BROADCAST engineering

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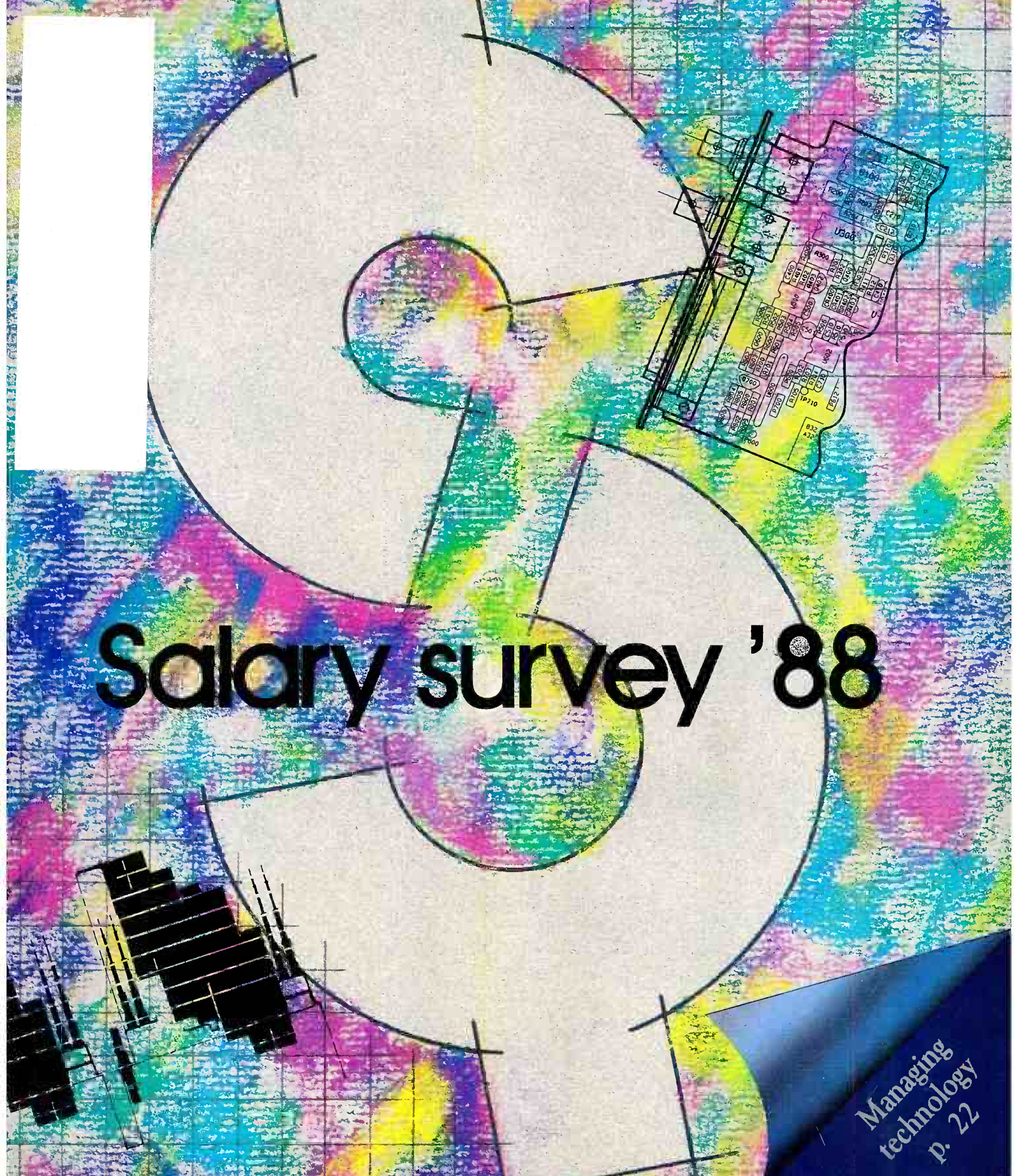

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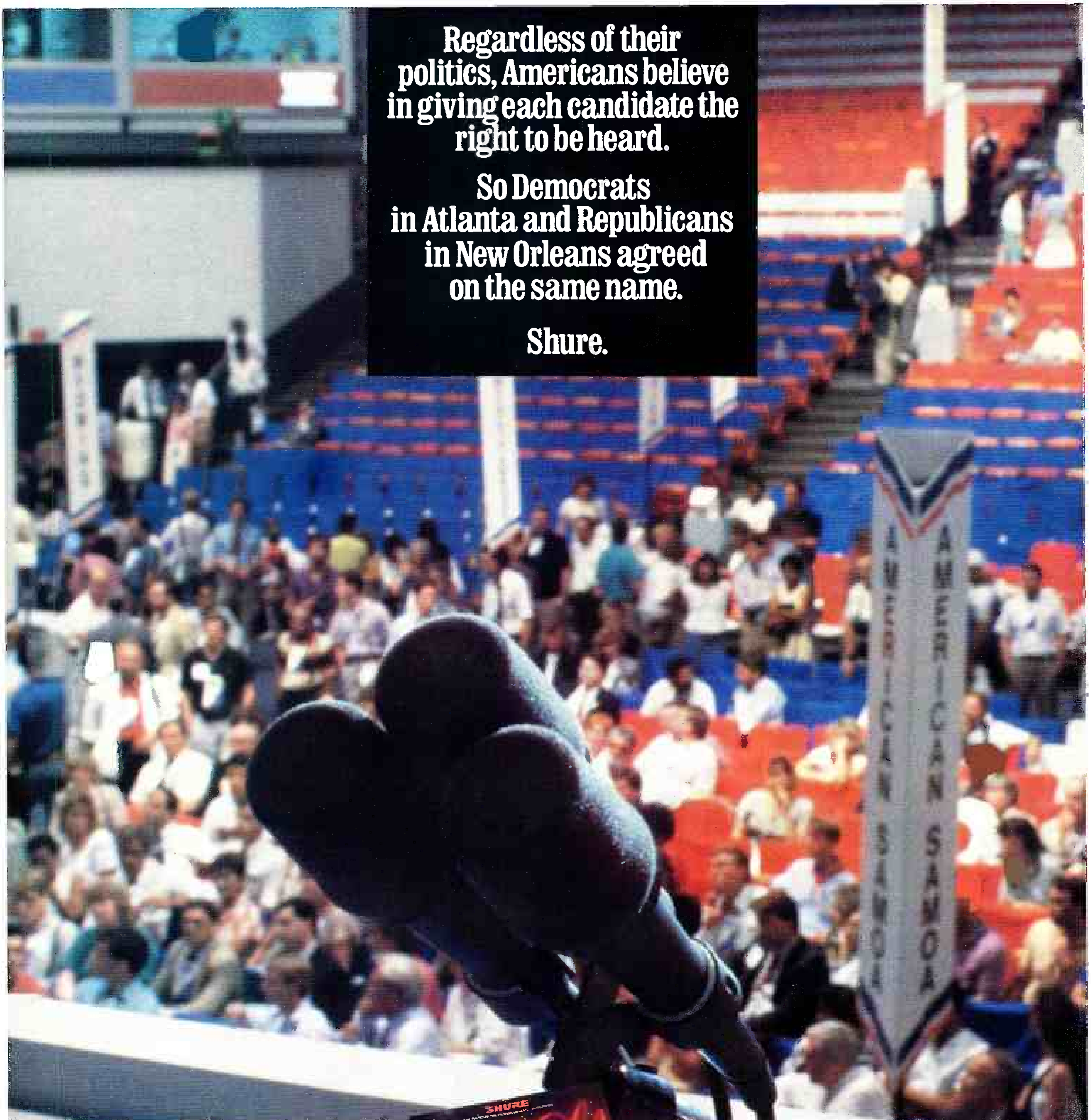

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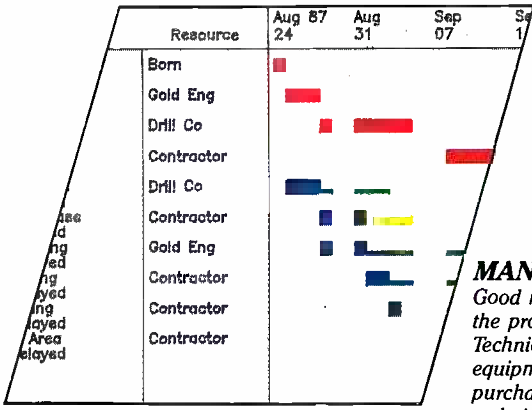

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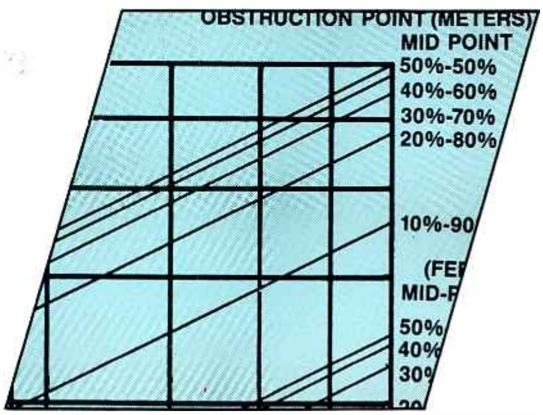

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BROADCAST ENGINEERING

MANAGING TECHNOLOGY:

Good management skills have never been more important in the professional audio-video industry than they are today. Technical managers must consider a wide variety of equipment and budgeting options for any major equipment purchase. Our special report examines some key elements of technical management.

OTHER FEATURES

ON THE COVER

Broadcasting is a business. And, like any business, its success depends on good management skills. Our cover this month illustrates a key aspect of management—employee pay and benefit levels—reported in our 8th annual salary survey. (Illustration by Dave Henderson, Magni Systems.)

DEPARTMENTS

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Faroudja completes preliminary test of SuperNTSC HDTV

Faroudja Laboratories has completed preliminary testing of the SuperNTSC HDTV transmission system. The company plans to begin testing it in two functioning cable TV systems this month, in Pacifica and Sunnyvale, CA. One of the cable TV systems is a modern, 54-channel service, and the other is a more traditional, 32-channel system.

SuperNTSC combines preprocessing at the transmitter and post-processing at the TV set. To the viewer, the resultant picture resolution will be equivalent to that of 35mm film. The system runs on a single 6MHz channel and maintains full compatibility with the current NTSC TV format. The system uses no additional subcarrier and no extra bandwidth for cable or broadcast transmission. Because of its special preprocessing, SuperNTSC not only can be received by standard TV sets, but actually improves the reception by eliminating all the annoying "wiggles and movements," rainbow patterns and other artifacts brought on by traditional NTSC transmission.

The SuperNTSC system was presented last month at the Advanced Television Technology demonstration, arranged by the Telecommunications Subcommittee of the U.S. House of Representatives.

NAB opposes national licensing for expanded AM band

The National Association of Broadcasters filed comments with the FCC urging rejection of the concept of national licensing in authorizing stations on the expanded AM band. AM frequencies from 1,605kHz to 1,705kHz will be opened for broadcast use within a few years.

The NAB criticized the national licensing proposal, whereby the commission would grant an expanded band channel to a single licensee for nationwide use. The association called the proposal "unlawful" under the Communications Act, in that the commission would illegally exempt itself from its statutory responsibilities for broadcast licensing.

The NAB urged that existing daytime-only AM stations be allowed to "homestead" the expanded AM band. It pointed to the judicially approved "daytimers' preference" used in FM licensing and asked the commission to establish a similar policy for AM band expansion.

The association said that by granting existing daytimers a full-time, high-power opportunity on the expanded band, on the condition that the daytime-only station ultimately turn in its daytime-only license, the commission would serve the interests of everyone. This would provide daytimers with needed benefits and reduce the levels of AM interference on the existing AM

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BROADCAST ENGINEERING

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Are you laughing? If so, I can understand. Surely, you recall dealing with the local toll test board 10 years ago. Now that was a bundle of fun! If, in 1978, I had suggested that Ma Bell and her offspring would dare to challenge broadcasting—the pinnacle of technology—I would have been put away somewhere. But not anymore.

The difference between then and now is fiber optics. Picture this: Your friendly local telephone company installer comes by one day to put in the new "local loop" to your home. He doesn't have twisted-pair cable on the truck, but a roll of fiber-optic (FO) line and a bottle of glue. He installs your video display terminal, keyboard, audio communication handset (we used to call them phones), and a little computer disk packed full of software.

The installer leaves, you boot up your new system and—presto!— instant *home entertainment/information center* (HE/IC)*. Now, if you want your new HE/IC to be a plain old telephone, just punch in the numbers, and talk to your friends. When that gets dull, use the new 2-way fiber-optic link to tie your computer into CompuServe or check in with the file server at the office to see what's going on. And after you've done all the things that you should do, it's entertainment time. (This is the scary part, broadcasters!)

With a moderate amount of technical innovation, five to 10 years of work, and a few billion dollars here and there, there is no reason that video signals could not also come down the FO pike from the phone company. Not all at once, as in present-day cable systems, but as selected by viewers on their terminals and switched at the telco central office (CO). The number of available channels would be limited only by the number of signals reaching the CO.

If you thought that cable television caused audience erosion of TV viewing because of increased entertainment and information choices, look out for this one! By the way, I forgot to mention that the video feed from the CO would be in *high definition*. And not just NTSC-compatible HDTV, but the real McCoy. Are you depressed yet?

NAB president, Eddie Fritts, touched on this topic a few weeks ago during a speech at an HDTV conference sponsored by the Association of Maximum Service Telecasters. He warned broadcasters to prepare for a battle with the Bell operating companies. Fritts said that NAB has received calls recently from various "baby Bells" expressing an interest in TV delivery by fiber. He said some had gone so far as to claim that they were going to put broadcasters *and* cable operators out of business! So much for diplomacy.

The threat to broadcasters from HDTV via Ma Bell is not yet a reality, but it has the potential to make the video entertainment business a whole different ball game. What happens within the next few years on the regulation front may well dictate the direction of over-the-air TV, as we know it, in the late 1990s and beyond.

Jerry Whitaker

Jerry Whitaker,
Editorial Director

* Remember, you saw that phrase here first.

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Advanced television policies announced

By Harry C. Martin

The FCC has issued preliminary conclusions regarding the development of advanced television (ATV) systems in the United States:

- The commission has determined that the current system of terrestrial broadcasting through privately owned stations would be the best medium for implementing ATV technology. Rules and guidelines will be shaped to allow existing TV stations to use their facilities to transmit the enhanced signals.
- ATV signals must be compatible with the current TV (NTSC) standards to ensure that consumers will be able to continue receiving broadcast signals on existing sets after the implementation of the improved standards.
- It has been tentatively decided that allocation of frequencies outside the current UHF and VHF spectrum for television will be unnecessary. Additional space needed for ATV services will be carved out of existing TV frequency bands. There are four possible methods for allocating spectrum, and the commission will be seeking comment on each of them.

The key issue deals with how much additional bandwidth should be allocated to facilitate high-definition transmissions. Possibilities range from no supplemental channels to 3MHz or 6MHz channels. If 3MHz channels are used, it is likely that most existing TV stations will be able to transmit an enhanced signal. However, if a 6MHz channel is used to provide higher-quality transmissions, allocations will be limited, particularly in urban areas.

FCC Chairman, Dennis Patrick, emphasized the commission's plan to allocate *fallow* UHF spectrum for ATV use. He views unused UHF TV spectrum as a resource that broadcasters should be pleased to see used for ATV. Patrick also said that the commission will consider negotiated adjustments of the initial spectrum assignments rather than requiring the allocation scheme to be considered final, because of particular market situations. He asked for comment on these ideas as well as on the main ATV proposals.

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

Main studio rule clarified

The decision that licensees may maintain their main studios within the principal community (city grade) contour of their stations has been affirmed. The principal community contour for an AM station may be based on the actual (measured) or the predicted contour. FM and TV stations must use the predicted city grade contour.

The commission defined *main studio* as a facility that is equipped with production and transmission facilities, is able to maintain continuous program transmission capability, and has a "meaningful management and staff presence." Maintenance of production and transmission facilities and program transmission capability would allow broadcasters to continue to produce local programs at the station at their option and as the marketplace demands.

Main studio continues to designate a broadcast station's only studio if no auxiliary studio is maintained. However, if a station has two or more studios that meet the applicable criteria, one may be selected within its principal community contour to be designated as the main studio.

Several other rules have been clarified by the commission. Non-commercial stations *are* covered by the rules. A station's public inspection file must be maintained within the community of license even if the studio is located within the principal community contour but outside the community's boundaries. A licensee who chooses to locate the main studio outside the community of license must provide a local or toll-free telephone number if local residents would incur a charge by calling the station.

Cable technical standards to be changed

The commission is proposing to extend the technical signal quality guidelines applicable to Class I cable channels to include signals on Class II, III and IV cable channels. It also has asked for comment on establishing separate standards for non-video signals on Class III and IV channels.

Class II channels are used to deliver non-encoded, non-broadcast cable programming such as cable networks and private, commercial, public, educational and government access services. Class III channels deliver non-video communications and encoded video programming. The Class IV channels have 2-way interactive capability.

In explaining the proposal, the agency noted that the quality standards for broadcast signals are appropriate for video transmissions at all four classifications. The majority of cable systems already are meeting these signal standards, so broadly applying the Class I standard will do little more than streamline the technical performance guidelines.

Network affiliation term to be extended

The rule limiting affiliation agreements between TV stations and networks to two years is being reconsidered. The commission views the rule as obsolete and unnecessary in today's marketplace. The rule, dating to 1941, was intended to protect new, small networks from being locked out of local broadcast markets by long-term contracts between the established networks and their affiliates. Since the appearance of cable, UHF and a large number of new broadcast stations, the bottleneck is no longer a problem.

Comment is sought only on ending the 2-year rule. The commission is not interested in a general overhaul of its other network TV rules at this time.

Editor's note: Additional information regarding FCC activities is available on CompuServe. !GO BPFORUM

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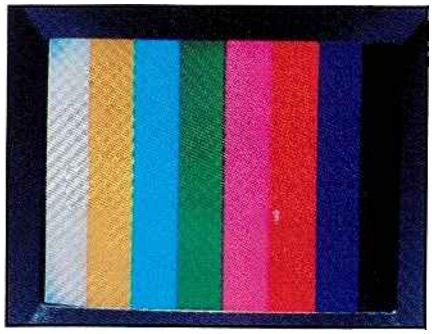

Inside the visual PA

By Carl Bentz, technical and special projects editor

A number of system parameters for the broadcast TV signal that should be measured, monitored and maintained within certain operational limits are detailed in V.3, Part 73 of the FCC rules. As engineers and technicians, you see these terms and waveforms every day, but a different point of view sometimes brings a better understanding. Also, because of turnover and other changes in personnel, what follows may be useful in bringing new staff members up to date.

Visual vs. aural

The modulation signals of a visual transmitter are more complicated than TV aural or radio signals. For example, the sound broadcasting signal is quite narrow, compared with a visual signal. Because the TV channel is 6MHz wide for NTSC and the aural carrier is offset by 4.5MHz from the visual, it is safe to say that you are dealing with information ranging from 0Hz to 5MHz. This information includes luminance, chroma and pulse trains for horizontal and vertical synchronization.

For the picture to appear correctly on the home receiver, all parts of the signal must pass through the transmitter-receiver chain with exact timing in relation to one another.

For the picture to appear correctly on the home receiver, all parts of the signal must pass through the transmitter-receiver chain with exact timing in relation to one another. They also should not be individually degraded by the transmission path or influenced by any other signal in the process. To ensure that the system is performing according to plan, there are many more measurements needed for television than for radio.

A pulse framework

The actual visual content of the TV signal is embedded in a pulse-based framework that services both horizontal (line) and vertical (field) synchronization. Also contained within the framework is a reference signal for the color subcarrier (burst).

The maximum amplitudes of the visual content of the signal are defined by the pulse framework. The framework is defined in terms of time and amplitude at the input and output of the visual transmitter chain. The system is designed to maintain the time and amplitude relationships from input to output. Maintenance of the transmission system within prescribed limits is the responsibility of the broadcast engineer.

Negative modulation

Most TV transmission standards work on the basis of negative modulation in the visual transmitter. In other words, the largest value of RF amplitude corresponds to the zero level of modulation signal (sync). The minimum value (residual carrier) of the RF amplitude corresponds to the maximum value of the modulation (white level). The result is that you may see a representation of the transmitted signal with sync pulses toward the top because it represents the greatest RF amplitude. (This also indicates why a TV transmitter is capable of 0% modulation!) It is more common to illustrate the output signals with sync toward the bottom because it is easier to compare them with the input video waveform.

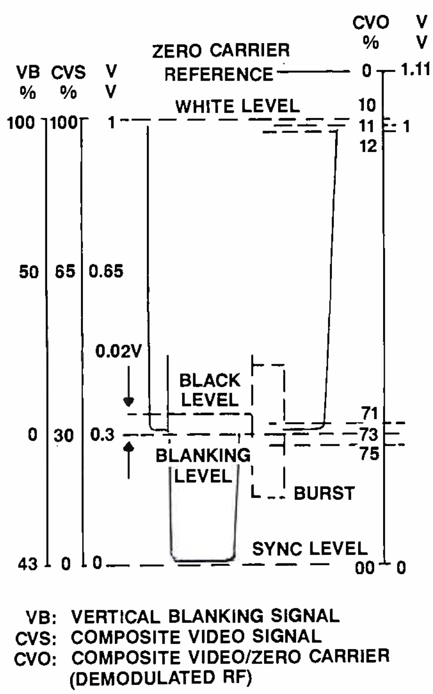

Figure 1. This illustration of the horizontal sync interval compares level designations of a composite video input signal (left) and the composite video zero or demodulated signal (right).

...the largest value of RF amplitude corresponds to the zero level of modulation signal (sync).

There should be no fluctuations in the output power of the system as long as no low-frequency transients are allowed to pass through the power-supply and control circuitry of the transmitter. When such transients do exist, they are recognizable in a waveform monitor or oscilloscope display of the signal.

In the next part of this series, we will examine how to set the output level to find faults that may exist in the power supply.

Editor's note: This article has been adapted with permission from "Rigs and Recipes: How to Measure and Monitor," a publication of Rohde & Schwarz.

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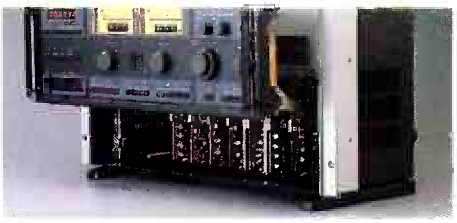

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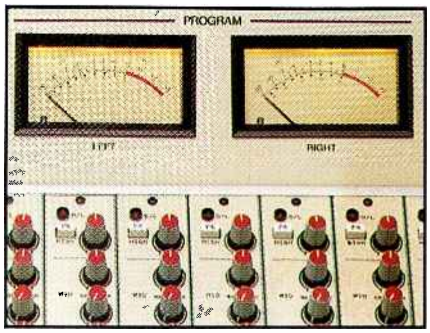

Who takes the blame for lo-fi AM?

By John Battison, P.E.

Everyone is talking about AM radio, but only a few are doing anything about it. The NAB certainly is pushing for new mandatory standards, probably with some justification. AM has undoubtedly fallen on hard times, but I am inclined to think that some of the blame lies with the receiver manufacturers.

Low-fi AM

For years, AM broadcasters have been transmitting reasonably broad signals with low distortion and little variance from smooth response up to 7.5kHz. Until recently, the FCC required annual proofs showing that audio response was in accordance with its rules. I've been involved with enough AM stations to know that most of the engineers performed honest proofs and were proud of the performance of their transmitters.

So where does the blame lie for the low-fidelity sound of AM radio? The broadcaster was transmitting a broad signal with reasonably good fidelity. However, the receiver manufacturers continued to produce receivers with restricted bandwidth and loudspeakers that would barely qualify as telephone instruments.

AM listeners simply accepted the continuous deterioration of sound that came over their radios. Then came FM and its far greater bandwidth. One of FM's early marketing techniques was promotion of the improved fidelity of the signal. Listeners noticed the difference in audio quality, and the swing away from AM accelerated.

The commission continued to grant licenses for additional AM stations that were permissible in accordance with the circa 1935 rules. Unfortunately, this process only increased the interference problem.

Attempts by various organizations and individuals to change the rules to prevent or reduce the adjacent and co-channel interference were largely unsuccessful. Some of these attempts met with hostility from many potential and existing broadcasters. The feeling on the part of some members was that the "haves" (large stations and multistation owners and their organizations) were attempting to prevent the "have-nots" from acquiring stations. Large owners were perceived as trying to influence the commission to make licensing new stations much more difficult, thus helping to ensure the status quo.

Industry action

The benefits of sideband control began to be understood and appreciated about the time of the 1986 NAB convention. An all-industry committee, the National Radio Systems Committee (NRSC), had been formed earlier. This committee was composed of broadcast station representatives, receiver manufacturers and companies actively involved in manufacturing broadcast equipment. Research into the possibilities of restricting AM bandwidth and introducing pre-emphasis was begun, and the NAB demonstrated a proposed system. (See Figure 1.) The combined elements were approved by the NRSC as a voluntary standard in January 1987.

As expected, those companies with products directly connected with the audio chain were in the forefront of the growing force trying to revive AM broadcasting. Approximately two years ago, Texar filed a petition with the commission requesting that a formal mandatory change be made in the rules requiring the use of pre-emphasis, similar to that used in FM, and a sharp cutoff frequency. The petition was designed to show that this type of audio control could reduce second adjacent-channel interference and improve the apparent quality of AM audio.

Manufacturers expressed interest in the proposal, but many broadcasters and engineers did not. The proposal limited the theoretically wide response of AM broadcasting (10Hz to 15kHz) to approximately 10kHz. Stations in the wide-open spaces, without the restrictions of nearby adjacent channels, were happy transmitting a signal of ±10kHz. But stations in the heavily congested metropolitan areas, where the 40kHz separation between channels was a fact of life, viewed the proposed rule as a lifesaver.

NRSC improvement

Demonstration tapes from two stations in the District of Columbia/Maryland area illustrate the benefits of the NRSC proposal. The stations were separated by 20kHz, and when the NRSC system of pre-emphasis and the sharp cutoff filter were used, the improvement was dramatic. Even in the interference zone, with the new equipment, reception was good. When the NRSC equipment was bypassed, the resulting audio signal was unlistenable. The major unexpected dividend was the apparent improvement in audio quality.

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

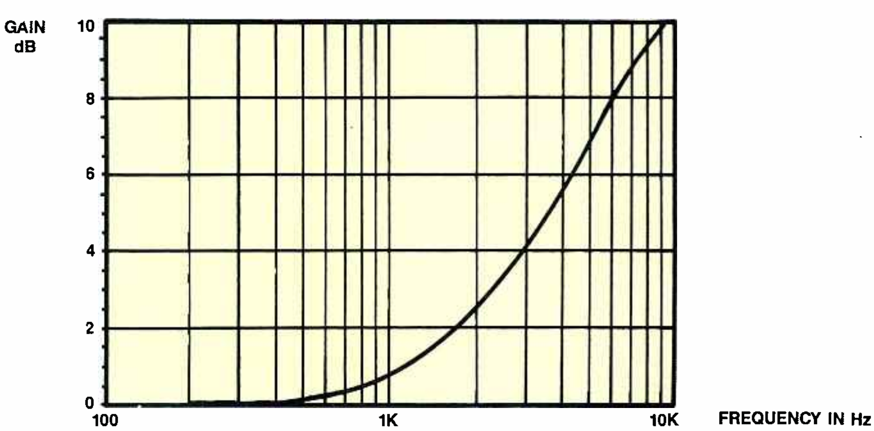

Figure 1. The NRSC pre-emphasis curve is similar to that used in FM transmitters.

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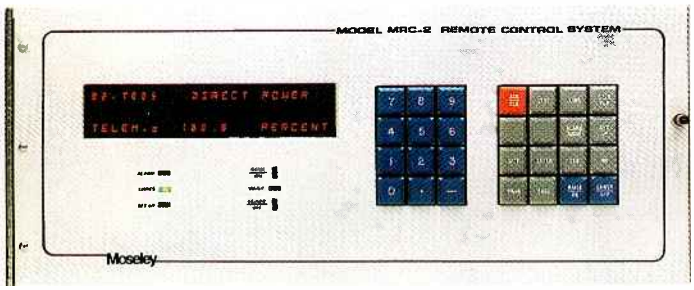

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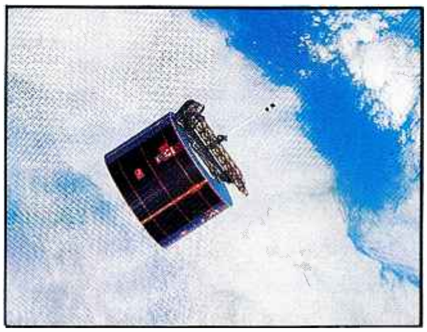

Artificial intelligence system in the works

By Elmer Smalling III

Most of the command, control and communications operations connected with the present version of the space shuttle are the direct result of input from the on-board crew or ground command stations. The working time of these people is spent examining, collecting and loading data into computers and control systems.

To help free the time of key personnel and make the flight systems more reliable, NASA, as part of a project called the Systems Autonomy Demonstration, is developing an artificially intelligent system called the Executive Controller. The major goal is to focus research on artificial intelligence, human factors and dynamic control systems in support of total space shuttle operation.

Artificial intelligence, or AI, is computer programming that is based on logic, decisions and a large database culled from expert human input, the *expert system*. AI programs usually are written in logical languages such as LISP, PROLOG and LOGO.

The project also will research human factors, the study of the interaction of people with machines. In designing a TV control room, for example, a human factors engineer would decide how large a monitor wall should be by determining whether operating personnel could see all of the monitor screens without craning and whether all screens were visible, at least peripherally.

The distances from the console to the monitor wall and the design of the operators' chairs also are human factors to consider, especially if personnel must spend many hours in the control room. Human factors engineers are most famous for designing cockpits for optimum interaction with the pilots. Even the handle on your coffee cup is probably the result of human factors engineering!

Dynamic control, the second-by-second control of the spacecraft's navigation, rocket thrust, environmental and power systems, is the third area of interest. Most systems are controlled by computers programmed or updated by humans. If you analyze a flight path and, based on the analysis, enter new flight parameters into the navigation computer, you are part of the dynamic control of the spacecraft.

A closed-loop system, such as a thermostat and air-conditioning system or a gyroscope and navigational computer, is not an artificial intelligence system. AI systems must include an expert database. As an example, when the two pieces of metal in a standard home thermostat warm up as the room becomes warm, they come together and make contact to turn on the air-conditioning system. When the bimetallic strips cool sufficiently to spread apart, the air conditioning stops.

The thermostat is set by manually moving the dial. This changes the gap between the two metal contacts, allowing the strips to come together when the predetermined temperature has been reached.

What if other variables come into play? Consider some basic rules that constitute the hypothetical spacecraft air conditioning knowledge base:

- Cooling to 72° is required only during take-off and landing or under forces less than 2G.
- The relative humidity shall not exceed 30% while cooling is taking place.
- The system must be shut down when the cabin is de-pressurized.
- The air conditioning shall be of rank 6 in power shutdown priorities.

It is easy to see that an AI computer using these rules to control the air conditioning would be superior to one that simply turns off and on according to temperature.

The feasibility for the Executive Controller system to run space shuttle operations such as communications, tracking, life support, data-processing support, guidance and navigation, power, mission ground support and more, is being studied. Advanced AI systems are being planned that will communicate among themselves during the course of a mission.

Using logical languages such as LISP, PROLOG or LOGO, the software can be written in structured module form, so that many programmers may combine their efforts on large programs. (This is done currently for word processors or automation and control systems).

NASA is working on specifications for an Executive Controller Shell, which will control programming of displays, controllers, diagnosers, planners, executors and effectors, to use a few NASA terms. The shell, like a PC operating system, will provide control and housekeeping for the systems listed. It will be universal enough to allow researchers around the world to contribute software input to the project.

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

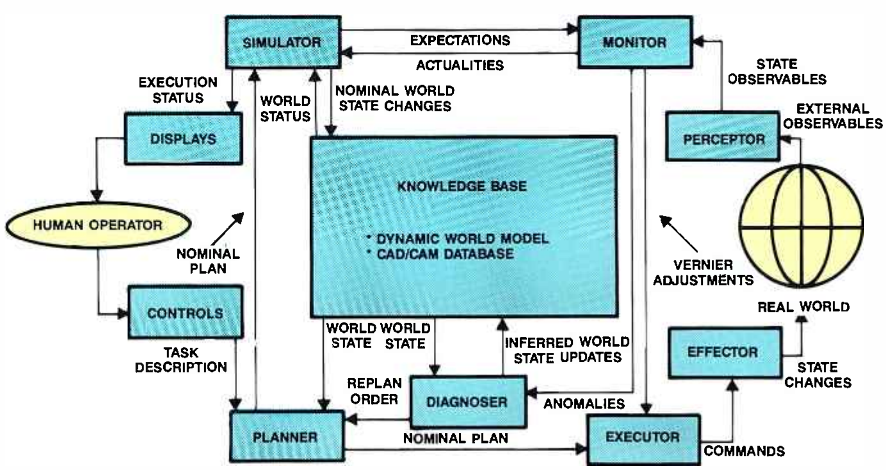

Figure 1. *An overview of the intelligent autonomous system.*

INTRODUCING THE NEW MX-55

Before you take us to task for trying to improve the BII, a design that has become the "workhorse" standard for two-channel audio machines, consider what the new MX-55 offers:

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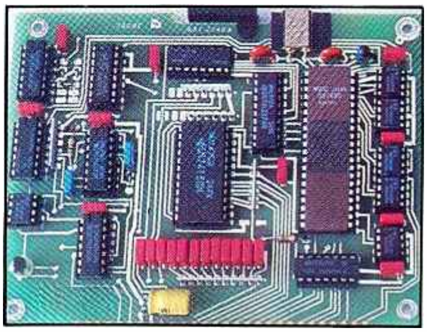

Looking behind the glass

By Carl Bentz, technical and special projects editor

When you're choosing a CRT, should you opt for delta gun or in-line gun? It depends on the intended use of the display. Also consider the three prime points of contention between the two tube designs: convergence, white-field uniformity and apparent resolution. As indicated in Part 1 of this series, cost factors have driven all manufacturers to use in-line technology for some models of their monitor lines. (RCA had predicted the rapid increase in in-line technology in 1982.)

Convergence circuits are more stable than those of a few years ago. However, the delta-gun CRT requires dynamic and static convergence to be performed periodically. All the adjustments are somewhat interactive and, when you consider three dynamic and three static controls along with pincushion and a few others, the delta-gun tube does require some time to get everything at an optimum setting.

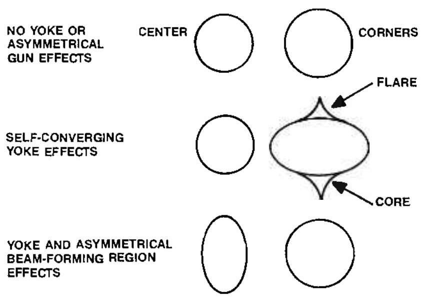

__Figure 1.__ Effects of self-converging deflection fields and asymmetrical beam-forming on spot shape.

Once set, the drift is quite stable. Perhaps one of the greatest assets of the delta-gun CRT is that convergence can be adjusted.

The technology of the in-line gun makes the CRT similar to a replaceable module. The tube is called self-converging, and most of the adjustments you might expect to find have been replaced by the special patterns used in the windings of the deflection yoke. In fact, there are no dynamic convergence circuits.

The same yoke fields that achieve self-convergence of the three beams, however, distort the shape of the individual beams. As a result, a slot is added in grid No. 2 (the asymmetrical beam-forming region) to shift the horizontal and vertical beam crossovers. This causes the beams to tend to overconverge in the horizontal direction and underconverge in the vertical direction. To ensure that the deflection yoke fields are applied correctly to the tube, the yoke is cemented to the tube at the factory.

This solution addresses spot-shape problems at the extremes from the center of the screen, but it also introduces a new problem. At the center there are no deflection fields, and the spot should be circular, but the asymmetrical beam-forming region causes them to be longer vertically than horizontally. Now, if the yoke were to turn slightly—oops!

Color purity, and the uniform white-field test in particular, are more difficult to achieve using a delta-delta CRT rather than an in-line device. The reason, in part, is that the deflection coils of the in-line tube are fitted and cemented to the device at the factory.

The primary reason that broadcasters and production houses still want the delta-delta tube is linked to apparent resolution. A discrete dot structure produces a picture that appears to have higher resolution. On slot-mask, stripe-phosphor tubes, lines in the video that cross the stripes at 90° angles, or are in line with the stripes, look fine. Lines crossing at other angles introduce a degree of aliasing, reducing apparent resolution.

