour of radio and TV facilities in the Chinese cities of Beijing, Shanghai and Guangzhou (Canton).

Statistics provided by our host, the Broadcast Ministry of the PRC, showed a quantum leap in the number of TV stations signing on the air between 1982 and 1984, doubling from 52 to 104. Rapid growth continues, with domestic plans to complete 85 more TV centers during this year.

The TV receiver population also is growing at a high rate. Most of these sets are built in 60 factories spread throughout China. According to another official source—the Ministry of Electronic Industry's Bureau of Radio and Television—current statistics of nationwide ownership of TV sets show 45 million for monochrome and 4 million for color. In 1985, manufacturers in the PRC expect to build more than 10 million TV sets, of which perhaps 20% will be color models.

Roizen is president of Telegen, a consulting firm, Palo Alto, CA. All photos by Donna Foster-Roizen.

TV facilities

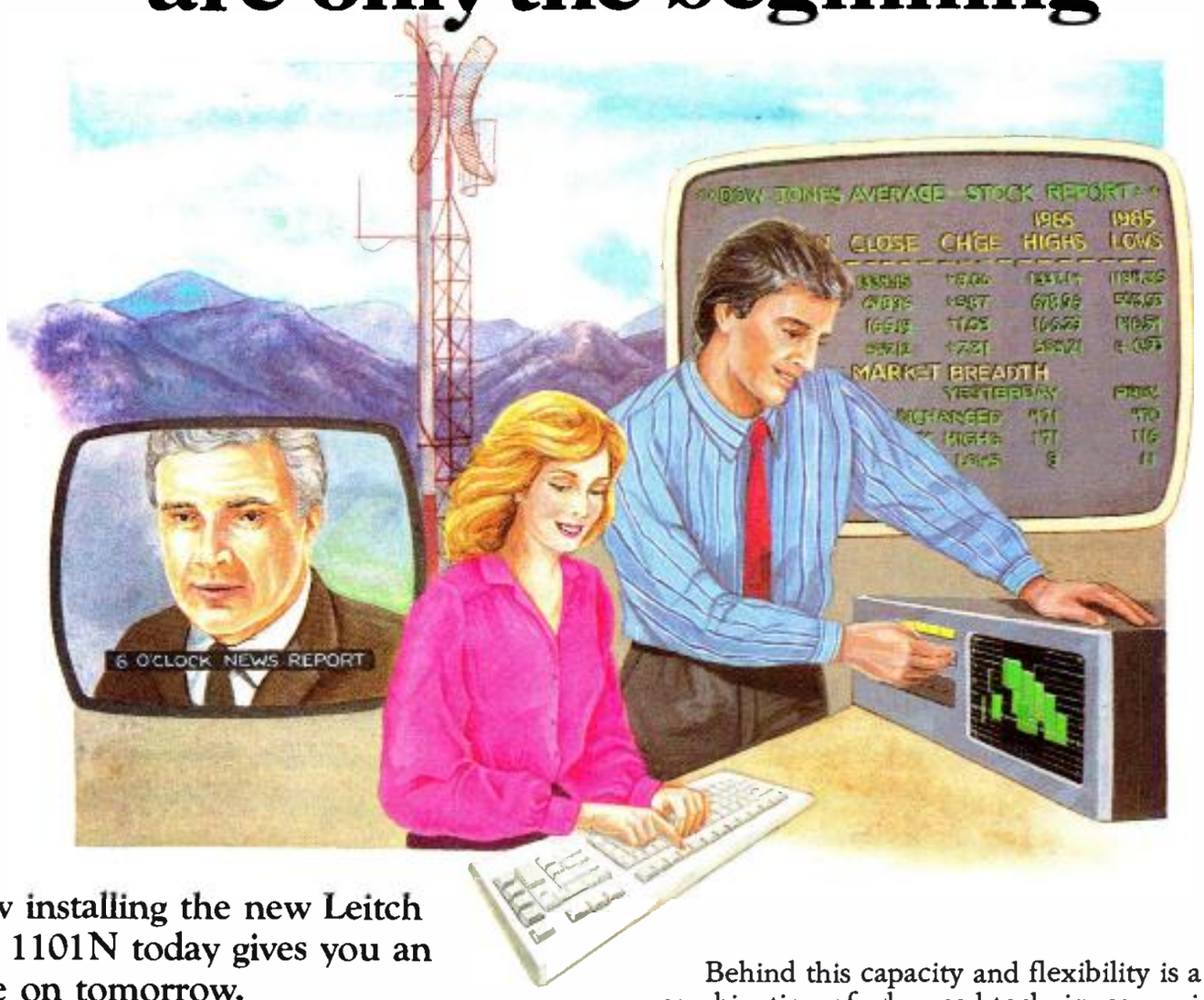
Because China's primary electrical power is 50Hz, the country adopted the CCIR 625-line/25-frame scanning standard in 1958 (when Beijing TV started monochrome operations). Color television was introduced in 1970 and the PRC chose the German-developed PAL-D standard, using a 4.43MHz color subcarrier and a bandwidth of 8MHz. Now, all major metropolitan channels operate in color on both the VHF and UHF bands. The three principal cities we visited each had multiple stations operating between channels 2 and 30.

Beijing's three channels are 2, 6 and 8. All have programming after 6:30 p.m., and channels 2 and 8 carry some morning or midday programs. By our standards, you see a lot of test patterns on the air. The musical background often sounds familiar, with such typical Chinese tunes as the "Tennessee Waltz" and "Aloha Hei."

The stations air commercials, but they are clustered together in blocks of up to 20 minutes and have no obvious relationship to the program content. Commercials advertise both domestic and foreign products, but there is a 10% to 20% cost differential favoring the home team. The 600 to 1,000 yuan ($250 to $350 U.S) that the stations charge per commercial minute, however, is probably within the budget for most advertisers.

Shanghai and Guangzhou also have three full-color channels each. In Shanghai, VHF channels 5 and 8 operate with 10kW ERP, and UHF channel 20 uses a 30kW transmitter. These three channels share a common production facility and an adjacent 209-meter transmitting tower. A gondola at the top of the tower acts as a microwave relay and receive point for ENG crews.

Closed captioning and teletext are only the beginning



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An editing suite at the TV center in Beijing. Shown is a production session during Chinese subtitling of an NBC special program on the New York Philharmonic.

All three on-air channels can be monitored from this TV center control room in Shanghai.

Shanghai will open a fourth channel before the end of 1985.

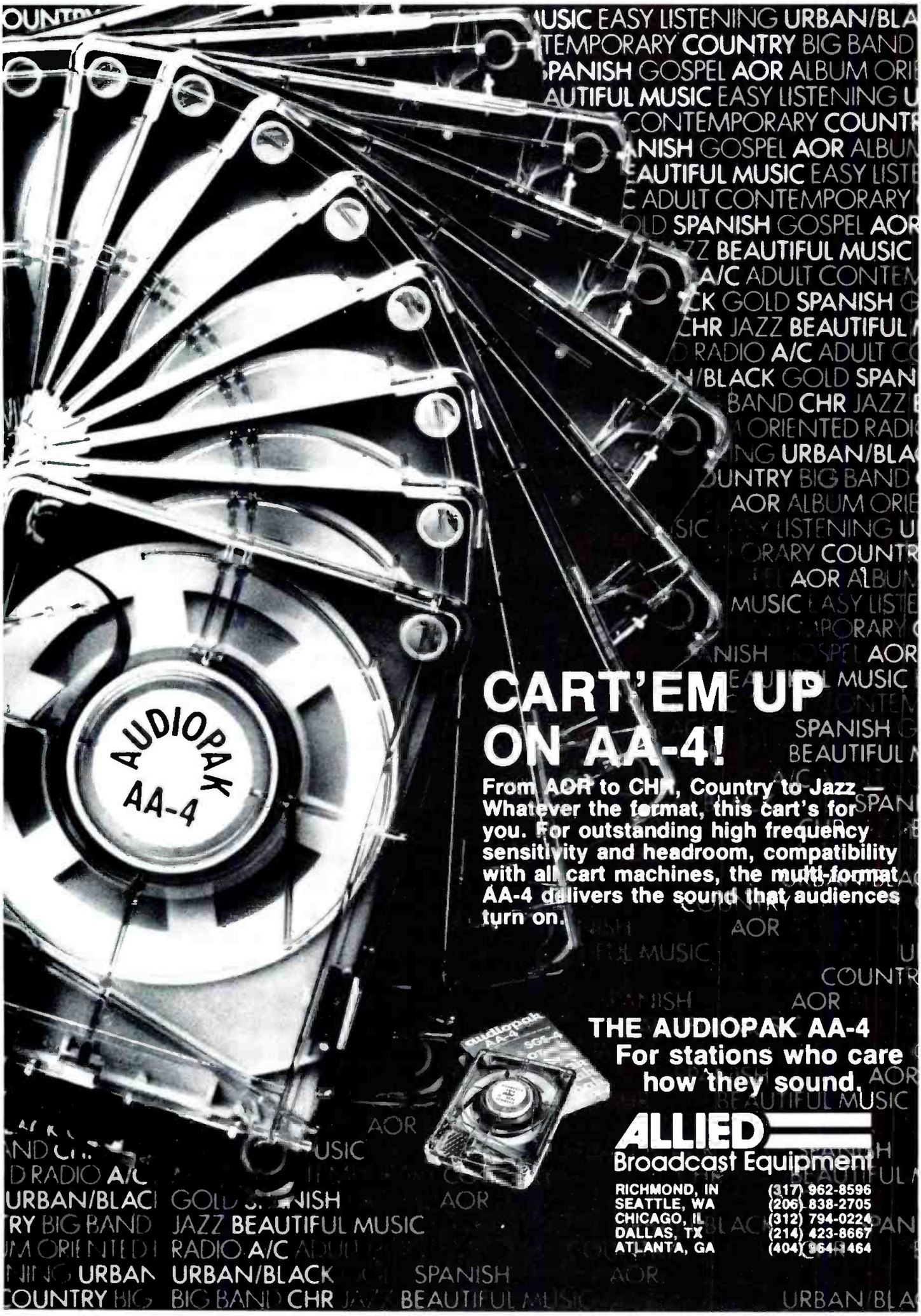
Guangzhou operates channels 2, 8 and 14 with similar power outputs and a common TV tower. The city's TV production center, however, is at a different location. Guangzhou is planning to implement a new TV production studio and another channel in 1987.

The principle of *prime time* is recognized in China. Referred to as *golden hours*, prime time is 7 p.m. to 9 p.m. on weekdays. The weekends are even more valuable, bringing another increase in commercial rates. Guangdong TV's average commercial load is five minutes per hour of program, although it is not necessarily that structured. Background music for the commercials sounds very Western, with George Gershwin's "Rhapsody in Blue" being repeated frequently.

The impact of television in the PRC is every bit as far-reaching as it has been in other countries. Program fads sweep urban populations just as "Dallas" and "Dynasty" have in this country. A kung-fu series, which airs on Sunday nights, recently drew such rapt audiences that foreign visitors complained of not being able to get taxis or restaurant service during the show. Cab drivers and waitresses were huddled around the nearest TV sets to catch the latest episode starring their white-gloved martial arts hero. (I suppose the bad guys wear the black gloves.)

Most of the broadcast equipment in China's studios and post-production facilities is as modern as that found in New York, London or Paris. In fact, it is by and large the same equipment one would see at NBC, the BBC or the SFP. One-inch helical Type C recorders.

Continued on page 90



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"REVERB TIME" display mode showing difference in reverb time in each of four frequency bands.

"MEMORY TITLE" display showing the titles of internal ROM memories.

The logical grouping of the parameter controls on the remote also makes it easy to create any effect you like. Then store it in any of 60 memories for instant recall.

The remote also contains 9 additional RAMs so you can store programs and carry them with you to use anywhere there's an REV-1.

And there are 30 additional ROMs with factory preset sounds. Many of which can be completely edited (as can the user-programmed sounds) by using the LEDs to tell you the set value or indicate in which direction to move the control so you can easily and precisely match the value of the originally programmed sound.

And the sound itself is far superior to any other digital reverb. The REV-1 uses specially developed Yamaha LSIs to create up to 40 early reflections and up to 99.9 seconds of subsequent reverberation. So the effect can be as natural (or unnatural) as you want it to be.

We could go on about the REV-1. Tell you about its 44.1 kHz sampling rate that provides a full 18 kHz bandwidth to prevent the natural frequency content of the input signal from being degraded.

How it has a dynamic range of more than 90 dB for the delay circuitry and more than 85 dB for the reverb circuitry.

But why not take a closer look at the REV-1 at your authorized Yamaha Professional Audio Products dealer. Or for a complete brochure, write: Yamaha International Corporation, Professional Products Division, P.O. Box 6600, Buena Park, CA 90622. In Canada, Yamaha Canada Music Ltd., 135 Milner Ave., Scarborough, Ont. M1S 3R1.

YAMAHA

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At left, the news studio set in Shanghai looks about the same as such a facility anywhere else in the world, with an ENG camera, teleprompter and blue chroma-key panel. (Here, Donna Foster-Roizen sits next to the station's associate chief engineer He Zheng-Sheng to simulate a news broadcast.)