A close look at the positioning of dots vs. stripes explains why the aliasing tends to show up and why apparent resolution is different. The dot pitch is a measure of the distance from center to center of dots of the same color. If you look at a 13-inch diagonal high-resolution CRT, the pitch between dots of one color is 0.31mm. Yet, when measured at a 30° angle, the distance between two dots of the same color is 0.27 inches.

Let's compare these numbers to those of a similar 13-inch tube with an in-line gun. Phosphor stripes here are on 0.67mm centers measured horizontally, but at a 30° angle, the measurement is 0.774mm.

The shadow-mask tube often is rated by the number of phosphor-dot trios. Resolution is determined by the beam-spot size and the contrast ratio of lighted dots to unlighted dots. For the eye to perceive the location of the lighted dots on the screen, the beam must light enough dots to be visible. For high-resolution CRTs, a rule of thumb is that there must be at least three columns or rows of lighted dots for the eye to interpret the beam location.

Which CRT should you choose? That judgment is as easy as deciding whether to use cane or beet sugar on your breakfast cereal.

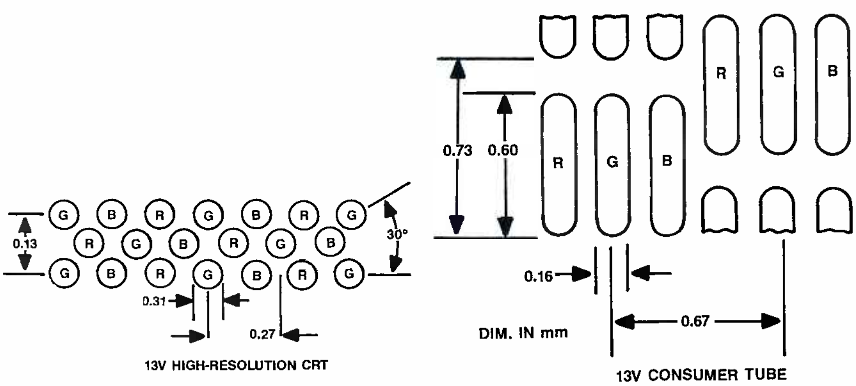

__Figure 2.__ Comparison of dot and stripe pitches for delta-dot and stripe phosphor CRTs.

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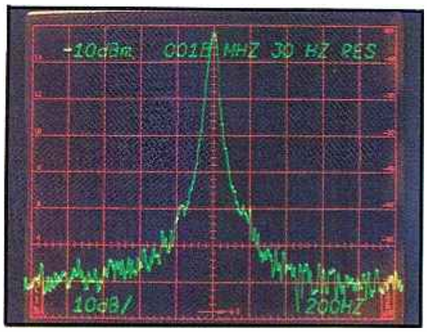
Part 1

Troubleshooting



Video terminations play important role

By Peter Hughes

Proper use of terminations appears to be a simple chore. Unfortunately, the typical 75Ω terminator used in video systems often goes unnoticed—until a problem develops. This article will show that the role of the termination is much more important than is normally realized and that poor-quality units can cause problems that are often blamed on something else.

The 75Ω termination is everywhere that coaxial cable is found in the broadcast video environment. Even the slide switch on the back of a monitor conceals a termination. A piece of equipment that has looping inputs must have a connection termination either on the equipment or at the end of the cable.

Properly terminated

When you think of terminations, it is probably from the viewpoint of matching the characteristic impedance of the coaxial cable to minimize reflections and return loss. You know that if the cable is missing its termination, then the video level at that end of the cable is too high.

Modern TV systems, even relatively simple ones, distribute via multiple output amplifiers and routing switchers. Video from various sources is distributed throughout the plant by coaxial cable. It may be fed into and out of the same routing matrix to control rooms, edit suites, studios, mobile trucks and the GM's office.

Hughes is president of Target Technology, Penn Valley, CA.

This whole system assumes that the video level outside of any particular piece of equipment, and certainly within the coaxial cable, is at the nominal level of 1V P-P (140IRE units) with the sync at 286mV (40IRE units) for composite systems and 700mV for component systems. However, unless every build-out resistor and every termination has exactly the same value, these optimum levels seldom appear.

The hidden problem

You'll eventually encounter the case of the missing termination. Suddenly, a video feed that was supposed to have an amplitude of 1V is too high. Panic ensues, and out comes the inevitable tweaker. The result: Some pot on the front of a distribution amplifier (DA) gets thoroughly abused in an effort to "get the level down." A missing termination usually causes an apparent level increase of 6dB. However, most DAs do not allow for a −6dB adjustment with front-mounted pots, so the level still ends up being too high. At this point, somebody usually realizes what is wrong, and the missing termination is installed.

The unterminated coaxial cable is a readily identifiable problem that must be solved immediately. Terminations that are of poor quality are much more difficult to identify and, in the long run, they cause a lot more trouble and expense.

Adjusting video levels

Terminations within a system have a pervasive effect on video levels that is not easily recognized. Figure 1 shows a single video DA fed from a high-quality source and accurately terminated at the looping input in 75Ω. Each of the six outputs of this DA are terminated with a ±5% tolerance termination.

The drawing shows a normal distribution of resistor values that might be expected with a ±5% variation. The example assumes that the DA build-out resistors numbered R1 and R6 are exactly 75Ω.

The level at output 1 is displayed on the waveform monitor, and the level-adjust control on the DA is set for 1V P-P. Note that the other five output levels all are different from output 1 and from each other. Although each termination has a tolerance of ±5%, the total range of error at each output is ±2.5% because each termination is half of a voltage divider.

Assume that the six outputs are available at a patch panel and that they normally feed studios 1 to 6. On Monday, studio 1 is used, and a setup is performed by monitoring output 1 and adjusting the level as previously discussed. When studio 2 is used on Tuesday, the level is checked and is found to be 25mV (3.5IRE units) high. Who gets the blame? Did the DA drift? Did the engineer who performed the line-up on Monday do a poor job? Has the level of the feed to the DA changed? These are the kind of questions that get asked and sometimes never get answered because nobody thought to ask, "How good are the terminations?"

This illustrates the problem with only one DA. In the complex system of a modern TV facility, these level errors are compounded to the point that it is extremely difficult, if not impossible, to operate with the entire system at the correct level at the same time.

An important point to remember is that a termination is an integral part of the equipment that is the source of the video. As shown in the diagram, T1 might be several hundred feet away from R1 and in another building, but it's just as important.

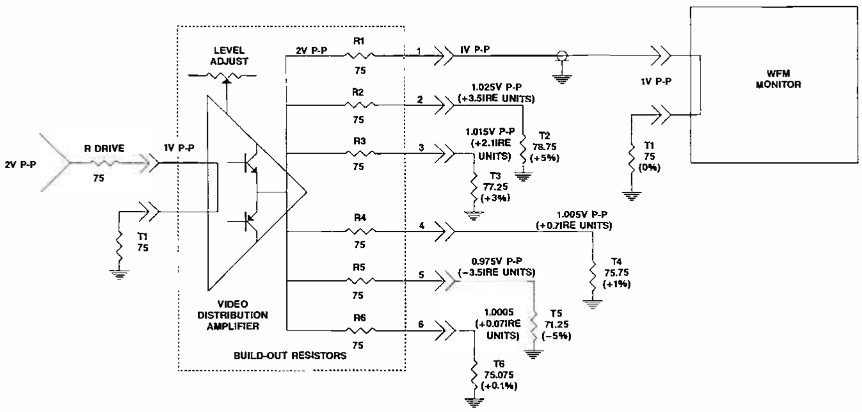


Figure 1. Even 5% tolerance terminations can cause levels to vary widely within a video system.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Part 2

Management
for engineers

Techniques for dealing with problem behavior

By Brad Dick, radio technical editor

You can't go through life without having to deal with people who are 'a pain in the neck.' They are everywhere. Generally, you can avoid somebody who regularly exhibits problem behavior. But what if that somebody is your boss? If you encounter problems with a coworker because of a difficult personality, there's more at stake than your good mood—your job may be on the line. It's in your own best interest to learn special skills to help you interact effectively with these people.

We discussed seven common types of problem behavior or personalities last month: hostile/aggressive, complainer, unresponsive, super agreeable, negative, know-it-all and indecisive. You may already have identified some of these at your workplace.

Identify the situation

Six general steps can be taken to cope with people who display these personalities. No matter what type of problem behavior you are facing, these steps can help you gain some control over the situation.

To be effective in planning the proper response, you must remain objective.

The first bit of advice is to distance yourself from the situation. Back off emotionally. In some cases, you may have to physically remove yourself from the problem environment. Take a walk or do whatever it takes to help clear your mind. To be effective in planning the proper response, you must remain objective.

Next, assess the situation. Is the person's behavior typical or unusual? Did a particular situation or incident trigger it? Will direct, open discussion resolve the problem? Answering these questions will enable you to determine whether you are dealing with a chronically difficult person or somebody who's just having a bad day.

Last month's "Management" column described a tirade by Rob, the hostile/aggressive program director. Rob's tantrums were a recurring problem.

If he hadn't been angry about a broken CD player, something else would have launched him into running over some other person. Rob has established a pattern of verbal attacks on others.

The third step is to stop wishing the person or situation was different. This is wasted emotional energy and only fosters anger. Never forget: You control your emotions. You choose how to respond in these situations, and no one else can make you feel angry.

Plan and respond

The next step is to develop a strategy to improve these confrontations. By changing your reactions, you will develop the tools that interfere with patterns of difficult behavior and that will right the power balance.

If you're dealing with a hostile/aggressive person, visualize a typical outburst. See yourself standing firm and effectively dealing with the situation. If the problem is indecisive behavior, envision yourself getting a firm commitment from the person. You may want to practice what you will say. If your fantasy of a successful interchange falters, start over and practice it again.

The final step is to implement your plan. Choose the time and place carefully. Timing is critical. Don't try out your new scheme when the other person is in a particularly bad mood or under extra stress.

Monitor your success while you try your techniques. If you don't seem to be getting the results you had expected, reassess the situation. You may have misjudged or incorrectly categorized the other person's behavior. If that is the case, using the wrong technique can make the situation worse.

Stop the tank

Following these general principles, let's look at some specific techniques for dealing with the hostile/aggressive (Sherman tank) personality. Remember that when the engineer, Chris, was attacked by the program director, he retreated to the engineering workshop. This approach is the opposite of what is needed to correct the problem behavior.

If you allow the Sherman tank to push you around, you cease to exist in that person's mind. When encountering this personality, you must stand your ground. When Rob began to chastise the engineer for the CD player problem, Chris could have responded by saying, "Wait a minute, Rob. I did repair the player last Wednesday. It worked without error for over a week."

This non-threatening response would have forced Rob to recognize Chris's presence. And it would have helped tip the power balance back toward neutral.

If the hostile/aggressive continues to yell, which is typical, hold your position. Don't back off. Look directly at the Sherman tank and, when the attack begins to lose momentum, jump into the conversation. If you wait for an opening, you may never get a chance to respond.

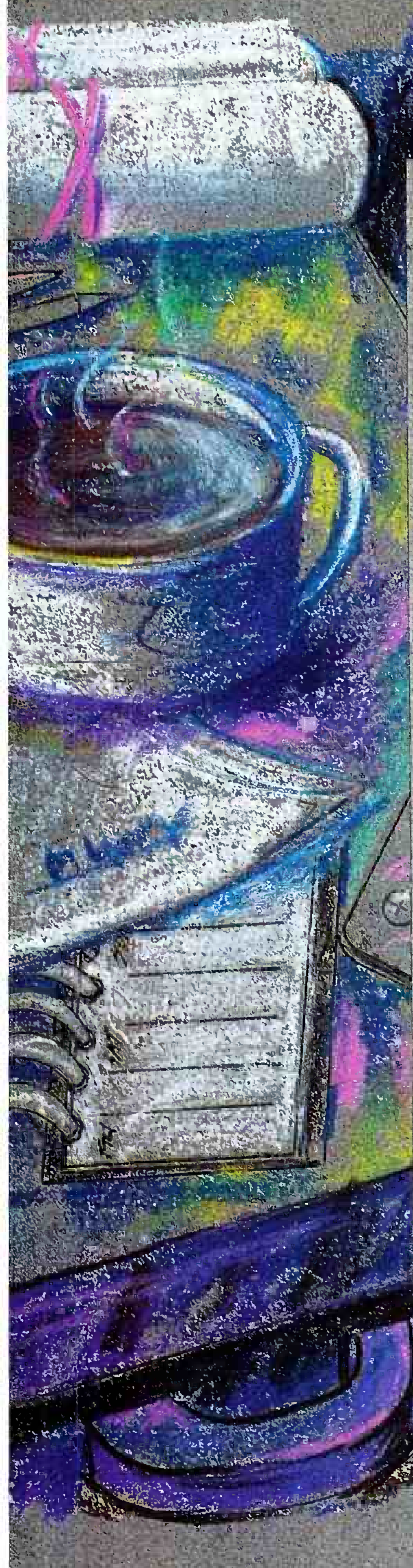
Avoid the fight

Don't let it turn into a shouting match. Trying to win a shouting match with a hostile/aggressive is a losing proposition. These people usually are trained fighters, and they have many victories under their belts. But there are other reasons to avoid a fight.

The important thing is to attack the issue, not the person.

If you win the battle, and the tank perceives the encounter as a loss, you might be in for a surprise attack later. If you win by sniping (lobbing negative personal comments) at the tank, you've set yourself up for a counterattack. The important thing is to attack the issue, not the person.

Next month, the negative personality. It is behavior you've probably encountered. If you're not sure, listen for key phrases such as, "But we've always done it this way," and "It can't be done."



Managing technology

Brad Dick, issue editor

Managing people is as much an art as it is a science.

Technology is of no use without competent personnel to design it into a working system, operate it on a daily basis and fix it when it breaks. Enter the technical manager.

It is no secret that the job description for an engineering manager at a radio, TV or post-production facility has changed dramatically within the past eight years. Since 1980, the professional audio-video industry has seen radical changes in federal regulation, economic realities and labor relations.

Technical managers of today are *systems engineers*, concerned not so much with how a particular box works, but how it will—or will not—work with other boxes at the facility; *budget experts*, making sure the department's bottom line stays where it should; *scheduling experts*, charged with completing a wide variety of projects on time; *personnel administrators*, solving hiring, firing, promotion and salary problems; and, still, hands-on *engineers* who know how to patch around a problem and get back on track.

Good management skills never have been more important in the industry than they are right now. Technical managers must consider a broad range of equipment and budgeting options for any major purchase. These demands require more than just a passing interest in the art of managing people. This month, we examine some key elements of technical management:

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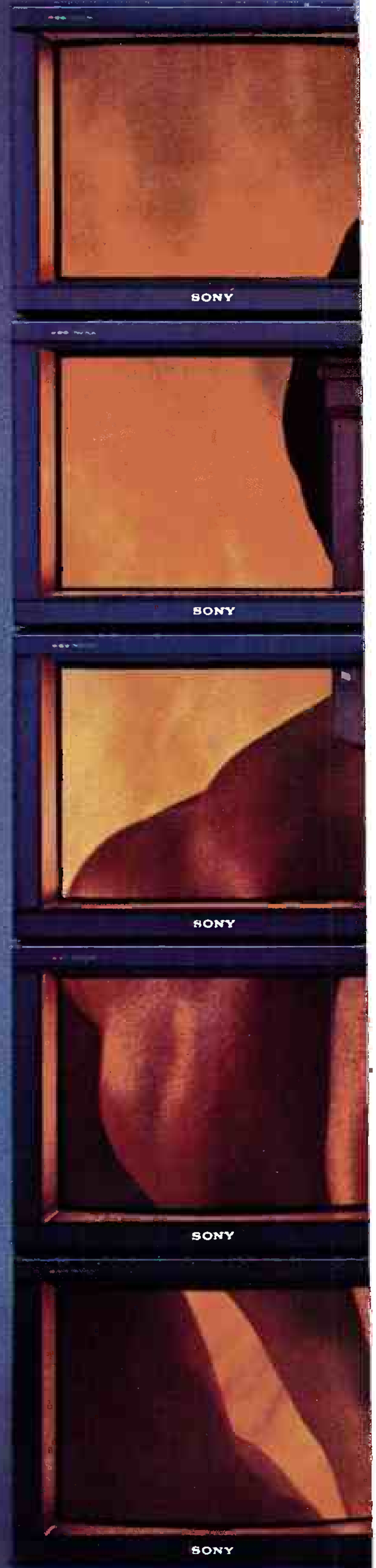

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8th annual salary survey

By Brad Dick, technical editor

And the survey says: moderate change and no big surprises.

Many of you seem to have a love-hate relationship with the annual salary survey issue of **Broadcast Engineering**. You love to find out that you're being paid more than the next guy. But if that's not the case, you hate finding out about it. When your October issue arrives in the mail, it's kind of like receiving a telegram. Is it good news, or bad?

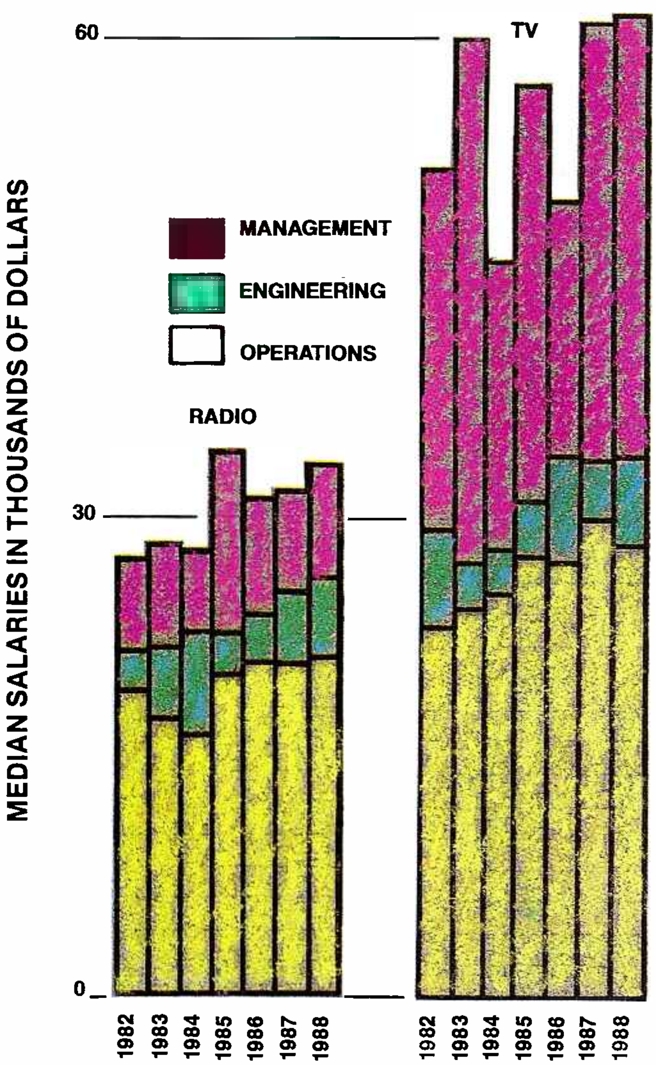
For most of you, it's both. You may earn more than some of your friends, but it's never quite "what you're worth." How does your salary compare? Read on and find out.

The survey

The salary survey, more than any other article, probably generates the most questions to this editor. Usually, the person calling is looking for ammunition to negotiate a higher salary. I also get a number of calls from managers trying to determine appropriate salaries for their engineers and operators. The good news is that most of them are trying to justify higher, not lower, salaries for their technical staffs.

The survey will help you see how your pay compares with salaries for similar positions. To make the comparisons as useful as possible, the results are grouped in several ways. Salaries are grouped by job type: management, engineering and operations. Each of these categories is further broken down by market size. Using these breakdowns, you should be able to get a good idea of how your salary compares with those in other markets.

One new category was developed this year. Because of the large number of requests for data about non-commercial broadcast salaries, this year's survey includes this information. Now, for the first time, you will be able to directly compare your salary against paychecks in both non-commercial and commercial stations.



The 1988 **BE** salary survey was scientifically conducted by the marketing research department of Intertec Publishing. On June 6, 3,172 questionnaires were mailed to recipients of **BE** on an "nth name" basis. By Aug. 7, 1,037 completed forms had been returned, providing a response rate of 33%. The data contained within this report is based on those responses.

Tabular results

The survey results are summarized in Tables 1 through 7. Tables 1 through 3 summarize the major portion of the data collected from the survey. Use the tables to develop detailed comparisons.

Tables 4 and 5 summarize the median salary information for both radio and TV stations over the past two years. Salary trends of the past 4-year period are shown in Table 6. Note that non-commercial station data is available only for this survey period.

Bear in mind also, that the results are based on *median* salaries. *Average* salaries may vary greatly from median salaries. The median salary represents the salary midpoint, where the responses are ranked from smallest to largest. Half the respondents will earn a salary higher than the median value, and half will earn lower. The median value provides a better statistical representation of the overall data and is used throughout the report.

Not much action

Continuing the trend begun last year, salaries show, for the most part, moderate change. Measured across all markets, radio and TV salaries ranged from a drop of 1% for operators to an increase of 14% for managers. Engineering salaries increased by a modest 4%.

The 4% rise in median radio/TV engineering salaries, meas-

TABLE 1.—MANAGEMENT STAFF PROFILE*

	ALL MARKETS	TELEVISION					RADIO				
Management	**Total %**	**Total TV %**	**Top 50 %**	**Top 100 %**	**Below Top 100 %**	**Non-Comm. %**	**Total Radio %**	**Top 50 %**	**Top 100 %**	**Below Top 100 %**	**Non-Comm. %**
Salary Level											
Less than $15,000	8.7	1.4	.....	.....	8.3	.....	13.2	.....	14.3	18.3	8.6
$15,000 to $24,999	10.8	1.4	.....	.....	.....	3.2	16.7	.....	.....	21.8	17.1
$25,000 to $34,999	17.8	8.5	7.1	.....	.....	16.1	23.7	8.3	28.5	18.3	37.1
$35,000 to $49,999	23.8	22.5	7.1	21.4	41.7	22.6	24.5	8.3	42.9	23.3	28.6
$50,000 to $74,999	23.2	35.2	28.6	28.6	33.3	42.0	15.8	58.4	14.3	13.3	5.7
$75,000 or more	14.1	31.0	57.2	50.0	16.7	16.1	3.5	16.7	.....	3.3	.....
No answer	1.6	.....	.....	.....	.....	.....	2.6	8.3	.....	1.7	2.9
Median =	$42,500	$61,500	$83,250	$75,000	$50,000	$53,000	$33,000	$62,500	$37,550	$30,000	$31,200
Received Salary Increase During Past Year	56.2	73.2	50.0	78.6	58.3	87.1	45.6	50.0	42.9	28.4	74.3
Percentage of increase											
Less than 3%	1.1	2.8	.....	.....	.....	6.5	.....	.....	.....	.....	.....
3% or 4%	9.7	9.9	7.1	7.1	8.3	12.9	9.7	.....	.....	1.7	28.6
5% to 9%	30.8	46.4	7.1	64.4	41.7	58.0	21.0	25.0	14.3	10.0	40.0
10% to 14%	7.6	11.3	21.6	7.1	8.3	9.7	5.3	16.7	14.3	5.0	.....
15% or more	4.3	1.4	7.1	.....	.....	.....	6.1	.....	14.3	6.7	5.7
No answer	2.7	1.4	7.1	.....	.....	.....	3.5	8.3	.....	5.0	.....
Median =	7.6	7.5	11.7	7.5	7.5	7.1	7.7	9.2	NA	10.0	6.1
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	89.2	95.8	85.7	100.0	91.7	100.0	85.1	91.7	85.7	78.3	94.3
Dental insurance (paid)	41.6	56.3	71.4	57.1	33.3	58.1	32.5	50.0	57.1	13.3	54.3
Life insurance (paid)	62.2	76.1	64.3	78.6	75.0	80.7	53.5	58.3	57.1	55.0	48.6
Sick leave	77.8	90.1	71.4	100.0	91.7	93.6	70.2	91.7	85.7	51.7	91.4
Vacation	86.0	91.6	78.6	100.0	91.7	93.6	82.5	100.0	100.0	71.7	91.4
Stock purchase plan	10.3	18.3	28.6	64.3	.....	.....	5.3	16.7	.....	6.7	.....
Profit sharing plan	11.9	18.3	21.4	28.6	41.7	3.2	7.9	8.3	.....	13.3	.....
Savings plan	10.8	22.5	21.4	28.6	16.7	22.6	3.5	.....	.....	3.3	5.7
Pension plan	39.5	56.3	42.9	57.1	33.3	71.0	29.0	16.7	14.3	5.0	77.1
Bonus	30.8	36.6	57.1	50.0	66.6	9.7	27.2	41.7	28.6	36.7	5.7
Trade show/convention/ seminar expenses paid	47.6	59.2	28.6	85.7	66.6	58.1	40.4	41.7	28.6	35.0	51.4
Tuition refund plan	22.7	25.4	7.1	35.7	16.7	32.3	21.1	8.3	28.6	6.7	48.6
Automobile furnished	33.5	36.6	35.7	50.0	58.3	22.6	31.6	41.7	42.9	45.0	2.9
Years in Present Job											
1 or 2	23.2	19.7	7.1	21.4	33.3	19.4	25.4	25.0	28.6	25.0	25.7
3 or 4	17.3	21.1	14.3	35.8	16.7	19.4	14.9	8.3	.....	18.3	14.3
5 to 9	24.4	24.0	28.6	21.4	16.7	25.8	24.6	25.0	42.8	21.7	25.7
10 to 14	11.9	12.7	14.3	7.1	8.3	16.1	11.4	8.3	14.3	6.7	20.0
15 to 24	12.4	14.1	14.3	14.3	8.3	16.1	11.4	.....	14.3	15.0	8.6
25 or more	8.1	5.6	7.1	.....	16.7	3.2	9.7	25.0	.....	10.0	5.7
No answer	2.7	2.8	14.3	.....	.....	.....	2.6	8.4	.....	3.3	.....
Median =	6.7	6.6	8.8	4.6	6.0	7.2	6.7	7.5	7.5	6.2	7.0
Years in Broadcast Industry											
Less than 5	4.9	1.4	.....	.....	.....	3.2	7.0	.....	14.3	8.3	5.7
5 to 9	9.2	5.6	.....	7.1	.....	9.7	11.4	8.3	28.6	11.7	8.6
10 to 14	12.4	11.3	7.1	7.1	16.7	12.9	13.2	16.8	.....	8.3	22.9
15 to 24	36.2	32.4	21.4	35.8	25.0	38.7	38.6	33.3	.....	41.7	42.8
25 or more	35.1	47.9	64.4	50.0	58.3	35.5	27.2	33.3	57.1	26.7	20.0
No answer	2.2	1.4	7.1	.....	.....	.....	2.6	8.3	.....	3.3	.....
Median =	21.2	24.6	27.5	25.0	26.7	21.8	20.3	19.2	26.3	19.3	21.3
Do Part-Time or Free-Lance Work	28.1	23.9	35.7	57.1	7.1	9.7	30.7	16.7	42.9	20.0	51.4
Education											
High school	10.8	9.9	7.1	.....	16.7	12.9	11.4	8.3	28.6	16.7	.....
Two years of college	21.1	15.5	21.4	35.7	.....	9.7	24.6	25.0	28.6	33.3	8.6
Four years of college	33.0	42.1	43.0	50.0	58.3	32.3	27.2	8.3	14.3	33.3	25.7
Post-graduate school	30.8	29.6	14.3	14.3	25.0	45.2	31.6	50.0	28.6	10.0	62.9
Voc/tech school	9.7	8.5	21.4	7.1	.....	6.5	10.5	.....	.....	13.3	11.4
No answer	2.2	1.4	7.1	.....	.....	.....	2.6	8.3	.....	3.3	.....
Age, Years											
Under 25	2.2	.....	.....	.....	.....	.....	3.5	.....	.....	5.0	2.9
25 to 34	13.5	4.2	.....	7.1	.....	6.5	19.3	8.3	28.6	16.7	25.7
35 to 44	33.9	31.0	21.4	28.6	25.0	38.7	36.0	33.3	.....	40.0	37.1
45 to 54	22.2	25.4	43.0	28.6	41.6	9.6	20.2	33.3	57.1	16.7	14.3
55 to 64	18.4	31.0	21.4	35.7	16.7	38.6	10.5	16.8	.....	6.7	17.1
65 or over	7.6	7.0	7.1	.....	16.7	6.5	7.9	.....	14.3	11.6	2.9
No answer	2.2	1.4	7.1	.....	.....	.....	2.6	8.3	.....	3.3	.....
Median =	44.8	50.6	50.8	50.0	51.0	50.0	42.2	46.3	48.8	41.7	40.8

*Management staff: president, owner, partner, vice president, general manager.

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TABLE 2.—ENGINEERING AND TECHNICAL STAFF PROFILE*

	ALL MARKETS	TELEVISION					RADIO				
Engineering	**Total %**	**Total TV %**	**Top 50 %**	**Top 100 %**	**Below Top 100 %**	**Non-Comm. %**	**Total Radio %**	**Top 50 %**	**Top 100 %**	**Below Top 100 %**	**Non-Comm. %**
Salary Level											
Less than $15,000	6.7	1.5	.....	2.1	9.7	.....	12.5	5.6	11.8	20.3	15.4
$15,000 to $24,999	26.9	21.2	12.2	20.8	29.0	33.8	33.2	11.1	50.0	49.2	41.0
$25,000 to $34,999	27.5	28.6	16.5	45.9	41.9	30.8	26.3	27.8	26.4	23.2	28.2
$35,000 to $49,999	25.7	32.1	43.5	22.9	12.9	27.7	18.5	32.2	11.8	7.3	12.8
$50,000 to $74,999	12.2	15.4	25.2	8.3	6.5	7.7	8.6	21.1	.....	.....	2.6
$75,000 or more	1.0	1.2	2.6	.....	.....	.....	.9	2.2	.....	.....	.....
Median =	$31,000	$34,700	$42,350	$30,900	$27,700	$30,300	$26,600	$37,550	$23,750	$21,250	$23,850
Received Salary Increase During Past Year	74.6	86.9	91.3	91.8	71.0	83.1	60.9	70.0	55.9	45.0	71.8
Percentage of increase											
Less than 3%	5.1	6.6	6.1	2.1	6.5	10.8	3.5	2.2	5.9	4.4	2.6
3% or 4%	26.5	35.5	42.6	39.6	16.1	29.2	16.4	18.9	8.8	11.6	25.6
5% to 9%	30.6	32.1	25.2	39.6	38.7	35.4	28.9	32.2	32.4	18.8	35.9
10% to 14%	6.9	7.3	8.7	4.2	9.7	6.2	6.5	8.9	2.9	4.4	7.7
15% or more	4.5	3.5	6.1	4.2	.....	.....	5.6	7.8	5.9	5.8	.....
No answer	1.0	1.9	2.6	2.1	.....	1.5	.....	.....	.....	.....	.....
Median =	5.9	5.1	4.8	3.2	6.7	5.1	6.9	7.2	7.1	6.8	6.1
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	83.9	89.6	94.8	89.6	80.7	84.6	77.6	83.3	76.5	68.1	82.1
Dental insurance (paid)	51.5	62.6	78.3	45.8	41.9	56.9	39.2	48.9	41.2	20.3	48.7
Life insurance (paid)	63.8	73.4	78.3	70.8	71.0	67.7	53.0	67.8	55.9	34.8	48.7
Sick leave	85.7	93.1	92.2	93.8	93.6	93.9	77.6	86.7	73.5	66.7	79.5
Vacation	95.9	98.1	98.3	97.9	100.0	96.9	93.5	100.0	91.2	87.0	89.7
Stock purchase plan	13.9	16.2	27.8	16.7	6.5	.....	11.2	22.2	2.9	5.8	2.6
Profit sharing plan	17.1	20.5	23.5	37.5	19.4	3.1	13.4	17.8	5.9	18.8	.....
Savings plan	25.5	33.6	50.4	31.3	12.9	15.4	16.4	30.0	11.8	2.9	12.8
Pension plan	47.7	62.2	71.3	39.6	29.0	78.5	31.5	40.0	8.8	10.1	69.2
Bonus	13.2	8.5	9.6	14.6	9.7	1.5	18.5	23.3	17.7	23.2	.....
Trade show/convention/ seminar expenses paid	37.3	34.4	27.8	39.6	45.2	36.9	40.5	47.8	38.2	27.5	48.7
Tuition refund plan	26.7	33.6	42.6	20.8	9.7	38.5	19.0	25.6	11.8	4.4	35.9
Automobile furnished	14.3	11.2	10.4	18.8	22.6	1.5	17.7	21.1	17.7	20.3	5.1
Years in Present Job											
1 or 2	22.4	18.2	15.7	25.0	19.4	16.9	27.2	32.2	35.3	17.4	25.6
3 or 4	19.1	17.0	20.9	8.3	19.4	15.4	21.6	21.1	32.4	17.4	20.4
5 to 9	28.2	28.5	26.1	35.4	19.4	32.4	27.5	27.8	14.7	33.3	28.3
10 to 14	10.2	10.4	11.3	6.3	9.7	12.3	9.9	6.7	8.8	14.5	10.3
15 or more	18.5	23.2	22.5	22.9	28.9	21.5	13.4	12.2	8.8	15.9	15.4
No answer	1.6	2.7	3.5	2.1	3.2	1.5	.4	.....	.....	1.5	.....
Median =	6.4	7.4	7.3	7.2	7.5	7.6	5.2	4.7	3.9	7.2	5.7
Years in Broadcast Industry											
Less than 5	6.7	6.2	4.4	10.4	9.7	4.6	7.3	6.7	8.8	8.7	5.1
5 to 9	18.7	21.6	23.5	12.5	25.8	23.2	15.5	11.1	20.6	10.1	30.8
10 to 14	19.8	15.4	15.7	12.5	29.0	21.5	24.6	20.0	35.3	30.4	15.4
15 to 24	31.4	30.2	30.3	37.5	6.5	24.6	32.8	42.2	23.5	26.1	30.8
25 or more	22.0	24.3	23.5	25.0	25.8	24.6	19.4	20.0	11.8	23.2	17.9
No answer	1.4	2.3	2.6	2.1	3.2	1.5	.4	.....	.....	1.5	.....
Median =	16.3	16.8	16.4	19.1	17.5	15.0	15.8	17.5	12.9	15.0	14.6
Do Part-Time or Free-Lance Work	47.9	38.2	36.5	31.3	38.7	46.2	58.6	54.4	61.8	60.9	61.5
Education											
High school	24.6	23.9	23.5	25.0	29.0	21.5	25.4	26.7	20.6	30.4	18.0
Two years of college	32.8	32.1	27.8	33.3	48.4	30.8	33.6	38.9	32.4	29.0	30.8
Four years of college	24.0	24.7	28.7	22.9	6.5	27.7	23.3	21.1	29.4	18.8	30.8
Post-graduate school	6.5	5.0	4.4	2.1	3.2	9.2	8.2	6.7	5.9	5.8	18.0
Voc/tech school	41.1	44.8	46.1	47.9	51.6	36.9	37.1	36.7	26.5	46.4	30.8
No answer	1.6	2.3	2.6	2.1	3.2	1.5	.9	.....	2.9	1.5	.....
Age, Years											
Under 25	3.3	2.3	.9	.....	6.5	4.6	4.3	6.7	5.9	2.9	.....
25 to 34	33.9	33.2	35.7	35.4	19.4	33.9	34.5	31.0	44.1	36.2	30.8
35 to 44	29.5	27.0	28.7	33.3	29.0	18.5	32.3	38.9	26.5	27.5	30.8
45 to 54	16.9	19.7	21.7	8.3	25.8	21.5	13.8	5.6	20.6	14.5	25.5
55 to 64	12.2	12.4	8.7	14.6	12.9	16.9	12.1	15.6	2.9	14.5	7.7
65 or over	2.4	3.1	1.7	6.3	3.2	3.1	1.7	1.1	.....	2.9	2.6
No answer	1.8	2.3	2.6	2.1	3.2	1.5	1.3	1.1	.....	1.5	2.6
Median =	39.1	39.9	39.2	39.1	42.8	40.8	38.3	38.0	35.0	38.7	40.8

*Engineering and technical staff: technical manager, chief engineer, engineer.