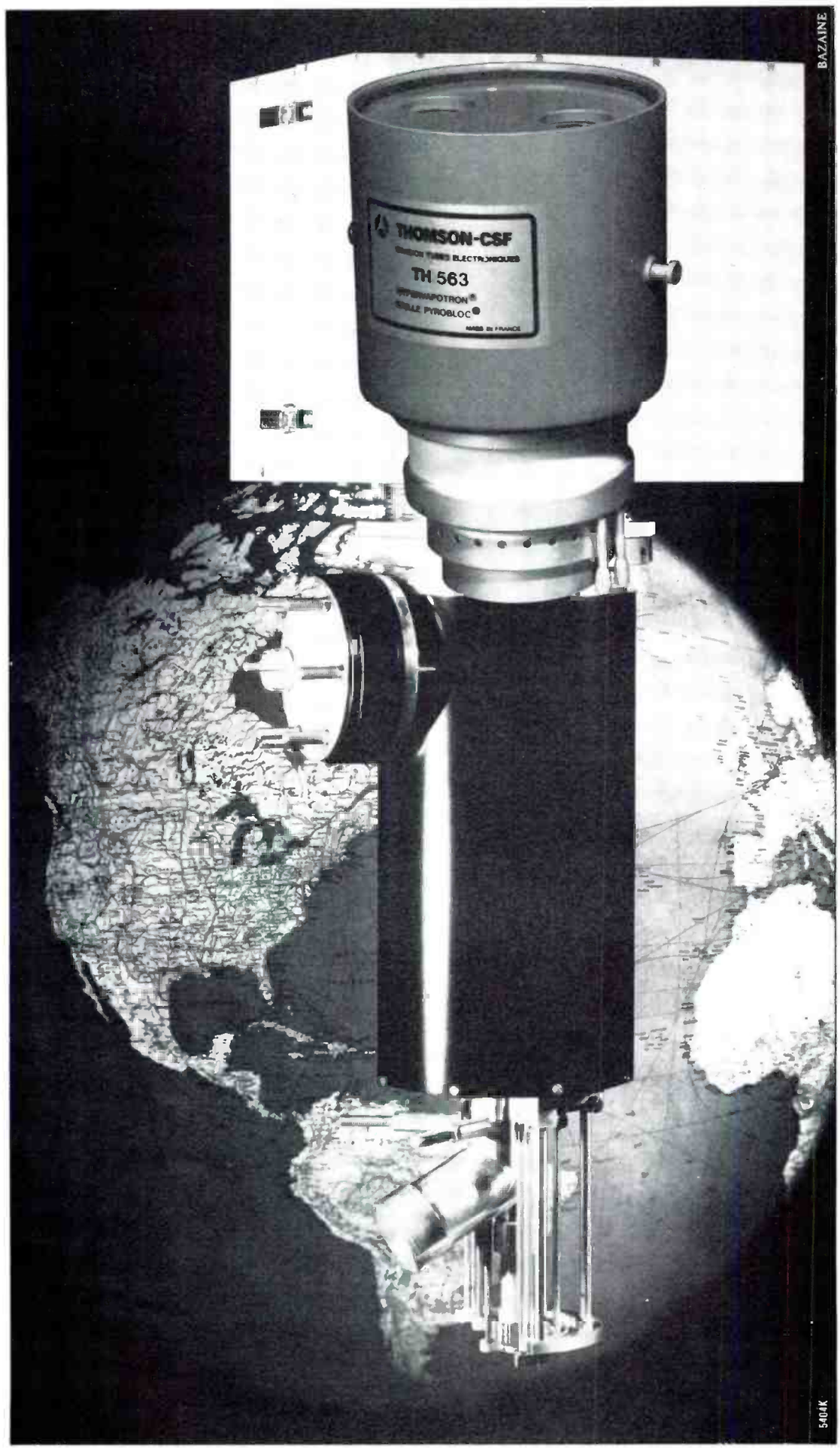
Below, Beijing CCTV is currently housed in a sprawling building that dates back to the 1950s. Both radio and TV services originate there, and are locally transmitted or relayed via microwave to the national network. A new 30-story TV center is under construction. Shown here is the tower above the CCTV building, which serves as the antenna site for the local transmitters.

Continued from page 86

operating in the PAL standard, were everywhere. Color cameras included studio and ENG versions from all the major manufacturers. Switchers also ran a wide gamut of suppliers. There were even a few Chinese-made audio and video consoles in some of the control rooms.

Two 1-inch editing and post-production rooms at the CCTV building in Beijing were on-line during our visit, and each had an interesting mix of equipment for the Chinese technicians and programming staff.

In the first suite, operators were editing an NBC program of the New York Philharmonic Orchestra playing at Lincoln Center. The editing required some sophisticated subtitling, with Chinese characters overlaid on the program material. Three 1-inch machines, under the control of a joystick-style editor, were connected to a switcher that mixed subtitles from a Chinese typewriter with more than 3,000 characters (*ideographs*). The result was a smooth transition from the uncaptioned original show to a fully titled version for Chinese audiences. We were told that viewers in China are fascinated by the few Western programs they see. The New York Philharmonic performing the classics must have



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thrilled a few million PRC music fans.

Another post-production facility in the same Beijing building was actively assembling a Chinese Music Video piece that looked like an Oriental version of a Michael Jackson take. Three 1-inch tape machines at the back of the room were in an A-B roll mode, connected to a digital effects generator. Although most of the technical equipment in the room was imported, the multichannel audio console was a Chinese-made product.

Except for the language difference, the control room activities resembled what you might see at Teletronics or the Post Group. The A-B reels were cued up and rolled in sync, edit-decision lists were made and the compiled tape yielded a finished program. The result was not quite up to the razzle-dazzle of an American production, but in a country where art is also a form of political expression, the programs have come a long way from what we saw just a decade ago when we first visited the PRC.

ENG crews in China work much the same as their counterparts anywhere else. The U-matic format is popular, and small microwave links are used to beam pictures and sound back to receive-units at the central studio sites. In Guangzhou, ENG tapes recorded on location could be edited in any one of 14 suites. Again—except for the language—it could have been Televisa in Mexico, Rede Globo in Rio or ATN-7 in Sydney.

An engineer punches up a studio signal at Shanghai TV. The equipment is a mix of Chinese- and American-built hardware.

A Chinese-manufactured transmitter at Shanghai TV, which also contains an American-made audio processor.

The PAL system used in China is somewhat forgiving in terms of color picture quality because of the nature of the basic encoding technique. Those hours of test patterns on the air gave us plenty of opportunities to assess the technical aspects of Chinese transmissions. The test pattern used in China is similar to the EBU format, with a row of color bars and multiburst segments overlaid on circular and square geometric elements. In all cases, colorimetry was quite good, and there was no need to adjust the receiver. However, as we switched channels, we saw a noticeable difference in high-frequency luminance response and cross-color effects, which I assume was due to different quality PAL encoders.

Marked differences in image quality seemed to be related to program content. Educational programs, featuring a talking head, a blackboard and a pointer, seemed to have originated on camera tubes with low resolution and plenty of lag. Dramatic shows, Chinese operas and video documentaries looked the best, and reflected the quality potential of the 1-inch Type C format.

Another similarity between Chinese and European television is the way movies are shown. If the film was produced in an anamorphic format, the TV picture is allowed to show the full width of the image, which leaves black spaces above and below the image on the home screen. A number of films are transferred to 1-inch tape for subtitling, editing or other reasons. The transfer is combined with overlays and then put on the air.

The programs that look most like the results of American production techniques are the daily news shows. Tripod-mounted ENG cameras look at a basic

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Quality reproduction starts with the heads, and TASCAM has three decades of design experience behind the MS-16's new micro-radii heads. They bring "head bumps" under control and ensure flat frequency response. And unlike most tape machines, the MS-16 record/sync and playback heads are identical in performance. Because sync response equals repro response on the MS-16, you can make critical EQ and processing decisions on overdubs or punch-ins without having to go back and listen a second time. You get what you want sooner and with fewer headaches.

The MS-16 cuts down on the time you spend locking up with other audio and video machines as well. A 38-pin standard SMPTE/EBU interface affords speedy, single-cable connection with most popular synchronizers and editing systems. It's the easy, efficient way to get the most out of today's sophisticated synchronization equipment. The MS-16's new Omega Drive transport is tough enough to stand up to long days of constant shuttling... while handling tapes with the kid-glove kindness they deserve.

Record/Function switches for each track allow effortless, one-button punch-ins. Input Enable allows instant talkback during rewinds, fast forwards and cue searches. These features speed you through sessions and let you concentrate on the project at hand... not on your tape machine.

Take a closer look at the MS-16. See your TASCAM dealer for a demo or write us for more information at 7733 Telegraph Road Montebello, CA 90640.

THE TASCAM MS-16 SIXTEEN TRACK

TASCAM THE SCIENCE OF BRINGING ART TO LIFE.

Circle (57) on Reply Card

The Shanghai TV tower is 209 meters tall and includes a gondola at the top for observation and equipment placement. The antennas at the top transmit the three local channels.

set, behind which the newscasters (usually a man and a woman) sit under heavy lighting. A vivid blue backdrop serves as the ubiquitous chroma-key panel, and a second small camera picks up the TV station logo or a picture on which the commentators will be overlaid.

On seeing a certain news program during our stay, we admired the nice background image of China's most historical and best-known architectural achievement, the Great Wall. Imagine our surprise on visiting that newsroom the following day and finding that the photo was actually a 3" x 5" color postcard that you could buy for a few Fen (pennies) at the gift shop in our hotel.

The future

TV technology in China is on a fast-rising trajectory aimed at acquiring useful developments from abroad and adapting them to internal needs. The country also intends to develop the means to build its own broadcast equipment, and already does so in a few limited areas such as audiotape recorders, test signal generators, routing switchers and transmitters.

The Chinese have instituted training programs to develop the skilled personnel they will need to operate and maintain their broadcast equipment and to produce programs to fill their airwaves. Increasing numbers of Chinese engineers are participating in standards committees, visiting TV trade shows—such as NAB and Montreux—and joining professional societies such as SMPTE. These efforts should lead to the mutual benefits of better understanding and greater trade between the PRC and the Western world.

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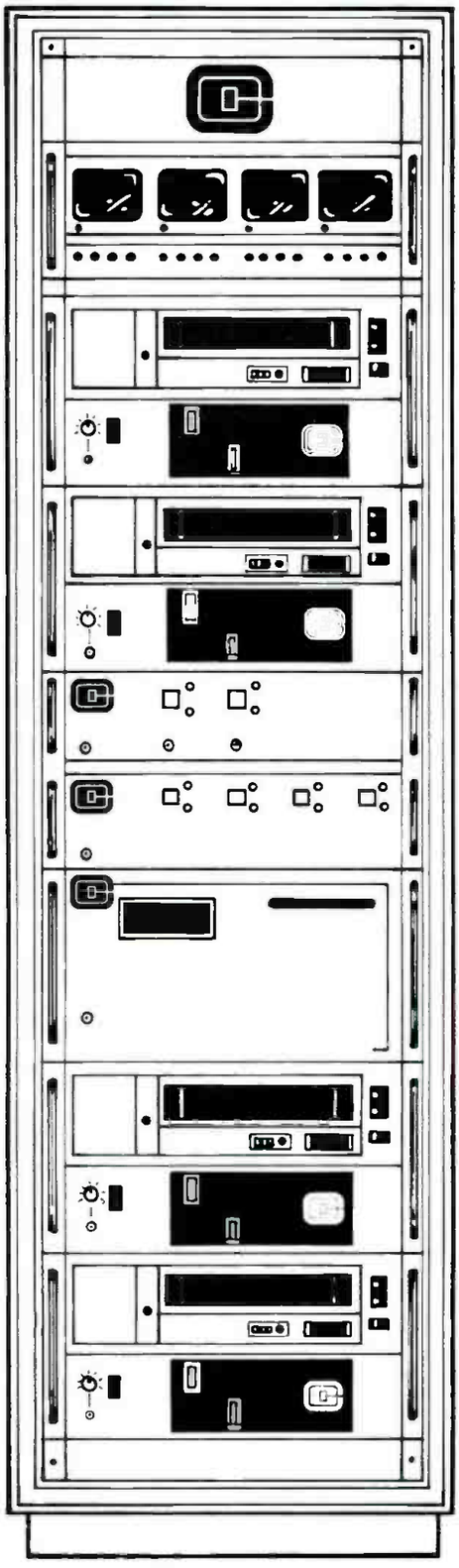

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What's in store at Radio '85

By Brad Dick, radio technical editor

It could be the biggest radio show on earth. That's what is predicted of the NRBA/NAB Radio '85 Management and Programming Convention, scheduled for Sept. 11 to 14 in Dallas. Formerly the Radio Convention Programming Conference (RCPC), the convention is cosponsored this year by NAB and NRBA, but the focus of the annual event remains directed toward the needs of station management, including engineering management.

The Dallas Convention Center will house the event. Approximately 200 exhibitor booths, primarily radio-oriented, are expected to occupy more than 16,000 square feet of space in the exhibit hall. The Radio '85 planners anticipate 6,000 to 7,000 attendees. In addition to the 50 panel discussions related to radio management, programming and sales, eight have been specifically designed for the broadcast engineer.

Legal issues

In light of today's rapidly changing rules and regulations, the *Living With the New FCC Rules* session should prove helpful. The session will address some of the most recent FCC rule changes and how they may affect the radio station. If you're pretending the changes haven't come about, this is your chance to see what might happen if you don't take the blinders off.

Another session dealing with the changing regulations, *80-90 Allocations, Applications and Opportunities*, will address the complex issues and changes that affect FM broadcasters. Unless you thoroughly understand just how 80-90 affects you and your FM station, try to attend this session.

Maintenance

For most of us, our main concern is keeping the station on the air and operating properly. Because we all can use an extra dose of new ideas in this area, you might plan to attend the session on *Studio and Transmitter Maintenance*. The panel will cover some of the basics as well as some of the more detailed topics of both studio and transmitter operation and repair. Several people with top-notch credentials are scheduled to appear on this panel.

Although some of us golden ears may not like to admit it, our audio processing must be as good as, or better than, our competitors' if the station is to remain in business. *Competitive Audio Processing* will address this topic. The panelists include both engineers and programming experts. They will provide suggestions on how a station can become competitive in the marketplace by effective use of audio processing.

AM/FM improvement

If there is one area that was not contested at this year's NAB convention, it was the need to improve the quality of AM broadcast signals. In an effort to address the problem, the NAB announced at its convention the formulation of a resource or data bank of information on AM broadcasting. The intent was to provide a central location for information on the design and maintenance of AM broadcast facilities.

The panel on *AM/FM Improvement* will outline details about the resource center and explain how engineers can take advantage of it. The center is designed to provide information on topics ranging from the basic to the complex. The panel will discuss exactly what subjects are covered and how the broadcast engineer can obtain copies of the various articles. The availability of this resource center, and knowing how to access it, will be a valuable tool to the AM engineer who wants to improve the station's sound.

The results of the NAB RF interference study are to be announced at this session. Commissioned by the NAB, the study examined the potential for interference to station signals from non-broadcast sources, such as RF lighting.

Finally, this panel will review the current state of affairs of both AM and FM receiver designs. There have been a number of proposals offered to improve receivers. This session will outline some of them, and the results to date.

By the way, you can pursue this topic further by attending demonstrations in the exhibit area showing improved AM stereo receivers and the Torick (FM-X) companded FM transmission system. This system uses a companded L−R signal transmitted in quadrature with the normal stereophonic subcarrier to reduce noise. The demonstrations offer you the opportunity to hear how good both AM and FM can sound.

New technology

The application of new technology to current capabilities is always interesting. For the FM broadcaster, there now exists the possibility of transmitting text at the unheard-of rate of 38,400 baud. A session entitled *SCA Update & Opportunities* will provide a forum for the discussion of this and other subcarrier possibilities.