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TABLE 3.—OPERATIONS STAFF PROFILE*

Operations	ALL MARKETS Total %	TELEVISION Total TV %	TELEVISION Top 50 %	TELEVISION Top 100 %	TELEVISION Below Top 100 %	TELEVISION Non-Comm. %	RADIO Total Radio %	RADIO Top 50 %	RADIO Top 100 %	RADIO Below Top 100 %	RADIO Non-Comm. %
Salary Level											
Less than $15,000	14.1	6.2	1.5	11.1	16.2	2.2	22.0	24.3	11.5	29.0	.....
$15,000 to $24,999	38.8	35.7	26.1	44.5	43.3	39.1	41.7	19.5	30.8	52.7	50.0
$25,000 to $34,999	22.7	20.7	14.5	25.9	21.6	26.1	24.7	22.0	46.2	16.1	40.9
$35,000 to $49,999	16.9	25.1	28.9	14.8	18.9	30.4	8.8	22.0	11.5	2.2	9.1
$50,000 to $74,999	6.4	10.1	23.2	3.7	.....	2.2	2.8	12.2	.....	.....	.....
$75,000 or more	1.1	2.2	5.8	.....	.....	.....	.....	.....	.....	.....	.....
Median =	$24,200	$28,900	$39,200	$23,950	$19,450	$28,300	$21,300	$27,800	$26,700	$18,600	$25,000
Received Salary Increase During Past Year	69.8	81.5	84.1	81.4	75.6	82.6	58.3	68.3	65.5	46.4	81.9
Percentage of increase											
Less than 3%	3.6	3.4	2.9	3.7	.....	6.5	3.9	4.9	3.9	2.2	9.1
3% or 4%	21.3	27.9	31.9	33.3	21.6	23.9	14.8	12.2	15.4	8.6	45.5
5% to 9%	27.2	34.6	31.9	29.6	37.8	39.1	19.8	26.8	26.9	12.9	27.3
10% to 14%	11.6	9.5	8.7	7.4	10.8	10.9	13.7	17.1	15.4	15.1	.....
15% or more	4.7	3.9	5.8	7.4	2.7	.....	5.5	7.3	3.9	6.5	.....
No answer	1.4	2.2	2.9	.....	2.7	2.2	.6	.....	.....	1.1	.....
Median =	6.7	6.2	5.9	5.7	7.0	6.3	7.6	8.2	7.5	9.6	4.4
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	82.0	84.9	87.0	66.7	86.5	91.3	79.1	80.5	92.3	72.0	90.0
Dental insurance (paid)	41.8	55.9	68.1	22.2	54.1	58.7	28.0	34.2	34.6	11.2	54.6
Life insurance (paid)	57.9	67.0	81.2	51.9	56.8	63.0	48.9	43.9	65.4	40.9	72.7
Sick leave	83.4	91.6	95.7	100.0	75.7	93.5	75.3	70.7	80.8	69.9	100.0
Vacation	95.6	97.8	100.0	96.3	97.3	95.7	93.4	85.4	96.2	94.6	100.0
Stock purchase plan	12.7	20.1	29.0	25.9	18.9	4.4	5.5	14.6	7.7	2.2	.....
Profit sharing plan	12.2	16.2	20.3	7.4	35.1	.....	8.2	7.3	7.7	10.8	.....
Savings plan	20.2	29.1	46.4	25.9	8.1	21.7	11.5	22.0	11.5	7.5	9.1
Pension plan	38.5	55.3	63.8	29.6	29.7	78.3	22.0	29.3	15.4	8.6	72.7
Bonus	20.8	16.2	27.5	14.8	10.8	4.4	25.3	34.2	30.8	25.8	.....
Trade show/convention/ seminar expenses paid	33.0	36.3	40.6	37.0	27.0	37.0	29.7	31.7	38.5	21.5	50.0
Tuition refund plan	21.6	29.6	39.1	11.1	10.8	41.3	13.7	22.0	3.9	2.2	59.1
Automobile furnished	10.5	11.2	13.0	14.8	13.5	4.4	9.9	9.8	15.4	8.6	9.1
Years in Present Job											
1 or 2	32.7	33.0	30.4	33.3	54.1	19.6	32.5	41.5	34.6	26.9	36.3
3 or 4	21.3	21.8	17.4	40.8	18.9	19.6	20.9	19.5	26.9	19.4	22.7
5 to 9	24.4	24.0	34.7	18.5	10.8	21.7	24.7	22.0	23.1	27.9	18.2
10 to 14	11.1	11.7	8.7	3.7	10.8	21.7	10.4	14.6	7.7	8.6	13.6
15 or more	8.6	7.8	7.3	3.7	5.4	13.0	9.3	2.4	7.7	14.0	4.6
No answer	1.9	1.7	1.5	.....	.....	4.4	2.2	.....	.....	3.2	4.6
Median =	4.5	4.5	5.2	3.8	1.9	7.0	4.6	3.9	4.1	5.4	4.0
Years in Broadcast Industry											
Less than 5	9.4	11.2	10.1	7.4	24.4	4.4	7.7	7.3	3.9	8.6	9.1
5 to 9	21.3	25.7	21.7	44.5	27.0	19.6	17.0	12.2	7.7	19.4	27.3
10 to 14	24.1	26.2	26.1	33.3	27.0	21.7	22.0	34.2	23.1	19.4	9.1
15 to 24	29.4	23.5	29.0	7.4	13.5	32.5	35.1	36.5	53.8	30.0	31.7
25 or more	13.6	11.7	11.6	7.4	8.1	17.4	15.4	9.8	11.5	18.3	18.2
No answer	2.2	1.7	1.5	.....	.....	4.4	2.8	.....	.....	4.3	4.6
Median =	13.8	12.4	13.4	9.8	9.8	15.5	15.5	14.5	17.2	15.2	15.9
Do Part-Time or Free-Lance Work	50.4	43.0	34.8	48.2	32.4	60.9	57.7	63.4	88.5	45.2	63.6
Education											
High school	16.1	11.2	8.7	22.2	10.8	8.7	20.9	19.5	15.4	26.9	4.6
Two years of college	21.6	16.8	15.9	11.1	29.7	10.9	26.4	26.8	26.9	29.0	13.6
Four years of college	44.9	49.7	58.0	48.2	48.7	39.1	40.1	51.2	57.7	32.3	31.8
Post-graduate school	14.1	19.6	15.9	18.5	8.1	34.8	8.8	2.4	.....	6.5	40.8
Voc/tech school	11.4	8.9	8.7	7.4	13.5	6.5	13.7	4.9	11.5	20.4	4.6
No answer	1.9	1.7	1.5	.....	.....	4.4	2.2	.....	.....	3.2	4.6
Age, Years											
Under 25	7.2	7.8	5.8	14.8	13.5	2.2	6.6	4.9	.....	8.6	9.1
25 to 34	42.6	45.2	43.5	63.0	51.4	32.5	40.1	43.8	46.2	38.6	31.8
35 to 44	32.7	30.2	34.8	14.8	27.0	34.8	35.1	36.6	42.3	32.3	36.3
45 to 54	12.2	10.6	10.1	7.4	2.7	19.6	13.7	9.8	11.5	15.1	18.2
55 to 64	2.8	3.9	2.9	.....	5.4	6.5	1.7	4.9	.....	1.1	.....
65 or over	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
No answer	2.5	2.3	2.9	.....	.....	4.4	2.8	.....	.....	4.3	4.6
Median =	34.7	34.1	34.8	30.6	32.1	38.8	35.5	35.3	35.9	35.2	36.9

*Operations staff: operations manager, station manager, production/program manager.

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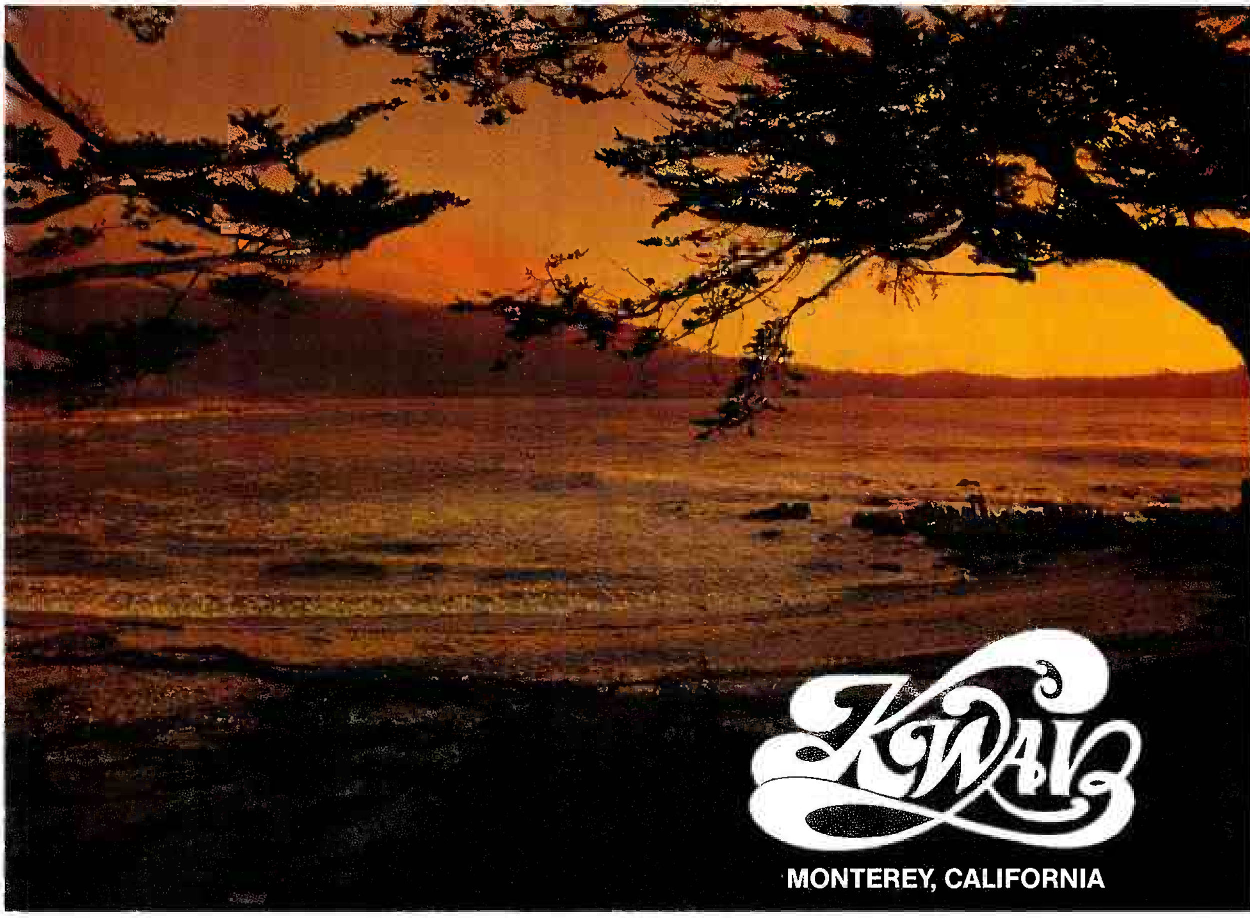

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TABLE 4.—MEDIAN SALARY SUMMARY FOR 1987 and 1988, TV

	1987 SURVEY				1988 SURVEY				
Category	All Markets	Top 50	Top 100	Below Top 100	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial
Management	$61,250	$70,000	$66,000	$51,500	$61,500	$83,250	$75,000	$50,000	$53,000
Engineering	$34,300	$41,150	$30,600	$26,800	$34,700	$42,350	$30,900	$27,700	$30,300
Operations	$30,900	$38,300	$27,700	$24,750	$28,900	$39,200	$23,950	$19,450	$28,300

TABLE 5.—MEDIAN SALARY SUMMARY FOR 1987 and 1988, RADIO

	1987 SURVEY				1988 SURVEY				
Category	All Markets	Top 50	Top 100	Below Top 100	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial
Management	$31,900	$41,600	$36,500	$30,100	$33,000	$62,500	$37,550	$30,000	$31,200
Engineering	$25,800	$32,100	$28,600	$19,900	$26,600	$37,550	$23,750	$21,250	$23,850
Operations	$20,950	$24,300	$22,500	$18,050	$21,300	$27,800	$26,700	$18,600	$25,000

TABLE 6.—MEDIAN SALARIES ACROSS ALL MARKETS

	TELEVISION				RADIO			
Category	1985	1986	1987	1988	1985	1986	1987	1988
Management	$57,750	$50,750	$61,250	$61,500	$34,800	$31,400	$31,900	$33,000
Engineering	$31,500	$34,900	$34,300	$34,700	$23,000	$23,650	$25,800	$26,600
Operations	$28,800	$27,200	$30,900	$28,900	$20,000	$20,350	$20,950	$21,300

TABLE 7.—MEDIAN VALUE PROFILE OF BROADCASTERS (Radio and TV Combined)

	MANAGEMENT			ENGINEERING			OPERATIONS		
Category	1986	1987	1988	1986	1987	1988	1986	1987	1988
Salary Level	$39,350	$37,250	$42,500	$29,800	$29,800	$31,000	$23,500	$24,450	$24,200
Received Salary Increase	58.2%	44.2%	56.2%	74.6%	67.9%	74.6%	75.3%	70.6%	69.8%
Amount of Increase	9.2%	8.7%	7.6%	7.1%	6.5%	5.9%	7.8%	7.5%	6.7%
Years in Present Job	6.6	8.6	6.7	6.7	6.1	6.4	3.8	3.9	4.5
Years in Broadcasting	20.7	22.8	21.2	16.0	16.1	16.3	12.7	13.5	13.8
Does Free-Lance Work	26.9%	33.1%	28.1%	41.8%	47.5%	47.9%	43.7%	43.7%	50.4%
College > 2 years	80.7%	82.4%	84.9%	71.3%	64.9%	63.3%	82.7%	81.7%	80.6
Age, Years	45.8	46.8	44.8	39.1	38.9	39.1	33.6	34.9	34.7

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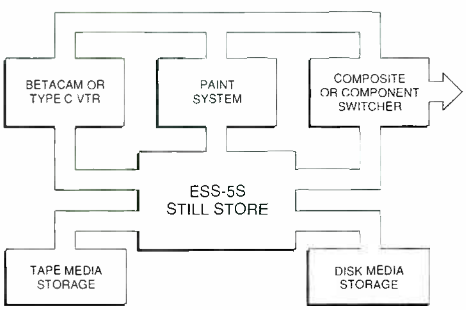

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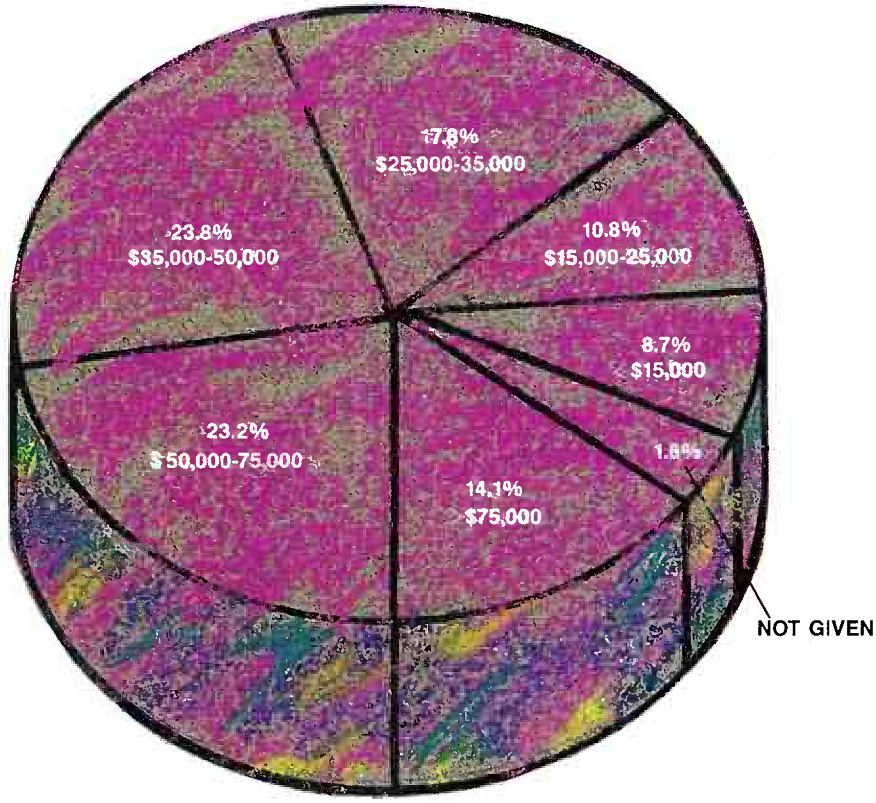


Figure 1. *Median salaries of management personnel, by salary category.*

ured across all markets, increased salaries from $29,800 to $31,000. Radio/TV operator salaries fell from $24,450 to $24,200 (–1%). Management salaries rose from $37,250 to $42,500.

TV manager salaries, measured over all markets, show no increase from last year. This trend is not carried across all markets; both the top 50 and top 100 market TV management salaries reflect healthy increases.

Tough times may be affecting the management salaries in the below top 100 markets, where the TV management salaries fell by 3%. Despite the overall net change of zero, it appears that TV management salaries continue to be the highest and show the widest swings.

Radio manager salaries, measured over all markets, show a 3% increase. This brings the median salary up from $31,900 to $33,000. The increase in this category last year was only 2%.

Median radio engineering salaries increased from $25,800 to $26,600, or 3%. This is only one-third the increase seen last year. Part of the reason for the modest increase may be the drop in median salaries in the top 100 markets. Salaries in this category fell from $28,600 to $23,750, a loss of 17%. Below top 100 market engineering salaries rose by 7% from $19,900 to $21,250. Engineering may be becoming more valuable in the top 50 markets; these salaries rose from $32,100 to $37,550, or 17%.

TV engineers are in the second year of small fluctuations in salary. These salaries increased by 11% in 1986, but fell by 2% last year. This year's increase was only 1%, taking the salary from $34,300 to $34,700.

Modest change is reflected across all markets. Top 50 market TV engineering salaries rose 3%, from $41,150 to $42,350. Top 100 market engineering salaries rose only 1%, from $30,600 to $30,900. The below top 100 market engineering salaries rose by 3%, from $26,800 to $27,700.

Generally, both radio and TV operators continue to receive the lowest salaries. Measured across all markets, radio operator salaries rose by 2%, from $20,950 to $21,300. This category saw a 3% increase last year. Although the increases in this category are small, they are consistent, showing no loss over the past 5-year period.

Salaries for TV operators across all markets fell by 6%, from $30,900 to $28,900. This is quite the opposite of last year, when TV operator salaries rose by 14%. The decrease was even greater for those working in the top 100 and below top 100 markets, where the median salaries dropped by 14% and 21%. Only the top 50 market TV market salaries showed an increase, which was 2%.

Non-commercial stations

As expected, the salaries paid at non-commercial stations are generally smaller than those at commercial stations. However, the salaries of those at non-commercial stations tended to be in line with those paid at top 100 market commercial stations.

The median non-commercial radio manager's salary is $31,200, which is slightly

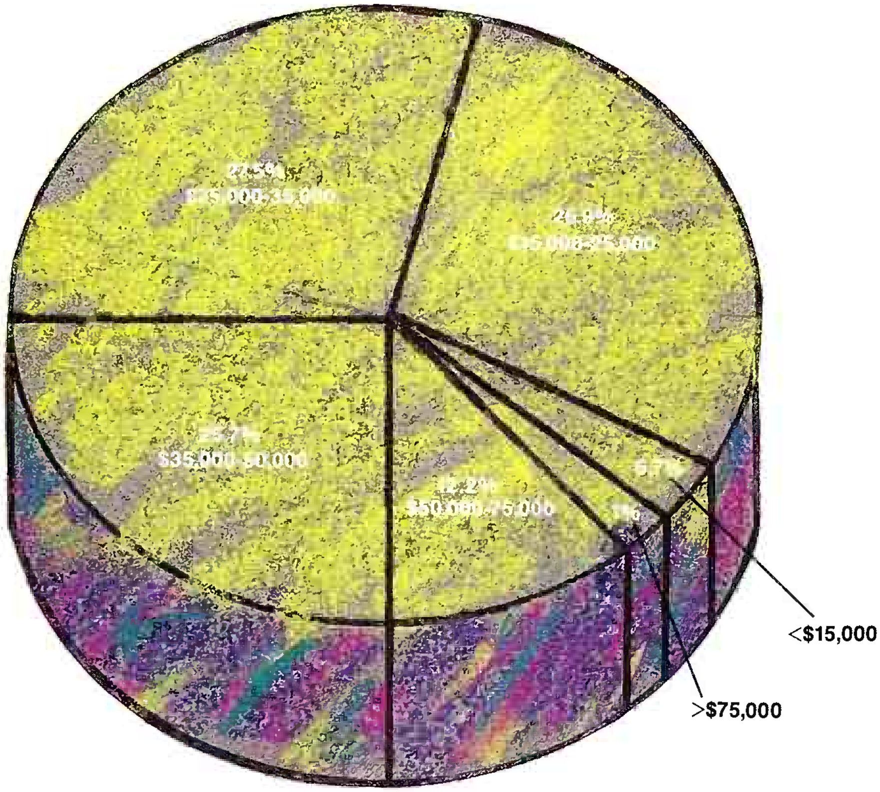


Figure 2. *Median salaries of engineering personnel, by salary category.*

more than at commercial stations in the below top 100 markets. However, it is 20% below that paid in the top 100 markets. Non-commercial TV manager salaries follow the same trend. These salaries are 6% higher than the below top 100 market and 42% lower than the top 100 market levels.

Engineers in non-commercial radio stations earn about the same as the median salary paid in the top 100 markets. This is 12% higher than the below top 100 market median salary. Non-commercial TV engineering salaries follow exactly the same trend. They match the salaries in the top 100 markets and are 9% above those paid in the below top 100 markets.

Market size comparison

It's interesting to study the differences in median salary based on market size. As you move from the below top 100 to the top 100 markets, the median radio managerial salary increases by 25%. A similar market-size change for engineering talent nets a 12% increase. The TV operator's median salary increases by a whopping

Continued on page 42

Are you thinking what I'm thinking?

Reading the survey comments is the most enjoyable part of preparing this report. People like to tell you what they think, and this year's survey was no exception. See how many of the thoughts expressed here parallel yours.

"I resent that some people think a broadcast engineer is also a carpenter, plumber and handyman. I am an electronic technician!"

"Opportunities are vast. Broadcasting is a good field in which to work."

"It's hard to get motivated people who have an intense desire to be in broadcasting and do everything well to work for hamburger-joint wages."

"I love the biz!"

"Radio is great—if you like low pay. I'm not complaining, though. I did 12 years of factory work, and now I'm much happier."

"At my station, the new owner is not interested in broadcasting, only the money. After taking over, he fired 13 employees, rehiring some as operators at one-third their original salaries. He then offered to hire one engineer (who used to make $26,000) for $8,000 and require him to carry a pager."

"I see a lot of investment in hardware and buildings and little investment in people because of the bean counters."

"The shortage of RF engineers is becoming alarming."

"The full-time radio engineer is a dying breed."

"Skilled engineers are in the driver's seat. Because of the lack of engineers in the broadcasting field, there is no lack of work. This is raising the pay that can be demanded."

"It's tough to make it working at only one station."

"HDTV is both the biggest problem and opportunity for broadcast TV."

"Broadcasters are our own worst enemy."

"It's a great time for contract engineering. You can just about name your price."

"The biggest problem is plastic parts."

"The opportunities offered by this industry are endless."

"I hate to see the growing trend of selling broadcast properties like they are pork bellies."

"The problem is that FM sounds like AM."

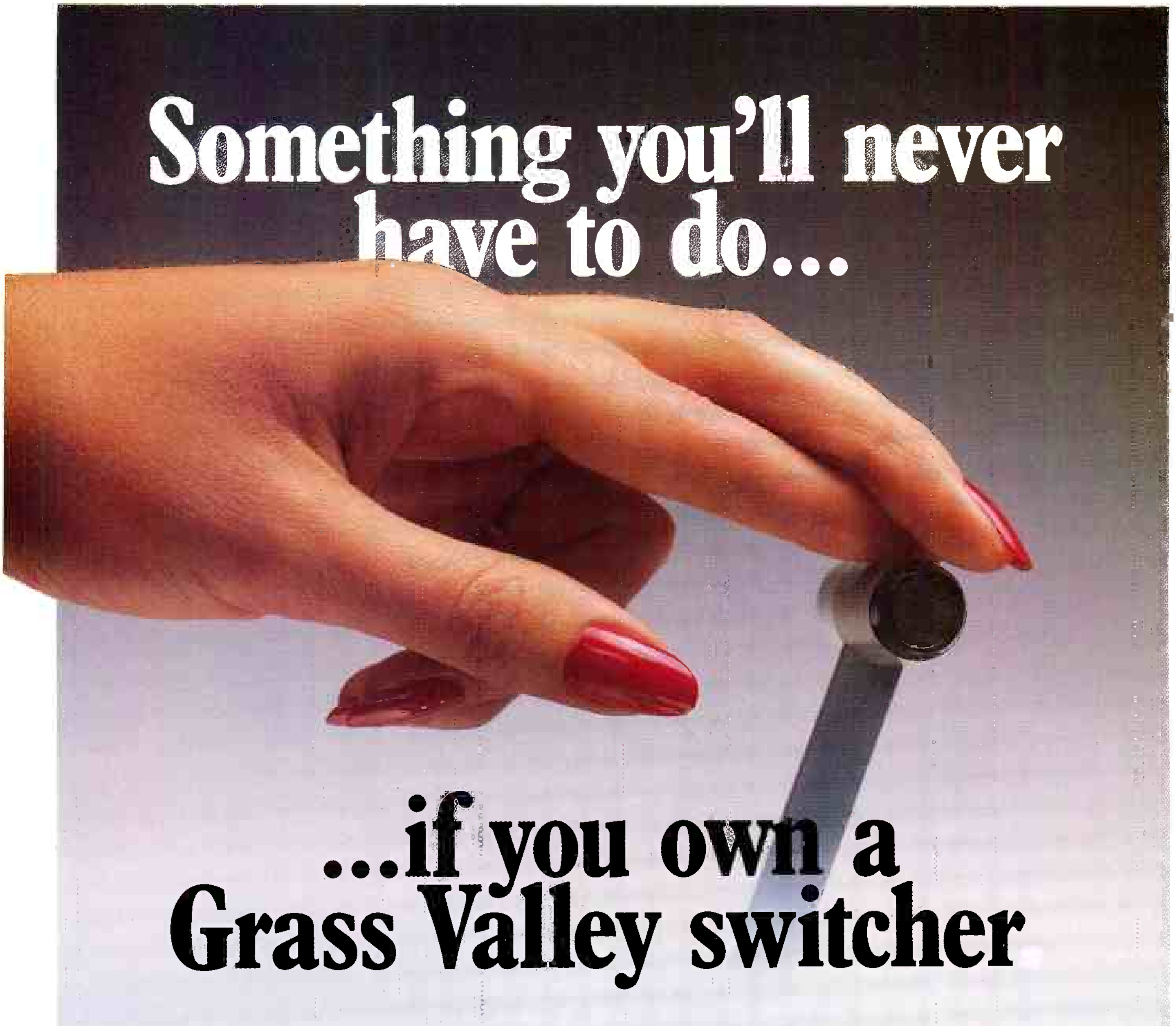
"The problem is GMs who want a big market sound for about $3."

"The use of part-time and free-lance people is hurting not only quality, but also those of us trying to make a living. These part-timers receive no benefits, thus encouraging management to continue the practice."

"I never thought I'd see the day where robotics would replace people in TV stations. But it's happening now."

"Larger-market stations are relying too much on part-time employees and are forcing full-time employees out."

"Despite the problems and competition, this is an exciting, vibrant field to be in."



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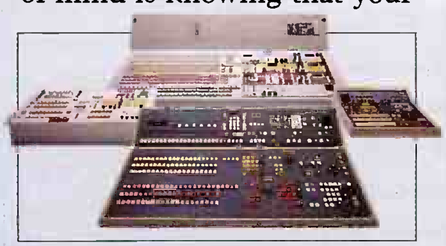

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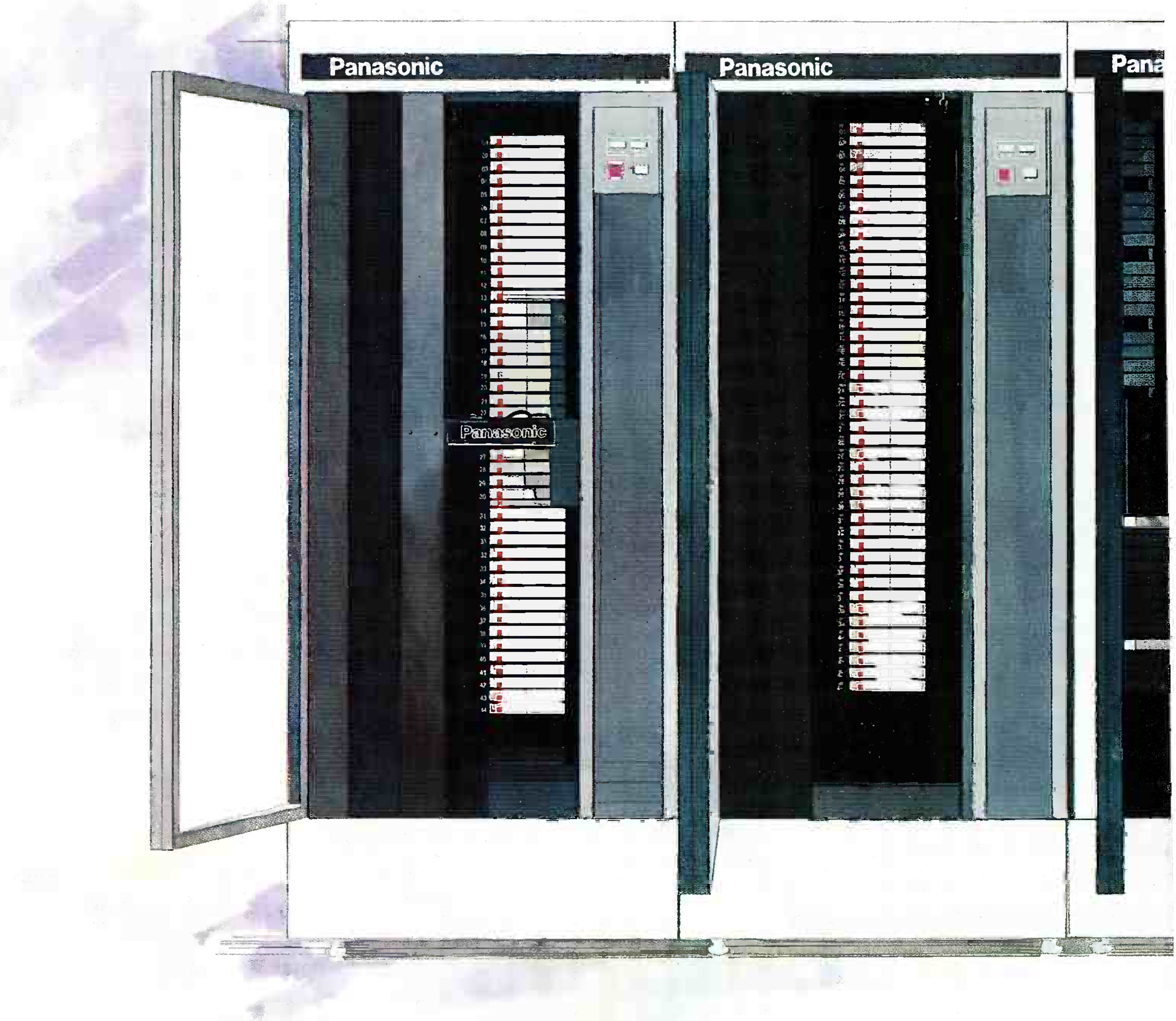

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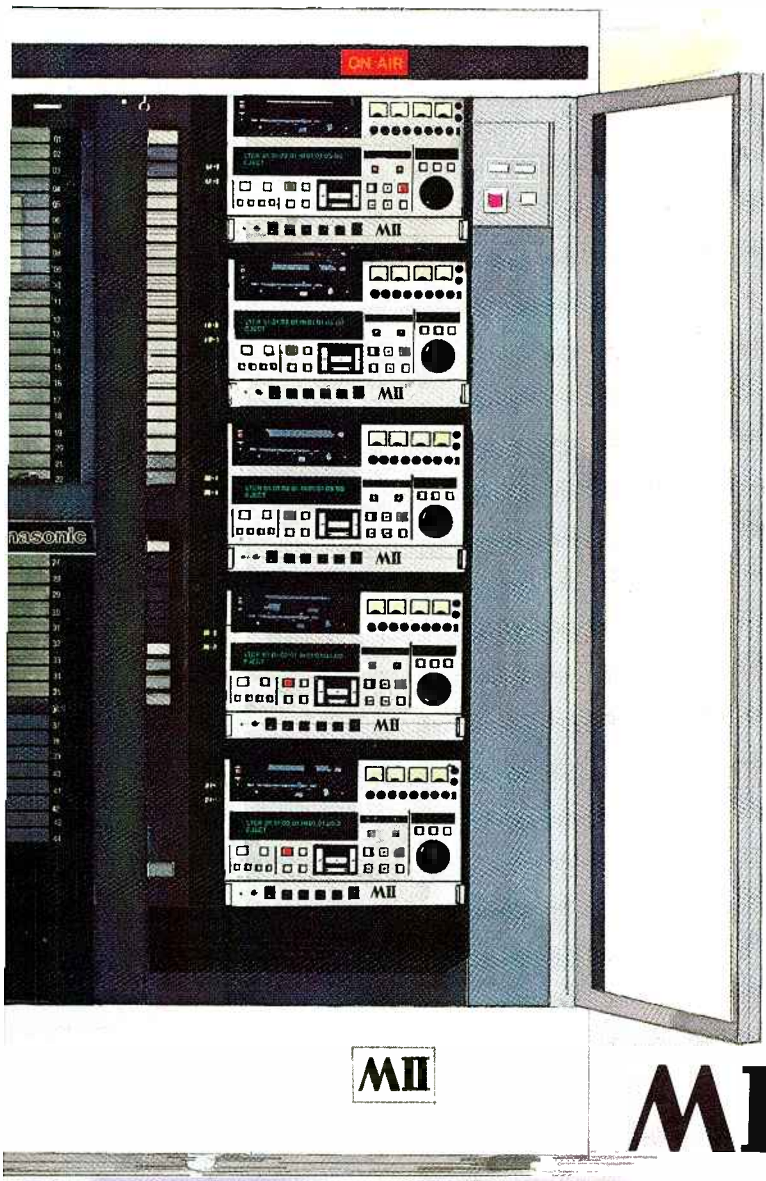

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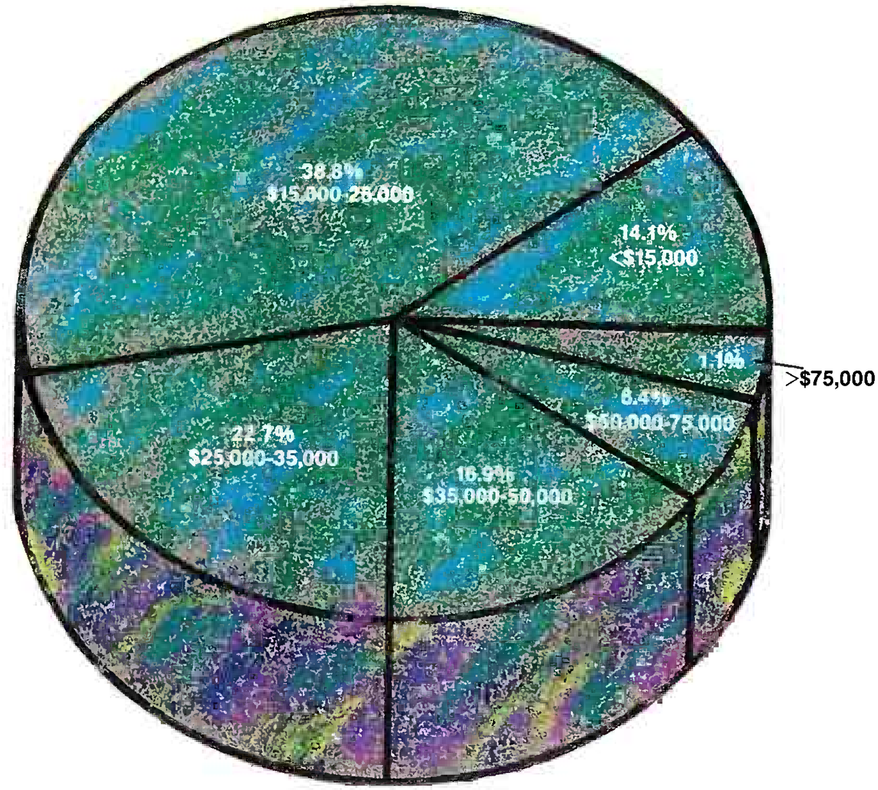

Figure 3. Median salaries of operations personnel, by salary category.