In *New Technologies*, the panel will address the use of new ideas and equipment for broadcast applications. For instance, with the skyrocketing cost of telephone loops, alternative audio delivery systems are becoming attractive. Panel members, both broadcast engineers and manufacturers, will offer suggestions on how to apply new ideas to solve this problem as well as others.

A job with a future

Just a few years ago, anyone wanting to work in a technical area of radio needed an FCC first class license. That license doesn't even exist today. As changes occur within the industry, they inevitably filter down to the broadcast engineer, affecting our daily routines and influencing the way we perceive our jobs. A panel of engineers will gaze into the crystal ball to look at the *Future of the Broadcast Engineer as a Profession*. With the knowledge that our work as broadcast engineers has drastically changed, the panel will attempt to predict what tomorrow will bring for the profession.

|:-)))|

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In its various configurations, the Harris 9100 provides intelligent remote control; automatic transmitter control; automatic logging; plant protection through intrusion and fire alarms; and automatic control of tower lights and building temperature. It can even exercise your standby equipment...and operate up to three remote sites from a single location!

The Harris 9100 watches over your transmission system and physical plant. It makes decisions automatically, based on pre-programmed limits...with a minimum of operator intervention. Quite simply, it is the most intelligent remote control system on the market.

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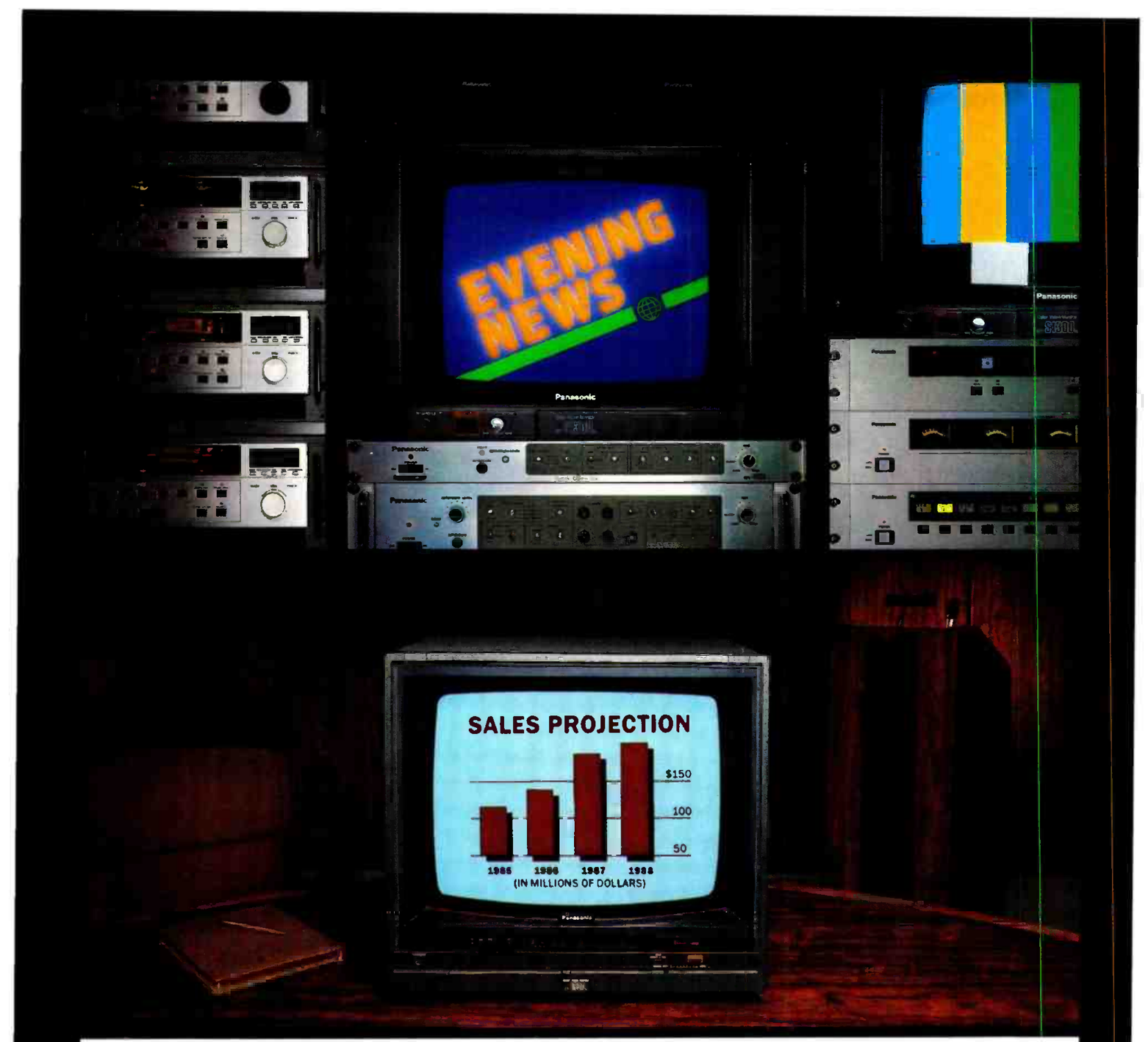

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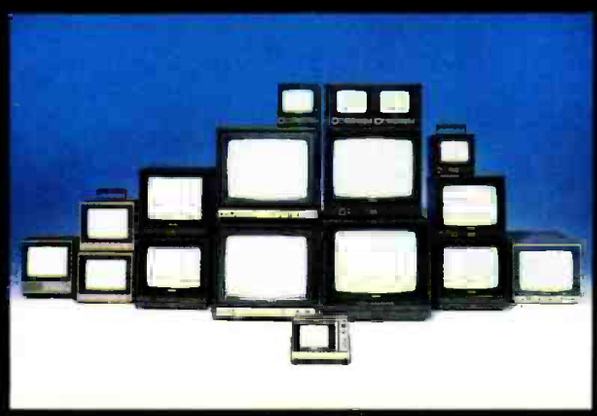

Video. More and more it's playing a larger role in entertainment, industry, education, even medicine. That's why, no matter what your special application, all you need are the monitors in the Panasonic BT, CT and MT Series.

Our BT Series monitors are ideal for broadcast because they all have the quality and important controls broadcasters require. Like a normal/underscan switch that lets you select either the camera view or the actual monitor picture. Pulse-cross circuits for easy observation of sync detail. And blue only for easy chrominance adjustment. The 13" and 19" BT Series monitors (all screen sizes meas diag) have our special CompuFocus™ picture tube. Add to that a switchable comb filter and the result is increased definition and color sharpness.

Perhaps the most versatile of the BT Series are the 7" monitors. There's one that operates on both AC and DC so it's perfect for field use. Another model includes switchable line inputs, external sync terminals and is available as a single unit or in a dual rack.

Our CT monitors also come in a wide variety of configurations. You can choose from our 19" models. One comes with a tuner, and one can be used internationally because it lets you switch between NTSC, PAL and SECAM. The CT Series 13" and 14" monitors include models with a built-in tuner, NTSC composite and RGB inputs for use with computer graphics. And when light weight and portability are important, there's the CT Series 5" monitor receiver.

For medical use, the MT-1340G conforms to the UL-544 standard. Its Data Grade in-line picture tube provides the precise resolution medical applications require. While RGB inputs assure you of critically accurate color reproduction.

By now it should be clear, no matter what your special application, the monitors in the BT, CT and MT Series have the right qualifications. Monitor pictures simulated.

For more information, call your nearest Panasonic regional office. Northeast: (201) 348-7620. Midwest: (312) 981-4826. Southeast: (404) 925-6835. Southwest: (214) 257-0763. West: (714) 895-7200. Northwest: (206) 251-5209.

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Tips from the field

By Edward Alciatore III

When we installed a new master control switcher, it became necessary to boost the output levels of several Spotmaster 500-series audio cart machines to +8dBm, as required by the new audio-follow-video system. Because these machines would be used only at this switcher, we did not want to spend hundreds of dollars per machine to install distribution amplifiers or line amplifiers.

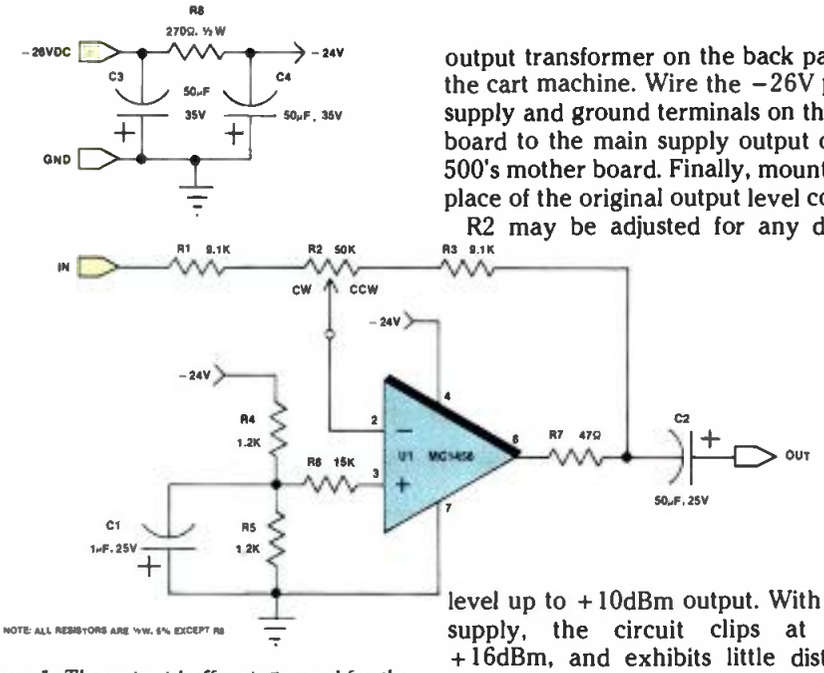

Figure 1. The output buffer stage used for the modification project.

The circuit shown in Figure 1 provided a simple solution at minimum cost. It is arranged to fit in place of the original output level control, both electrically and physically. Figure 2 shows the layout used to construct the circuit.

Although component placement is not critical to performance, we chose this design because it allowed the modification card to fit in place of the original output level pot. You should check the clearance in your machine before starting construction.

Build the amplifier on perf-board with push-in terminals. Glue R2 in place with fast-drying epoxy. The original output level control should be removed and shielded cable run from the program amplifier output to the input and ground terminals on the line amplifier board.

Another cable goes from the new board output and ground terminals to the output transformer on the back panel of the cart machine. Wire the −26V power supply and ground terminals on the new board to the main supply output on the 500's mother board. Finally, mount R2 in place of the original output level control.

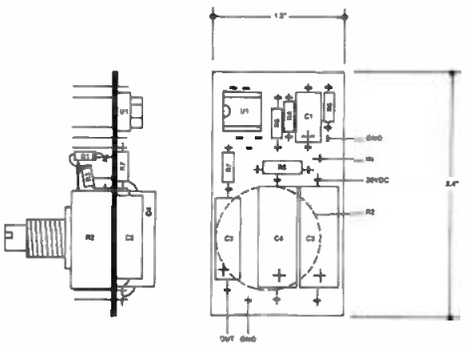

Figure 2. The suggested component layout of the buffer amplifier board.

R2 may be adjusted for any desired level up to +10dBm output. With a 26V supply, the circuit clips at about +16dBm, and exhibits little distortion below that point. The circuit has a tendency to "motorboat" at outputs above +10dBm, but with a little work, this could be cured.

U1 is an improved version of the 741 operational amplifier, which is capable of a high output level over the entire audio band. R1, R2 and R3 form the feedback network and gain control with a 32dB range, from a 16dB loss to a 16dB gain. The decoupling network of C3, C4 and R8 is necessary to prevent feedback to the low signal level stages of the machine.

Because both the input and output terminals of U1 operate at about one-half of the supply voltage, C2 is required for dc blocking on the output. Make sure the program amplifier's output is capacitively coupled to the input of the new board.

Older and newer models of the 500-series have been modified with this circuit with equal success. With appropriate changes, this board could also be used to boost the output of other types of audio equipment.

If this modification is used on equipment that does not have an output transformer, add a 600Ω-to-600Ω transformer rated for at least +10dBm output, or try the circuit shown in Figure 3. R7 and R12, along with the output impedance of the IC, determine the output impedance of the buffer amplifier ($R_{out} \cong R7 + R12 + 50\Omega$).

For positive power supply voltages, the circuit can be modified by reversing the polarity of all electrolytics and changing pin 4 of the MC1456 to ground and pin 7 to +V. Remember that the maximum output level available from the buffer stage will vary with the power supply voltage, which should be about 24V. An MC1556 allows power up to 44V, if higher output levels are required.

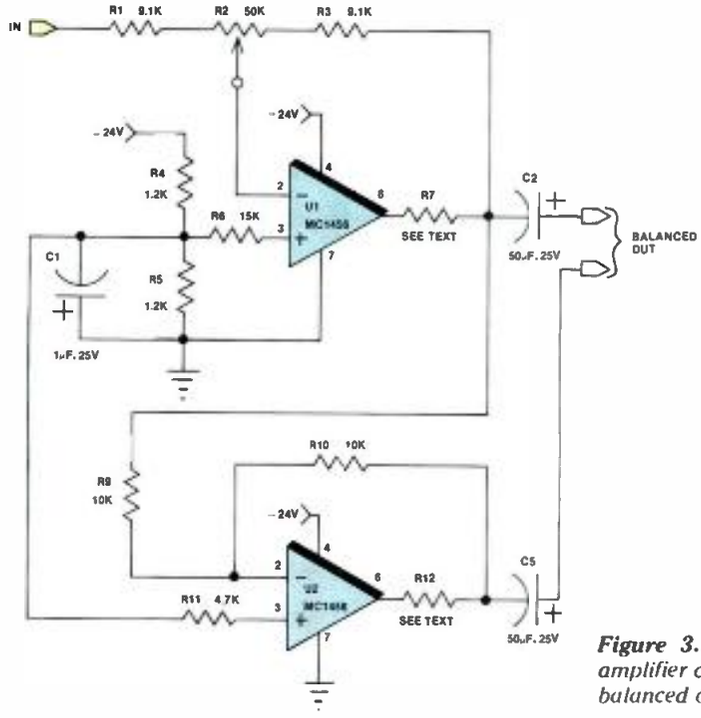

Figure 3. An optional buffer amplifier circuit that provides a balanced output.

Alciatore is project engineer, WPLG-TV, Miramar,FL.

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The first, PCN-1400 Series VHF Transmitters, includes a powerful new one tube 35 kw system, available in the U.S. for the first time.

All our new V's give you 50% improvement in MTBF (now 30,000 hours). With 30% fewer exciter parts to repair and replace. And stereo without modification. They're 100% solid-state up to 10 kw, and only one tube to 35 kw.

Up the dial, you'll find our 4th and most futuristic generation of IF modulated UHF transmitters. The PCU-900 Series.

These new U's range from 10 kw to 120 kw, with maximum output power to 240 kw (parallel running). And feature new, high efficiency Amperex or EEV Klystrons. To cut your power consumption, maintenance, and replacement costs.

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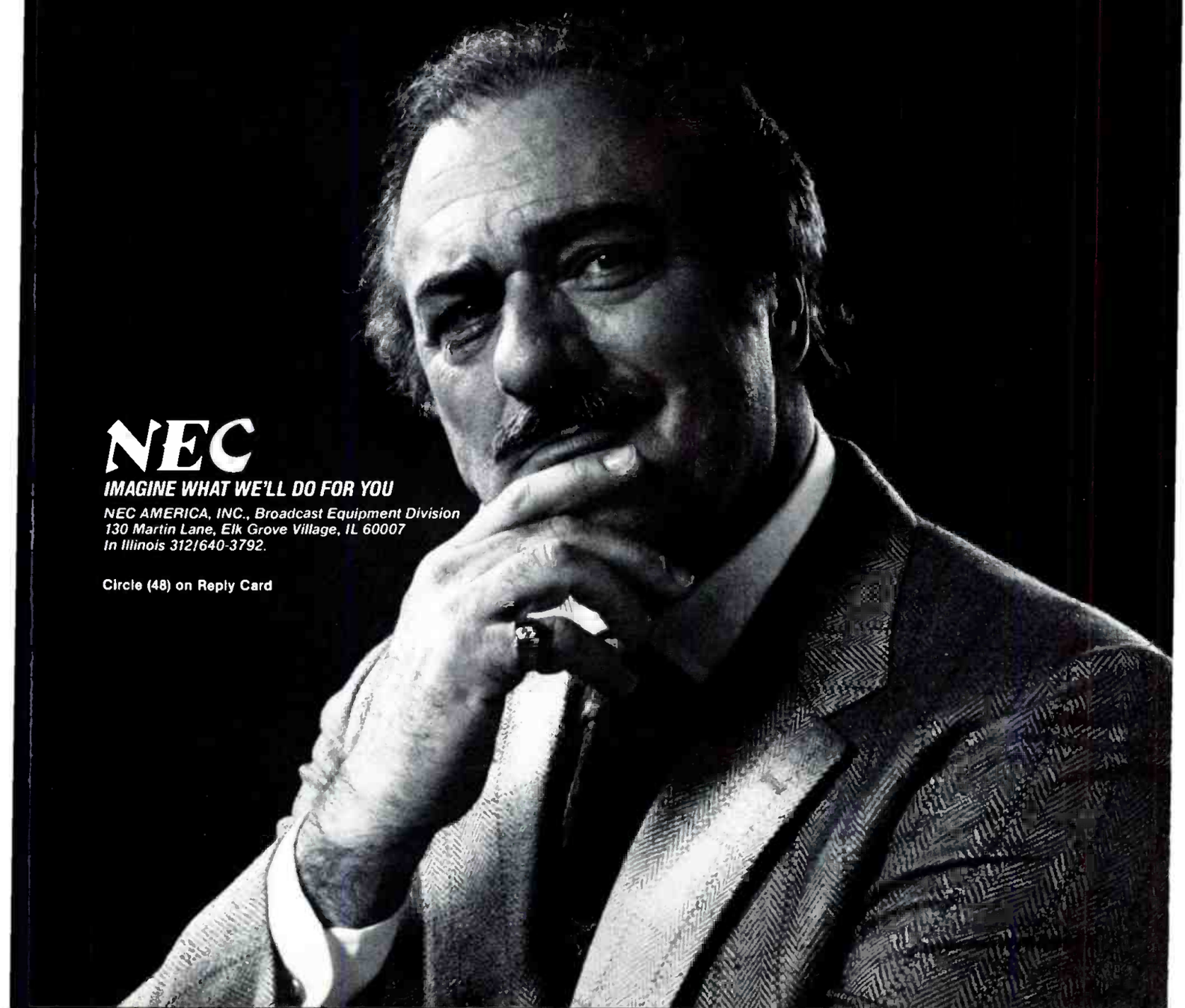
For more information, call Joe Engle toll free at 1-800-323-6656.



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Business

Mitsubishi approves Ampex tape

Ampex digital audio mastering tape has been approved by Mitsubishi for use on its X-800 and X-850 32-channel digital recorders, according to a joint announcement made by Warren K. Simmons, senior product manager, *Ampex Magnetic Tape Division*, Redwood City, CA, and Tore B. Nordahl, president, Digital Entertainment Corporation, a subsidiary of Mitsubishi Electric Sales America. The approval comes after more than one year of product development.

New order for Thomson-LGT in Turkey

Thomson-LGT has entered into a 20-million francs contract with Turkish Radio Television for the supply of TV relay transmitters. The order concerns the supply of 18 solid-state 1kW relay transmitters, equipped with an automatic switchover providing for reserve stages to take the place of failing ones. They will be installed at the end of 1985, in 18 TV centers, in order to cover the shadow regions of Turkey's first channel. This new equipment complements the 58 transmitters and relay transmitters already installed by Thomson-LGT in Turkey.

Catel delivers fiber-optic systems to ATC

On April 3, 1985, the first commercial, multichannel, single mode fiber-optic link for a CATV operation was activated in Indianapolis. The installation of the optical fiber cable plant, approximately 7.9 miles, was a cooperative effort between ATC and Indiana Bell. Fiber-optic cable was overlashed by ATC along the existing CATV plant between Catel's optical transmitters and receivers and the series 3000 broadband FM transmission system.

This link-up provides local advertisers in both the American Cablevision of Indiana (a division of ATC) and Indianapolis Cablevision (an independent system) access to eight cable networks, including ESPN, Cable News Network, MTV, Lifetime, The Nashville Network, Financial News Network, USA Cable Network and Christian Broadcasting Network.

SSL opens Far East office

Solid State Logic (SSL) has announced the opening of a new regional headquarters in Kowloon, Hong Kong, and has affirmed its commitment to the Far East recording and broadcast industries. The office will serve SSL clients in China, Singapore, the Philippines, Malaysia, Indonesia and Thailand. There are currently six multilingual staff members operating under the direction of SSL Far East's managing director, Bingo Tso.

Solid State Logic Far East is headquartered at Austin Tower, Suite 301, 22 Austin Ave., Tsimshatsui, Kowloon, Hong Kong. The telephone number is 852-3-721-2162; Facsimile 852-3-723-5465; Telex: 47580.

HM Electronics relocates

HM Electronics, San Diego, has moved to a new facility in the Scripp's Ranch area. The new building has allowed increased production capability and expansion of company personnel.

R-42 diversity receiver • Now with GaAsFET's.

Improved sensitivity and system range, with ultralow noise.

Cetec Vega's top-of-the-line PRO PLUS R-41 and R-42 wireless-microphone receivers have quickly become the worldwide standard of excellence. Overall quality of the PRO PLUS wireless system is equal to wired microphone systems, with respect to dynamic range, signal-to-noise ratio, distortion, etc. *We invite your comparisons.* Check these features of the new, improved PRO PLUS receivers:

- **GaAsFET front end.** Provides the highest achievable sensitivity for maximum system range. Also incorporates a high-performance helical filter.
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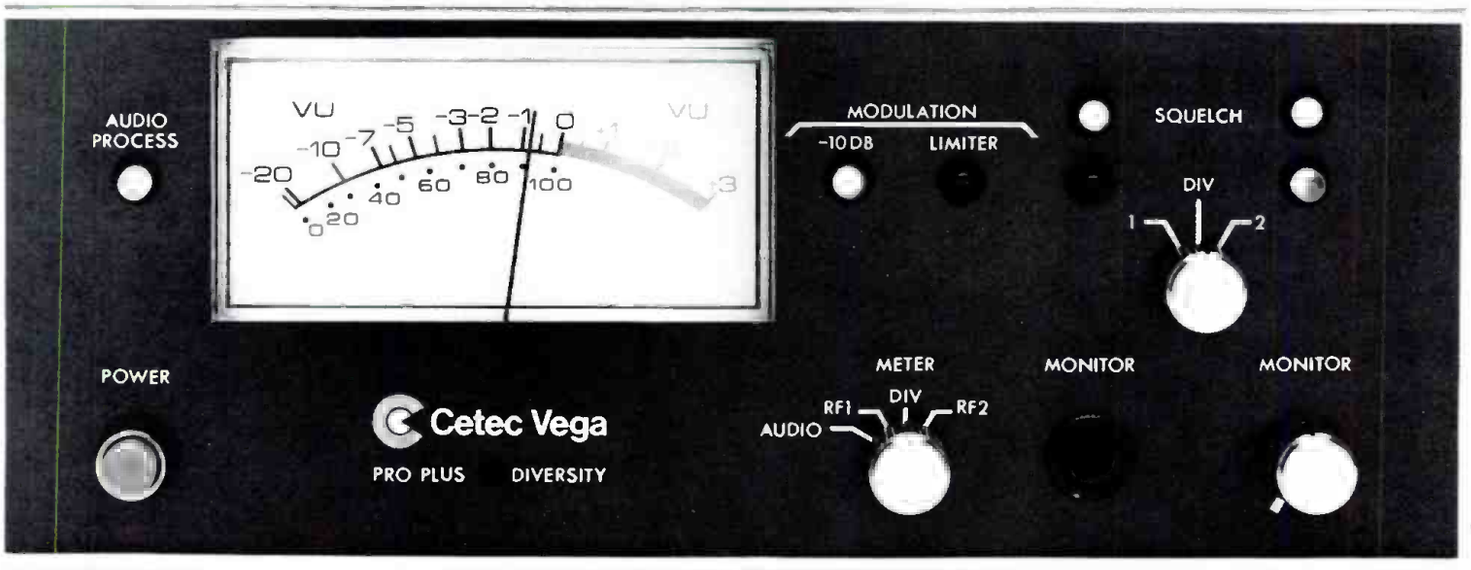
- **True dual-receiver diversity.** The R-42 diversity system is the most reliable method to avoid dropouts. The R-41 nondiversity receiver has all of the other features of the R-42.

PRO PLUS wireless-microphone systems achieve the highest performance possible with today's advanced technology.

Write or call for further information and location of your nearest dealer: Cetec Vega, P.O. Box 5348, El Monte, CA 91734. (818) 442-0782.

The best wireless gets even better.



Cetec Vega
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Soundcraft receives Queen's Award for Export

Soundcraft Electronics, London, England, has received its second Queen's Award for Export. The award, which is given to companies who can show an outstanding increase in export business over a 3-year period, was first awarded to Soundcraft in 1979. That was the first time a professional audio mixing console manufacturer had received the award. The award marks another first; Soundcraft is the first console manufacturer to receive two Queen's Awards for Export. The announcement of the award came at the opening ceremonies of its new manufacturing complex in Borehamwood, Hertfordshire.

Paltex sales to major corporations

California Paltex Corporation, Los Angeles, announced the sale and installation of its Esprit editing system to several major corporations, including the Prudential Life Insurance Company. Prudential will use the editing system at its corporate headquarters in Newark, NJ, for making training films.

Howe relocates facilities

Howe Audio Productions has moved its manufacturing and corporate facility. The new facility is in the Flatirons Industrial Park at 2300 Central Ave., Suite E, Boulder, CO 80301.

ATTI contract awarded to California Microwave

California Microwave, Sunnyvale, CA, announced that its subsidiary, Satellite Transmission Systems (STS) has received a letter of intent from AT&T International (ATTI), which will lead to an $8.5 million contract for satellite earth station equipment. STS is proceeding with the project under ATTI's first-phase funding.

RMS relocates western office

RMS Electronics, Bronx, NY, announced that it has relocated its western operations office. The new office address is 27281 Las Ramblas, Suite 200B, Mission Viejo, CA 92691.

The telephone numbers remain the same. In California, call toll free 800-247-8435. In the continental United States, Puerto Rico, U.S. Virgin Islands, Alaska and Hawaii, call toll free 800-624-2511.

AEG receives orders for transmitters

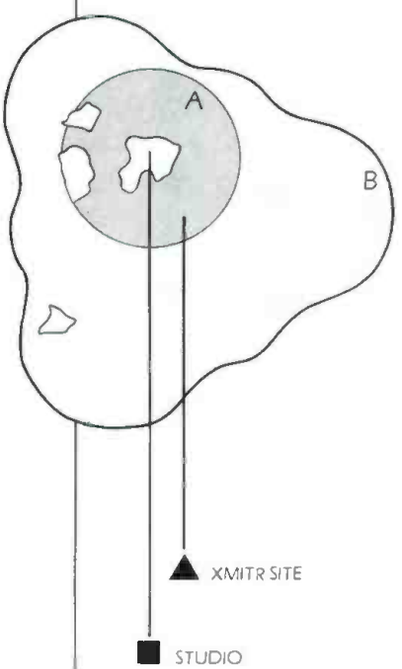
AEG-Telefunken, parent company of Bayly Engineering, of Ajax, Ontario, Canada, has received orders worth several million dollars for high-power AM broadcasting transmitters. The energy-saving Pantel modulation system, invented by AEG-Telefunken, was influential in completing this sale. Two 300kW transmitters will be used in the international shortwave service of Radio Japan. A 500kW shortwave transmitter will be supplied for the Voice of America at the Greenville Station in North Carolina, and will be installed and ready for service in mid 1986.

BMA opens San Francisco office

Broadcast Marketing Associates, San Jose, CA, has opened a branch office in San Francisco and has named Bud Schneider as manager. The new address is 131 Townsend St., San Francisco, CA 94107. The telephone number is 415-543-3191.

IF TRANSMITTER FAILURE HAS CAUSED YOU TO LOSE REVENUE, LET US INTRODUCE OUR INEXPENSIVE EMERGENCY TRANSMITTER.

What happens at your station when your FM transmitter goes down? Or your studio transmission link is disrupted? Or a power loss at the transmitter site occurs?