Continued from page 38

44% when a move is made from the below top 100 market to top 100.

As you might expect, significant increases in median radio salaries also occur with a move from top 100 to top 50 markets. Radio management salaries increase by 66%, engineering salaries increase by 58% and operator salaries by only 4%. As noted previously, the largest operator salary increase comes with a move from below top 100 to top 100 markets.

Market-size differences also are reflected in TV salaries. Median management salaries increase by 50% and 11% as the market size changes from below top 100 to top 100 to top 50 markets. Engineering salaries increase by 12%, then 37%. Operator salaries also increase by market size, rising 23% and 64%.

General trends

If there is any trend to note, it must be that salary increases have reached moderate levels. The double-digit percent in-

Continued on page 160

A certifiable difference in the paycheck

Does SBE certification mean anything in terms of salary? The data shows that it does pay. The median salary of the SBE-certified radio engineer is 16% higher than the non-certified counterpart in the top 50 market. In the top 100 market, the certified salary is a whopping 27% higher. In the below top 100 markets, the certified salary is still 19% above that received by a non-certified engineer. The differential is reversed in the non-commercial category, with certified salaries being 3% below the non-certified salary.

The results from TV engineers are less clear. In only the top 50 and non-commercial categories were there sufficient responses to make a comparison. In the top 50 markets, the certified TV engineer's salary is only slightly higher. Non-commercial TV engineers carrying SBE certification reported salaries 17% higher than their non-certified counterparts.

When combined radio and TV categories are compared across all markets, the salaries of SBE-certified engineers are 11% above those of non-certified employees. The wages of radio engineers, measured across all markets, were 24% higher than non-certified salaries. The same comparison for TV salaries shows a 16% advantage in carrying SBE certification.

The percentage of respondents reporting SBE certification is the same as last year: 20%. A closer look shows that 14% of the TV engineers and 27% of the radio engineers are SBE certified. Compared with last year, certification of TV engineers is down slightly, and radio shows a small increase.

Obtaining SBE certification may not immediately get you a raise, but the data continues to show that it surely might help. If you are interested in learning more about SBE certification, contact the SBE national office at 317-842-0836. Or write to the certification secretary, Society of Broadcast Engineers, 7002 Graham Road, Suite 216, Indianapolis, IN 40026.

	Total	Total TV	Top 50	Top 100	Below Top 100	Non-C	Total Radio	Top 50	Top 100	Below Top 100	Non-C
Median salary	$31,000	$34,700	$42,350	$30,900	$27,700	$30,300	$26,600	$37,550	$23,750	$21,250	$23,850
Certified salary	$33,400	$39,200	$42,500	———	———	$34,000	$30,700	$40,700	$28,600	$24,000	$23,350
Non-certified salary	$30,200	$33,800	$42,350	$30,300	$27,700	$29,000	$24,700	$35,000	$22,500	$20,200	$24,050

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Using management science in broadcasting

By Marvin Born

Computer programs make it easier for you to effectively manage a construction project.

When you're faced with managing a major construction project, you go into the project with two goals in mind: to complete the project on time and within budget. And it sounds so simple. But it isn't. Just ask any engineer who's been there.

The normal procedure is to draw up a set of plans and go to work, but the outcome might be less than optimum. The problem might be late-arriving equipment, which results in storage fees and interest charges. Or labor may be improperly assigned, with either too much or too little for a given task. Even worse, the right amount of labor may be on site, but there may be no equipment or materials. All these problems can result in increased costs and delayed projects.

An effective solution is to rely on management techniques such as Pert and Gantt charts to help plan and monitor the progress of large projects. The use of project management techniques is common in many large corporations because they help reduce costs and maintain project schedules from beginning to end.

Before the widespread use of computers, many of these planning tools required special expertise and a certain amount of graph-plotting and clerical work. Today's personal computers take the drudgery out of using these tools and allow even the smallest broadcast station to plan and implement projects more effectively.

Born is vice president of engineering, Gulf Coast Broadcasting, Corpus Christi, TX.

Project management

A project is often defined as a series of related tasks performed to reach a specific objective. An engineer who runs around the facility fixing one emergency problem after another is not working on a project, because the tasks are not related.

The series of related tasks involved in a project also must have a beginning, middle and end. Constructing a transmitter building is a project. Operating the equipment in the building is not a project. If the tasks are developmental rather than operational, they constitute a project.

Project management generally is divid-

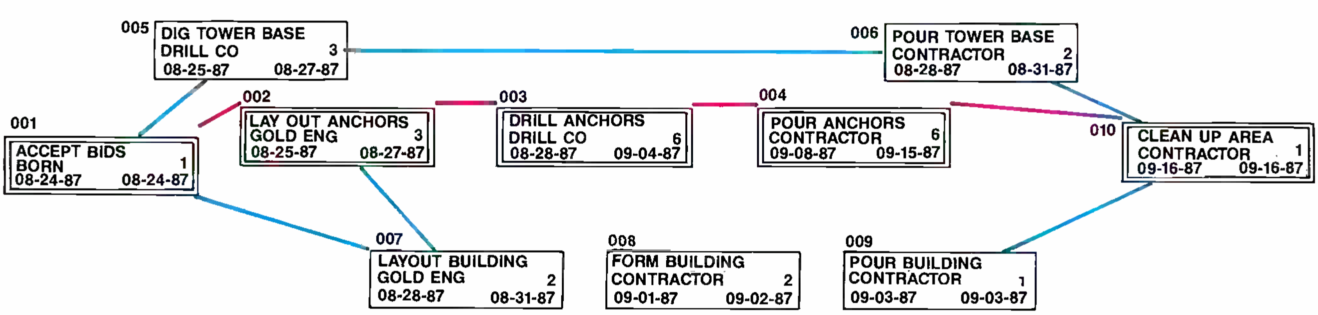

Figure 1. The Pert chart is an important visual tool to help identify the critical path of the project.

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ed into four areas: *strategic planning, tactical planning, managing and evaluating.* Each area meets a specific managerial need and should be given sufficient detailed attention. Let's look more closely at these four areas.

Strategic and tactical planning

The way to understand strategic planning is to stand back and look at the overall picture, including present and future perspectives. Then address these questions: Is this a viable project? Does it meet the long- and short-term needs of my company? What would be the impact on the company if the project was not undertaken? Strategic planning evaluates the current needs of the company in relation to the project's cost and future company needs.

Tactical planning is a detailed outline of the individual aspects of a project, such as:

- Tasks needed to finish the project.
- Designation of people to complete the individual tasks.
- Length of time required to complete the tasks.
- The cost of each task.
- Time relationships among tasks.
- Equipment and personnel requirements.

Proper tactical planning requires detailed knowledge of each task and its relationship to the overall project. It is here that computer-aided project management techniques can be of great benefit in automating the planning/tracking process.

The Pert chart

Two tools commonly used in project management are Pert charts and Gantt charts. When combined with other interconnected schedules and calendars, these planning tools are effective ways to plan and execute a project.

A Pert chart, shown in Figure 1, is a visual aid comprised of small boxes that represent tasks. The name of the task is listed in each box, along with the resources, the amount of time required to complete the task, and the starting and ending times. The tasks then are linked in the desired order of occurrence.

Notice the red line in Figure 1 linking tasks 1, 2, 3, 4 and 10. This is the *critical path.* Changes on this path will affect the project completion date. The green line connecting tasks 5, 6 and 10 represents a non-critical path. Minor changes can be made in this path without affecting the critical path. However, changing the duration of a non-critical task can cause that task to move to the critical path, which would affect the ending time.

This visual aid is a useful tool in analyzing "what if" scenarios such as bad weather, missing materials or labor problems. Major changes show up as spectacular movement among the tasks on the Pert chart. Small modifications change only a single date and are not noticed as easily. It's better to track minor time movements on a Gantt chart, which will be discussed further in this article.

Example case

Let's say the project is the construction of a transmitter tower. Following is an example of how the charts might have been used to manage the construction.

The first step was to accept bids. The resource allocated for this task was assigned to the chief engineer, and the time required to open, evaluate and accept a contractor was one day.

When this project was planned, three parallel activities were to be carried out. The anchors for the guy cables, the actual tower base and the transmitter building were to be constructed simultaneously. The resources allocated included the surveying company, the contractor, a drilling company and the chief engineer. During a planning session, various tasks were assigned by allocating the necessary resources to minimize the amount of time contractors needed to be on site. Also, the tasks were examined to ensure that no time conflicts existed for tasks assigned to a single resource.

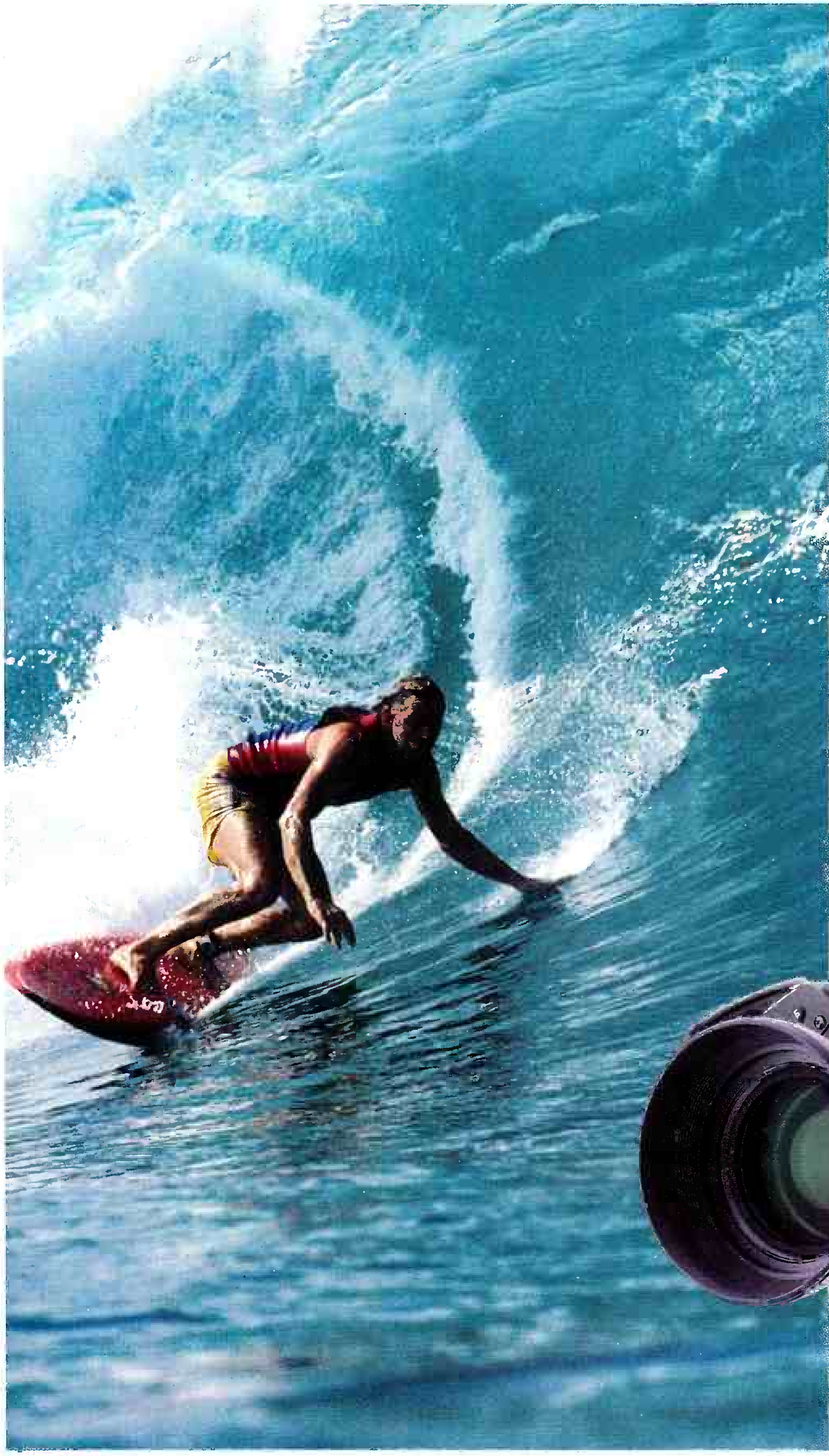
The original plan called for the survey crew to lay out the tower base and the guy anchors and, later, to lay out the building foundation. The drilling company was to dig the tower base and drill six anchor holes. The contractor was to pour the holes, the base and the building foundation, then clean the area in preparation for the tower erection.

Using computer project management, each task was assigned a number, a resource and a length of time necessary to complete the task. Each task then was linked to the next task. The computer established the critical path and non-critical paths for the project, thus completing the Pert chart. The computer program also checked for conflicts in resources and prepared a Gantt chart and a resource calendar.

Gantt chart

The Gantt chart, shown in Figure 2, lists the scheduled time required for each task on a time-line basis. The red blocks represent days on the critical path and may not be changed without affecting the completion date. The blue blocks represent non-critical path tasks that can be moved or delayed.

The yellow blocks symbolize free-



Canon is proud to introduce a lens designed to perform flawlessly in a wide range of broadcast applications, whether in the field or in the studio. And despite the J15X9.5B IRS' compact size, it boasts a long list of impressive features. Like a powerful 15X zoom with built-in 2X extender and macro focusing as close as half-an-inch. And full compatibility with all 2/3" CCD cameras. Yet this incredible lens is affordable too, making it the perfect choice for any size TV station, the educational marketplace and everyone else in between.

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SPECIFICATIONS:

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Max. Relative Aperture: 1:1.8 (9.5-121mm), 1:3.6 (19-242mm)
Angular Field of View: 49.7° at 9.5mm, 26.1° at 19mm 3.5° at 143mm, 1.8° at 286mm
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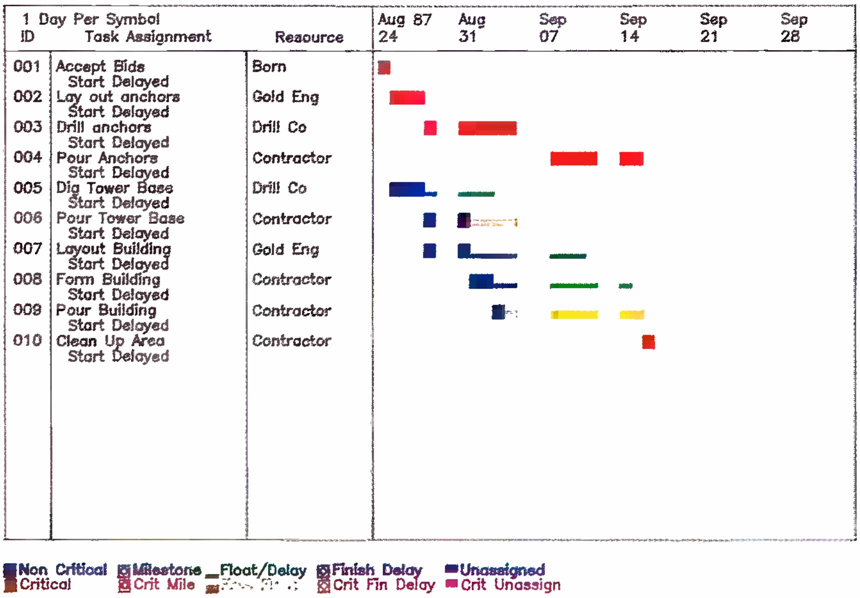

Figure 2. *The Gantt chart quickly identifies areas where a task can be delayed without affecting other tasks. The interrelated time frames of tasks are identified clearly, which helps avoid conflicts that might result in expensive delays or overtime.*

floating days. A blue task can be moved along a yellow line with no change in another task. The green lines are float/delay days. Changes during this period may delay a second task, but will not affect any tasks on the critical path. The chart provides a quick visual representation of the relationships among tasks.

For example, note that "form building" (task 8) requires two days to complete, represented by the blue block followed by a green line. The project manager can quickly see that the forming of the building can be put off as much as a week without delaying the project.

However, task 9, pouring the building foundation, is scheduled to start one day later than task 8. If task 8 is delayed, task 9 would be delayed the same amount. Note also that task 9 has several free-floating days available. In this case, pouring the building foundation can be delayed up to seven days without delaying any part of the project.

Gantt charts allow a manager to see how the time frame of a specific task can

Continued on page 53

S VHS

WHAT YOU SHOULD KNOW ABOUT JVC's S-VHS

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Now with JVC's S-VHS you have separate Y/C video signals, wider bandwidth, and better than 400 lines of horizontal resolution to give you higher quality, sharper, clearer images...in short, better pictures.

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They're the true camcorders you've always hoped for.

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The BR-S410UN is a true portable VCR which can be used with your existing composite color camera or any Y/C camera.

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The BR-S810U editing VCR combined with the RM-G810U editing controller tackles the most demanding post-production applications with ease.

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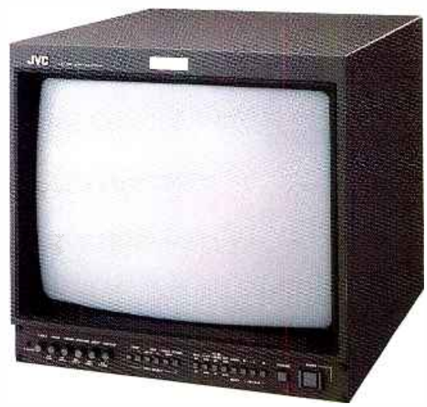

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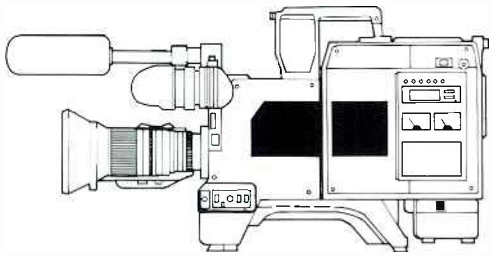

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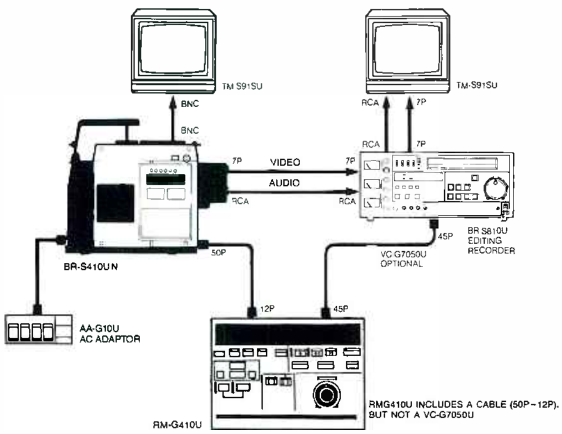
MV-P602U	Stereo Microphone
AA-P250U	AC Adaptor/Charger
TM-22U	5″ Color Monitor
NB-P1U	Battery for TM-22U
CB-15U	Shipping Case For Camera/VTR
ST-120	120 Min S-VHS Video Tape

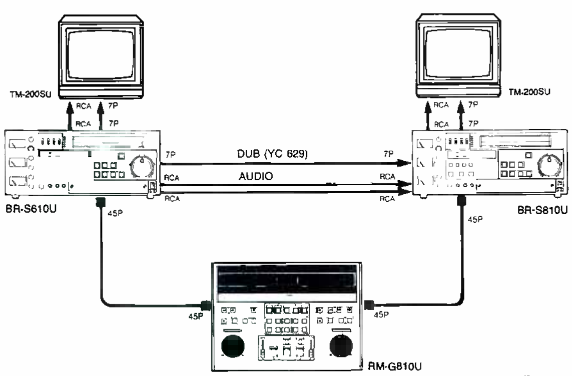
BR-S410UN EDITING SYSTEM



- Multiple Use VTR, Dockable, Portable and Source to Editing System
- BR-S410UN Can Be Used As The Source Deck To An Integrated Multi-Format Editing System
- Easy-To-Use Cuts Only Field Editing System

MODEL	DESCRIPTION
BR-S410UN	S-VHS VTR
BR-S810U	S-VHS Editing/Recorder/Player
RM-G410U	Editing Controller
TM-91SU	9″ S-VHS Monitor
AA-G10U	AC Power Adaptor
VC-G7050U	Cable
VC-G1035U	7 Pin-7 Pin Cable
ST-120	120 Min S-VHS Video Tape

BR-S810U EDITING SYSTEM



- Full 2-Hour Recording/Playback Editing System
- Maintains High S-VHS Quality With No NTSC Artifacts
- BR-S810U Serves As An Editor Or Source In An Integrated Multi-Format Editing System

MODEL	DESCRIPTION
BR-S610U	S-VHS Recorder/Player
BR-S810U	S-VHS Editing/Recorder/Player
RM-G810U	Editing Controller
TM-200SU	20″ High Resolution Color Monitor
VC-G1035U	7 Pin-7 Pin Cable
ST-120	120 Min S-VHS Video Tape

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Continued from page 48

be changed without disrupting the total project. Likewise, the manager can enter a change on a "what if" basis to see what effect it would have on the project completion time. Similar tests can be made in either the Pert or Gantt chart data screens. Recording a change in the program not only changes the Gantt chart, but updates the Pert chart and the project calendar. The interconnection of charts greatly aids the tracking of any project.

Project calendar

The project calendar shown in Figure 3 contains all holidays and weekends that apply to the project. Each day is automatically assigned an available number of hours, usually eight. The number of hours can be increased or decreased as needed on a daily basis, and when there are more than eight, they can be assigned as overtime hours. Rain days also can be inserted into the project calendar.

An individual resource calendar is assigned to each resource, and all information from the general project calendar is transferred to that calendar along with the exact work days from the Pert chart. (Changes in the Pert or Gantt charts will be reflected automatically on these calendars.)

Let's look at an example that demonstrates the value of these calendars. A typical question is, "Should I pay overtime to complete a task before the weekend or hold the crews over and work them straight time next week?" Holding a crew over the weekend involves paying expenses for lodging and food, and it delays the project. However, paying time and a half or double time could be more expensive. The question of time vs. money moves the discussion to yet another chart.

Calendar for: Contractor — Number of units: 1

1987	Sun 0	Mon 8	Tue 8	Wed 8	Thu 8	Fri 8	Sat 0
Aug	23 WKND	24	25	26	27	28 8	29 WKND
Aug Sep	30 WKND	31 8	01 8	02 8	03 8	04	05 WKND
Sep	06 WKND	07 LaborDay	08 8	09 8	10 8	11 8	12 WKND
Sep	13 WKND	14 8	15 8	16 8	17	18	19 WKND
Sep	20 WKND	21	22	23	24	25	26 WKND

***Figure 3.** The project calendar helps identify holidays and weekends that occur within the project's time frame. Rain delays also can be incorporated into the project from the beginning.*

Gulf Coast Broadcasting Tower Project

Name: CPM-DEMO.PJ :Gulf Coast Broadcasting Tower Project
Directory: C:/PROJ/

		Defaults		Totals	
Author: BORN	ID Code: P1	Hours:	40	Var:	5400.00
Leader:	Unlocked:- - - -	Fixed:	50.00	Fixed:	100.00
Created:08/22/87	Revised: 11/07/87 #9	Bill Rate:	25.00	Total:	5500.00
Start:08/24/87<		Overtime Mult:	1.50	Actual:	20.00
Finish:09/16/87	Dur: 170h	Duration:	5	Hours: 216	Ovr: 0
Owner Project:		Alloc: 9x	Pri: 50	Tasks: 10	Resc: 15

Workday	Start	Finish	Hrs	6a7 8 9 10 11 12 1 2 3 4 5 6p7 8 9 10 11 12 1 2 3 4 5
Sunday	12:00a	12:00a	0	. . . .
Monday	8:00a	5:00p	8	..yyyyyyyy..yyyyyyyy..................
Tuesday	8:00a	5:00p	8	..yyyyyyyy..yyyyyyyy..................
Wednesday	8:00a	5:00p	8	..yyyyyyyy..yyyyyyyy..................
Thursday	8:00a	5:00p	8	..yyyyyyyy..yyyyyyyy..................
Friday	8:00a	5:00p	8	..yyyyyyyy..yyyyyyyy..................
Saturday	12:00a	12:00a	0	. . . .

***Figure 4.** The resource details chart contains cost information unique to each resource used on a project. This provides the data used by the program to recalculate costs when overtime or weekend work is required.*

Resource details

The resource details chart shown in Figure 4 contains billing-rate information for each resource, the overtime rate and fixed costs for food and lodging. With all the information for each resource entered in the project details chart, you can generate a report using the overtime situation, then generate a second "what if" situation.

This feature allows you to examine the options to find the least expensive one. Not only are such calculations faster, but the program also checks to see how your choices will affect other tasks.

Evaluation

The final step of the project, evaluation, is intended to help you determine how well you accomplished the original task. Step back, and take a look at the results. Did you achieve your goal? Did your resources produce and cost as expected? Were your time estimates close to the actual times? Using the computer allows you to compare the original planning charts with the final working charts so that you can analyze your mistakes.

The evaluation stage also helps prepare you for the next project. You gain insight into the value of services, people and equipment. Careful analysis of the performance of each person (or company) reveals strong and weak areas that can be used, corrected or avoided.

Computer project planning is a tool that allows you to plan your work in greater detail. Perhaps even more valuable is the ability to re-evaluate and adjust your plans as you go along, knowing what each adjustment will cost in time and money. The objective is to complete the project on time and within budget. If the computer and project planning make you look like a genius, so much the better.

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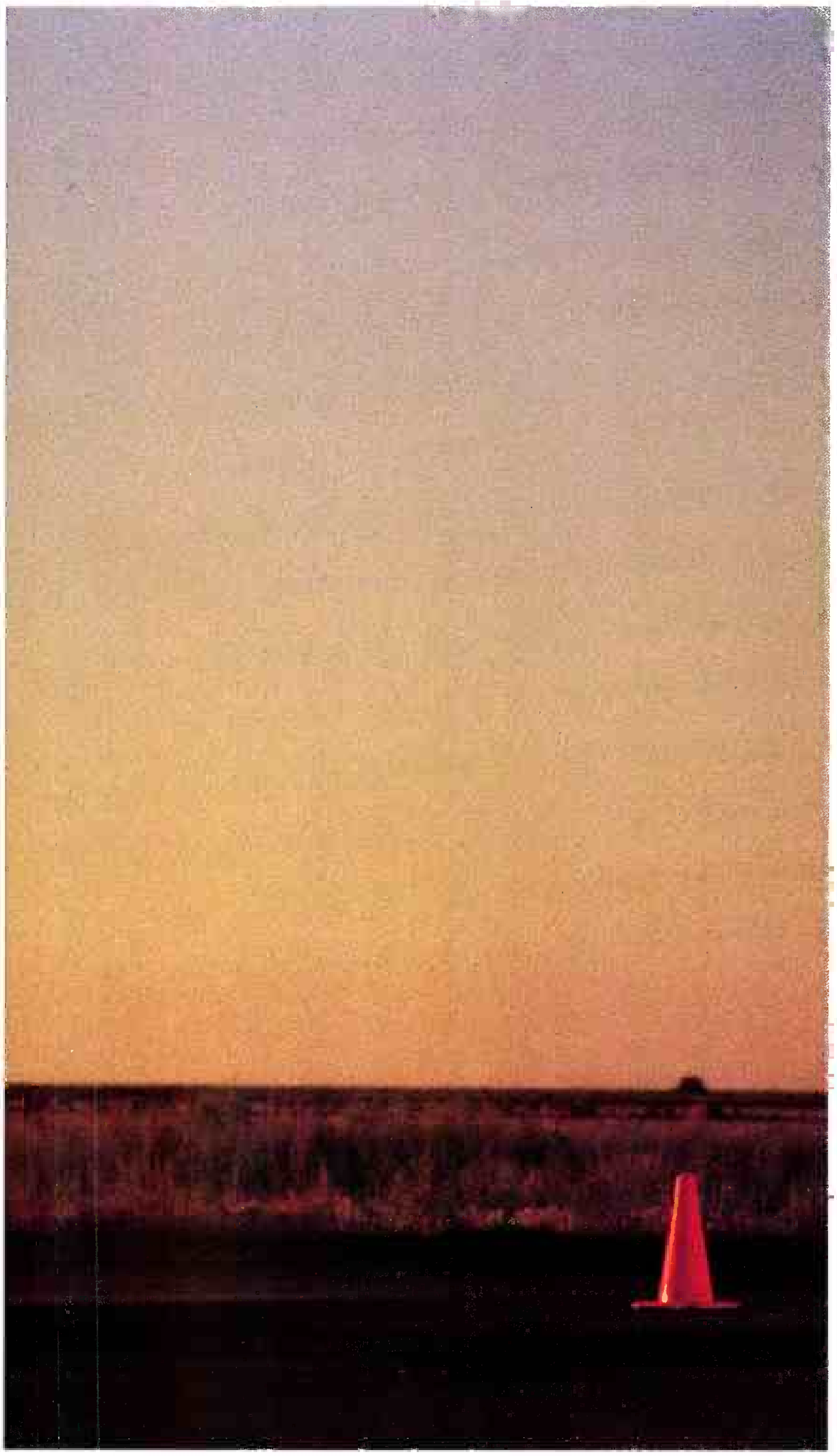

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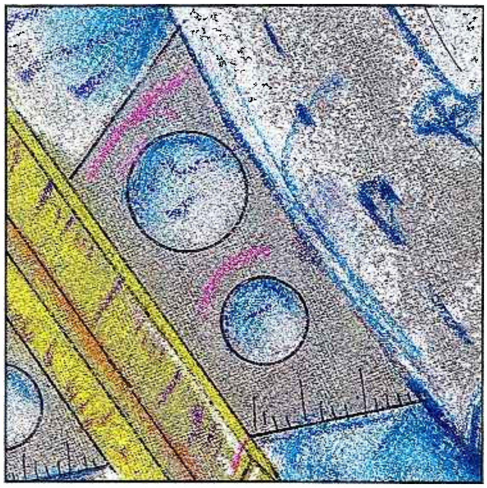

The art of project management

By Rick Morris

You've got the go-ahead, and now it's up to you to manage that project you've been fighting for. Take it step by step.

Seasoned engineer or not, when you finally get the authorization to build a major capital project, you must be able to complete the project not only on time, but also within the budget. This is not the stage at which you begin to develop the skills to manage engineering projects. You must already know how.

For better or worse, an engineering manager's qualifications often determine how well projects are managed. Everyday operations are expected to go without hitches. And the successful completion of major projects allows an engineering manager to really shine.

The management of major projects can be broken down into discrete managerial steps, each requiring a different set of management skills. For this discussion, let's look at the processes used to build a large edit suite. The seven major managerial steps of this capital project are broken down as follows:

1. Determine the performance objectives.
2. Select the equipment.
3. Develop a project budget.
4. Make a request for bids.
5. Oversee construction.
6. Test the equipment.
7. Conduct training sessions.

Performance objectives

The first, and perhaps most important, step to complete is that of determining performance objectives. Two factors are crucial to this step: users' needs and available money. Although it's the chief engineer's responsibility to select and purchase the appropriate equipment, these decisions must be based on meeting the users' needs. A project may be technically perfect, but if the equipment fails to perform as envisioned by the users, the project has not been entirely successful.

One of the best design techniques relies on a survey approach to determining performance objectives. In this example of building an edit suite, the editors provide information on essential operational features. Using this information, the engineering manager develops the hardware list and purchases the equipment.

Written criteria

The final performance objectives should be carefully written out. This process prevents misunderstandings between engineering and operations about equipment and facility operational performance. Listing operational needs forces the users to review carefully just how their jobs are performed. It also helps the engineering staff to better understand important operational criteria that otherwise might go unmet.

Once the overall objectives are determined, periodic design review meetings should be held with a user representative. Keep this person informed on how the project is progressing and where changes may be needed. This person should be empowered to make decisions for the group of users, to eliminate the need for several large-group meetings.

Equipment selection

Once the performance objectives are well-defined, it is time to survey the equipment available to meet the listed needs. The following steps may be interlocking, especially if the entire project depends on a specific piece of equipment, such as a particular special-effects device. However, for the purposes of this discussion, let's assume that several competing and equivalent pieces of equipment meet the performance criteria.

Contact the manufacturer, and request literature and pricing. If this is the first time you've used a new technology (for example, ½-inch videotape) educate yourself on the basic technology. You must understand how it works and know the available features and advantages before you can make an informed purchasing decision.

One way of evaluating several brands of equipment is by attending trade shows organized by NAB, SBE and SMPTE. You can see functioning equipment in practically side-by-side comparisons. Another method is to require a manufacturer's representative to bring a sample into your station for evaluation by your maintenance and operations staffs. This approach has the additional advantage of allowing many people to ask questions and get a firsthand look. Visiting other stations that have

Morris is project manager for the broadcast systems division of NBC.

similar equipment is also a useful idea.

Develop the budget

Once you determine the major components needed, you'll be able to develop a budget for the project. Using the major equipment list, call each manufacturer's representative, and ask for the best price. In many cases, you will be able to benefit from industry discounts. In other cases, your broadcasting group may have negotiated discounts with major broadcast suppliers. If not, try to negotiate a discount price with a manufacturer. Don't forget to require a written quote. Verify that shipping and insurance costs are included in the quote. Shipping costs can quickly increase the cost of a project if large components are being purchased.

If you cannot obtain a discount, use the list price for budgetary purposes. This approach assures that you still will be able to buy the product for full price and remain within your budget.

Next, think about the environment. Will you need a new equipment countertop? Does the new area require cleaning, painting or carpeting? Will new technical or task lighting be required? What related equipment must be supported? If you were rebuilding a master control room, for example, you probably would need to provide compressed air for any quad machines still in use.

Environmental needs

If this is a major project, you probably will have hired a consulting engineer, even if you intend to do most of the construction work with the help of station personnel. Be sure to have the consultant calculate the important structural parameters such as:

- Floor loading by equipment.
- Cooling requirements.
- Windloading and building stresses from anything attached to the outside of the building or tower. (A roof-mounted satellite dish, for example, can require extensive structural work.)
- Acoustical surveys for operating noise levels.
- Equipment electrical power load.
- Required environmental tests. (Sometimes an asbestos test is required when a facility is remodeled.)

It's important that all these areas be addressed by a competent engineering consultant. Not only are there legal aspects, such as permits, but also operational concerns. The engineering manager may not be expected to know all the aspects related to acoustical, environmental and structural concerns, but is expected to be aware of their importance. In other words, you don't necessarily need to know the answer, but you do have to know where to find it.

Final design/budget check

You are now ready to develop a final project block diagram. The diagram helps users "see" what the project really will look like. Once the users see these prints and rack layouts, they may want to make some changes. Invite the users to request any changes that make it easier for them to operate the equipment. Tell them when requested changes will increase the cost.

Now examine each major piece of equipment with an eye for ancillary needs. For example, each ½-inch tape recorder requires a rack-mount adapter, as does each scope and test signal generator. At $200 to $400 a set, such important ancillary equipment must be identified to prevent a disastrous effect on your budget.

Using the final block diagram, determine the required support equipment. This may include audio and video distribution amplifiers, power-supply trays, audio and video jackfields, interface connectors and video or audio connector blocks. When determining the number of needed equipment racks, remember to order all the small rack parts needed, such as rack screws, rack sides, tops, casters, distribution and grounding bars.

Also allocate money for cable ties, heat shrink tubing, hardware and cable labels. Despite your best efforts, you probably will forget something. In addition, some aspects of the project can't be foreseen before construction actually begins.

As an example, what if all the cable trays that were hidden in the ceiling of your new area are full and can't be used for your project? If you've failed to allow for these types of unforeseen costs, the project immediately runs the risk of being over budget.

Such costs should be covered through a contingency in your budget, typically 5% to 10% of the entire project's cost. In the case of a high-risk project—one that involves custom-designed equipment or the cutting edge of technology—you easily may justify a higher contingency. Remember to allow for sales tax and shipping. Also include funding for maintenance spares and personnel training. A sample project budget is shown in Table 1.

Once the budget has been approved, complete the design by documenting each lug and pin on every connector. The design prints of the project can be completed by a competent engineering staff member or the chief engineer. If someone else does it, be sure you carefully review the documents for accuracy.