A — Coverage using QEI studio location transmitter

B — Coverage using station's primary transmitter

QEI has an inexpensive solution. Our low-power FM transmitter designed for studio operation can handle all these emergencies and keep you on the air. In many cases you'll retain the majority of your audience simply because your studio is usually located more central to your market than your transmitter site.

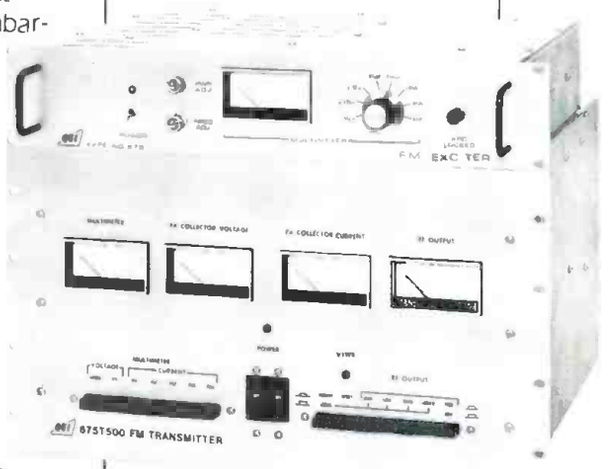
For a small investment your station will gain protection against lost revenues and the embarrassment of discontinued service.

QEI's low-power transmitters are all solid-state and are available in 150w, 300w or 500-watt power output levels. No warm-up is required. They are on the air in less than 10 seconds . . . and have hundreds of thousands of trouble-free hours. Virtually silent in operation, all our transmitters use QEI's famous 675 synthesized exciter.

So cover yourself with a QEI low-power FM transmitter located at your studio site . . .

Solve the problems caused by an STL or main transmitter failure . . . and do it on a modest budget.

For more information contact John Tiedeck at 609 728-2020. He will put a package together to meet your station's needs.



QEI Corporation
One Airport Drive
P.O. Box D
Williamstown, NJ 08094
Phone: 609-728-2020

QEI Corporation

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Universal Studios orders HME mics

HM Electronics, San Diego, announced that Universal Studios recently placed an order for 53 HME System 820 wireless microphones.

Solid State Logic sells world wide

Solid State Logic, Oxford, England, has announced the sale of three SL 6000 E series stereo video systems to Sveriges Television, Sweden's national network. All three systems will be delivered to the network's production center in Stockholm; the first will be installed in time to handle coverage of the Swedish General Elections. The second system, also planned for use in live teleproduction, will be shipped in late 1985, and the third system, which will service post-production needs for the network, is due for early 1986 delivery.

In West Germany, Solid State Logic has completed installation of a 64-channel SL 6000 E series stereo video system for Suedwestfunk Television (SWF-TV). The custom L-shaped system is being used for large-scale live TV production at SWF's Studio 5/6 complex in Baden-Baden. Elsewhere, the new audio mobile unit of RTVE (Radio y Televisión Español) in Spain has been outfitted with a 32-channel SL 6000 E series stereo video system equipped with the SSL studio computer. The mobile, based in Madrid, provides both live broadcast and multitrack recording for delayed broadcast.

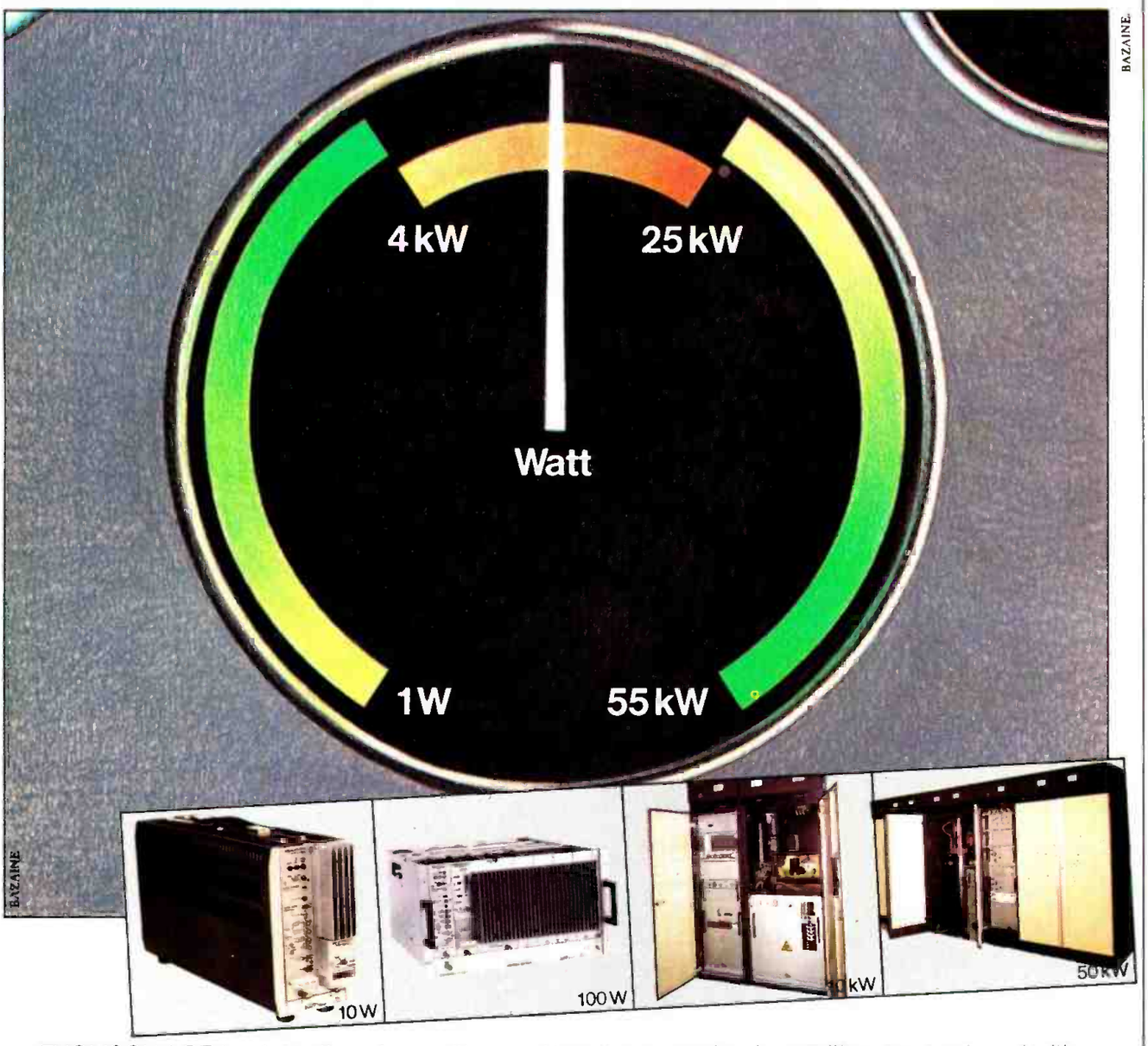
Solid State Logic has also been awarded a contract to supply two SL 6000 E series stereo video systems to Television South (TVS) in Southampton, England. The first system, a 48-channel console equipped with the SSL studio computer, is due for an August installation in the completely refurbished Studio 1 production complex. Danmarks Radio and Television have taken delivery of four Solid State Logic SL 4000 E series master studio systems for its Radio House complex in Soborg, and NBC Television has installed its second SL 6000 E series stereo video system on the Brooklyn Stage in New York City.

Canadian station selects Ikegami

Ikegami Electronics, Maywood, NJ, has announced the sale of five HK-322 and two HL-79E Triax broadcast color TV cameras and color monitors to CFCN-TV, Calgary. The sale was made through Applied Electronics Limited, Ikegami's Canadian distributor, and marks the first HK-322 purchase in Canada. CFCN-TV is using the Ikegami equipment in its 48-foot mobile unit. The station has covered important sports activities and special events in Canada since 1962.

Television Transmission

CAPABILITY AT ALL POWERS



THOMSON-LGT, leader in the field of transmission, manufactures a complete range of television transmitters and transposers, from 1 W to 55 kW in all standards allowing single or dual sound broadcasting IRT or FM/FM.

A high level of technology has allowed the modular design of a complete range of fully solid state transmitters and transposers up to 500 W in UHF an 4 kW (2 x 2 kW) in VHF.

In low power, reduced power consumption and small dimensions are the preferential elements of small networks and all television networks supplied with new sources of energy, such as solar power. In VHF and UHF THOMSON-LGT transmitters are equipped with TETRODE tubes up to 20 kW and KLYSTRONS from 25 kW to 55 kW. The exceptional efficiency of these tubes, provides for large energy savings.

These transmitters can be operated in either active reserve or passive reserve, thus providing for flexibility of application.

30 YEARS OF BROADCASTING EXPERIENCE.

THOMSON-LGT

LABORATOIRE GÉNÉRAL DES TÉLÉCOMMUNICATIONS
51, boulevard de la République / BP 51 / 78401 Chatou Cedex / France. Tél. (3) 071 92 60.

5272

Circle (81) on Reply Card

People

Camille Perillat has joined the magnetic tape division of Ampex Corporation, Redwood City, CA, as associate administrator, marketing communications. Perillat will administer the division's national trade show schedule, Ampex Golden Reel Award program, direct mail advertising and print production. Prior to joining Ampex, Perillat was an account representative with INFOMEDIA Corporation.

Alan McIlwaine and **David Fenton** have joined Rank Electronics Pty, Melbourne, Australia. McIlwaine will be manager, TV products. He was a former marketing manager at Rank Cintel. Fenton has been appointed sales manager, Rank Cintel UK.

George Gilbert and **David Grinsted** have assumed positions at Solid State Logic, Stonesfield, Oxford, England. Gilbert has been appointed service manager. He will supervise all UK-based console and computer service and coordinate new systems commissioning. Grinsted will be training manager. He will conduct the company's comprehensive 5-day maintenance and operational courses at Oxford, and coordinate SSL's international technical training program.

Donald Millar and **Russell Knight** have received new positions at Dielectric Communications, Raymond, ME. Millar has been promoted to senior field service engineer. He has eight years experience with Dielectric broadcast and custom RF products. Knight has been transferred from the custom repair and factory service group. He brings 20 years experience with Dielectric's dehydrator products.

John Shike, Richard Sirinsky and **Richard G. Canfield** have been appointed positions at CMX Corporation, Santa Clara, CA. Shike has been named product manager. He previously worked at Laumic where he handled sales, training and customer service activities. Sirinsky has been named director of sales. He was a former vice president and general manager of AF Associates. Canfield has been named vice president of operations. He joined CMX in 1984 as director of manufacturing and materials.

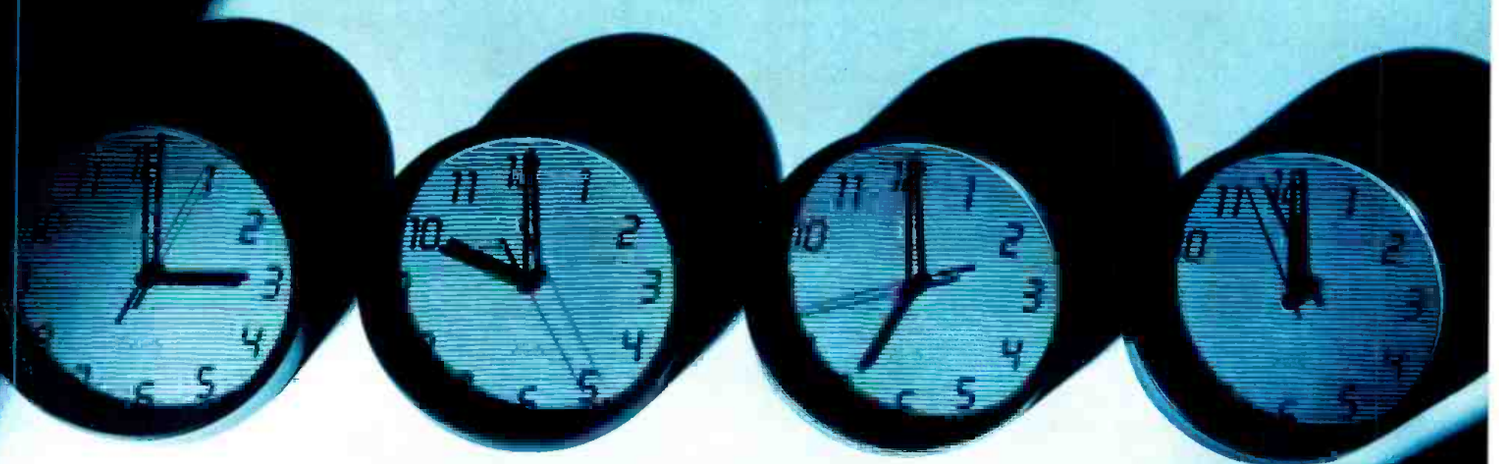
Brent Judd has joined Fujinon, Carson, CA, as the lens company's Western region manager. He has more than 20 years of broadcast engineering experience. Judd will be responsible for OEM, dealer and end user sales, support and service for the west coast as well as management of the office and its staff.

Mike (Makato) Sato has been named director, telecommunications and accessories, for Sony Consumer Products Company, Park Ridge, NJ. Sato will be responsible for telecommunications and audio/video accessory products. Sato joined Sony in 1970 and has been with Sony Consumer Products Company for five years.

George Alexandrovich Sr. is president of his own company, Island Audio Engineering (IAE), and its subsidiary Dynamic Sound Devices, Commack, NY. IAE and its subsidiary are serving broadcast and recording industries by designing and manufacturing custom audio devices and systems. Alexandrovich was former vice president of engineering and professional products manager for Stanton Magnetics.

Bruce E. Heeb has been appointed as vice president of engineering at Switchcraft, Chicago. Heeb joined Switchcraft from Federal Signal.

LOCK AROUND THE CLOCK.



LONDON NEW YORK LOS ANGELES TOKYO

The ability to synchronise video and audio recorders is an increasingly vital facility required in studios all over the world. As much as three-quarters of today's audio recordings involve a visual aspect, and recording is more international than ever before. Basic tracks in New York, string and brass overdubs in London, dubbing in Los Angeles ... modern international productions need an international standard for machine synchronisation, and there's really only one: Q-Lock by Audio Kinetics.

It's the same all over the world. The simple, uncluttered controls. The custom interfaces that suit your machines. The remarkable software capability. The integrated system with built-in expansion possibilities. It all adds up to accuracy and ease of use, and that means speed and creative flexibility. It means Q-Lock. If you're looking for an international standard, you've found it.

Now, more than ever, you need to keep in sync with the times. Lock around the clock – with Q-Lock.

Audio Kinetics Inc.
1650 Hwy 35, Suite 5, Middletown,
New Jersey 07748, U.S.A.
Tel: 201-671-8668

AUDIO KINETICS

Audio Kinetics Inc., 4721 Laurel Canyon Boulevard,
Suite 209, North Hollywood, California 91607, USA
Tel: 818-980-5717

Circle (86) on Reply Card

Criss Onan has been appointed sales manager of Northeast Broadcast Lab, South Glens Falls, NY. Onan joined the company a year ago after managing several broadcast stations.

Jim Peacher has been appointed Western sales manager for EECO's video products division, Santa Ana, CA. Peacher will be responsible for directing the sales of EECO's line of videotape editing systems and time code peripheral products, as well as providing sales support for its expanding network of authorized distributors in the Western United States. Peacher joins EECO following eight years with Hoffman Video Systems, where he was sales manager.

Waldemar (Waldy) Wisniewski has joined HEDCO, Grass Valley, CA, as senior design engineer. Wisniewski will be responsible for the microprocessor-controlled products manufactured by Hedco. Wisniewski spent the last 13 years as senior design engineer at Exploration Logging.

Charlie Winkler, Mark D. Taylor, Greg Silsby and **Rock Wehrman** have received new positions with Audio-Technica, Stow, OH. Winkler will be manager of professional products marketing and sales. Taylor was named national sales manager for music products. Silsby has been appointed marketing manager, studio products, and Wehrman will serve in the newly created position of assistant advertising manager.

John P. Ahrens and **Logan "Pat" Hines** have taken on new positions at ADDA Corporation, Los Gatos, CA. Ahrens has been named Western regional manager. He will be responsible for all direct and distributor sales for the far Western states. Hines will serve as president and chief executive officer. He was a former president and chief executive officer at Advanced Matrix Technology.

Lawrence H. Nadler has been named field sales service engineer for the Southeast region at Ikegami, Maywood, NJ. Nadler will provide technical support for Ikegami's complete line of broadcast products to customers in Georgia, Florida, Alabama, North and South Carolina, Tennessee and Puerto Rico. He has more than 15 years of experience in the mobile broadcast engineering field.

Nadler was formerly director of engineering at F&F Productions, a division of Hubbard Broadcasting.

Frank Caletti, has been named "Manufacturing Man of the Year," at Ampex, Redwood City, CA. Caletti is manager, fabrication, at Ampex's Colorado Springs facility, which manufactures professional videotape recorders and digital special effects equipment. Caletti is responsible for the plant's fabrication operation, which covers engineering, production and production control of piece parts and assemblies for the audio-video systems division, data systems division, computer products division and the Ampex Switcher Company in Wheat Ridge, CO.

Tom Kidd has been appointed marketing manager at Hubbard Communications, St. Petersburg, FL. He was applications engineer with Microdyne previously.

Mark Stenejhem has been appointed regional manager for Maxell's professional industrial division, at Maxell Corporation, Moonachie, NJ. Stenejhem will be responsible for the sales of professional/industrial video products in Washington, Oregon, California and the Rocky Mountain states.

Continued on page 116

Are YOU Suffering From

THE STEREO NIGHTMARE?

For years, science has known that many people dream in colour. Recently though, large numbers of television audio engineers are experiencing an entirely different phenomenon: The Stereo Nightmare.

The VTR starts arguing with the synchroniser. The multitracks struggle with the VTR. As the music and efx fight the dialogue, the automation is having yet another brilliant disagreement with itself. The clock looms ominously. The producer is emitting homicidal glares. Maintenance tries to reach the scene, but can't break through the writhing mass of incompatibilities. In the middle of this chaos, a nervous voice comes on the intercom and informs you that the entire management structure has just exploded!

The most frightening thing is that The Stereo Nightmare strikes when its victims are wide awake. The syndrome is all too real. And as it spreads, the industry's loss in man-hours and production costs has become staggering.

Fortunately, there is a cure. Developed by dedicated specialists in a private research laboratory near Oxford, England, it's effectiveness has been proved in case after case, by leading broadcasters and post-production houses throughout the world. We call it the SL 6000 E Series Stereo Video System. Our clients call it a dream come true.

If your facility suffers from The Stereo Nightmare, you owe it to yourself and your family to get all the facts. Write for our 40 page colour booklet on the SSL Stereo Video System. Better yet, give our specialists a call. We'll have you working faster and sleeping better — in no time at all.

Solid State Logic

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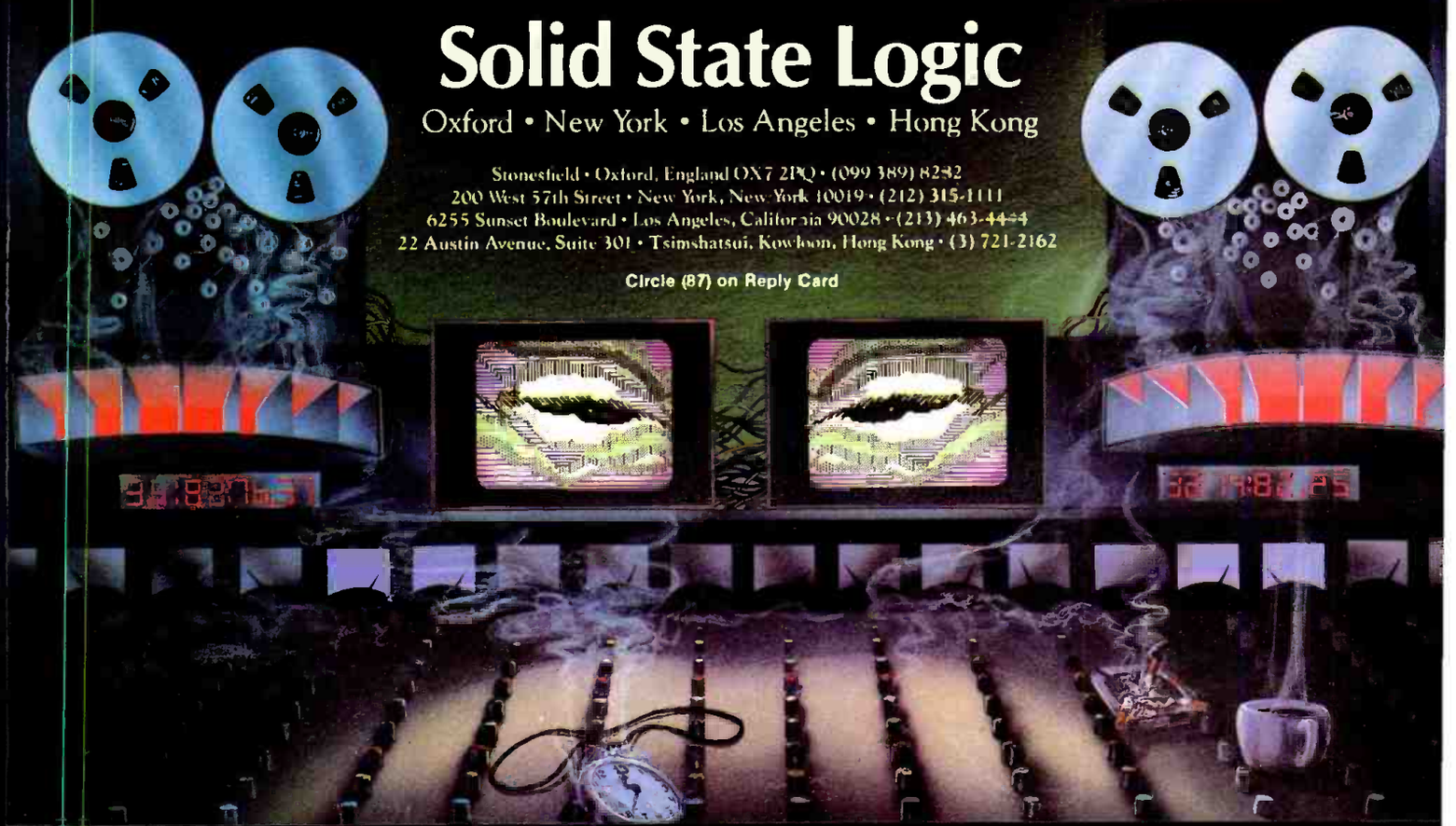
Circle (87) on Reply Card



GO WITH THE WINNERS. DYNAMAX CTR100 SERIES

"We installed Dynamax CTR100s at KIIS-FM, #1 in Los Angeles. We plan to make Dynamax Cart Machines standard equipment at all our stations."

Joe Dorton
President
Gannett Radio

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BROADCAST PRODUCTS BY FIDELIPAC

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Circle (117) on Reply Card

Why are...

the Philips LDK 6 and LDK 26 the fastest selling cameras in their class?

Why have...

$40,000,000 in orders been placed in the past 2 years for the LDK 6 family . . . by networks, groups, independents, public broadcasting service stations, universities and teleproduction facilities?

Total Computer Control

That's why.

What if...you had to replace a camera tube 15 minutes before the 6 o'clock news?

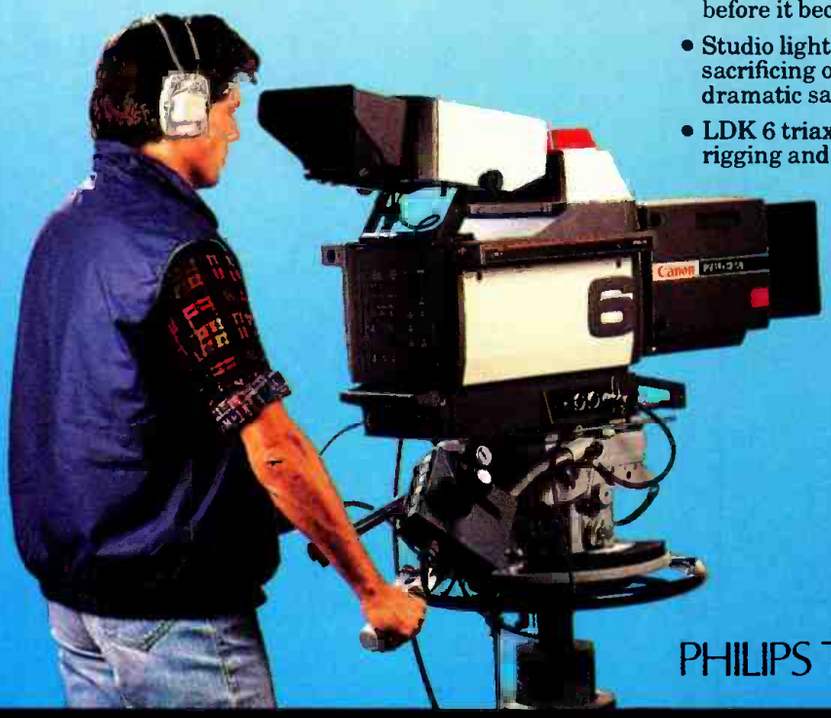
Impossible? No.
An LDK 6 will have you back on-air within 10 minutes... before the anchor team has a chance to panic. The LDK 6 exclusive *Total Computer Control* makes the difference... a major advance over the *partial* control of all other 'automatic' cameras.

Only the *Total Computer Control* of the LDK 6 makes feats such as this possible. It also permits you to use unmatched tubes, because the computer has total extended range control of all tube parameter adjustments. Even back focus is adjusted automatically, another Philips exclusive. There are no preset electrical adjustments; therefore no pots to tweak.

Further, the 'full auto set-up' program aligns the green channel automatically, using the diascope integral to the camera head (other cameras use a lens diascope). Red and blue are subsequently aligned to green.

And there are more *Total Computer Control* operating features that clearly elevate the LDK 6 above the partial-control cameras:

- On-line diagnostics warns of a potential problem . . . before it becomes a fault that results in costly downtime.
- Studio light levels can be reduced 40% to 70% without sacrificing operating flexibility or picture quality, with dramatic savings in lighting and cooling power.
- LDK 6 triax system hugely reduces costs of pre-cabling, rigging and service . . . plus extra between-studio maneuvrability means less cameras.



Prove the *Total Computer Control* difference to yourself. A demonstration will prove why the LDK 6 family is years ahead in design, performance and cost-effectiveness.

Call or write for a demonstration or request the descriptive LDK 6 or LDK 26 (2/3" version) technical brochure.

Philips Television Systems, Inc
900 Corporate Drive
Mahwah, New Jersey 07430
(201) 529-1550

PHILIPS TELEVISION SYSTEMS, INC.

LDK6 – the total computer control camera.

PHILIPS

PHILIPS

Reliability through Quality

Circle (89) on Reply Card

Bob Johnston has been appointed Midwest regional sales manager, professional products, at Ikegami, Maywood, NJ. Johnston will have sales management responsibilities for 13 states ranging from Ohio to Nebraska and extending southward to Missouri, Kansas and Kentucky. Johnston previously served as Midwest regional sales manager for Hitachi Denshi.

Dennis M. Heymans has been appointed marketing manager at Micro Communications, Manchester, NH. Heymans will be responsible for customer sales, market development, contract negotiations and customer relations. Heymans has extensive experience in the design and testing of MCI's products including the responsibility of worldwide installing and servicing of MCI's RF systems. He joined MCI in 1973 as a design technician.

Sergio Marino has joined Lake Systems, Newton, MA, as senior systems sales consultant. Marino will be responsible for the custom design of automated systems for the TV broadcast industry using the La-Kart automation system. He brings more than 20 years of experience in sales and engineering in the audio/video industry.

Michael Wilke has been promoted from product manager, Ampex 196 and 175 videotape products, to marketing manager, videotape products at Ampex Corporation's magnetic tape division, Redwood City, CA, according to Phillip M. Ritti, division director of marketing. Wilke will be responsible for the development and implementation of all Ampex videotape marketing programs. He will oversee and coordinate the activities of all video product managers.

Howard Mullinack has been appointed marketing and sales manager for Orban Broadcast Products, Orban Associates, San Francisco. Mullinack will be responsible for coordinating the Orban broadcast dealer network worldwide, and developing the markets for the Optimod-AM, FM and TV products. Before joining Orban, Mullinack held management positions at PRS and Lake Systems.

Robert Cavanaugh has joined Dolby Laboratories, San Francisco, as technical marketing consultant. Cavanaugh has been involved with the professional audio industry for more than 10 years in areas of technical sales and product design. He will be responsible for Dolby professional product sales in the United States, with an emphasis on product applications and training, as well as dealer relations.