The engineering manager should verify that the entire design conforms to "good

Continued on page 62

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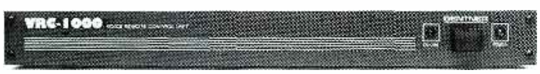
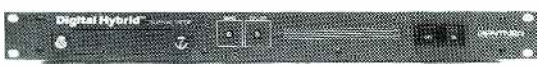
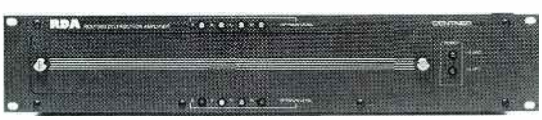


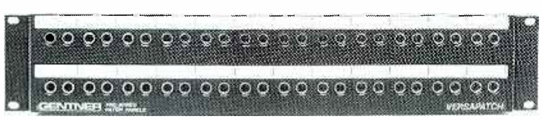
VRC 1000



Digital Hybrid



Routing Distribution Amplifier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Acoustical	500
Asbestos	500
Labor	
Design engineering (160 hours @ $40/hr)	6,400
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Test (40 hours @ $40/hr)	1,600
Training	
(40 hours @ $40/hr)	1,600
Drafting (320 hours @ $30/hr)	9,600
	$479,000
Architectural	
Cleaning	1,000
Painting	1,000
Carpeting	1,000
Furniture	2,000
Lighting	5,000
	$489,000
Project contingency (@ 10%)	**48,900**
Project total	**$537,900**

Table 1. *A sample project budget for an edit facility. Note that consultants' fees are based on bids and that the assumed labor rates are included in each category. The costs are location-dependent, so the costs you encounter may vary.*

Continued from page 58
engineering practice," and that the equipment will produce the highest-quality broadcast signal and meet FCC requirements. Finally, verify that the design conforms to the written requirements stated in the performance objectives.

Request for bids

Once bids have been issued and approved, order the equipment and prepare for its arrival. If possible, inspect every delivery to be sure no shortages have occurred. It may surprise you how even a small device with a long lead delivery time can jeopardize a project's completion date.

Develop a list of back-ordered items. Follow up on the missing items with calls to suppliers. Request firm delivery dates, and, where necessary, continue periodic checks to see whether the dates are being met. Don't let some small item delay the completion of a large project.

Construction

The construction phase is the most exciting because you can actually see progress being made. It is now important to have a sufficient number of staff members to perform the work. In most stations, the maintenance staff will do the work. Even if the entire job has been subcontracted, a staff member should be on site to see that the project is completed according to the plans.

If your staff is doing the work, be cognizant of the need to keep up with existing maintenance requirements. Don't let the level of maintenance fall because the engineering staff is busy working on a major project. It's your job to be sure that both the day-to-day tasks and the construction projects are staffed properly.

Consider using as many labor-saving devices as economically feasible. A good example is a motorized cable stripper. Similar devices can save more money in labor costs than the initial product expense.

Another labor-saving device is the computer. The data that must be tracked on even a simple project can be substantial. If you don't have a good word processor, spreadsheet and project management programs for your computer, consider buying them as part of the overall project. Spending $1,000 on such support equipment is an investment that will pay for itself many times over.

Monitor the progress

Major projects require careful planning and tracking. These tasks can be handled easily by computer programs, often called project managers. If you don't have a computer, use the same techniques in a simpler form.

Table 2 is a simplified task chart for the design and construction of the sample edit room. The hours listed represent an estimate of the time required to complete each task. The estimates are based on past experience for similar work. This chart helps you determine the resources needed to complete the project.

The chart provides two types of useful information. First, you get an idea of the resources necessary to finish the project. Second, the chart allows you to see how changing resources might affect the completion date. An accurate task chart allows the engineering manager to more closely track the hours (costs) expended on the project.

Task charts are easily ported to a spreadsheet format. This makes it easy to test "what if" scenarios on a computer. A spreadsheet also makes it easier to increase the chart's detail. The increased detail provides even more information to help you control costs and keep the project on time.

Another useful chart is shown in Table 3. The time-line chart lists each activity along with a beginning and end time. Through the chart, it becomes easy to identify how changes in one task will affect another task. These relationships (dependencies) then can be identified and coordinated.

Project tracking

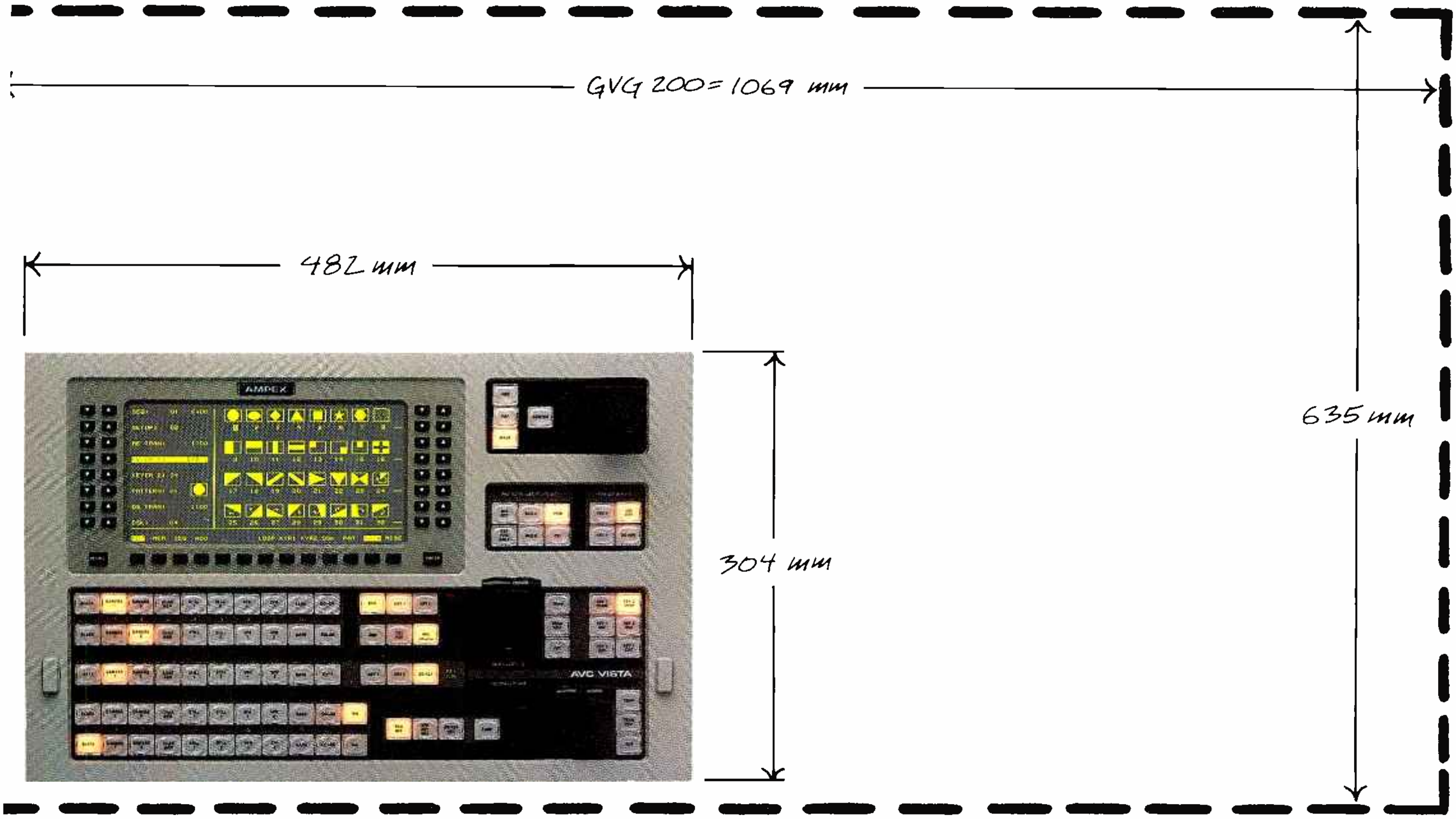
Once construction begins, you must keep track of costs and time expended. This is called *tracking*. A computer can be a great help here. Track all areas of the project, including equipment, labor and contractors. Debit a ledger balance as each equipment invoice or contractor bill arrives. This will tell you how much is left to spend on the project. It's also worthwhile to track billed prices compared with projected prices so that you will know whether your budget remains on target.

Labor and contractors should be similarly tracked. Keep a journal of all hours committed to the project on a weekly basis. Compare your projected time lines and task charts weekly with the project's status. If the project is falling behind, it may be necessary to add more workers or slide the time line to account for the delay.

It is important that you have control of your project at all times. Do not leave this financial tracking up to your business department or accountant. Their reports often are delayed 30 to 60 days, which is far too long for good project management. Also, the business department or accountant probably won't know whether the charges are accurate.

Testing

The testing phase actually involves two steps. First, each piece of equipment should be inspected upon arrival. Perform sufficient testing to ensure that it meets all manufacturer's specifications and operates according to your needs. This should be done at the time of delivery, at the same time the equipment is inspected for shortages.



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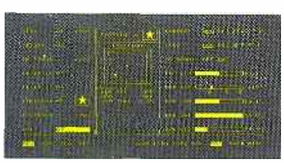

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Circle (37) on Reply Card

Design phase		
Audio single line		40 hours
Video single line		40 hours
Control/time-code single line		40 hours
External views/rack layouts		40 hours
Construction phase		
Audio wiring	(4 engineers x 1 week)	160 hours
Video wiring	(4 engineers x 1 week)	160 hours
Control wiring	(4 engineers x 1 week)	160 hours
Finish work	(4 engineers x 1 week)	160 hours
Testing phase		
Testing facility performance	(1 engineer x 1 week)	
Training phase		
Training operators to use the facility	(1 engineer x 1 week)	
Documentation		
Documentation drawings	(4 engineers x 2 weeks)	320 hours

Table 2. *A design task chart identifies the major project phases and required resources to complete the tasks.*

A second testing phase occurs when the individual pieces of equipment are connected together in the facility. Although each device may have worked properly by itself, that may not be the case when it is mounted and connected in the new facility.

After each device is installed, perform the required level setting and alignment. Adjust the video and audio distribution amplifier levels, and time the system, where necessary. Load any system software, and test the various computer functions.

The system must be operating properly before it is turned over to the operating staff. This is the time to discover wiring errors—not later, after the staff is depending on the equipment to do their jobs. It is far less embarrassing to correct a problem while engineering is in sole possession of the room.

After the engineering staff has verified that the equipment is operating properly, you may want a member of the operating staff to assist you. This is especially important with complex production equipment such as paint systems or special-effects devices. An operator may be familiar with equipment features or routines that might go unchecked by a maintenance person. This step allows the engineer to verify that each device is working properly with the other devices in many different operational modes.

In on-air projects, such as live master control rooms, be sure to check each day's work before putting that portion of the room back in service. One method of doing this is to stop working on the project at least one-half hour before sign-on and using this time to thoroughly test the system. It's far better to discover the problem before sign-on than to race to patch

ACTIVITY	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
Estimating	X O	Z								
Financial Approval		X O								
Design										
Audio			X							
Video			X							
Control				X						
Externals				X O Z						
Construction										
Audio				X						
Video					X					
Control							X			
Finish							X	O		
Test								X	O	
Training									X	O
Drafting								X	X	O

Table 3. *The time-line chart identifies time-dependent tasks as well as task beginning and end times. Each "X" equals one week. Completion milestones are represented by an "O." Client conferences are denoted by a "Z." In its advanced form, this is known as a Gantt chart.*

something together just to get on the air.

Training

Once the system is operating properly, conduct training sessions for operations and maintenance personnel. Provide each user with a copy of the equipment's operations manual. This manual can act as the basis for a hands-on training session. The classes can be taught by your staff or a manufacturer's representative. Maintenance staff should be sent to manufacturer's school whenever new technologies are implemented. Don't short-change the training aspect. Spending time thoroughly training the staff will help reduce the number of mistakes as well as make the transition as smooth as possible.

Properly planned and implemented, building a new facility can be one of the most satisfying aspects of broadcast engineering. The knowledge that you've "built" it will increase the pride you feel for both your station and your job. It also can boost the confidence of others in your ability.

Editor's note: Anyone contemplating a large technical project requiring architectural work may want to read the article by Malcom Burleson in the chapter, "Planning and Costs of Broadcast Facilities," in the 7th edition of the *NAB Engineering Handbook*. For an introduction to Gantt and Pert charting, see "Using Management Science in Broadcasting," on page 44.

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HARRIS

Circle (41) on Reply Card

Managing the PCB risk

By Brad Dick, radio technical editor

Mismanaging PCBs may be hazardous to your station's health.

Lightning hit the station about 11:30 p.m. According to the chief engineer, the strike damaged the AM transmitter's power supply. The station would be off the air for a day, until the new components arrived. Nothing unusual about this—it happens all the time.

The behind-the-scenes story is more complex. After being called by the announcer, the chief engineer traveled to the transmitter site and discovered a smoldering fire in the power-supply cabinet of the old AM transmitter. By the time he arrived, the room was filling with smoke and the telltale smell of a burning transformer.

The engineer didn't see any flames. He opened the power-supply cabinet door and discovered that the fire had practically burned itself out. As fresh air entered the cabinet, however, the flames reignited. The engineer quickly put out the remaining fire with a nearby fire extinguisher.

After things had settled down, the engineer proceeded to clean up the mess, develop a parts list and prepare for the installation of the replacement components. It was only then that he realized the fire had damaged several PCB (polychlorinated biphenyl) capacitors.

One large PCB capacitor apparently had ruptured under the stress, and fluid was leaking slowly onto the transmitter cabinet floor. Two smaller PCB capacitors also were ruptured. One of these capacitors was located above the transformer that

Continued on page 72

Figure 1. *The large marking label (ML) is used to identify PCB transformers and PCB large capacitors.*

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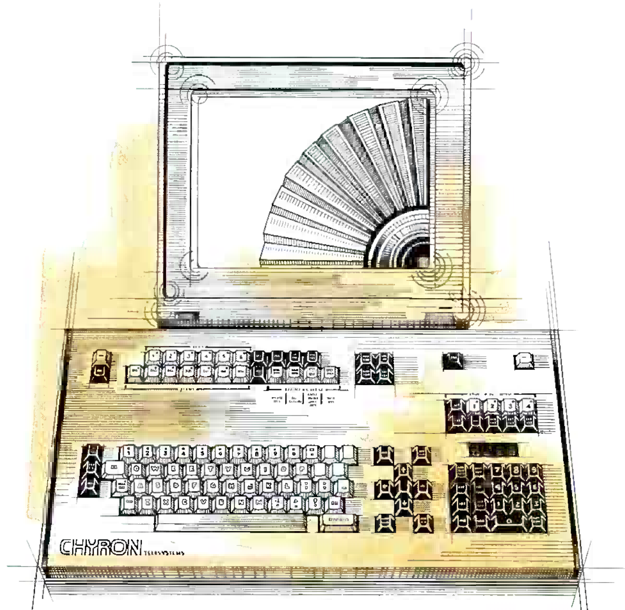

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Introducing a CCD cam
who are glued to

Continued from page 68

ASKAREL* TRADE NAMES

ALC	R.C. Uptegraff
Apirolio	- - - -
Aroclor, Capacitor 21	Monsanto Co.
Asbestol	American Corp.
Ask	Queensboro Transf. & Mach.
Clophen	Bayer (Germany)
Clorextol	Allis Chalmers
Chlorinol	Sprague
Clorphen	Jard
Diaclor	Sangamo Electric
Dicanol	- - - -
DK, Inclor, Fenclor	Caffaro (Italy)
Dykanol	Cornell Dubilier
EEC-18	Power Zone Transformer
Elemex	McGraw Edison
Eucarel	Electric Utilities Corp.
Hyvol	Aerovox
Inerteen	Westinghouse Corp.
Inflamol	Italiano
Kanechlor	Mitsubishi (Japan)
Kennechlor	Kanegafuci Chemical Ind.
MCS 1489	Monsanto Co.
N-3	Niagara Transformer
Nepolin	- - - -
No-Flamol	Wagner Electric
Non-Flammable Liquid	ITE
Peneoclor	Prodelec (France)
Pydraul, Pyroclor	Monsanto Co.
Pyralene	Prodelec (France)
Pyranol, Magvar	General Electric Co.
Saf-T-Kuhl	Kuhlman Electric
Santotherm	Mitsubishi (Japan)
Santovac 1,2, Santhotherm FR	Monsanto Co.
Shibanol	Toshiba
Solvol	USSR
Therminol	Monsanto Co.

* Askarel is the generic name for PCB fluids.

Table 1. *If any of these names appear on your transformer, consider the device a PCB transformer.*

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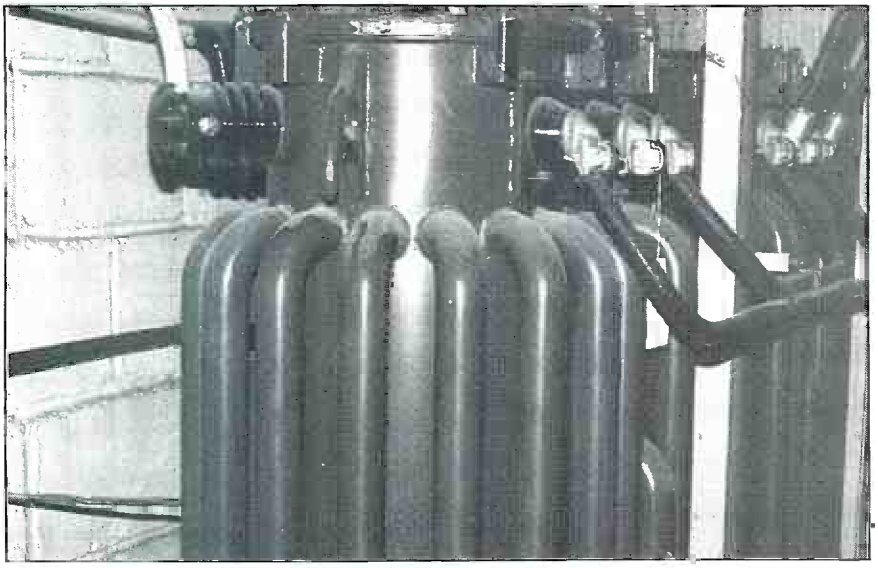
caught fire. The engineer wondered if any of the PCBs in that capacitor had burned.

Understanding the problem

Without trying to identify every problem this engineer now faces, suffice it to say that he and everyone else on the staff are in a real dilemma. Getting the station back on the air may be the least of their problems. Although a lot of publicity has been given to the effects of PCBs in the environment, many broadcast engineers and managers still do not recognize the problems or costs associated with their mishandling.



Photos by John F. Warner

Do not overlook ac distribution equipment when searching for PCBs.

PCBs belong to a family of organic compounds known as chlorinated hydrocarbons. Virtually all PCBs in existence today have been manufactured synthetically. They are of a heavy, oil-like consistency and are characterized by a high boiling point, a high degree of chemical stability, low flammability and low electrical conductivity. These characteristics led to the widespread use of PCBs in capacitors and transformers.

Commercial products containing PCBs were widely distributed from 1957 to 1977 under several trade names, including Aroclor, Pyroclor, Sanotherm, Pyranol and Askarel. Askarel is also a generic name used for non-flammable dielectric fluids containing PCBs. Table 1 lists some common trade names used for Askarel. The trade name typically is listed on a PCB transformer's nameplate or on a PCB capacitor.

Health risks

PCBs are harmful because once they are released into the environment, they usual-

Continued on page 78

At eight o'clock it was just another dull day. By nine o'clock I was working on Paradise

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PERFORMANCE DATA
(AG-7500A)

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

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

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

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The AG-A750 editing controller has everything you need for highly accurate single event editing.

And the AG-7400 portable 2-hour VCR is a natural performer in the field.

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SVHS

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Continued from page 74
ly do not break apart into other substances. Instead, they persist, taking several decades to decompose. By remaining in the environment, they can be taken up and stored in the fatty tissues of animals and humans.

Even if PCB exposure levels are quite low, the concentration of PCBs in the body tissues increases with time. This process is called *bioaccumulation*. Furthermore, as PCBs accumulate in the tissues of simple organisms, which are consumed by progressively higher organisms, the concentration becomes even higher. This process is called *biomagnification*.

These two factors—bioaccumulation in organisms and biomagnification in the food chain—are significant because PCBs are harmful even at low levels. Specifically, PCBs have been shown to cause chronic (long-term) toxic effects in some species of animals. Well-documented tests on laboratory animals show that various levels of PCBs can affect reproduction and cause gastric disorders, skin lesions and cancerous tumors.

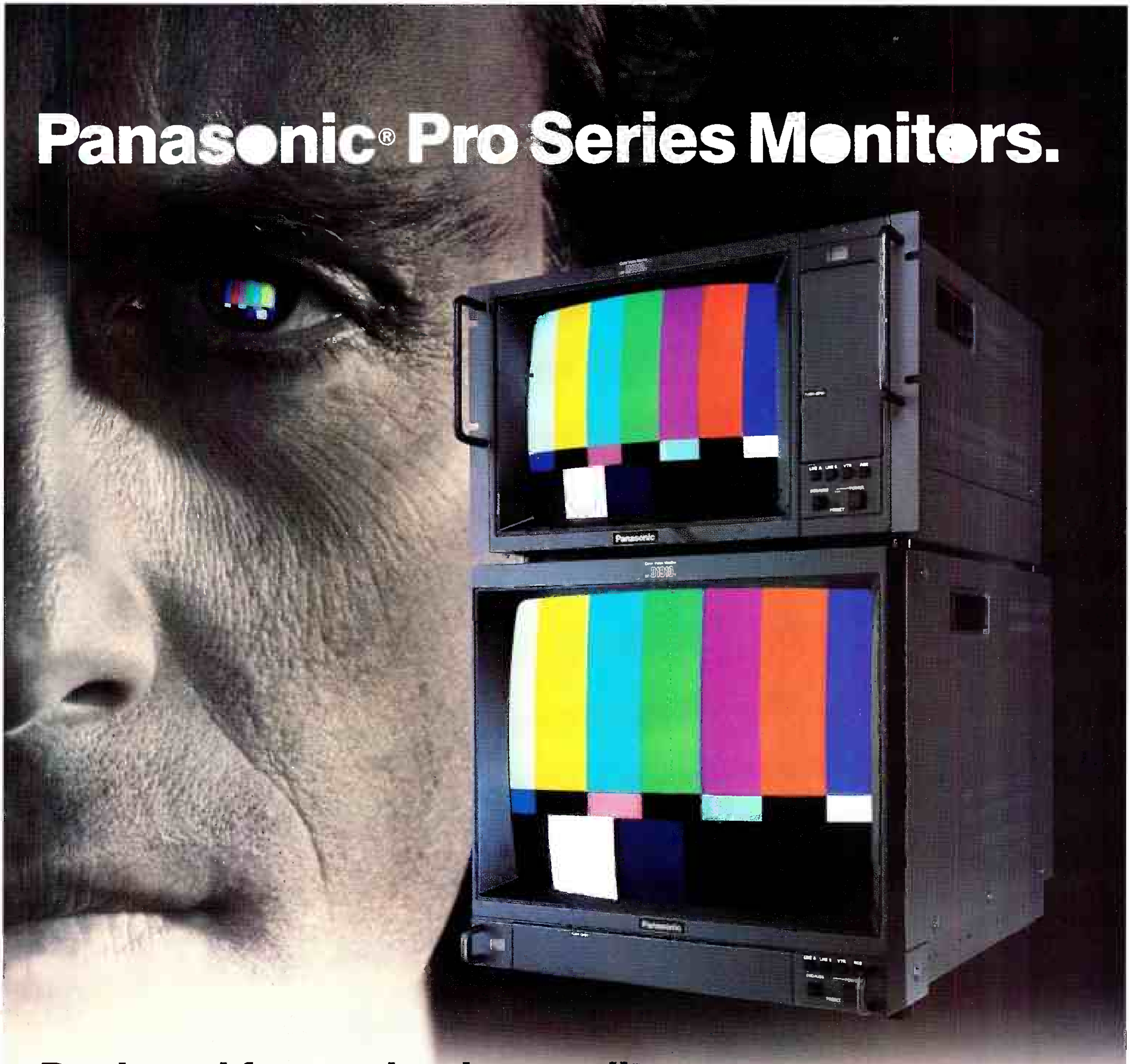
PCBs may enter the body through the lungs, the gastrointestinal tract and the skin. After absorption, they are circulated in the bloodstream and stored in fatty tissues as well as in the liver, kidneys, lungs, adrenal glands, brain, heart and skin.

Related hazards

The health risk lies not only in the PCB itself, but also in the chemicals that develop when PCBs are heated. Laboratory studies have confirmed that PCB by-products, including *polychlorinated dibenzofurans* (PCDFs) and *polychlorinated dibenzo-p-dioxins* (PCDDs), are formed

TERM	DEFINITION	EXAMPLES
PCB	Any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination of substances that contain such substances.	PCB dielectric fluids, PCB heat transfer fluids, PCB hydraulic fluids, 2,2',4-trichlorobiphenyl
PCB article	Any manufactured article, other than a PCB container, that contains PCBs and whose surface(s) has been in direct contact with PCBs.	Capacitors, transformers, electric motors, pumps, pipes, etc.
PCB container	A device used to contain PCBs or PCB articles and whose surface(s) has been in direct contact with PCBs.	Packages, cans, bottles, bags, barrels, drums, tanks
PCB article container	A device used to contain PCB articles or equipment, and whose surface(s) has not been in direct contact with PCBs.	Packages, cans, bottles bags, barrels, drums, tanks
PCB equipment	Any manufactured item, other than a PCB container or PCB article container, which contains a PCB article or other PCB equipment.	Microwave ovens, fluorescent light ballasts, electronic equipment
PCB item	Any PCB article, PCB article container, PCB container, or PCB equipment that deliberately or unintentionally contains, or has as a part of it, any PCBs.	
PCB transformer	Any transformer that contains PCBs in concentrations of 500 ppm or greater.	
PCB contaminated electrical equipment	Any electrical equipment that contains more than 50, but less than 500ppm, of PCBs. (Oil-filled electrical equipment other than circuit breakers, reclosers, and cable whose PCB concentration is unknown must be assumed to be PCB contaminated electrical equipment.)	Transformers, capacitors, circuit breakers, reclosers, voltage regulators, switches, cable, electromagnets

Table 2. *Broadcasters will be most concerned about PCB transformers and PCB-contaminated electrical equipment (primarily capacitors).*



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PCB TRANSFORMERS:	
• Standard PCB transformer	quarterly.
• If full-capacity impervious dike added	yearly.
• If retrofitted to less than 60,000ppm PCB	yearly.
• If leak discovered, clean up ASAP Retain these records for three years.	daily.
PCB ARTICLE OR CONTAINER:	
• If stored for disposal Must be removed and disposed of within one year.	monthly.
Retain all records for three years after disposing of transformer.	

Table 3. This inspection schedule applies to PCB transformers and other contaminated devices.

when PCBs or chlorobenzenes are heated to temperatures ranging from approximately 900°F to 1,300°F. These products are more toxic than PCBs.

The problem for the owner of PCB equipment is that the liability for PCB spills and fire contamination can be tremendous. A fire in Binghamton, NY, involving a large PCB transformer, resulted in $20 million in cleanup expenses. The consequences of being responsible for a fire-related incident with a PCB transformer may be monumental.

Governmental action

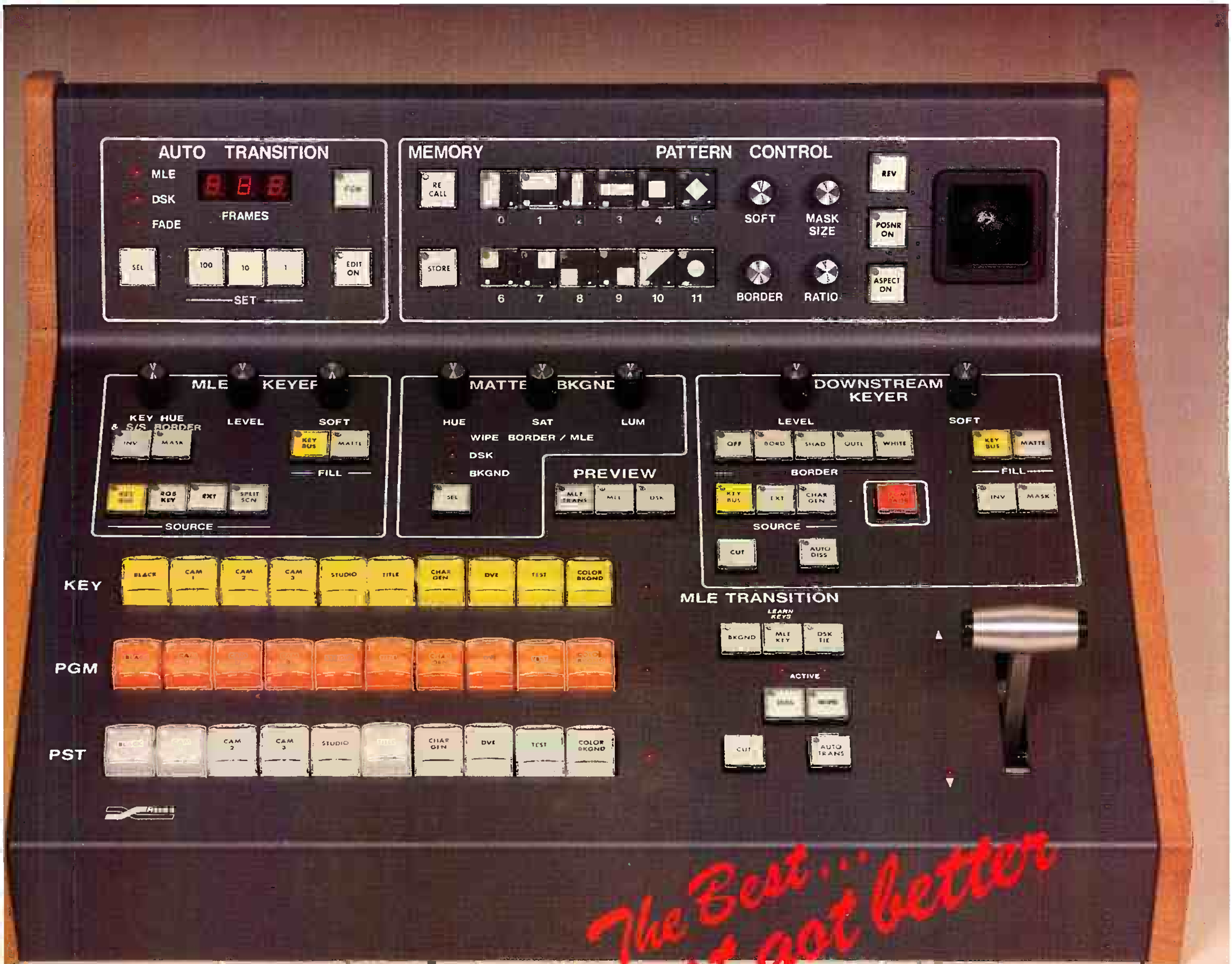
Congress took action to control PCBs in October 1975 by passing the Toxic Substances Control Act. A section of this law specifically directed the EPA to regulate PCBs. Three years later, the EPA issued regulations to implement the congressional ban on the manufacture, processing, distribution and disposal of PCBs.

In the following seven years, several revisions and updates were issued by the EPA. One of these revisions, issued in 1982, specifically addressed the type of equipment used in broadcast stations. Failure to properly follow the rules regarding the use and disposal of PCBs has resulted in high fines and even jail sentences.

Electrical products

Although PCBs no longer are being produced for most electrical products in this country, the EPA estimates that more than 107,000 PCB transformers and 350 million small PCB capacitors were in use or in storage in 1984. Approximately 77,600 of these transformers were used in or near commercial buildings. Approximately 3.3 million large PCB capacitors were in use as late as 1981.

The threat of widespread contamination from PCB fire-related incidents is one reason behind the EPA's efforts to reduce the number of PCB products in the environment. Broadcasters are affected by the regulations primarily because of the widespread use of transformers and capacitors.



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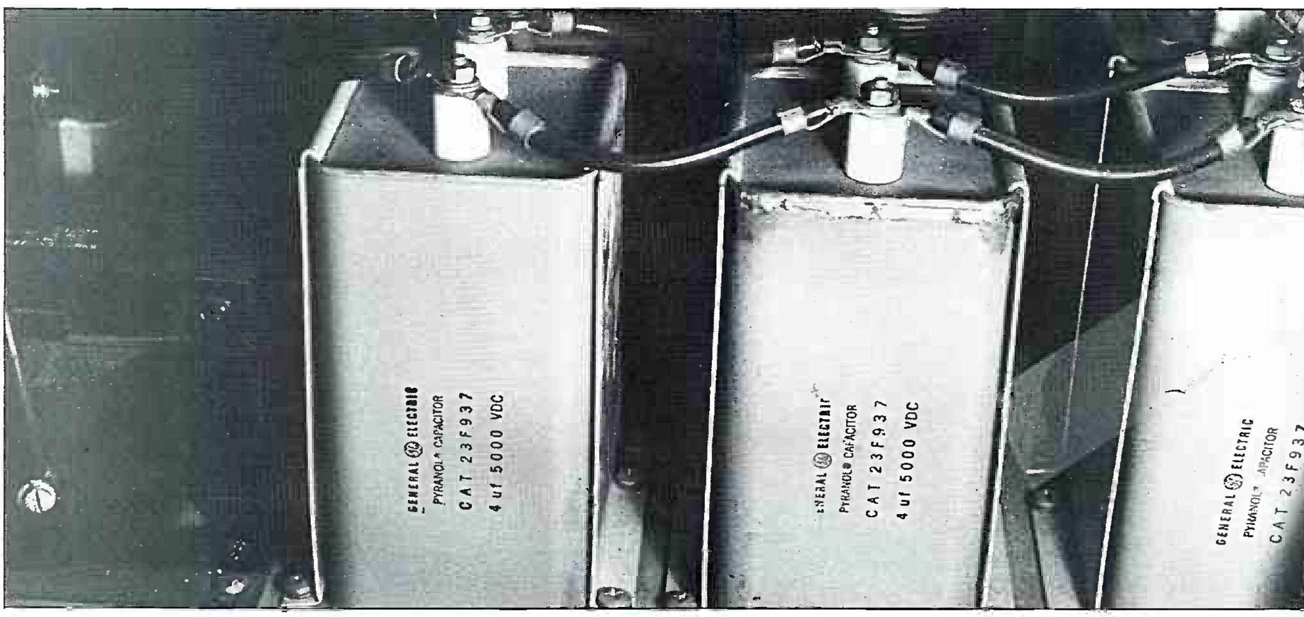
This ac switch was found in the basement of a transmitter building. Note the oil-fill plug on the front panel.

These components usually are located in older (pre-1979) transmitters, so that's the first place to look for them. However, some stations also maintain their own primary power transformers. Unless these transformers are of recent vintage, it is likely that they contain a PCB dielectric.

You should be familiar with several important classification terms. They are listed in Table 2. These classifications are important because they determine the disposal method to be used.

Transformers

The two most common PCB components in a broadcast station are transformers and capacitors. Let's look at transformers first. A PCB transformer is one that contains at least 500ppm (parts per million) PCBs in the dielectric fluid. An Askarel transformer generally has 600,000ppm or more. You can convert a PCB transformer into a PCB-contaminated device (50ppm to 500ppm) or a non-PCB transformer (less than 50ppm) by having it drained, refilled and tested. The testing must not take place until the transformer has been in service for a minimum of 90



These Pyranol-filled capacitors were found in a circa 1962 10kW transmitter. Pyranol is General Electric's trade name for a PCB dielectric.

Transformer location ________________
Date of visual inspection ________________
Leak discovered ______ (Yes/No)
If yes, date discovered ________________
(If different from inspection date)
Location of leak ________________
Person performing inspection ________________
Estimate of the amount of dielectric fluid released from leak ________________
Date of cleanup, containment, repair or replacement ________________
Description of cleanup, containment or repair performed ________________
Results of any containment and daily inspection required for uncorrected active leaks ________________

Table 4. *Inspection check list for PCB components. Add other pertinent information as desired.*

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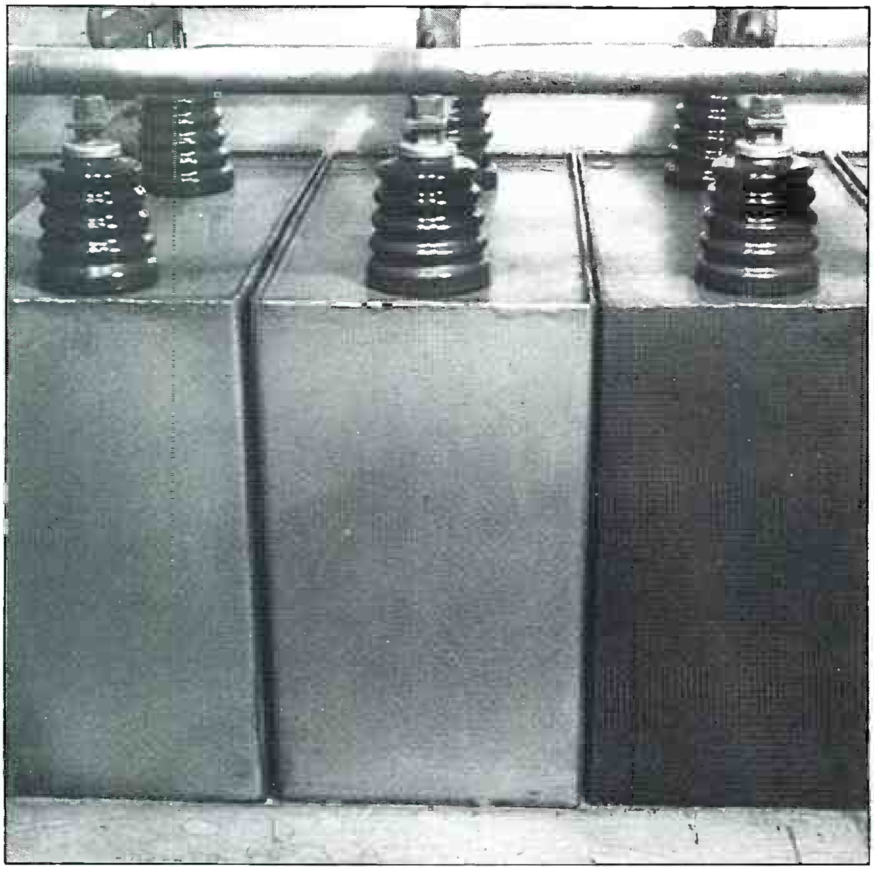

Oil-filled capacitors should be inspected for leakage around seams and binding posts.

days. Note that this is *not* something you can do yourself.

PCB transformers must be inspected quarterly for leaks. If an impervious dike is built around the transformer sufficient to contain all the liquid material, the inspections may be conducted yearly. Similarly, if the transformer is tested and found to contain less than 60,000ppm, a yearly inspection is sufficient. Failed PCB transformers cannot be repaired and must be properly disposed of.

If a leak develops, it must be contained, and daily inspections must begin. A cleanup must be initiated as soon as possible, within 48 hours. You also must keep adequate records of all inspections and leaks as well as any actions taken for three years after disposal of the component.

Combustible materials must be kept a minimum of 5m (10 feet) from a PCB transformer and its enclosure. This should not be a problem for devices located within a transmitter cabinet. Line-power transformers located within a building, however, might be surrounded by combustible materials. Any such materials must be moved at least 5m (10 feet) away from the transformer.

As of Oct. 1, 1990, the use or storage

Continued on page 88

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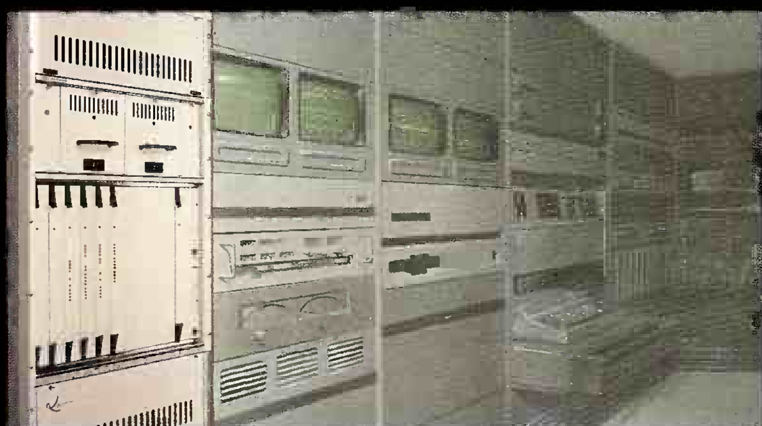

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Continued from page 84
of PCB transformers (500ppm or greater) will be prohibited in or near commercial buildings when the secondary voltages are 480Vac or higher. Radial PCB transformers may continue to be used if certain electrical protection is provided.

The EPA regulations also require that you notify others of the possible dangers. All PCB transformers (including those in storage for reuse) must be registered with the local fire department. Supply the following information: the location of the PCB transformer (the address of the building or a description of the outdoor site), the principal constituent of the dielectric fluid in the transformer, and the name and telephone number of the person to contact in the event of a fire involving the equipment.

You must register with the building owner any PCB transformers used or stored in a commercial building. All owners of buildings within 30m (100 feet) of PCB transformers also must be notified.

If you have a fire-related incident involving the release of PCBs, you must immediately notify the Coast Guard National Spill Response Center (800-424-8802) and take appropriate measures to contain and control any possible PCB release into water.

Capacitors

Capacitors are divided into two size classes: large and small. A small PCB capacitor contains less than 1.36kg (three pounds) of dielectric fluid. A capacitor having less than 100 cubic inches also is considered to contain less than three pounds of dielectric fluid.

A large PCB capacitor has a volume of more than 200 cubic inches and is considered to contain more than three pounds of dielectric fluid. Any capacitor with a volume of 100 to 200 cubic inches is considered to contain three pounds of dielectric, providing its total weight is less than nine pounds.

A large, high-voltage PCB capacitor contains three pounds or more of dielectric fluid and operates at voltages of 2kV or greater. Large, low-voltage PCB capacitors also contain three pounds or more of dielectric fluid, but operate at less than 2kV. Effective Oct. 1, the use of large, high- and low-voltage PCB capacitors is prohibited unless they are located in a restricted-access indoor area with adequate roof, walls and floor to contain any PCB release.

The use, servicing and disposal of small PCB capacitors are not restricted by the EPA unless there is a leak. In that event, the leak must be repaired or the capacitor must be disposed of, either by approved incineration or by burial in a specified container in a chemical waste landfill. Currently, chemical waste landfills are for disposal only of liquid PCBs (50ppm to 500ppm) or for solid PCB debris. Items such as capacitors that are leaking oil containing greater than 500ppm PCBs should be incinerated or taken to an alternate EPA-approved PCB disposal facility.

Identifying PCB components

The first task is to identify any PCB items in the station. If your equipment was built after 1979, it probably does not contain any PCB-filled devices. Even so, inspect all capacitors, transformers and power switches to be sure. A call to the manufacturer also may help.

Older equipment (pre-1979) is much more likely to have PCB transformers and capacitors than new equipment. A liquid-filled transformer usually has cooling fins, and the nameplate may provide useful information about its contents. If the transformer is not labeled or the fluid is not identified, it must be treated as a PCB transformer. Untested (not analyzed) mineral-oil-filled transformers are assumed to contain at least 50ppm, but less than 500ppm, PCBs. This places them in the category of PCB-contaminated electrical equipment, which has different requirements than PCB transformers.

Older transmitters are likely to have both large and small PCB capacitors. The power-supply cabinet may have several large, high-voltage capacitors. Don't assume they're not leaking; check to be sure. Even though a capacitor is leaking, it might continue to provide service. If you discover a leaking capacitor, replace it with a non-PCB capacitor, and properly dispose of the leaking device.

If a spill has taken place, it must be cleaned up, and the resulting waste must be properly disposed of in an EPA-approved chemical waste landfill. Old, large PCB capacitors that are removed must be incinerated according to EPA regulations.

Transmitter rectifier panels, exciter/modulators and power-amplifier cabinets may contain many small capacitors. In older equipment, these capacitors often are filled with Askarel. Unless they are

I. Dates when PCBs and PCB items are removed from service.

Dates when PCBs and PCB items are placed into storage for disposal and are placed into transport for disposal. The quantities of these items removed from service, stored and placed into transport are to be indicated using the following breakdown:

1) Total weight, in kilograms, of any PCB and PCB items in PCB containers, including identification of container contents such as liquids and capacitors.

2) Total number of PCB transformers and total weight in kilograms of any PCB contained in the transformers.

3) Total number of large, high- or low-voltage PCB capacitors.

II. For PCBs and PCB items removed from service, the location of initial disposal or storage facility and the name of the facility owner or operator.

III. Total quantities of PCBs and PCB items remaining in service at the end of calendar year to be indicated by using the following breakdown:

1) Total weight, in kilograms, of any PCB and PCB items in PCB containers, including the identification of container contents such as liquids and capacitors.

2) Total number of PCB transformers and total weight in kilograms of any PCBs contained in the transformers.

3) Total number of large, high- or low-voltage PCB capacitors.

Table 5. *Required information for PCB annual report.*

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leaking, they pose no particular hazard. If a leak does develop, however, proper disposal techniques must be followed.

Also, liquid-cooled rectifiers may contain Askarel. Although their use is not regulated, treat them as PCB articles (50ppm or more). The device first must be drained of free-flowing liquid, which is then incinerated. The device can then be incinerated or sent to a chemical waste landfill. Never make assumptions about PCB contamination; check with the manufacturer if you're not sure whether the device is contaminated.

It should be emphasized that any PCB removal must be done only by a licensed decontamination firm. The potential liability is great; don't take chances.

Any PCB article or PCB container being stored for disposal must be date-tagged on removal and inspected for leaks every 30 days. Within one year from the date it is placed in storage, it must be removed and disposed of. Items in storage for disposal must be kept in a storage facility meeting the requirements of 40 CFR, section 761.65(b)(1), unless they fall under other regulation provisions. If you plan to store any PCB items, be sure to verify that your storage plans meet these legal

PHASE 1:

- Deliver four approved drums for capacitor disposal.
- Furnish labor and materials to remove 18 oil samples. Send to laboratory for testing.

Total cost: $3,823

PHASE 2:

- Furnish necessary transportation of materials, and decommission and dispose of one 40kVA transformer (25″×25″×44″) and 30 gallons of Inerteen: $3,342
- Pick up and dispose of four drums of capacitors: $2,538
- Each extra drum of capacitors if needed (disposal cost): $472
- Replace transformer: $2,021

Total project cost: $11,724.00

Table 6. *Typical disposal costs for one station's PCB materials.*

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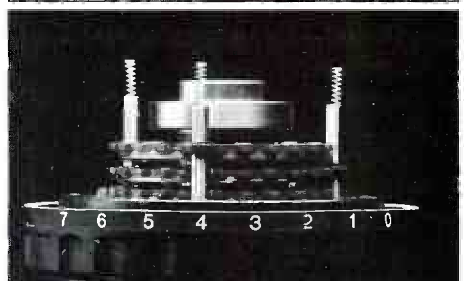

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restrictions.

There is a difference between PCB items stored for disposal and those stored for reuse. Once an item has been removed from service and tagged for disposal, it cannot be returned to service.

Labeling PCB components

After the PCB devices have been identified, they must be labeled properly. The requirements are simple to follow if you have the correct labels.

PCB article containers, PCB transformers and large, high-voltage capacitors must be marked with the standard 6″×6″ large label (ML), as shown in Figure 1. The equipment containing these transformer capacitors also should be marked. Large, low-voltage (less than 2kV) PCB capacitors do not need to be labeled until they are removed from service. If the capacitor or transformer is too small to contain the large label, a smaller (1″×2″) size is approved for use. Remember that unless access is restricted and the described safety precautions are followed, large PCB capacitors may not be used after Oct. 1.

Labeling each small PCB capacitor is not required. However, any equipment containing small PCB capacitors should be labeled on the outside of the cabinet or on access panels. Don't forget to properly label any spare capacitors and transformers that fall under the regulations.

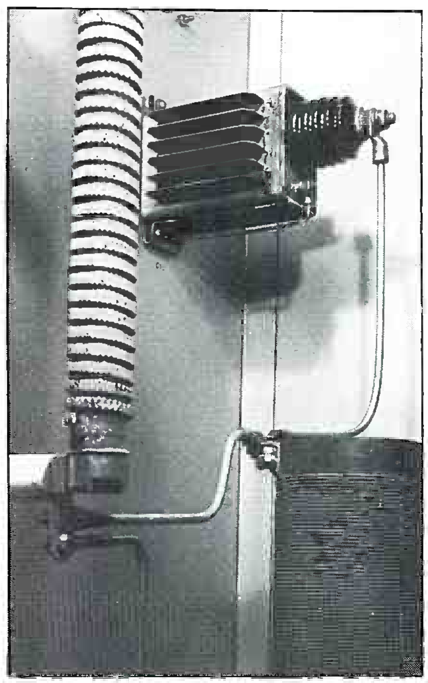
You must also identify on the large label any doors, cabinet panels or other means of access to PCB transformers. The label must be placed so that it can be read easily by firefighters. All areas used to store PCBs and PCB items for disposal must be marked with the large label.

Some sources for labels include: Seton Name Plate Corporation, 203-488-8059; Brady Signmark Division, 414-961-2233; and Labelmaster, 1-800-621-5808.

Record keeping

Inspections are critical in the management of PCBs. The EPA regulations specify a number of steps that must be taken and what information must be recorded. Table 3 summarizes the schedule requirements. Table 4 can be used as a check list for each transformer inspection. This record must be retained for three years.

In addition to the inspection records, some stations may need to compile an annual report by July 1 each year (see Table 5). This report details the number of PCB capacitors, transformers and other PCB items on your property. The report must contain the dates the items were removed from service, their disposal and detailed



This oil-filled capacitor is located in the plate decoupling circuit of a transmitter PA stage.

information on their characteristics. You need to prepare this report if the facility uses or stores at least one PCB transformer containing greater than 500ppm PCBs, 50 or more large PCB capacitors or at least 45kg of PCBs in PCB containers. Retain this report for five years after the facility ceases using or storing PCBs or storing PCBs and PCB items in the prescribed quantities.

Disposal

Disposal of PCBs is not a minor problem. First, it is not something you can do yourself. You don't simply dump PCB components into the trash. Second, the disposal process, when carried out by a licensed company, can be expensive.

When contracting for PCB disposal, verify the company's license with the area EPA office. That office also can supply you with background information on the company's compliance and enforcement history. You may even want to check on the waste site. What financial assurance has the company posted? In a worst-case scenario, your station could be held liable for contamination damages and cleanup costs, even if you handed off the PCBs in an approved manner.

Sometimes stations get into trouble simply by not recognizing the potential hazards. In one case, a radio station that was demolished by fire had the debris hauled to a county landfill recycling center. The staff didn't know that the waste contained some small PCB transformers, one of which broke upon being dumped.

The result was that approximately 70 tons of garbage became PCB contaminated. The recycling pit had to be scrubbed clean. Three truckloads of garbage were transported to and buried in a chemical waste landfill, instead of the county landfill. The cost was several hundred thousand dollars.

In another case, a broadcasting company donated transmitting station property and buildings to a philanthropic cause. Later, discarded PCB items were found on the premises by the new tenants. Elaborate soil-excavation and disposal procedures were necessary, at a considerable cost.

The fines levied in such cases are not mandated by federal regulations. Rather, the local EPA administrator, usually in consultation with local authorities, determines what cleanup procedures and costs will be involved. Civil penalties for administrative complaints issued for violations of the PCB regulations are determined according to a matrix provided in the PCB penalty policy. This policy, published in the Federal Register, considers the amount of PCBs involved and the potential harm posed by the violation. Needless to say, you do not want your station to be held responsible for such violations.

Table 6 lists the costs to dispose of several PCB components at one radio station. Although the costs may seem high, they are small compared with the potential liability of cleaning up a PCB spill.

Proper management

Properly managing the PCB risk is not difficult. The keys are understanding the regulations and following them carefully. The following steps may help you comply with the rules:

- Locate and identify all PCB devices. Don't forget to look at stored or spare devices. Check your old junk boxes. They may contain small PCB capacitors.

- Properly label PCB transformers and capacitors according to the EPA requirements.

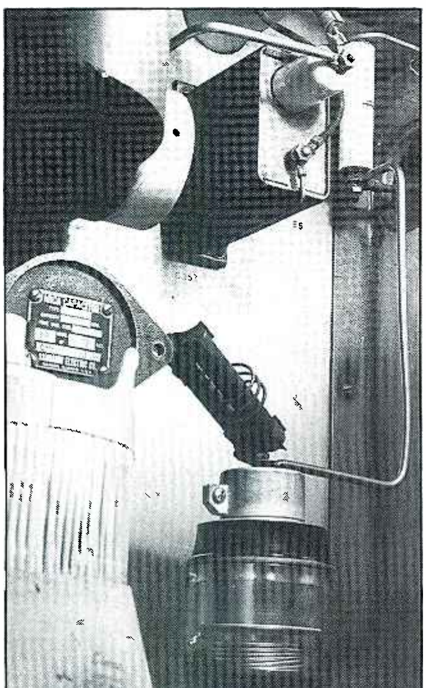
- Perform the required inspections, and maintain an accurate log of PCB items, their locations, inspection results and actions taken. These records must be maintained for three years after disposal of a PCB component.

- Complete the annual report of PCBs and PCB items by July 1. This report must be retained for five years.

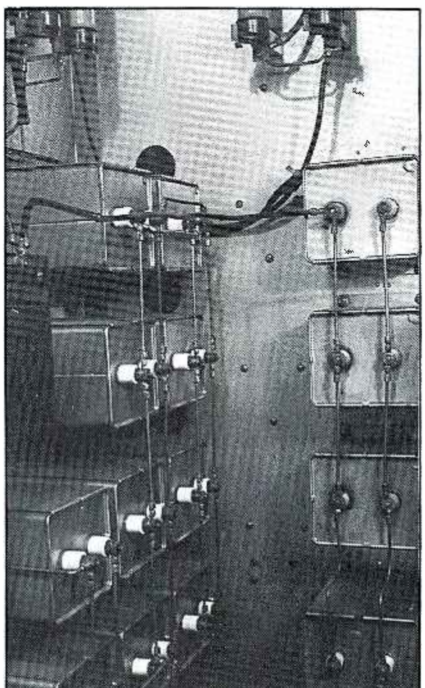
- Arrange for disposal through a company licensed to handle PCBs. If you're doubtful of the company's license, contact the EPA.

- Report the location of all PCB transformers to your local fire department and owners of any nearby buildings.

The importance of following the EPA regulations cannot be understated. When you look at the potential liability to your station that would be brought about by a PCB spill, a fire-related incident or improper disposal, the effort required for proper PCB risk management seems small. Update your station manager on the regulations. Then ask for the necessary funding and administrative support to bring your facility into compliance. Don't put off this task until an EPA inspector shows up, or you'll have a problem.



Oil-filled capacitors often are used to bypass plate and screen supplies in high-power transmitters.



These oil-filled capacitors were found in the low-voltage power supply of an RCA Ampliphase transmitter.

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Thanks.

As a result of their pioneering work in developing the FGS-4000, BTS Broadcast Television Systems Inc., a joint company of Bosch and Philips, is proud to accept the 1988 Emmy Award for "Technical Achievement in 3D Computer Graphics Technology."

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twined chains that tie the oxide particles and the abrasives down to the base film. Binders are rated as to their *cohesion*, the ability to hold together, and their *adhesion*, the ability to bond to the base film.

- *Solvents:*

The binder is helped to bond chemically with the base film through the use of solvents. They are sometimes used to suspend the oxide particles before their application to the base film.

- *Dispersants:*

During the mixing and application phases of tape manufacture, dispersants are used to keep oxide particles from clumping together. The dispersants and solvents usually are evaporated out of the tape as part of the baking process.

- *Backcoating:*

The backcoating is a carbon layer applied to the back of professional videotapes. The purpose of a backcoat is threefold. First, it is harder than the base film and protects it as the tape twists and turns through the tape path of the VTR. If the base film were scratched or dented, the oxide layer would not be as smooth, and the possibility of dropout would be greater. Second, the base coat is anti-static and serves to dissipate charges that may develop as the tape is run over guide posts. These charges could threaten sensitive components and could introduce noise into recordings. Third, the backcoat is somewhat rough in texture. This rough surface allows air to escape from between layers of tape in a fast-wind situation, making a better tape pack.

A magnetic personality

Two sets of factors are used to rate videotape. The first deals with the tape's bulk magnetic properties, and the second has to do with the tape's performance in a given application or format.

An important parameter for videotape is its *coercivity* (the amount of magnetic energy), stated in oersteds, that it takes to record a magnetic signal onto the tape. *Retentivity* is the amount of signal that is left on the tape after the magnetizing force is removed, stated in gauss. Good tapes retain about 60% to 80% of the magnetizing signal.

Retentivity is important because it is what keeps the recorded information recorded. Retentivity is also important for good low-frequency response. High-frequency response is more greatly affected by coercivity, because of a phenomenon known as the "demagnetization effect." Basically, the fields from adjacent North and South polarized particles interact. What's left of the field after the fields fight each other may not be enough to induce much current into the playback heads. Higher coercivity in a tape implies that the domains will be harder to align, but will have stronger magnetic fields. This ensures that all the North-South transitions will be induced into the playback head, guaranteeing high-frequency response.

Another bulk tape property is dropout. Many engineers consider dropout to be what occurs when something gets between the head and the tape in a VTR. But when it comes to bulk tape, dropout can occur anytime there is a fault in the magnetic layer of a tape. Good adhesion of the magnetic layer to the base film and good tape smoothness are elements that affect the dropout properties of a tape.

Performance parameters

Describing the magnetic personality of tape—its bulk magnetic properties—

\ Clean Sweep

For every one of their new cameras, :TV Television Network, Ltd., host roadcasters for the '88 Winter Olym-ics, selected Fujinon — more than 8 lenses in all. In the strongest domi-ation of the games, all the action aptured by CTV cameras — from the /idest panoramas to the longest, tight-st close ups on the slopes — will be ırough Fujinon lenses.

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Fujinon's brand new 13kg A34X10ESM will be on 10 new CTV cameras. No larger than the lens it re-places (the A30X11ESM), its coverage is wider and longer. From 10mm to 340mm with an F1.6 that's flat to 229mm. Naturally, it has a built-in 2X extender.

In the handheld competition, Fuji-non wins hands down with 28 new CTV cameras equipped with the A14X9ERM, 7 cam-eras with the A8.5X5.5ERM ultrawide zoom, and five cameras with the A18X8.5ERM. All three compact, light-weight, weatherized lenses have built-in extenders.

Long the industry's fa-vorite ENG lens, the A14X9ERM zooms from 9mm to 126mm while the maximum aperture is F1.7 out to 103mm.

For events demanding wider and longer coverage, the 18X provides 8.5mm to 153mm range with an F1.7 aperture constant from 8.5mm to 116mm (F2.3 at 153mm). And for wide angle abilities, nothing beats the A8.5X5.5ERM. It's an F1.7 that zooms from 5.5mm to 47mm. And even with its 1.7X extender in posi-tion, it provides a familiar 9.4mm wide angle.

In addition to the CTV cameras, most of the production companies supporting the coverage will be bringing Fujinon equipped cam-eras. And, naturally, Fujinon will be on hand to provide field support. After all, one reason Fujinon len-ses are so widely used is Fujinon serv-ice — it's as good as gold, too.

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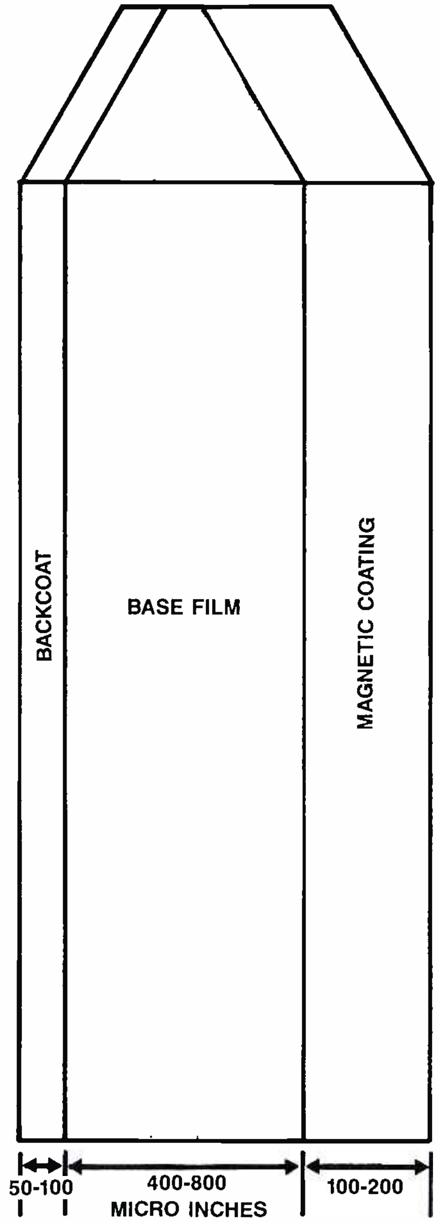

Figure 1. *Videotape consists of a base film, a magnetic coating and a backcoat that protects the base film and dissipates static.*

doesn't tell all about how well a tape will perform in a given format. The application ratings of a tape include factors such as RF output, luminance and chrominance signal-to-noise ratios and resolution.

The term "RF output" may be on the verge of becoming an anachronism. Analog videotape recorders write to tape using an FM modulation system. This is why

Main story continues on page 108

MULTI-FORMAT INTEGRATION

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Multi-Format Integration is an exciting, cost-effective way to merge your existing video equipment with today's technology and tomorrow's expectations. The result is superior performance and enormous versatility. Best of all, Multi-Format Integration doesn't come with a high price tag.

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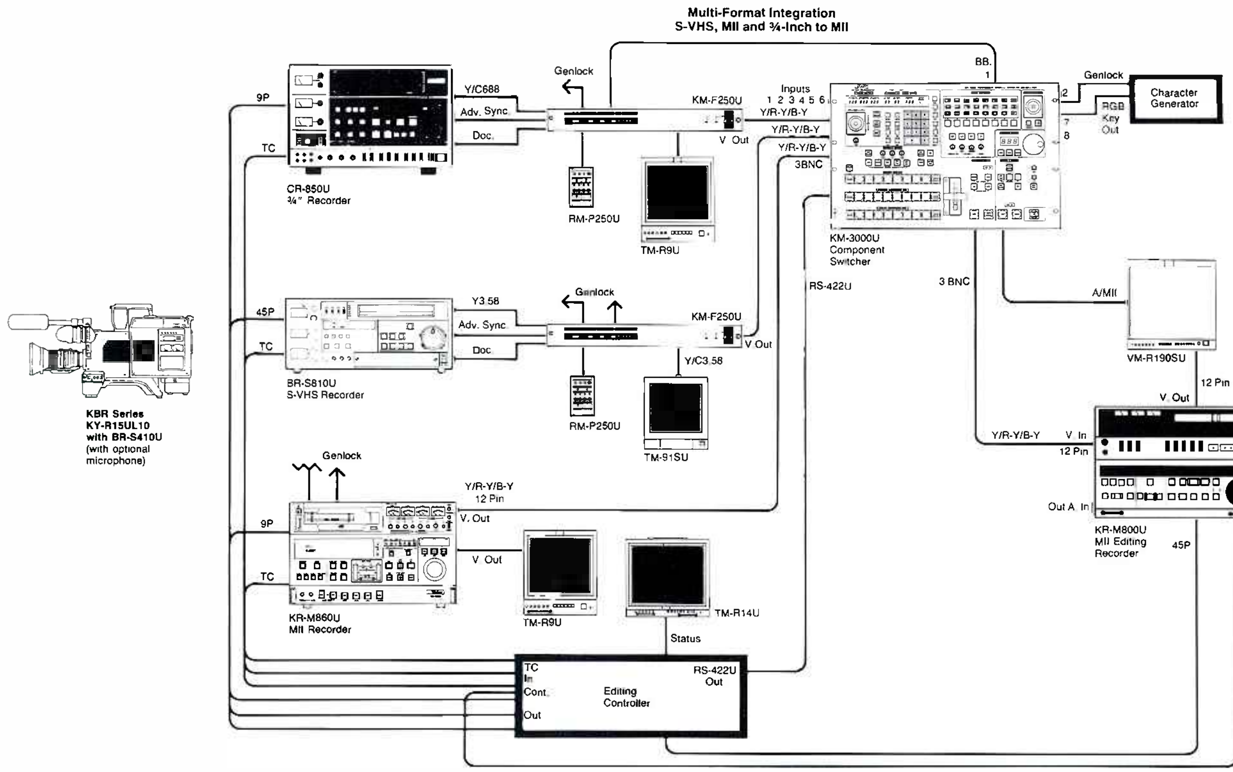

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How tape is made

Some industry experts joke that the manufacture of videotape is little more than dragging a rusty nail over pieces of plastic. The truth is that videotape manufacture can require an environment to be 10 times cleaner than a hospital operating room. Some visitors to tape manufacturing plants report having to walk over adhesive flooring that picked the dust off their soles, *just to look through a window.* Quality control is strict and continuous, with samples taken from raw materials and from the finished product, as well as at regular intervals throughout manufacture.

The process begins

The creation of magnetic tape can be broken into several steps, but in practice it is nearly continuous. The major steps include preparation of the magnetic coating and backcoat, application of coatings, drying, calendering, curing and slitting.

After manufacturers work out what is needed in magnetic particle and base film parameters, most contract with outside vendors to supply them. Film comes on jumbo rolls. The particles arrive either in bags (for the oxides) or in sealed drums (for the metallics).

The formulation process begins by preparing the magnetic particles for mixture into the binder system. When the particles arrive at the tape manufacturer, they are likely to have been clumped together by the forces of surface tension and, perhaps, magnetism. Milling and filtering stages separate the particles for use. The particles may be mixed with solvents or some part of the binder to form a milky fluid, then are tossed about in a machine resembling a giant rock polisher.

Small beads or pellets, called "media," may be introduced into the fluid to aid in breaking up the clumps and dispersing the particles. The more uniformly dispersed the particles are, the better the tape will perform. Samples are pulled off periodically to check for quality. The remaining ingredients and additives for the magnetic coating are added eventually, the media are removed, and the material is filtered. When it is ready for application, the fluid has the consistency of molasses.

The film is coated and dried in ovens. At this point, the solvents that help the binder bond to the base film are, for the most part, dried off. Calendering comes next. The tape is pressed between massive heated rollers to make the coating uniform. Following application of the backcoat, the coated roll is left to cure for two days to two weeks. This allows time for the polymers to interlink, to provide the cohesion necessary to keep the tape together during the record/playback cycles of its life. Additionally, the curing phase provides a chance for any remaining solvent to evaporate.

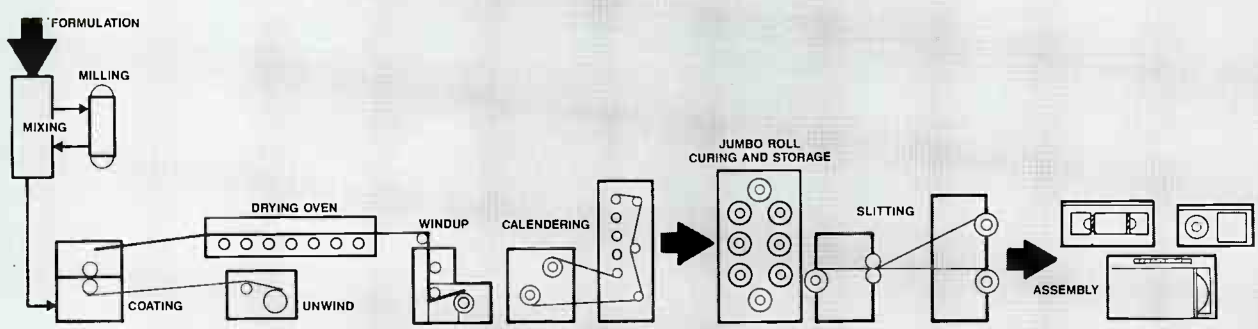
The tape is then slit into the appropriate widths. Slitting is another highly proprietary area of manufacture. The accuracy of the slitting process is extreme. On D-2 tapes, the 19mm width is maintained to ¼-mill (0.00025 inches). Improper slitting might result in a tape that has width variations, that has an edge that drifts in and out of tolerance, or is prone to edge damage. Some slitting apparatuses use counterrotating carbide wheels. The result is a cut similar to one that would be made with scissors, except that it's continuous.

Following slitting, it may be necessary to clean cutting residue off the tape. The slit portions are wound off into standard-sized pancakes, from which they will be loaded onto reels or cassettes.

It's in the wrist

Some of the biggest secrets of tape manufacture lie in the doing of it. Many of the major manufacturers purchase base film and particles from the same vendors. Although the precise formulations are protected by non-disclosure agreements, it would take more than just the recipe to copy the product. This is due to the interactivity of the binders, additives and treatment methods.

Tape manufacturers and equipment manufacturers work constantly to develop new formats that more closely meet the needs of broadcasters and video professionals. The quality of recordings today is astounding, compared with the experimental quad machines of just a few decades ago. New methods and formulations will surely keep the state-of-the-art on the rise in the tape domain.



An overview of the tape-manufacturing procedure. The magnetic particles are milled and mixed with binder, solvent, abrasives and lubricant, and then applied to tape. The magnetic coating is dried, and the tape is calendered for precision thickness and smoothness. The rolls are cured to allow molecules to interlink, then the tape is slit, wound onto pancakes and loaded into reels and cartridges.

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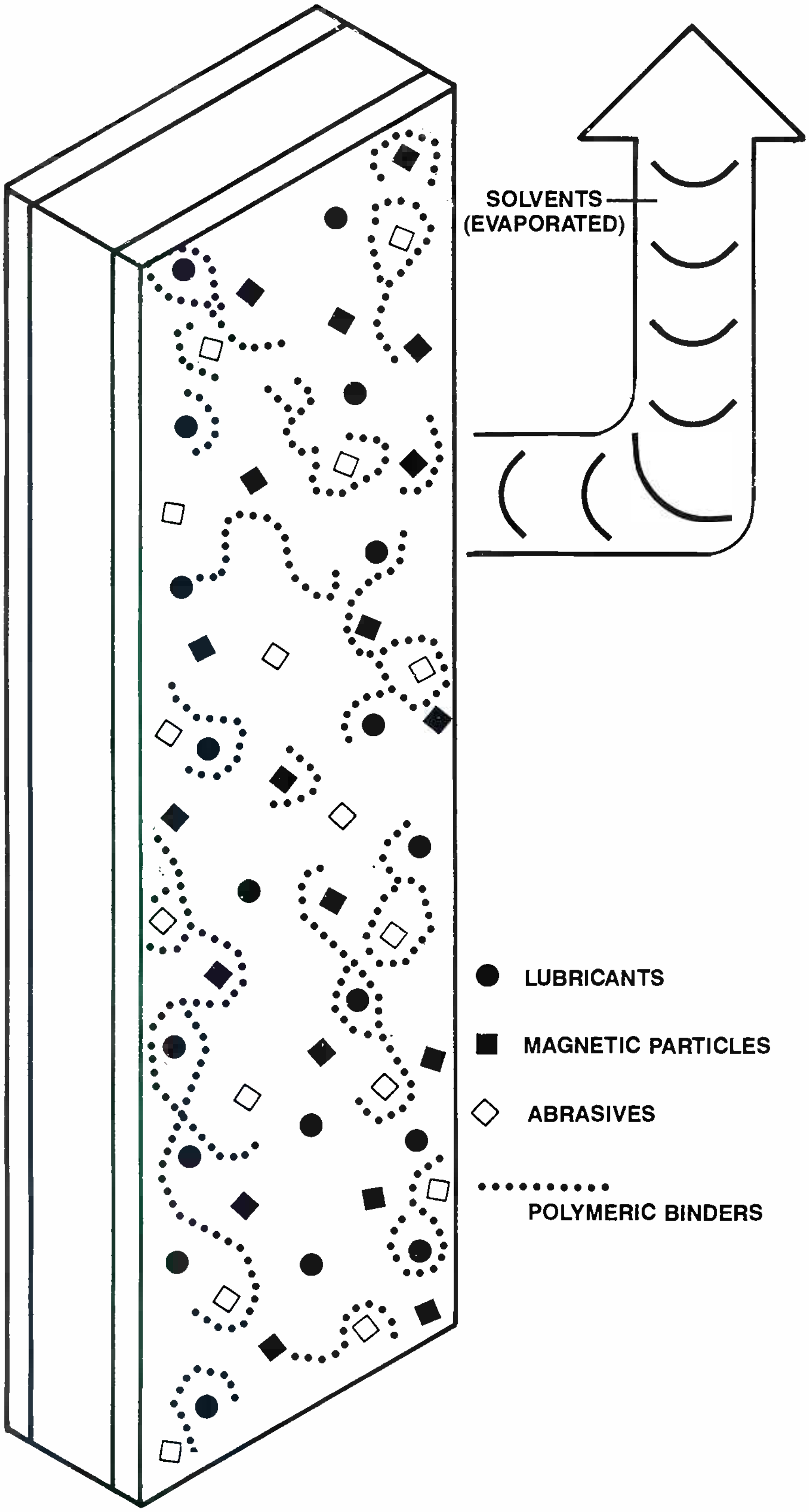

Figure 2. *The binder system of videotape. Long polymeric molecules of the binder interlink, binding the magnetic particles and the abrasive particles to the base film. Solvents and dispersants help binders join to base film and keep magnetic particles separated in the binder solution. These evaporate later in the drying ovens.*

Main story continued from page 100
the recovered signal is called RF. In digital VTRs, however, RF may not be an intentional part of the recorded signal. Nevertheless, the energy envelope that is recovered from tape is, for tradition's sake, called the "RF envelope."