Lon Le Master has assumed the position of president of U.S. operations at Trident's new offices located in Los Angeles. Le Master has an extensive background in the professional recording industry and experience in sales and marketing with Everything Audio.

Roy C. Blankenship has been appointed national sales manager for Symetrix, Seattle. Blankenship was previously employed as a manufacturer's representative with Michael Chafee Enterprises. His experience includes retail sales, marketing, computer operations and manufacturing. Blankenship's duties will include domestic sales, operations and marketing.

Peter I. Jorgensen has joined Modulation Associates, Mountain View, CA, in the newly created position of vice president of operations. Jorgensen will be responsible for all operations departments, including materials, manufacturing engineering, production, facilities and technical services. Jorgensen has management experience at Ultratech-Stepper where he was manager of manufacturing engineering.

MAGNETIC TECHNOLOGY THAT ATTRACTS WORLD ACCLAIM.

In the world of magnetic technology, one name has attracted world acclaim. Producing more formats and providing more service than anyone else.

One name has won world recognition. With an Emmy in 1983 for pioneering the first videotape—and a Scientific and Engineering Award from the Academy of Motion Picture Arts and Sciences in 1985 for developing Cinetrak™ Magnetic Film.

That one name is Scotch™ Magnetic Technology—number one in the world of the pro.

Scotch™
AUDIO & VIDEO TAPES

NUMBER ONE IN THE WORLD OF THE PRO

3M

Circle (93) on Reply Card

New products

Lightning protector

Vicon Industries offers the model V15-LP lightning protector as a means of guarding the circuitry of sophisticated video components from lightning-induced power surges. The unit is easily installed in series between the video input cable and the video component using a supplied BNC connector.

The V15-LPs low internal capacitance assures signal transmission, while the voltage suppression circuitry provides spike protection. The device is required only on inputs that may be threatened by lightning, eliminating the cost of protecting those inputs not subject to electrical surges.

A silicon transient suppressor, which has a positive surge capability and fast response time, allows the unit to protect video equipment from repeated lightning strikes.

Circle (350) on Reply Card

Boundary-effect condenser mics

Shure Brothers has announced two additions to its line of state-of-the-art boundary-effect (surface) microphones. They are models 819 unidirectional and 809 omnidirectional condenser microphones.

Depending on whether an omni or a uni microphone is required, the 819 and 809 can be used for general PA and sound reinforcement applications; sound reinforcement, recording or teleconferencing of conference room or boardroom meetings; micing of musical instruments for live sound reinforcement or recording; film and video production, such as that done by college and university TV stations, small video and film production companies, CCTV and multimedia production houses; and rental applications.

Circle (351) on Reply Card

Portable wireless microphone

HM Electronics introduces a professional portable wireless microphone system for broadcast, ENG and EFP.

The system uses HME's Dynamic Expansion II, which allows a usable dynamic range of more than 115dB and full frequency response. The compact, full-function, battery-powered receiver can be powered by external dc or an available ac adapter. Up to 20 systems can be used compatibly because of RF shielding and filtering. An Auto-Lok discriminator tracks the transmitted RF signal to minimize audio distortion and to improve capture ratio performance.

Circle (352) on Reply Card

Machine control line

Mycomp Technologies Corporation (MTC) has announced its expanded line of Sericon machine control products with an analog status feedback system.

The system allows control of any number of record VCRs within a duplication facility from one or more remote locations. Controls include the standard VCR transport functions, plus special duplicator functions such as eject and hi-fi on-off. Delegation of the machine control signals to individual VCRs and banks of VCRs is possible through a digital serial data link (unidirectional) system or a digital serial RS-422 (bidirectional) system. This allows for VCR function and analog signal status feedback for certain pre-QC functions, monitored via an MTC computer interface.

Circle (353) on Reply Card

¾-inch videotape

Ampex Magnetic Tape Division is expanding its line of broadcast quality 197 ¾-inch videotape, with the addition of four configurations. The 197-BCS05 is a 5-minute mini-cassette that operates in portable and standard-sized VCRs.

For customers to safely ship commercial spots, Ampex also offers a 197-BCS05W (mini with shipper). Both products feature the ENG/EFP log sheets and user-friendly labels.

The 197-BCA45 (45-minute cassette) is to meet the news industry's demands for news editing and archiving of stories, and the 1987-BCA05 (5-minute) is designed for TV stations using ¾-inch U-matic VCRs in a cart capacity for commercials.

Circle (354) on Reply Card

Patchbay

Gaines Audio has introduced the model PB-16 patchbay, a 16-position, 2-row bay with ¼-inch phone jacks on both the front and back panels, in balanced and unbalanced versions.

Outboard equipment plugs in to the back of the unit. Patching is done with any standard ¼-inch phone plug.

Circle (400) on Reply Card

Transmitter/character generator

Gray Engineering Laboratories has introduced a SMPTE edit code transmitter, dual character generator. The model DT-213 generates longitudinal time code at 24-, 25- or 30-frame rates from sync or an internal crystal oscillator. In the NTSC 30-frame mode, the frame count can be color frame-locked. Field rate time code is also available to aid in video-assisted film editing. An advanced slave decoding system (jam-sync) is employed to minimize the effects of code drop-outs while in the slave mode.

A video character generator provides for display of both time and hexadecimal user bits. Using the real time slave code input, the DT-213 can be used as a reader/character generator for making window dubs. The size and location of the characters is controlled by on-card programming switches.

The front panel, which occupies one rack unit (1¾-inch), contains a digiswitch to set the time code, an 8-digit display of either time or user bits and controls for operating the unit.

Circle (355) on Reply Card

VCR speed rewinder

A VCR rewinder has been introduced by *Nortronics Consumer Products Division.* The rewinder allows a VCR user to have uninterrupted playback of videotapes by putting them directly into the rewinder after use.

The rewinder is capable of rewinding a T-120 VHS videotape in about two minutes, compared to four or more minutes for a VCR to do the same job. The unit has forwarding and rewind capability and features auto stop and auto power off.

Circle (356) on Reply Card

60kW TV transmitting antennas

Two lines of 60kW TV transmitting antennas have been introduced by *Bogner Broadcast Equipment.* The antennas are designed to help reduce the initial capital investment for a new station or a station planning a renovation of its transmission plant.

The model B24US represents an upgrading to 60kW capacity of the medium-power slot antenna line. It is available for top or side mounting in all standard patterns.

The DUI series consists of side-mounted versions of the BUI series of regular high-power antennas. They employ the tower as the support structure. They handle 60kW and are available in all patterns.

The units have greater power-handling capacity, lower height and weight and lower wind movement. The units feature convertibility of horizontal patterns in the field, and omnidirectional patterns. In addition to eight standard direc-

Continued on page 122

WE'VE GOT YOUR NUMBER!

Wilkinson 8090

Not just a tired design with a new exciter or a revised paint scheme, the 8090 Series is a new approach to meeting the challenge of competitive FM broadcasting today and tomorrow.

Superb craftmanship, unsurpassed performance, and tough reliability on the job make the Wilkinson 8090 Series your only real choice.

STANDARD FEATURES:

- **Full FIVE year warranty the industry's best*.**
- **Five subcarrier inputs.**
- **Single tube design up to 30 kilowatts.**
- **Internal RF routing for flexibility and redundancy.**
- **Designed from the ground up for impressive main channel audio performance with multiple SCA operation.**
- **Exclusive POWER-GARD™ control and protection package.**
- **Spare parts kit with each transmitter.**
- **Extra metering for ease of adjustment.**
- **Backed by 24-hour service.**

*Limited warranty, some exclusions apply.

Call our Marketing Department for more information on your winning number—8090.

TTC

Wilkinson Radio Division

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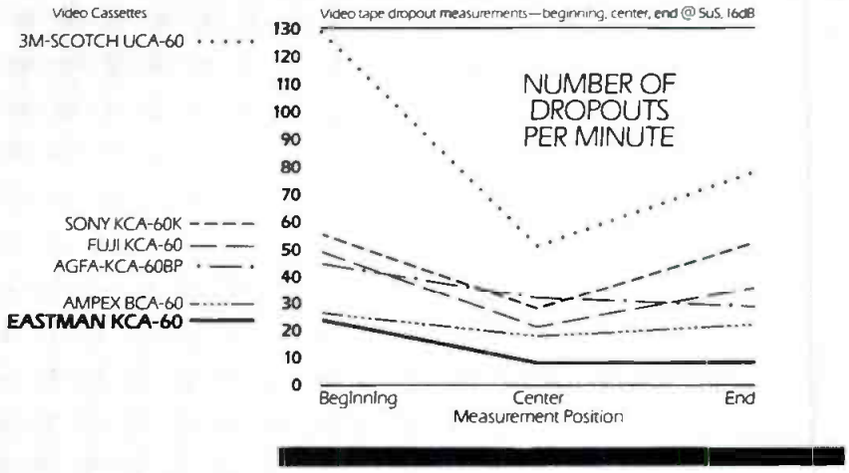
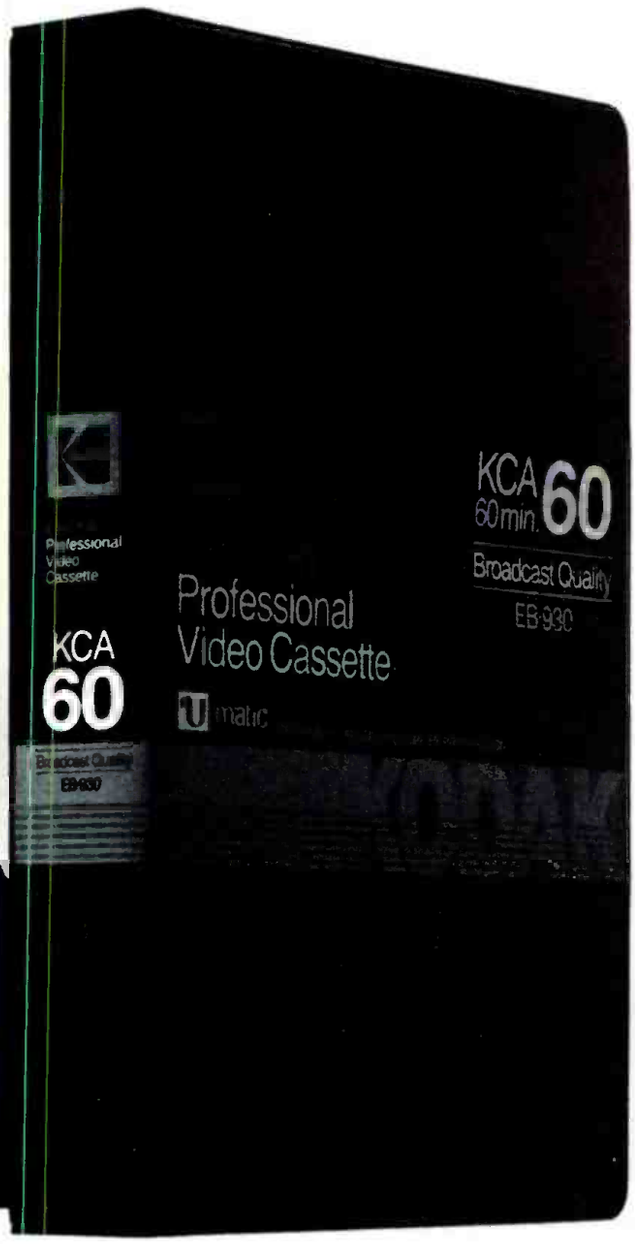
TWX: 910-938-0396

Circle (94) on Reply Card



EASTMAN VIDEO TAPE WINS DROPOUT TEST.



Six leading brands of ¾-inch broadcast-quality video cassettes were recently tested by an independent lab for a major video publication. When it came to dropouts, Eastman professional video cassettes outperformed every other tape tested. For a reprint of the published test results, write to Eastman Kodak Company, Dept A-3061, 343 State Street, Rochester, NY 14650. And for more information about Eastman professional video cassettes, contact your nearest dealer in Eastman professional video products or your Kodak sales and engineering representative.

Kodak

ATLANTA: (404) 351-6510 • CHICAGO: (312) 654-5300 • DALLAS: (214) 351-3221 • HOLLYWOOD: (213) 464-6131 • HONOLULU: (808) 833-1661 • NEW YORK: (212) 930-7500
SAN FRANCISCO: (415) 989-8434 • WASHINGTON, D.C.: (703) 558-9220 • MONTREAL: (514) 761-3481 • TORONTO: (416) 766-8233 • VANCOUVER: (604) 986-1321

Circle (95) on Reply Card

Continued from page 118
tional patterns, more than 100 special patterns and custom patterns are available.

Circle (357) on Reply Card

External power supply

Skyline Productions has introduced a battery-powered external power supply designed to operate in conjunction with the Sennheiser MKE-2 lavalier microphone. The power supply is a compact, rectangular box that can be plugged in-line with the MKE-2. The unit terminates in a standard XLR chassis connector for feeding the audio signal. The lavalier plugs into the power supply via a Lemo connector, thus allowing the option of using the mic directly with a radio transmitter or going hard-wire with a microphone cable.

The power supply uses one AA penlite battery, which will operate the MKE-2 for about 3,000 hours. The use of a transformer circuit provides a high gain output of the mic signal compared to the use of modified conventional lavalier power supplies.

Circle (358) on Reply Card

Digital-to-video converter

Jasmin Electronics has developed a digital-to-video converter to allow computer-generated information to be displayed on TV screens.

Each screen is connected to a converter that selects and displays the information appropriate for that screen. The converters, based on the latest microchips, are much smaller than previous models and require less power.

The displays can be either color or monochrome and the format is programmable to produce appropriate character sizes. The memory of each display can hold up to eight pages, which can be shown in a rolling page display or an automatic time cycle. The converters also can be combined with other technologies including information systems, teletext, viewdata, character generators and photo videotex.

Circle (359) on Reply Card

Audio-follow-dissolver mixer

The latest addition to the 200 series of audio-follow system, from *Scantex*, is the AFDM-208 audio-follow dissolver mixer. The system is a dual-channel PGM/PST type, with 16 audio channels mix-down capability, mix/dissolve VCA assignment, two independent channel controls and dual-frame accurate auto transition. Mode control includes breakaway, follow video, follow editor controller, interior/exterior transition and mono.

Parallel or serial interfaces to major editor controllers and video switchers are available. The system also provides equalizer insertion points in each VCA channel, enabling plug-in installation of additional facilities as required.

Circle (360) on Reply Card

Pegasus 5100 launches at Montreux

A.F. Associates has introduced its Pegasus 5100 system. The system, which automatically processes the compilation of commercials and other short-duration tapes using advanced digital computer techniques, is being offered to TV stations, cable systems and advertising agencies.