RF output can be increased by using tapes of higher coercivity. This is especially useful at high frequencies. (With D-2, for instance, the high frequencies on tape may be in the neighborhood of 32MHz.) RF output is important because, in most cases, every decibel counts. The playback pre-amp, which converts the minuscule signals returned from the heads into something the machine's electronics can work with, will introduce less noise into the signal if it doesn't need to provide enormous gain.

Recovering a lot of signal isn't worth much, however, if it's garbage. Luminance signal-to-noise is a ratio of the amount of noise in a luminance signal to a 1V p-p reference. Chrominance signal-to-noise is the ratio of the level of noise found at the chrominance frequency to a 1V p-p reference. Chrominance carrier-to-noise is a figure used by some manufacturers to describe the ratio of the chroma noise to the amplitude of the RF envelope. These measurements are taken through standardized filters, which are usually built into a video noise meter.

The tape manufacturer can keep noise to a minimum by ensuring that the magnetic particles are thoroughly dispersed throughout the binder. Irregular fields from clumps or voids of magnetic particles can induce noise. The smoothness of a tape is important, too. Even if video is FM-modulated, the distance to the head from the tape surface affects the signal output. The instantaneous AM caused by imperfect tape smoothness adds undesired noise. Also, the "slip-and-stick" action of the tape due to friction can cause small phase changes in the signal, hence added distortion.

Resolution is a property of both the format and the tape. The number of vertical lines of resolution is fixed by the format. The number of horizontal lines refers to the number of light-to-dark transitions that can occur on a single line. Of course, the more transitions, the higher the frequencies involved. Good coercivity increases high-frequency response.

Oxide and rusty nails

The magnetic action in videotape comes from the spinning electrons in the particles of the magnetic coating. The magnetic force from the record head coaxes the outer shells of the particle atoms to spin

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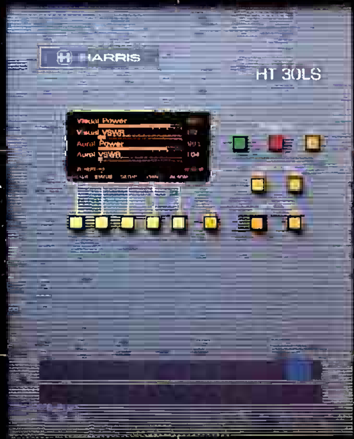

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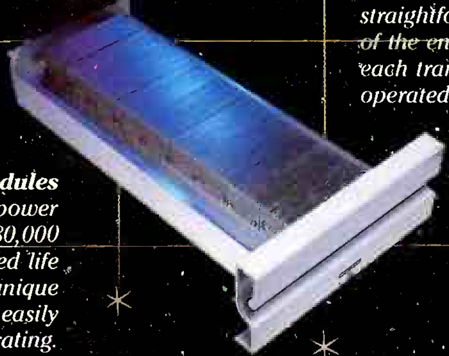

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The transmitter shown is Harris' HT 30LS 30 kW low band solid-state model, configured with the optional spare exciter and 20% aural option.

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in the same direction. This momentum, when shared by enough atoms, makes up what is called a magnetic domain. Alignment of magnetic domains is the principle upon which magnetic recording rests.

The trick is getting the domains in the first place. The development of particles is a highly complex, highly proprietary aspect of videotape manufacture. Iron oxide (rust) is the base, or precursor, particle for most of today's tapes. However, the iron particles used in tape have gone through a lot more treatment than just being left out in the rain.

Rust is not magnetic. The rust for tape oxide is produced in elaborate procedures that may include high pressure and chemical treatments. These processes change the particle's make-up by altering its crystalline structure. When the treatment is over, the particles have changed to a gamma state, in which they are magnetic. If processed into tape at this point, they would be rated at about 450 Oe. This type of tape was used on early quadrature machines.

To increase coercivity, oxide particles are doped with cobalt. Earlier procedures used "body" doping, which infused the cobalt throughout the particle. Currently, a popular technique is to coat the cobalt only on the outside of the particle, similar to the colored candy coating on M&Ms. This *adsorption* technique, as opposed to absorption, makes the particle more temperature-stable. Tapes using these particles are rated to about 950 Oe. Cobalt-doped iron-oxide tape is used for highband quadrature, C-format, U-matic, Betacam, D-1 and S-VHS formats, among others.

Metal particles

Only about 30% of an iron-oxide particle is magnetic. The coercivity of tape can be increased greatly if the particles are made of metal, not oxide. This makes nearly 100% of the particle magnetic, resulting in three times the retentivity. Unfortunately, the metal particles are volatile if exposed to air, so they must be processed in solution or beneath nitrogen curtains. Because they will unavoidably be exposed to air in the studio, a surface treatment is required. Typically, the outer surface of the particle is allowed to rust, halting further oxidation. Metal-particle tapes, rated up to about 2,200 Oe, are employed in Betacam SP, ED-Beta, M-II, "highband" 8mm, R-DAT and D-2.

In the future

The head in a VTR is subject to highly injurious force because of tip penetration and the speed with which it moves. Ferrite is one of the few materials that can withstand this kind of treatment. Unfortunately, ferrite may reach its magnetic saturation point before the tape it is trying to magnetize. This is particularly true in formats using metal-particle tape, such as D-2. For this reason, researchers are trying to perfect special metal-in-gap (MIG) heads that are built of ferrite but use pole-tip pieces plated with special alloys, such as Sendust, that increase the head's ability to generate magnetic flux.

As well as increasing the capability of tape heads, new processes are expanding the capability of tape. One process, using evaporated metal, yields superior performance. MET (metal evaporated tape) is produced by heating nickel-chromium alloy in a large vacuum chamber. A jumbo roll of specially designed base film—one that won't "outgas" vapors when subjected to the vacuum—is mounted in the vacuum

Continued on page 114

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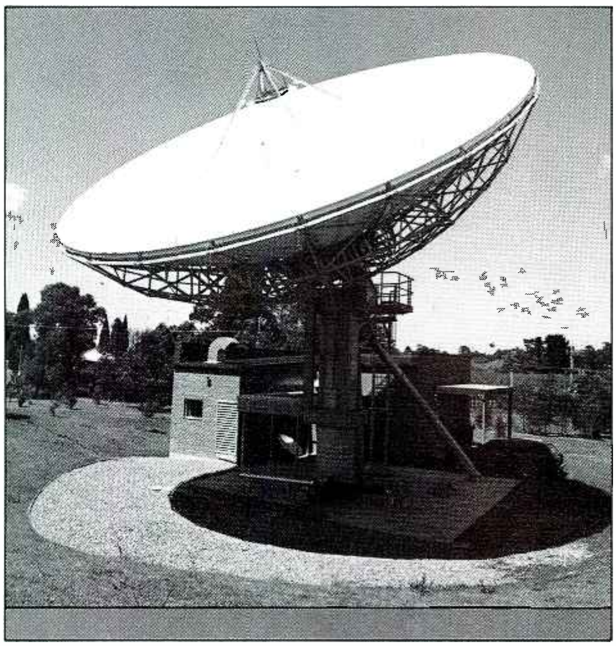
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Continued from page 110

chamber, as are a take-up reel and a water-cooled cylinder. The base film is wound over the cylinder to cool it and brought near the crucible of the boiling alloy. Because of the vacuum, the metal leaves the crucible and floats in the chamber, condensing on the chilled surface of the base film. The film continues winding onto the take-up spool until the entire roll has been coated.

The evaporated metal produces an ultrapure, ultrafine coating with extremely high coercivity. As with metal-particle tape, each particle can be said to be 100% magnetic. Additionally, the evaporative process requires no binders, so the tape surface is 100% magnetic rather than 30%, as with conventional tapes.

MET is ideally suited to digital formats. (In fact, it is rather poor for analog recording because it doesn't reproduce low frequencies such as control track or linear audio.) Some difficulties remain to be worked out, but metal evaporated tape is attractive because, in addition to its performance qualities, its continuous process is a strong manufacturing advantage. After coating, the tape is lubricated and sent off to the slitter without any intermediate steps.

High-speed video duplication

Another future trend in videotape will affect the way multiple copies are made. Currently, most duplication is performed in real time, making individual recordings on multiple decks. This is wasteful on two fronts. First, a production may run shorter than a standard-length cassette, meaning wasted tape at the end. Second, and worse, the recording must be made in real time.

A new technique takes advantage of the "print-through" phenomenon of magnetic tape. (Magnetic energy from one layer of a reel of tape realigns the domains on an adjacent layer, causing the signal to "bleed through" and appear as an echo. This is often heard in low-quality audiocassettes.) One system uses heat to effect the printing, and another uses magnetic fields. The result is excellent copies made at perhaps 60 to 90 times real speed. Also, because these systems operate using pancake tape and cassette loaders, the tape can be cut to fit the production, further eliminating waste.

Acknowledgment: Ampex, Fuji Film, Sony, 3M and other manufacturers assisted in preparing this article. Special thanks to Tom Neuman, senior staff engineer, Ampex recording technology group.

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Planning an STL system

By Ronald Balonis

Reliable STLs require thorough planning.

The demand for higher-quality broadcast links has forced many broadcasters to re-examine how the signal is relayed from studio to transmitter. The obvious way to meet the demand is through a *studio-transmitter link* (STL) system. What's not so obvious is how to install an STL that provides the desired quality and is reliable enough for broadcast service. Often, the message to the engineer is "You can't get there from here."

Balonis is chief engineer at WILK-AM, Wilkes-Barre, PA.

Design process

The planning and installation of an STL system ranges from simple to complex. Regardless of the complexity, however, each phase of the process should be addressed methodically.

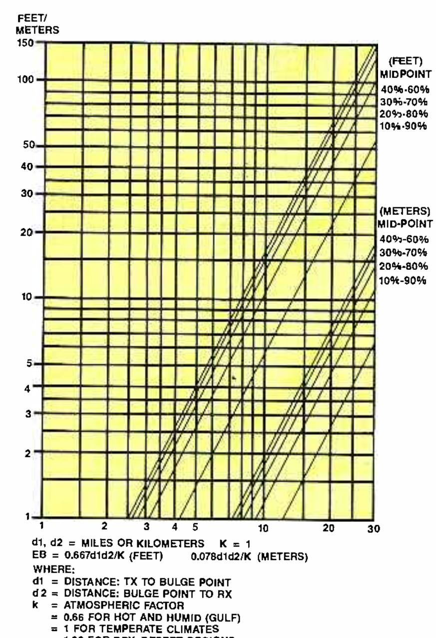


Figure 2. *It's important to take into account Earth bulge when designing STL paths. Short paths are not affected by Earth bulge as much as long paths.*

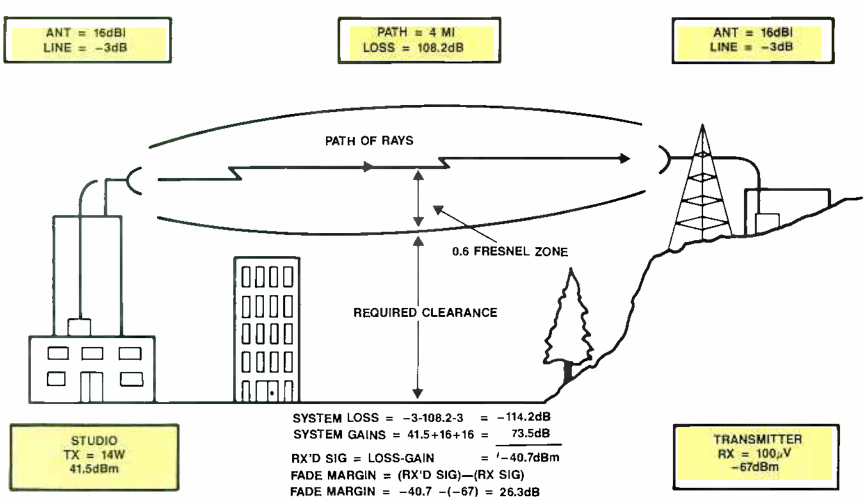
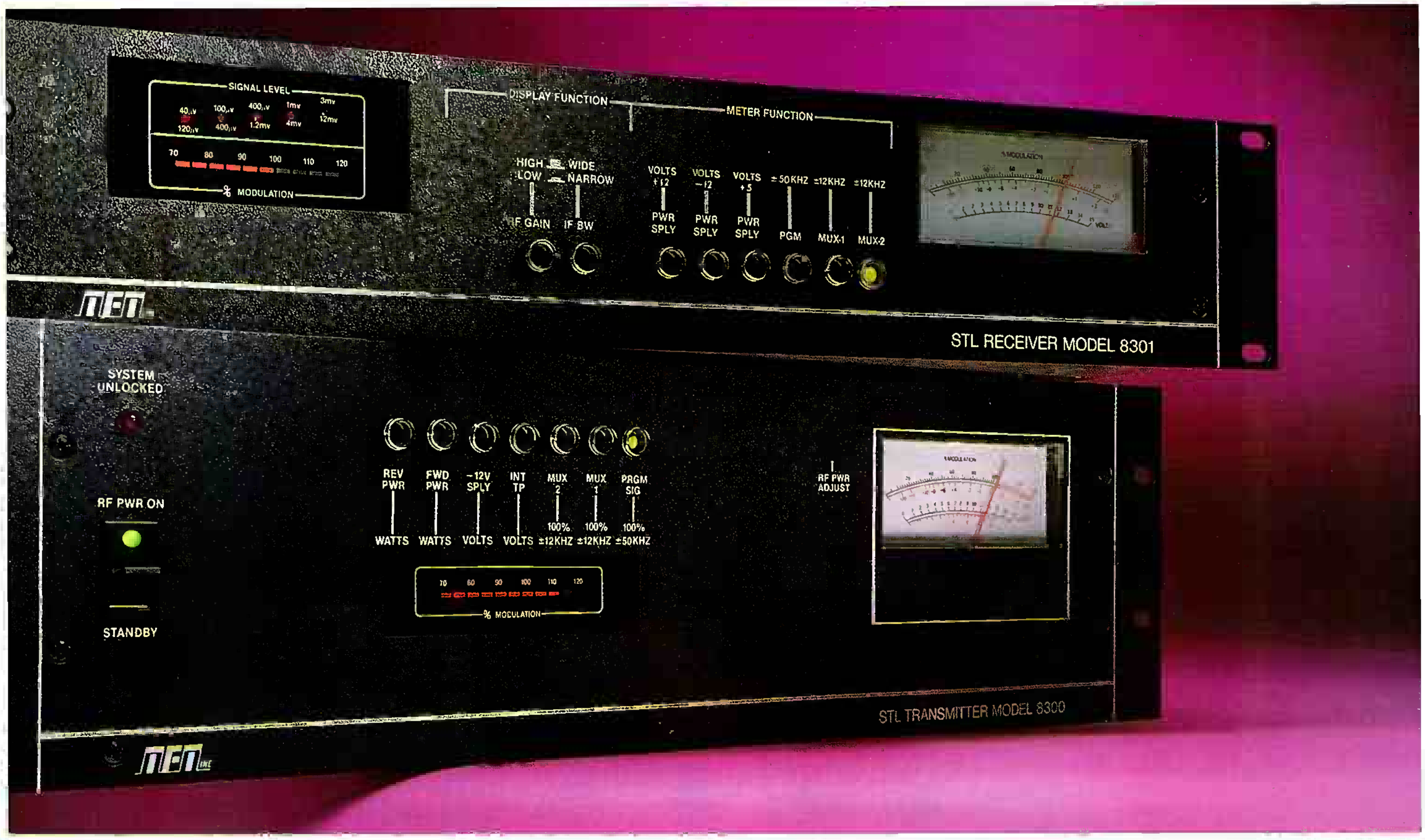


Figure 1. *A good way to help visualize the constraints faced in STL system design is through a simple drawing.*



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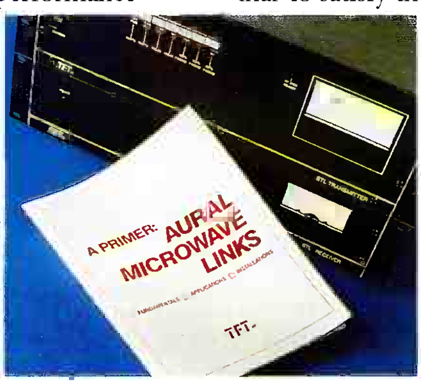

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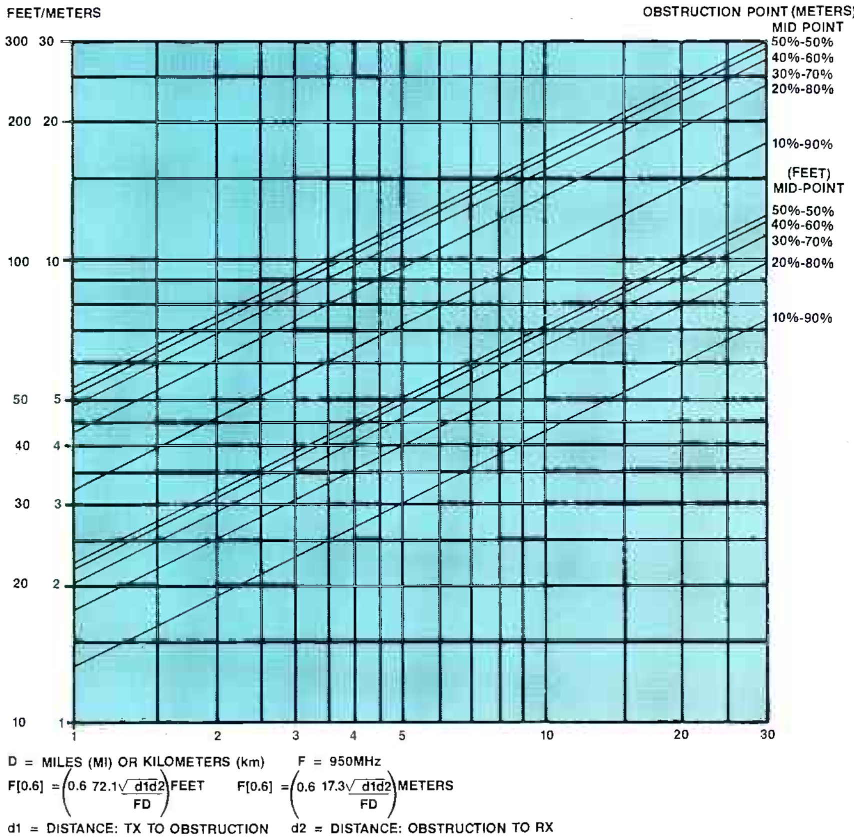

Figure 3. *One of the most important calculations in any STL path design is Fresnel zone clearance. Lack of proper clearance often results in a grazing path and poor reliability.*

The first, and perhaps most important, task is to identify an operating frequency. Although the FCC issues the license to use an STL frequency, it is the applicant's responsibility to identify one that will not cause interference to other stations.

The second step is to complete an STL path analysis. The path over which the microwave signal travels must be free of obstructions, which might block the signal. In the path analysis, two primary factors must be identified: transmission path loss and optimum antenna location.

These parameters determine the required transmitter power, receiver sensitivity, antenna type and required height above ground. These factors are critical to providing year-round reliable service.

Next, apply to the commission for the STL license. The process involves completing form 313 with the data derived from the first two planning steps: frequency, transmitter type, power and modulation, type of antenna and power gain, and antenna height above ground.

The final step is the construction phase. If the previous steps went well, this part will be simple: Mount the antennas, run transmission line, connect the components together and turn it on. If there have been path problems or difficulties with frequen-

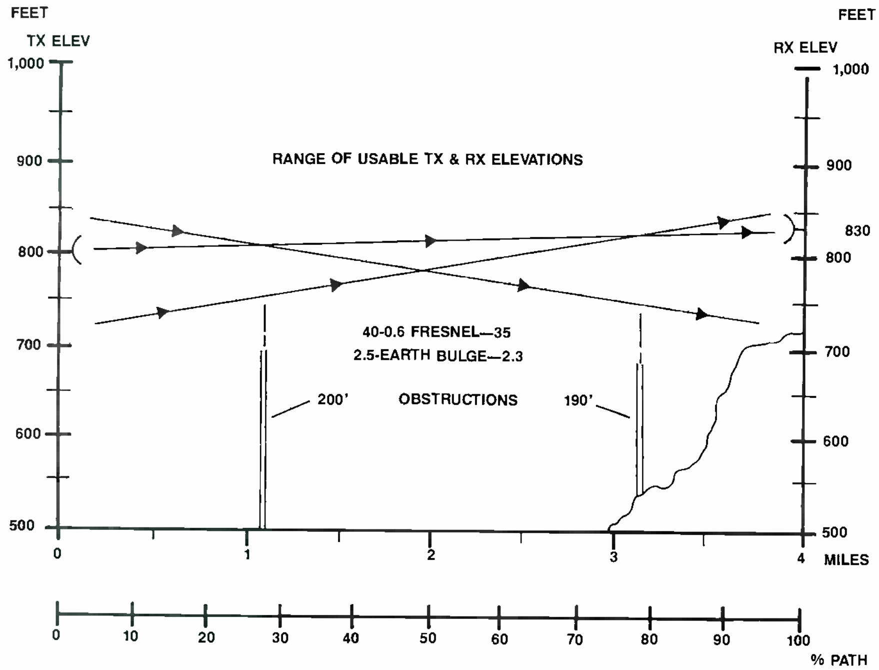

Figure 4. Using topographic maps, draw a terrain profile of the entire path. The height of any obstructions in the path should be identified accurately so the necessary Fresnel clearance can be calculated.

cy, equipment or interference, however, this phase can be complicated.

The construction phase also can be affected by local regulatory issues. Zoning or building permits may be required, all of which can turn the construction of even the simplest STL into a time-consuming, frustrating project.

In search of frequency

Each of these required steps presents problems, but with more than 3,000 STLs in operation, the biggest problem is finding a clear, non-interfering frequency to use.

The current STL band extends from 944MHz to 952MHz. The present STL frequency-allocation scheme (which, after much debate, became effective on Dec. 16, 1985) divides the STL band into 320 25kHz segments. The segments may be stacked to form a channel with a maximum authorized bandwidth of 300kHz.

A wider bandwidth channel (up to 500kHz) may be authorized where stations desire to transmit program material from one origin to one or more destinations. The station may lease the excess capacity for broadcast or other uses on a secondary basis.

Stations licensed for channels up to 300kHz in bandwidth (200kHz for AM stations) may lease excess capacity for broadcast and other uses on a primary basis. The required channel width depends upon the equipment and the type of aural STL system being configured—monaural, dual-channel or composite. See section 74.502 of the FCC rules for a full discussion of fre-

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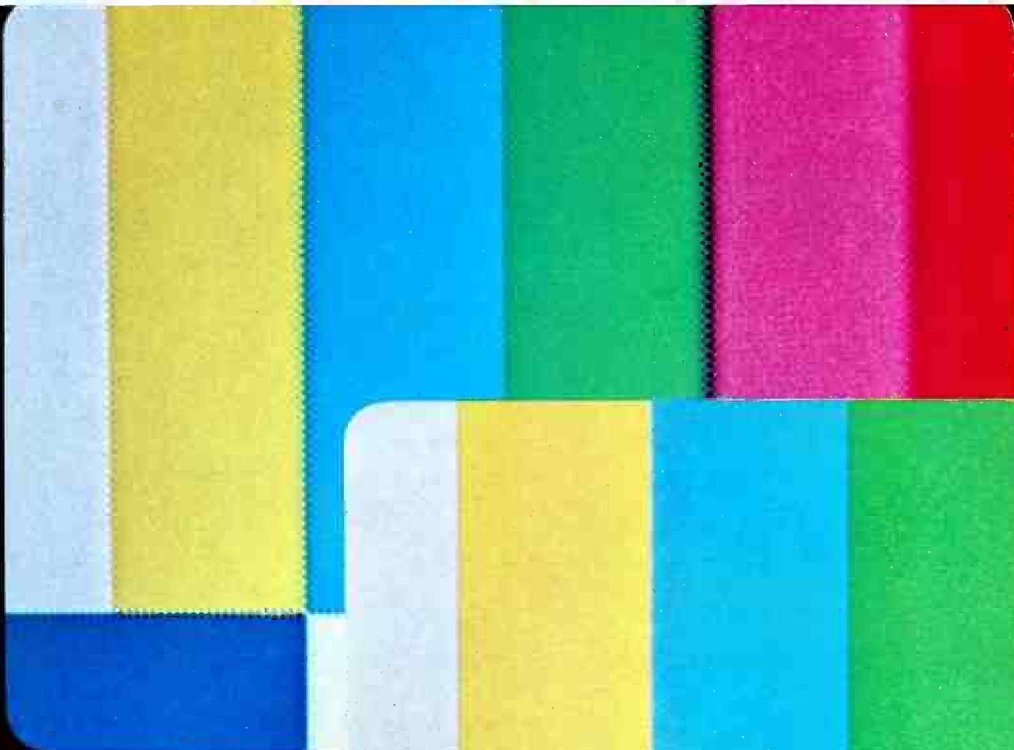

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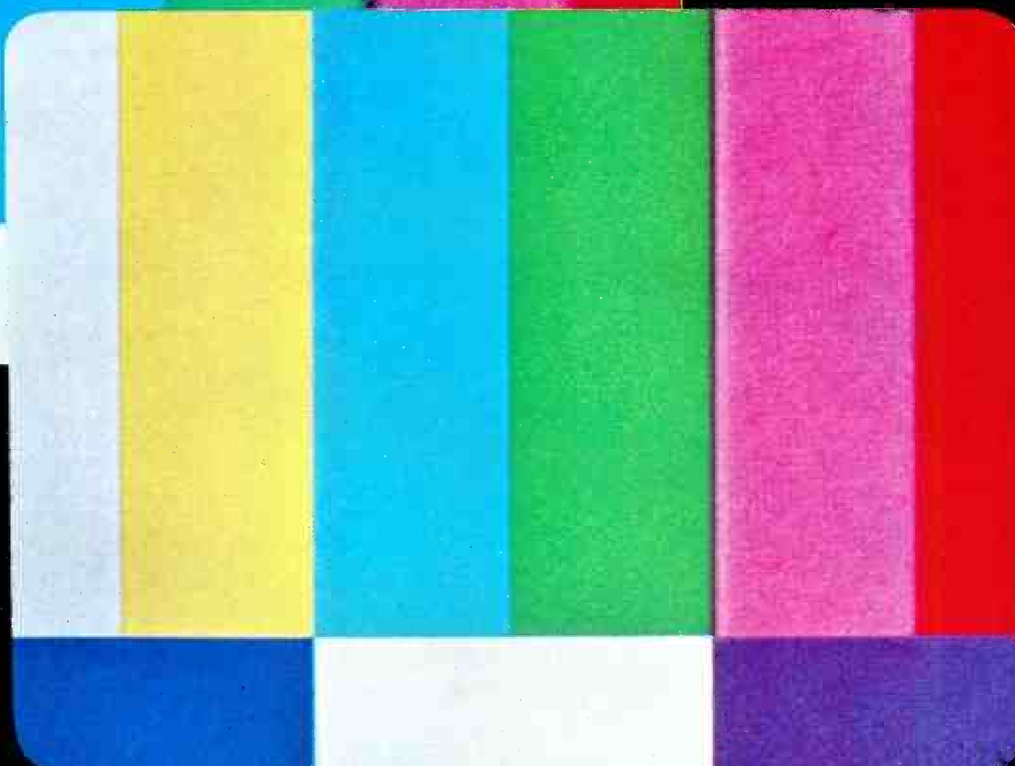

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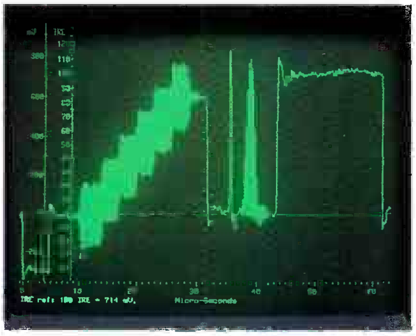
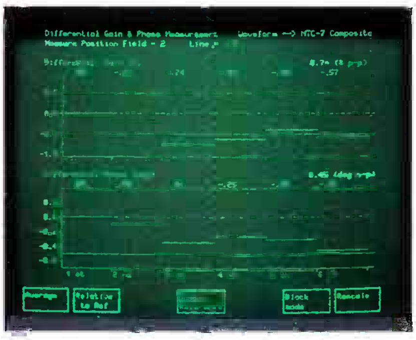
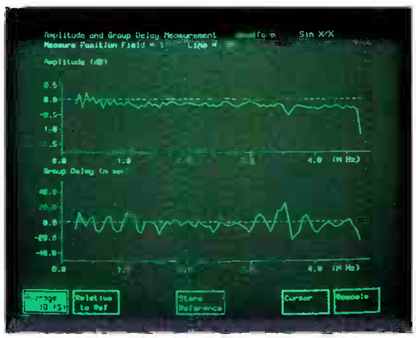
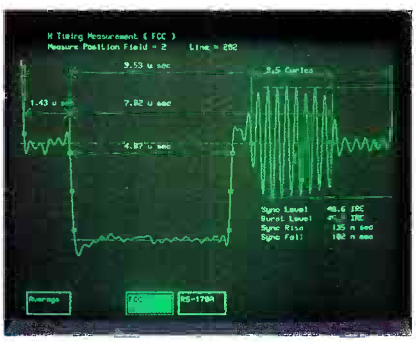
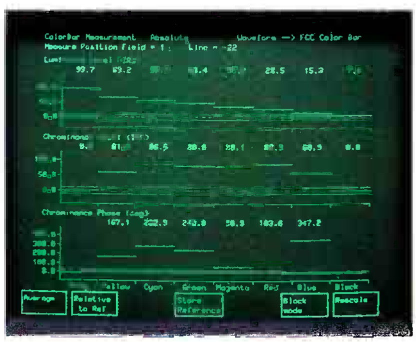


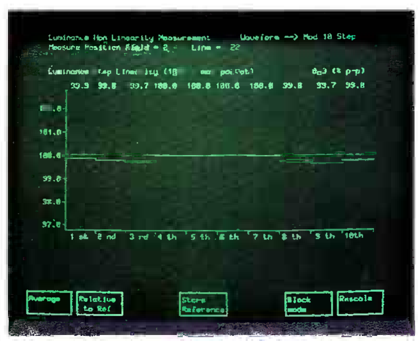
Video courtesy of KOIN-TV, Portland, OR.

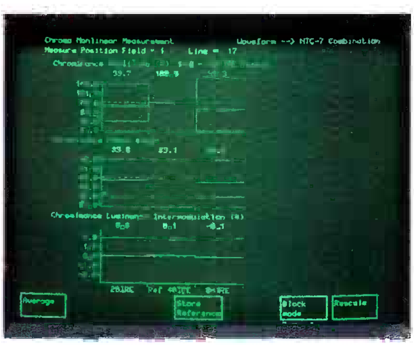


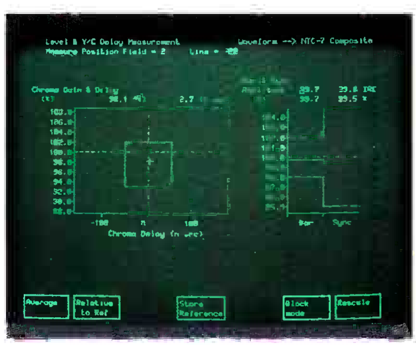


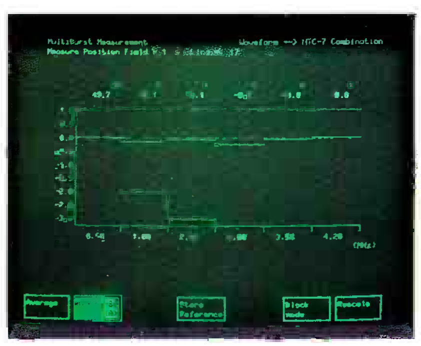












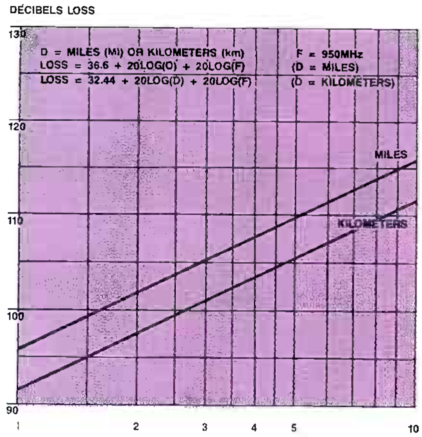


Figure 5. *One of the easier steps in the calculation of free-space loss. Be consistent in all calculations. Use miles or kilometers, but not both.*

Continued from page 120

quency assignment.

The purpose of new rules and allocation schemes is to increase STL spectrum efficiency by encouraging the use of state-of-the-art STL equipment. The process also allows the commission to authorize only the minimum required amount of channel space.

Most of the 3,000 STLs currently on the air were licensed under the old STL rules. For these stations, the STL band extends from 947MHz to 952MHz, originally allocated as 10 500kHz channels.

Even with the additional 3MHz, in many places, the search for a non-interfering STL frequency is a nearly impossible task. Even reuse, especially where common transmitter sites prevail, is often impossible. At many locations, the number of users simply exceeds the number of frequencies available.

Frequency coordination

The problem of finding an STL frequency is compounded because the commission relies on broadcasters to perform their own frequency coordination. Because it's in the station's best interest to avoid interference, it is essential to work with the local SBE frequency coordinator when searching for a frequency.

A list of the SBE frequency coordinators is provided in Table 1. Each local SBE frequency coordinator maintains a database of area frequency usage. The coordination effort is voluntary, and the coordinator does not assign frequencies. But, through a pooling of user experience and the database, the coordinator can assist you in selecting a frequency. Remember that the responsibility for any interference, and the burden of eliminating it, rests on the newest licensee.

Frequency coordination takes into account the frequency, type of modulation, transmitter location, radiated power, antenna orientation (azimuth) and antenna polarization (H/V). Additional factors, such as potential harmonic or subharmonic interference to or from an STL system, also should be considered.

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For locations where there are more stations than STL frequencies, frequency sharing is one way to squeeze more use out of the limited spectrum. The actual propagation loss can be much greater than the predicted line-of-sight loss if the stations capitalize on situational factors and the configuration of the STL systems. This often permits two or more STL systems to operate on the same frequency without interference.

Some of the techniques to increase isolation and reuse frequencies include blocking terrain, back-to-back antennas and opposite polarization.

Blocking terrain, for example, can add 20dB or more of loss to a transmission path. Back-to-back antennas can add another 20dB or more to the path loss. Using different antenna polarizations can further increase the isolation between co-channel signals by an additional 25dB to 30dB. In crowded areas, a combination of these techniques may be needed to get the new user on the air.

Path planning

As a design example of STL path analysis and planning described here, consider a typical broadcast case of a line-of-sight path of 20 miles or less. Figure 1 illustrates this configuration.

STL path analysis and system planning consists of interrelated smaller steps:

- Engineering the path to select the best line-of-sight route for the STL signal and determining the correct antenna orientation and height.
- Calculation of the path signal loss and the total overall system loss from transmitter output to the receiver input.
- Selection of the antennas, transmission line and transmitter power for required fade margin.

Path plotting

Path engineering starts with the drawing of the signal path from transmitter to receiver on a topographic map. From the map, determine the coordinates of the transmitting antenna, its bearing and the distance to the receiving antenna. The locations of both antennas and the transmitting antenna azimuth are needed for the license application. The path distance is needed for path loss calculations.

Use the map to take a field trip along the path. Note the locations and approximate heights of the natural and manmade obstructions along the path, marking them on the map. This is especially important for higher elevations. This information will be used to make a path terrain profile to determine the clear line-of-sight path for the STL.