The Pegasus 5100 was developed by Pegasus Systems Limited, Bracknell, England, in conjunction with AFA and other broadcasters.

Circle (361) on Reply Card

Microprocessor-controlled battery charger

PAG America announces the Mastercharger, a 4-channel microprocessor-controlled battery charger that sequentially fast charges (typically one hour each) or simultaneously slow charges (eight hours for all four) any assortment of four nickel-cadmium batteries or belts of any manufacture in the 2-12 Ah, 12-14V range. The charger also acts as a power supply, delivering 12V to 14V at a continuous 4A.

Outfitted with four BP-90 sockets and four quick-lock clips, the unit automatically selects the right charge for the various batteries attached, balances after charging, then reduces to a trickle charge. The unit has automatic 110V/220V ac switching, automatic circuit breakers and self-diagnostics.

The charger has a separate set of displays for each of the four channels, indicating standby, charging, ready and faulty battery. The unit's microcomputer checks the charger and attached battery status hundreds of times a minute, shutting down if there is a malfunction.

Circle (362) on Reply Card

Series production switcher

Vital Industries will debut its 3000 series production switcher at the October SMPTE Conference in Los Angeles. The system provides switching versatility in a traditional mix/effects format. It is offered in 1-, 2-, 3- or 4-mix/effects models. The 1-, 2- and 3-mix/effects versions can be purchased with or without the program/preset and line key section. Inputs range from 16 to 26. Each model comes with two color background generators.

Based on the 6800 16-bit microprocessor, all 3000 series switchers feature a keying system that provides up to four discrete video keys or a chroma-key plus four video keys in each mix/effects system.

Automation for the switcher is provided by the PSAS3000 system, which features individual PSAS control panels for each mix/effects system, and a master command center, which can operate any combination of the switcher's sections simultaneously.

Circle (363) on Reply Card

Audio processor, stereo limiter and audio compressor

Circuit Research Labs has introduced the TVS-3001, a 3½-inch rack-mounted multiband studio audio processor, which is designed in conjunction with a transmitter unit for TV stereo audio applications. The unit features a selectable input filtering to protect against horizontal sync leakage into the audio inputs, selectable CBS loudness control action, selectable gain-locking action and an automatic mono support circuit, which corrects temporary stereo phase reversal problems. Conventional left and right audio outputs are supplied as well as L+R and L−R outputs.

Also from CRL is a TVS-3002, a 3½-inch rack-mounted combination stereo limiter and generator transmitter unit, designed for use with the TVS-3001 studio unit. It features long-term studio/transmitter path gain stabilization, MTS compatible pre-emphasis limiting in left and right audio channels, as well as in L+R and L−R. The unit also features remote control and telemetry capability and balanced and unbalanced composite outputs.

The SEP800, a 1¾-inch rack-mounted stereo 4-channel audio compressor, is designed to replace the monaural pairs of SEP400B compressors. The unit has a wideband/multiband feature that allows the unit to control the normal dynamic equalization effect associated with multiband type compressors.

Circle (364) on Reply Card

Protective sheath for TV triax connectors

Lemo has developed a flexible neoprene sheath to absorb all the shocks and abuses that a triaxial TV cable connector has to endure. It protects the connector from dust, abrasion and water.

Circle (365) on Reply Card

Film recorder/reproducer

Telex introduces its Sondor OMA S magnetic film recorder/reproducer. It has a stepper motor offering sync accuracy of 1/8 frame without microprocessor-controlled servo circuitry. Standard film spools, plates and flangeless cores may be used. It has an LED status display and electronic switch-over 24 fps/25 fps is a standard.

It offers push-button control forward/reverse, sync mode with up to four different masters, shuttle mode 6 to 300fps, wind, clutch and remote control.

Circle (401) on Reply Card

Programmable attenuators

Kay Elemetrics introduces 6-step programmable attenuators for use in bench or OEM applications. This line includes the model 4480, which operates from dc to 1500MHz, with an attenuation range of 0dB to 63dB in 1dB steps.

The attenuator handles up to 0.5W input power at 50Ω input/output impedance.

Circle (402) on Reply Card

Stereo converter

Kintek introduces the KT-903 stereo converter, a 3-part automated electronic system providing continuous dynamic conversion of mono to stereo. The converter is a high density phase and amplitude synthesizer, which introduces complementary stereo cues to the mono track while retaining mono track integrity. Auto-centering automatically centers the dialogue. The third feature is the mono-stereo sense switch which bypasses the KT-903 when stereo is present on the input.

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Allied Broadcast Equipment	87	40	317/962-8596
Alpha Audio	104	69	804/358-3852
Amperex Electronic Corp.	34-35	18	401/762-3800
Ampex Corp. (AVSD)	125	103	818/240-5000
Ampex Corp. (AVSD)	37	14	818/240-5000
Ampex Corp. (MTD)	29	15	415/367-3809
Anchor Audio, Inc.	102	66	213/533-5984
Andrew Corp.	75	43	312/349-3300
Angenieux Corp. of America	70	39	800/258-1382
Arrakis Systems, Inc.	23	12	303/224-2248
Audio Kinetics Inc.	109	86	818/980-5717
Audio Technologies Inc.	38	20	215/443-0330
Belar Electronic Labs	116	91	215/687-5550
Bonneville International Corp.	32	16	801/237-2400
Broadcast Video Systems Ltd.	94	90	416/497-1020
C.O.A.R.C.	116	72	518/672-7202
Calvert Electronics Inc.	22	11	800/525-6362
Camera Mart, Inc.	63	34	212/757-6977
Canon USA Inc., Broadcast Lens	79	46	516/488-6700
Cetec Antennas	106	112	916/383-1177
Cetec Vega	103	67	818/442-0782
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Commercial Communications, Inc.	95	60	800/367-5742
Continental Electronics Mfg. Co.	94	105	214/381-7161
Crosspoint Latch Corp.	128	116	201/688-1510
Di Tech Inc.	5	4	516/667-6300
ESS	116	68	818/768-8064
Eagle Hill Electronics, Inc.	106	72	301/778-1667
Eastman Kodak Co.	120-121	95	212/930-7500
Fidelipac Corp.	113	117	609/235-3900
Fluke Mfg. Co., Inc.	57	30	206/356-5400
Fortel Inc.	72-73	41	404/449-4343
Gentner Engineering Co., Inc.	123	96	801/268-1177
Grass Valley Group, Inc.	9	5	916/273-8421
Harris Corp.	97	50	217/222-8200
Hipotronics, Inc.	122	85	914/279-8091
Hitachi Denshi America Ltd.	40-41	22	800/645-7510
Hollywood Rental	116	68	818/768-8064
ICM Video	50	47	405/232-5808
Ikegami Electronics Inc.	43	24	201/368-9171
Ikegami Electronics Inc.	49	38	201/368-9171
Ikegami Electronics Inc.	83	71	201/368-9171
ITC/3M	53	28	800/447-0414
JBL, Inc.	61	33	818/893-8411
JVC Company of America	19	10	800/582-5825
Lang Video Systems Corp.	106	76	800/222-5264
LEA Dynatech Inc.	74	42	213/944-0916
Leitch Video Ltd.	85	102	804/424-7290
Lenco Electronics	11	6	314/243-3147
Lerro Electrical Corp.	1		215/223-8200
3M	117	93	800/792-1072
Maxell Corp. of America	51	27	201/440-8020
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Microwave Filter Co., Inc.	104	70	315/437-3953
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NEC America Inc.	25	45	800/323-6656
NEC America Inc.	101	48	800/323-6656
NEC America Inc.	123	97	800/323-6656
Neve Inc.	65	36	203/744-6230
Opamp Labs Inc.	106	74	213/934-3566
Orban Associates Inc.	17	9	800/227-4498
Orban Associates Inc.	58	32	800/227-4498
Otari Corp.	15	8	415/592-8311
P.T.S.I.	114-115	89	
Panasonic	66-67	37	201/348-7336
Panasonic	69	26	201/348-7336
Panasonic	71	111	201/348-7336
Panasonic	98-99	63	201/348-7336
Polyline Corp.	108	83	312/297-0955
QEI	105	62	609/728-2020
Rohde & Schwarz Sales Co (USA) Inc.	90	55	516/488-7300
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Shure Brothers Inc.	3	99	312/866-2553
Sitler's Inc.	106	73	800/426-3938
Solid-State Logic	111		212/315-1111
Sony Corp. of America	81		
Sony Corp. of America	7		
Sony Tapes Products Sales Co.	30-31	54	
Sound Technology	47	106	408/378-6540
Standard Tape Laboratory, Inc.	106	75	415/786-3546
Studer Revox America Inc.	IBC	2	615/254-5651
Surcom Associates Inc.	108	84	619/722-6162
Switchcraft Inc.	59	31	312/792-2700
Tascam div. TEAC Corp. of America	93	57	213/726-0303
Thomson-CSF/DTE	91	56	201/438-2300
Thomson-CSF/LGT	107	81	
TTC/Ampro Scully	68	35	303/465-4141
TTC/Wilkinson	119	94	303/465-4141
Universal Elecon	82	45	818/846-6220
Utah Scientific Inc.	55	29	800/453-8782
Varian	33	17	415/592-1221
Videotek, Inc.	42	23	602/997-7523
Vital Industries, Inc.	39	21	904/378-1581
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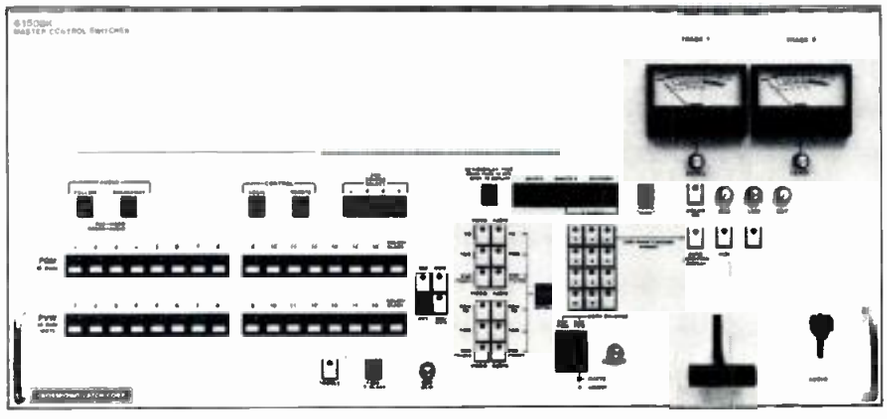

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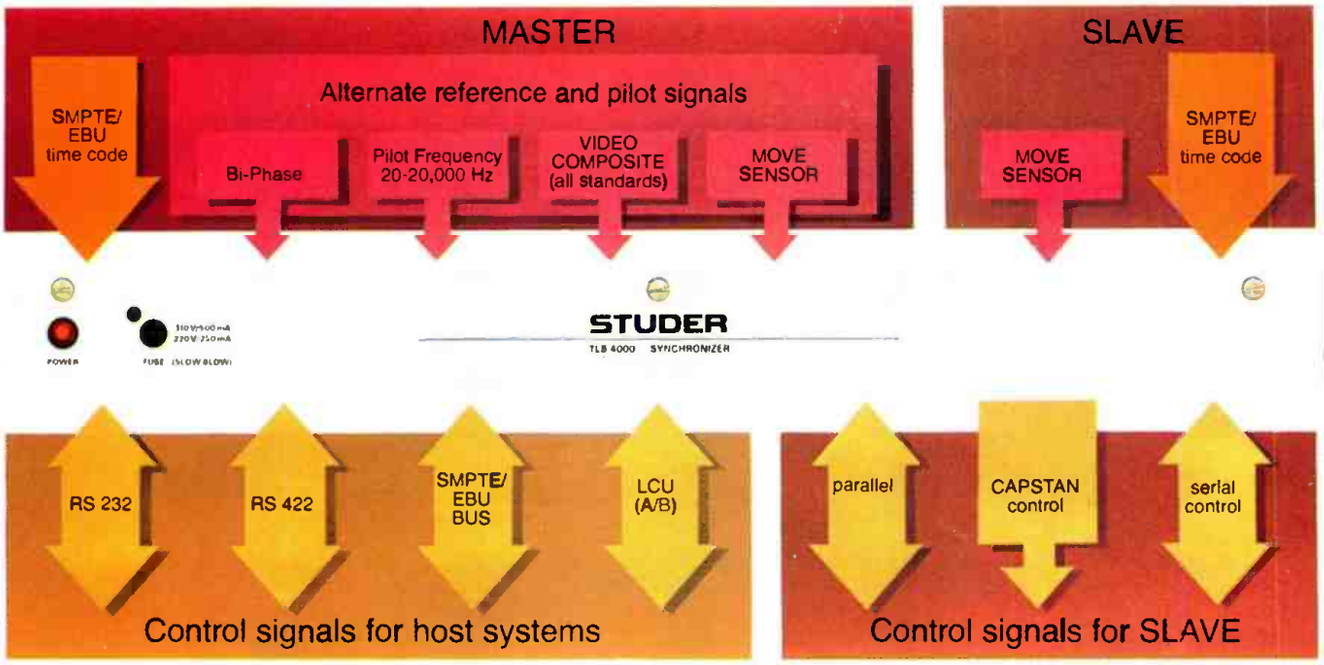

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Lock in a Box. The TLS 4000 "black box" unit functions as an extremely accurate chase lock synchronizer for one tape transport. It resolves two SMPTE time codes of any standard, and it will also accept pilot frequencies, video frame pulses, film bi-phase pulses, and move pulses. The RS232/422 serial port links the TLS 4000 synchronizer (in single or multiple units) to centralized controlling and editing systems.

Local Control Unit (LCU). A separate Local Control Unit for the TLS 4000 is available in two different versions: the basic version (type B) for many common applications, and the extended version (type A) which offers enhanced display capabilities as well as WAIT LOCK, SLEW MODE, LOOP, and CUE + GO-TO operating features. The compact Local Control Units fit in standard 19" racks as well as in the extended console overbridge on Studer A810 recorders.

Suit Yourself. Modular design lets you tailor a TLS 4000 system to fit your particular needs – present and future. For more information on Studer synchronizing systems, please write or call: Studer Revox America, 1425 Elm Hill Pike, Nashville, TN 37210; (615) 254-5651.

STUDER REVOX

Top to bottom: Type B LCU, Type A LCU, "black box."

Circle (2) on Reply Card

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