Path considerations

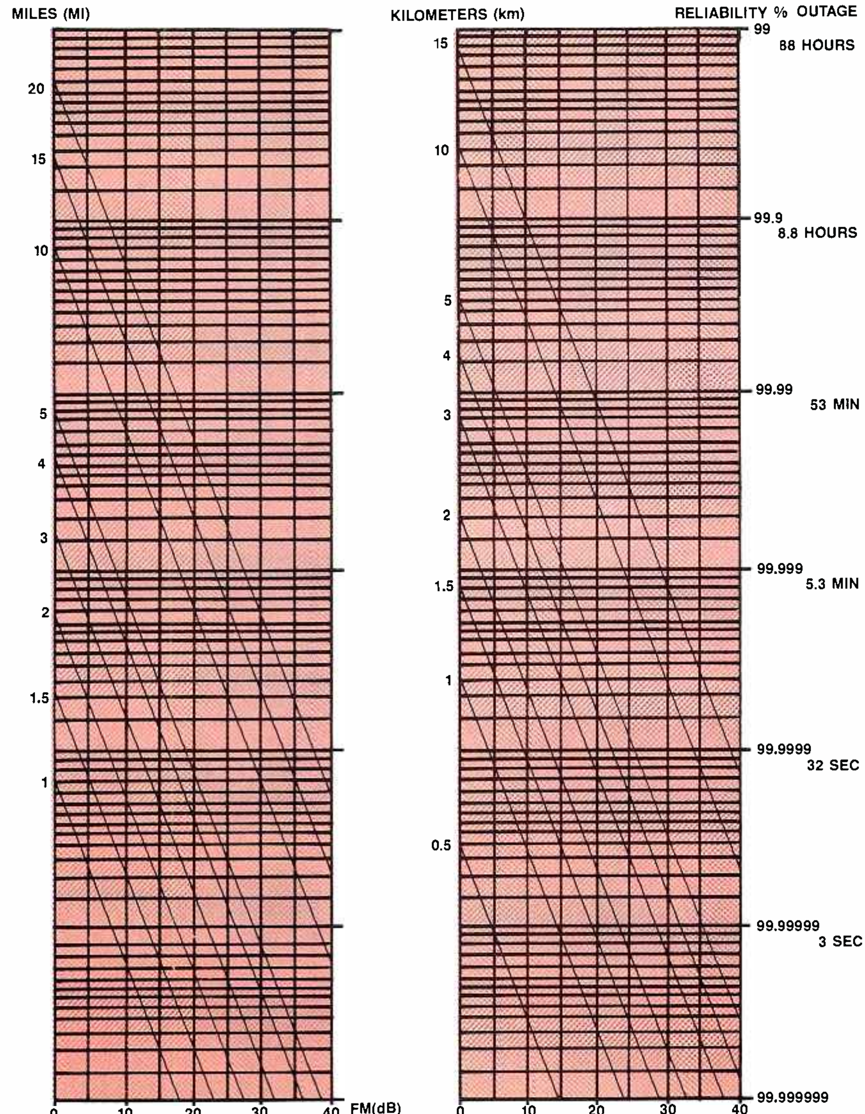
When you're looking at a proposed STL path, you must consider a number of factors. The Earth's surface affects microwaves in different ways. Soil-covered surfaces behave like lossy dielectrics, partially reflecting and absorbing microwaves. On the other hand, water-covered surfaces can reflect microwaves, much like a mirror reflects light. For this reason, over-water paths may exhibit deep fading. Surfaces covered with vegetation, whether in leaf or not, tend to absorb the microwaves.

Buildings have a complex effect on microwave signals. Structures with large plane sides or roofs can cause mirrorlike reflection, especially if they are located close to one of the antennas. Other building surfaces tend to scatter the radiation, acting as opaque obstacles for microwaves.

Reflections, especially those that change with time or weather, are particularly troublesome for an STL path. These reflections can produce interference at the receiver, known as *multipath fading*.

Minimum clearance

The clearance from obstacles for a line-of-sight path determines the orientation and height of the transmitting and receiv-



PATH RELIABILITY (%) = 100-100•(A•B•2.5E-6•F•D•D•D•EXP(−FM/10))
WHERE: A = TERRAIN COMPENSATOR
= 4—SMOOTH, WATER
= 1—AVERAGE ROUGHNESS
= 2.5—MOUNTAINOUS
B = CLIMATE COMPENSATOR
= 0.5—GULF COAST, HOT, HUMID
= 0.25—NORMAL INLAND
= 0.125—DRY OR HIGH ALTITUDE
F = FREQUENCY (GHz) D = DISTANCE (MILES) FM = FADE MARGIN (dB)

Figure 6. *A system's fade margin determines the overall reliability of the STL. The more margin, the higher the reliability. Broadcast applications often require more than 99.99% reliability.*

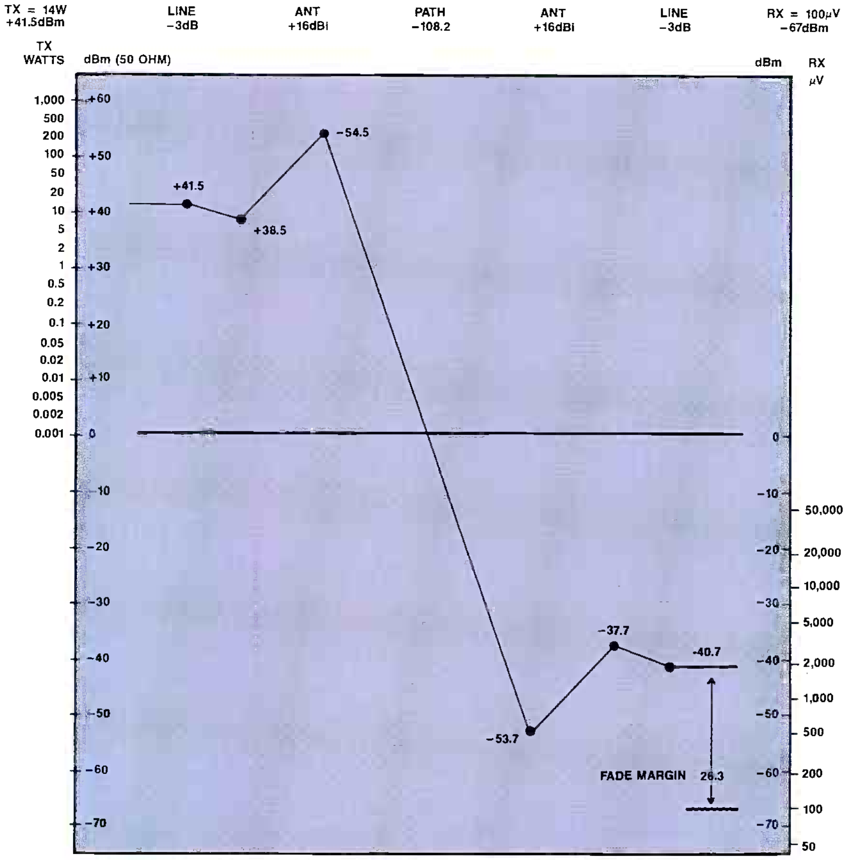


Figure 7. The final planning step should include a plot of the system's gain and loss. Such a graph visually indicates the gain structure and fade margin.

ing antennas. For the STL system to l highly reliable, a clear line-of-sight pa is necessary. Only then will the actual pa loss and the reliability approach tl calculated ideal free-space values.

The effective path clearance for micr waves is affected most by two facto Earth bulge and Fresnel zones. Rad waves seldom follow straight lines. Wi time, the dielectric constants of the a mosphere vary, bending (refracting) rad waves slightly, from an ideal straight-lir path. On the average, the wave ben downward as if the Earth's radius we four-thirds of its actual value. Figure 2 pr vides the Earth-bulge equation and gra in both feet/miles and meters/kilomete This information will be needed f deciding the antenna heights.

Another factor, Fresnel zone clearanc must be calculated. The Fresnel zone a result of the property of the wavefro to expand as it travels through spac When these parts of the wavefront pa over obstacles, reflections and phase tra sitions result. The effect causes an increa or decrease in received signal level. Tl phenomenon is named for Frenc physicist August Jean Fresnel, wl discovered it in the early 1800s.

The amount of clearance needed to pr

vent such diffraction-related problems is expressed in Fresnel zones. If an obstruction blocks more than 40% of the first zone, attenuation results. This means that a line-of-sight path must clear objects within its path by a distance equal to the 0.60 Fresnel zone radius. If the ray reflects from an even-number Fresnel zone, cancellation occurs. As the clearance is varied, the signal varies. Figure 3 gives the 0.60 Fresnel zone in equation and graph form for feet/miles and meters/kilometers.

Determining antenna height

Because of Earth bulge, it is customary to plot the STL path terrain on true Earth graph paper. Regular Cartesian graph paper works as well if you add back the calculated amount of bulge and the Fresnel clearance to the height of the plotted-path obstructions.

If the obstacle is vegetation-covered terrain (and especially if it contains trees), a 10-foot clearance for growth usually is added. Allow at least 20 feet of Fresnel zone clearance at points near the ends of the path.

To determine the required transmitting and receiving antenna heights, use Cartesian graph paper to make a profile plot of the terrain and obstacles along the STL path between the sites. (See Figure 4.) Using the highest obstruction in the path as a graphical leverage point, add the 0.60 Fresnel clearance, plus Earth bulge for the point, to the height of the obstruction. Draw straight lines between the sites that just touch the top of the obstruction. This locates the minimum antenna heights for both ends of the path.

Path analysis

The objective of STL path analysis and planning is to minimize the influence of the Earth factors, such as surface and atmosphere, on the path loss. If possible, achieve conditions that are similar to those of free space, where the intensity of a microwave signal decreases inversely as the square of the distance.

Figure 5 gives the clear path free-space loss between isotropic antennas in equation and graph forms for miles and kilometers in the 950MHz STL band. The chart shows that the free-space loss, in decibels, is related to a constant, to the inverse square of the distance and to the frequency.

System reliability

The ultimate goal of STL planning is to produce a system with a high degree of reliability. System reliability relates to total outage time per year and is expressed as a percentage. For example, a propagation reliability of 90% means that the system will be unusable for a yearly total of 876 hours. A 95% reliability factor equals 438 hours of outage. A reliability factor of 99.99%, almost perfection, still equates to almost an hour of lost air time. It's easy to see that the reliability of a broadcast STL must be extremely high.

In the early days of microwave system design, several rules of thumb were developed. An example is fade margin. The rule of thumb was that fade margins from 0.5dB to 1.5dB per path mile above the normal system loss resulted in a system with a 99.9% reliability.

Since the early days, there have been plenty of opportunities to verify the theory, and fade margin now can be predicted with more certainty. An example is the empirical formula shown in Figure 6, which was developed by W. T. Barnett, an engineer for Bell Laboratories. This formula compensates for both terrain and climate in determining path reliability.

Fade margin

Even so, this reliability equation predicts reliability on the basis of atmospheric

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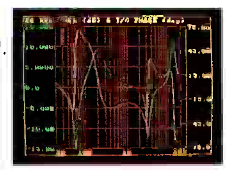

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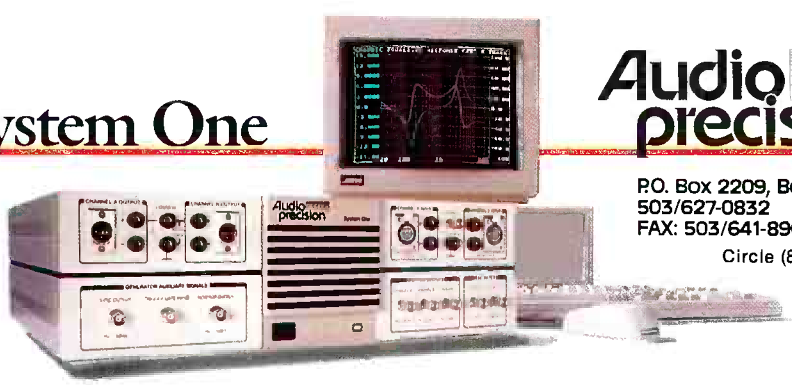

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multipath, as do most other equations. Because other factors contribute to a path's overall reliability, any mathematical model can provide only an estimate that corresponds to what is typically found in practice. The bottom line is that the reliability percentage is directly related to the amount of fade margin within the system's design.

On most STL paths, fading is a continuous process. Small fades of a decibel or more occur frequently, and deep fades of 30dB to 40dB occur infrequently. For an STL system, fade margin is the amount of built-in reliability insurance against outage. It represents the amount of excess

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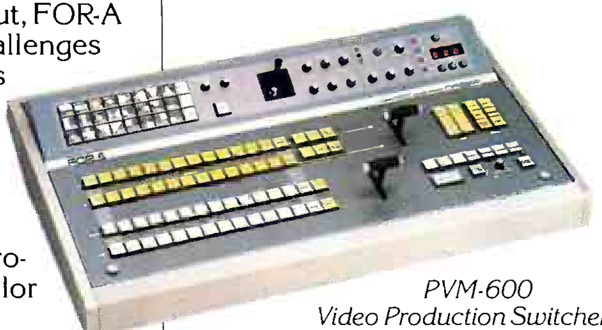

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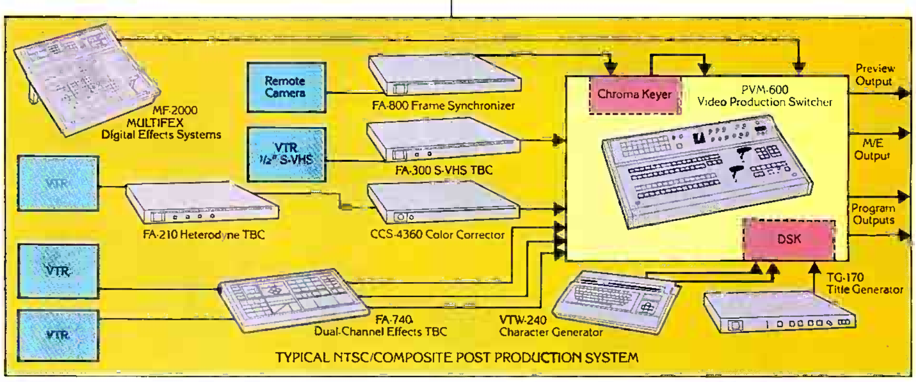

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Computer programs

STL system design can be assisted greatly by the use of computers. The many equations used to calculate losses, gains and fade margins can be handled easily by computers.

In order to assist you in the design of STL paths, two BASIC programs, two documentation files and one example record file have been placed on the CompuServe BPFORUM. The programs are free and can be downloaded to any computer.

Statistics

The first program, STLSITE.BAS, calculates a set of statistics based on an STL database. You build the database from the information provided by your local SBE coordinator. It is useful for finding a frequency or verifying a recommended one.

The program calculates the azimuth and distance between the transmitter and receiver and the line-of-sight propagation loss and distance to the proposed new STL receive location. The program also flags the frequencies unsuitable for shared use because of complementary azimuths (antennas looking at each other).

Documentation describing the use of the program is contained within STLSITE.DOC. A demonstration file, WBSCR.STL, contains records that can be used in learning how to use the program.

System calculations

Another useful program, STLRFB.BAS, performs the necessary RF calculations for an STL system. The necessary documentation is contained in the file STLRFB.DOC. The program calculates total system gain, loss, fade margin and path reliability. The program makes it easy to examine the effects of making changes in such things as antenna height or antenna gain.

All programs require a compatible version of Microsoft BASIC and an IBM-compatible computer. The programs are not long, so download time is relatively short. The programs complement the design philosophy used in this article.

system gain above overall system loss, which is above the design noise of the system and measured in decibels.

To calculate fade margin, add the system gains—transmitter power plus transmit antenna gain plus receive antenna gain plus the receiver sensitivity. Add the system losses—path loss plus transmission line and connector loss. Then subtract the system losses from the system gains to get the system's fade margin. Using this value, the system's reliability can be computed from Figure 6.

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The gain/loss plot in Figure 7 was developed using the data from the example system shown in Figure 1. The calculated fade margin for the system is shown to be 26.3dB.

Equipment selection

The equipment chosen depends on the amount of fade margin needed for the system. A short line-of-sight path in an uncongested area will have different equipment constraints than one with a long path or one that is located at a congested site.

The fade margin in an STL system can be increased in four basic ways:

- Increase antenna gain.
- Decrease the distance between transmitter and receiver.
- Increase transmitter power.
- Increase receiver sensitivity.

When adjusting these parameters, fade margin (path reliability) becomes the trade-off in equipment selection.

High-gain antennas cost more, weigh more, are bigger and require additional mounting effort, which increases the installation cost. Decreasing the distance is usually impractical because it's determined by the station's location. Increasing the STL transmitter power, depending on the desired increase, may be a viable option. Increasing receiver sensitivity also is a viable option if the potential for intermodulation and overload is not significant.

System planning requires a thorough evaluation of equipment parameters and specifications in light of the factors that can affect the planned STL system. A particular configuration that works well in one place may not work elsewhere. Before making any decisions, be sure you understand thoroughly what effect equipment changes will have on the entire system's performance.

Equipment manufacturers can provide detailed booklets outlining the steps needed to design the system. The literature often provides example systems so you can see how the pieces fit together. See the suggested reading list at the end of this article for other sources of information.

License application

Applying for the FCC license may be the easiest part of establishing an STL system. Form 313 has been simplified, requiring you to supply only 19 data items. The commission's instructional pamphlet, which accompanies the license form, is a step-by-step guide to completion of the application.

Fill in each appropriate blank with the data you developed from the STL system planning steps. Attach the applicable exhibits or statements, and have the licensee sign it. The final step is to include the required fee and send it to the commission.

LOCATION	CONTACT	TELEPHONE
AK, Fairbanks	Eric Nichols	907-488-2216
AL, Birmingham	Frank Giardina	205-933-8274
AR, Central	Felix McDonald	501-666-5572
AR, West	Kelsey Mikel	501-782-6964
AZ, (State)	Gerry Grunig	602-257-1234
CA, Northern	Ed Johnson, chairman	415-954-7711
CA, Southern	Howard Fine	213-460-3411
CN, (State)	Edward Nelson	203-243-4756
CO, Denver	Jeff Brothers	303-892-6666
CO, Denver (bbs)	Colorado Broadcast Freq Co Comm	303-572-6256
CO, Grand Junction	Chuck Hendrickson	303-248-1862
DC, Washington	Lyn Heiges	202-457-4304
DE, Northern	Larry Will	609-530-5069
FL, Central	Don Anglin	305-629-5105
FL, Gainesville	Brian Lietz	904-392-5551
FL, Miami	Henry Seiden	305-576-1010
FL, North East	Tim Derstine	904-399-4000
FL, Palm Beach	Jim Johnson	305-842-1077
FL, Tampa Bay	Ralph Beaver	813-879-1420
FL, West Palm Beach	George Danner	305-844-1212
GA, (State)	Ernie Watts	404-827-1787
HI, (State)	Robert Palitz	808-946-2869
IL, Chicago	Ken Steininger	312-943-3321
IL, Quad Cities	Rick Serre	309-764-8888
IN, (State)	Charles Sears	812-332-3685
IN, Motor Speedway	Tom Allebrandi	317-238-2500
IN, Southbend/Northern	Jim Lies	219-293-5611
KS, Wichita	Don Hogg	316-265-5631
KY, Louisville	Bill Bratton	502-582-7840
KY, Paducah	James Franklin	502-442-8214
LA, Baton Rouge (TV)	Kevin Burris	504-387-2222
LA, New Orleans (R)	Hugh Burney	504-529-4444
MA, Boston	Paul Puccio	617-787-7063
MD, Baltimore	Chris Bryant	301-338-6531
MI, Central	Larry Eastlack	517-484-7747
MI, Grand Rapids	Tom Bosscher	616-451-2551
MI, Southwestern	Jim Lies	219-293-5611
MN, Minneapolis/St. Paul	Jim Kutzner	612-646-4611
MO, Kansas City	Joe Snelson	913-677-7250
MO, St. Louis	Jeff Andrew	314-725-9814
NC, Charlotte	Bill Booth	704-374-3640
NC, Greensboro/High Point	Sam Mooney	919-727-8826
NC, Raleigh Durham/Chp Hl	James W. Davis	919-684-6232
NC, State (all)	Gary Liebisch	919-876-0674
NC, State (TV)	Harvey Arnold	919-933-2088
NE, Central	Jerry Fuehrer	308-743-2494
NE, Omaha	Mike Elliot	402-474-8033
NE, Western	Chris Davies	308-532-2222
NH, State (TV)	Bill Bumpus	603-868-1100
NY, Central	George Braungard	315-425-5555
NY, New York City	Larry Solow	212-975-1776
NY, Northwest	Paul Deeth	716-546-5670
OH, Central	Robert Dye	614-421-1714
OH, Eastern	Tom Hamilton	614-374-9647
OH, N. West/Central	Tom Taggart	419-244-8321
OH, North West	Bill Rossini	419-244-8321
OH, Northeastern	Ed Miller	216-431-5555
OH, Northeastern	Tom Miller	216-344-3358
OH, Southwest	Ron Lask	513-777-0037
OK, Central/West	Bob Ablah	405-478-1212
OK, Tulsa	Richard Hardy	918-627-2937
OR, Western/Cent	Bob Moore	503-231-4222
PA, Central	Rick Markey	717-393-5851
PA, Northeastern	Chuck Sakoski	717-823-3101
PA, Northeastern	Clifford Smith	717-323-5360
PA, Philadelphia	Larry Will	609-530-5069
PA, Western	Jerry Kalke	412-392-2565
PR, (All)	E. Rodriguez-Velez	809-878-1275
RI, Providence	David Hutton	401-438-7200
SC, Greenville	Jerry Massey	803-271-9200
TN, Memphis (R)	Jim Cope	901-578-1100
TN, Memphis (TV)	Pat Lane	901-458-2521
TN, Nashville	Randy Cain	615-242-5500

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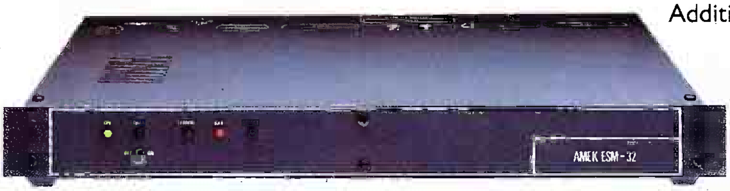

Additionally the ESM32 can be programmed to work with FOR–A and Grass Valley systems.

The Amek BCII is available with true stereo or paired mono channels operating with either parallel or serial control for mono, stereo or multi–language productions.

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TX, Austin (R)	Franklin Roberts	512-892-5821
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TX, Corpus Christi	Steve West	512-882-4394
TX, Dallas	Larry Kenward	214-620-2848
TX, Dallas (a voice MAIL)	Voice Mail Box System	214-404-2201
TX, Dallas (bbs)	Computer System	214-647-0670
TX, East	Butch Adair	214-597-5588
TX, El Paso	Mike Gaglio	915-584-5639
TX, Houston	William Cordell	713-630-3631
TX, San Antonio (R)	Paul Reynolds	512-690-1925
TX, San Antonio (TV)	Jerry Norkseik	512-366-5000
UT, Salt Lake City	John Dehnel	801-575-5555
VA, Norfolk	Ted Hand	804-393-1010
VA, Richmond	Allen Kass	804-780-3400
VA, Roanoke (TV)	Ron Smith	703-344-0991
WA, Eastern	Leon Skidmore	509-359-6390
WA, Seattle	Larry Brandt	206-582-8613
WI, Milwaukee	David Janzer	414-476-4200
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WI, South Central	Ken Dixon	608-263-2131
WI, South Central	Chris Cain	608-271-4321
WV, (State)	Tom Hamilton	614-374-9647
WY, State (Casper)	Tom Norman	307-237-3711

Table 1. *List of SBE local frequency coordinators. They will help you identify potential frequencies for your particular application.*

Expect to wait six to eight weeks for the license. During this time, you can order the equipment and prepare for the installation.

Construction and operation

There was a time when the installation of antennas and towers at a studio or transmitter site was nobody's concern except the station's. That is not the case today. Now, almost every city has rules and regulations that govern, to some extent (at the least, requiring permission), the installation of radio towers and antennas.

When planning an STL, you must find out about the local regulations and make the proper application. It may be necessary only to provide certain notices for antennas and towers. Other installations, especially those on tall buildings, may require the services of a registered professional engineer.

Although zoning laws, rules or regulations of the local political entities may not pack enough power to prevent the installation of an STL system, such regulations can delay the process. This is especially the case if the system is perceived as dangerous, as a violation of city ordinances or just plain ugly.

An STL system is an integral part of the electronic *critical path* of a radio station. This means that everything (staying on the air) depends on this system. It is imperative that the STL not become the "weak link" in the station's broadcast chain. Take the time to plan carefully so your STL can provide years of trouble-free service.

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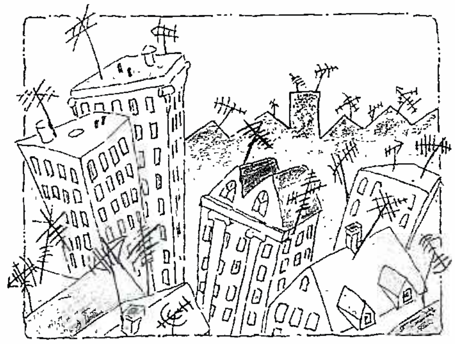

The American view of HDTV

By Howard T. Head, Washington correspondent

"On my honor, I will do my best to do my duty to God and my country, and to obey the Scout Law; to help other people at all times; to keep myself physically strong, mentally awake, and morally straight."

With those words, the author, then a tenderfoot Scout, starred in (and later saw himself on) high-definition television at the Chicago Century of Progress Exposition in the summer of 1933.

And boy, was it ever HDTV! Sixty lines, 24 frames, a light valve behind a rapidly whirling Nipkow disk. But it was television.

As the years passed, electronic television, already working in the laboratory, became a reality. Germany standardized HDTV at 180 lines in 1935. Great Britain raised the line count to 405 with regular service in 1936. (A plaque on the cornerstone of Alexandra Palace in London, the home of the BBC, commemorates this feat.) The United States upped the ante to 441 lines in 1939, then raised it again in 1941, to 525 lines. The 50Hz countries opted for 625 lines, France for 819 lines.

All the while, the "aspect ratio" of the TV picture has remained wedded to the old motion-picture ratio of 4:3, which was the keystone of the mammoth film industry for years. But people in the movie business already had recognized the need for a wider picture. They acted on it at least as early as 1927; portions of the silent movie, "Napoleon," were shot and shown in a version three screens wide.

Head is with the firm of A.D. Ring and Associates, consulting radio engineers, Washington, DC.

Wide-ly compatible?

Just how wide is wide-screen television? Purists hold out for the "golden section," the Fibonacci rectangle of 1.618:1. There is also support for a variety of other values, as long as they are greater than the present 4:3. But the HDTV consensus today holds at 16:9 (equal to 1.778).

So with more vertical lines, more horizontal resolution and a wider aspect ratio, the HDTV of the 21st century has arrived. But all these characteristics, no matter how desirable, come at a price: more bandwidth, frequency-compression techniques, signal-to-noise trade-offs.

And there is another aspect, that of "compatibility." How does a new HDTV system get started? The vaults of the movie-makers are full of full-color, wide-screen productions. But if these are transmitted over a system that delivers them only to a limited universe of brand-new, expensive HDTV receivers, the new service will be a lot slower to catch on than if a system is adopted that also makes these programs viewable (in lower definition) on present-day receivers.

U.S. HDTV efforts

The United States got off to a modest start in high definition as a more or less passive observer, watching Japan demonstrate HDTV, which went public there in 1974. The first concerted U.S. effort was ATSC, the Advanced Television Systems Committee, which has been pressing for the national (and international) adoption of a 1,125-line, 60-field production standard. Qualified observers rate the chances for U.S. (ANSI) standardization of these parameters as good. But as reported in the February 1988 issue of **BE**, the other half of the TV world, which has 50-field systems, is likely to go in a different direction.

ATSC is continuing other activities, much of them in the area of propagation measurement. A particular focus of the propagation work has to do with relative time delays as a function of frequency band and terrain characteristics. In this context, nanoseconds are important.

On Nov. 17, 1987, the FCC issued an official call upon the TV industry for the formation of an Advisory Committee on Advanced Television (ATV) Service, with the following objective:

"The Committee will advise the Federal Communications Commission on the facts and circumstances regarding advanced television systems for Commission consideration of the technical and public policy issues. In the event that the Commission decides that adoption of some form of advanced broadcast television is in the public interest, the Committee would also recommend policies, standards and regulations that would facilitate the orderly and timely introduction of advanced television services in the United States."

A 6-month time frame was set for the submission of an interim report. This report, primarily the work of the ATV Planning Subcommittee, was presented to the commission in June 1988. ATV has invited proponents of all HDTV systems, (which

Landmarks in HDTV

1873	Photoconductive properties of selenium discovered.
1880	Raster scan invented.
1884	Nipkow disk patented.
1897	Cathode-ray tube invented.
1904	Fleming invents the diode. German color TV patent.
1906	DeForest invents the triode.
1907	Geometrical images displayed on CRT.
1913	Practical photo-emissive cell developed.
1923	Zworykin invents the iconoscope.
1926	Baird gives first demo of "True TV" (30 lines, 10 fields per second).
1925-1929	Early color TV demonstrations (New York to Washington at 50 lines).
1932	Zworykin produces the iconoscope (first all-electronic TV, 120 lines).
1935	Germany begins regular service at 180 lines.
1936	BBC begins regular service (405 lines interlaced).
1941	First NTSC report; United States begins regular service.
1948	Shockley invents the transistor.
1953	Second (color) NTSC report.

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number about 20) to submit candidate systems for testing, to be undertaken by the ATV Systems Subcommittee. All candidate systems will be studied, but only those that exist in hardware form can undergo testing.

The committee's interim report imposes various constraints. First, the FCC has no jurisdiction over non-broadcast systems. Consequently, HDTV distribution by "alternative media," such as CATV, VCRs and videodiscs, is outside the jurisdiction of the commission. Thus, ATV will concern itself primarily with HDTV transmission standards rather than production standards.

More important, ATV will consider only terrestrial (not satellite) broadcast standards. The purpose of the ATV effort is different from that of Japan and the West European countries, whose goals are tied largely to the carriage of HDTV on direct broadcast satellites.

Spectrum requirements

The requirement that ATV be carried by terrestrial broadcasting raises the question of the availability of frequency spectrum space to accommodate the added information of the HDTV signal. Most, if not all, of the known candidate HDTV systems require total bandwidths of one, one and one-half or two standard TV channels—6MHz, 9MHz or 12MHz. In some cases, the added spectrum space that carries the HDTV information beyond the basic 6MHz does not necessarily have to be contiguous with the main channel; it may even be in a different frequency region, such as above 1GHz.

Any use of the present VHF and UHF TV broadcast bands must take into account co-channel and adjacent-channel interference protection. At UHF, an additional concern is that of the effect of the UHF "taboos" on the availability of any extra frequency space for the HDTV signal. These taboos are restrictions on the use of UHF channels other than the desired channel. They are a result of the imperfect response of (existing) TV receivers to unwanted signals such as those on image frequencies, local oscillator radiation and front-end intermodulation.

With the commission's adoption of the interim report, subcommittees on systems and implementation will go into action. Actual testing may begin right away and is likely to continue for a year or more.

And when will the commission take action to standardize a system? Not immediately. However, the need for a single HDTV broadcast standard should be apparent in the wake of the AM stereo debacle.

In the meantime, both system performance and consumer acceptance may be put to the test in the marketplace through "alternative media." Cautious buyers, however, may be reluctant to invest in an expensive HDTV display for a VCR or videodisc player that might not work with a broadcast standard adopted later.

Shades of FM?

Like everything else, it all boils down to giving the viewers what they want—a wider picture with more detail, programs they want to see, or both.

In 1945, FM radio broadcasting, which had begun regular operation in the 45MHz band shortly before World War II, was moved to the present FM band at 100MHz with high expectations. Its immunity to noise and interference, along with its (presumed) superior audio fidelity, were supposed to make it the wave of the future for radio broadcasting.

That's what finally happened, but it took about 30 years. How long will it take HDTV to do the same thing to TV broadcasting? BE))))

FCC acts on ATV HDTV recommendations

With uncharacteristic promptness, the FCC has responded to the interim report of the Advanced Television Systems Committee (ATV), which was submitted on June 16. The commission, on Sept. 1, issued a 77-page, 164-paragraph "Tentative Decision" looking to the future of high-definition television (HDTV).

Most of the work remains to be done, but the commission's report now sets the guidelines in three principal areas. First, and most important, HDTV in the United States will be delivered by a network of conventional land-based broadcast transmitters. This doesn't rule out an eventual complete system of HDTV by satellite, but the commission points out that real demand in the United States for direct broadcast satellites (DBS) has been negligible. In contrast, the Japanese and European authorities plan to deliver HDTV principally by DBS.

Second, these broadcast HDTV transmissions must be compatible; that is, they must be receivable (in LDTV, of course) on existing receivers, just as present-day color TV transmissions are receivable on monochrome receivers. Broadcasters using their channels for an incompatible system may do so only if they also provide transmissions in compatible form on a "duplicate" channel, an option which is not feasible in most areas because most channels are occupied.

Systems under consideration range from those that can be compressed in "compatible" form into a standard 6MHz channel to systems requiring an "augmentation" channel of 3MHz to 6MHz, which may or may not be contiguous with the main 6MHz channel. Some of the systems that require more than 6MHz are incompatible with the standard NTSC format; the commission does not propose to consider these systems.

HDTV transmissions must be confined to the frequency bands already assigned to TV broadcast service, scattered from 54MHz to 806MHz. The commission does not propose the reassignment of any existing stations ("repacking"). This means that for systems requiring an augmentation channel, frequency space must be found in an already crowded TV broadcast spectrum, of 3MHz or 6MHz for the enhancement signal. And that's no easy task.

Allocation "freezes" on further expansion of conventional television in major markets and on land-mobile encroachment on TV broadcast spectrum will remain in effect.

Actual system testing will be undertaken by an Advanced Television Test Center (ATTC), established and funded by the major public and private TV networks and major trade associations. Some tests are already under way. Major cable television (CATV) groups are still on the fence about participating and have formed their own Cable Television Laboratories to look into various problems, which include the carriage of HDTV via cable.

The commission's report addresses the matter of technical standards for the "alternative media," CATV, VCRs, satellites, asking for comments but concluding to take no action at the present time. Indeed, the commission itself raises the question as to its own authority to regulate HDTV where the use of broadcast spectrum is not involved.

So now we wait for the egg to hatch. Test work has already begun, and 1989 should see the first results. Only the passage of time will tell whether HDTV will hatch full-blown or whether it simply has laid an egg.

It's a lot easier to be done than to be satisfied.

You've been there — locked in the battle between perfection and reality. There's always one more thing you'd like to try. And the last thing you need to worry about

is the tape. So choose ours. Because, in our products and service, 3M is committed to one goal: **We won't be satisfied until you are.**

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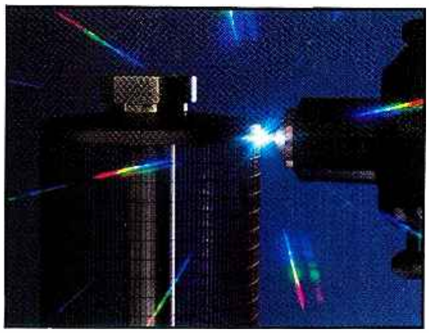
Applied technology



New suspension design yields improved CRTs

By C. Admiraal and H. Bongenaar

Since domestic color television appeared about 35 years ago, the traditional way of suspending the shadow mask in the picture tube has been by means of special mounting springs at or near the centers of each side. This tradition flies in the face of sound engineering principles, which dictate that a corner suspension system would be far more satisfactory.

The reasons are largely historical, dating back to the early, round, color picture tubes. Shadow masks of these tubes had three mounting springs spaced equally around the circumference. As the tubes evolved into the rectangular designs of the '60s, it was technically simpler just to add an extra mounting spring and to keep the springs at the center of each side. And, of course, once the suspension design had been settled, it would have required a major development program and a huge investment to switch to corner suspension. Until recently, there didn't seem to be any incentive for manufacturers to make the switch.

The change came with the advent of the flat-square picture tube, which presented designers with new problems in terms of beam landing and color purity—problems that could best be solved by introducing a completely new, optimized suspension system. It was during the introduction of its own flat-square (FS) tube, when major factory retooling was needed anyway, that Philips took the opportunity to develop its corner-pin suspension system.

System requirements

To maintain color purity, any movement of the shadow mask relative to the screen must be controlled or compensated for within limits that are so narrow as to be in the region of microns. Some movements, such as the thermal expansion of the faceplate glass or the shadow mask under conditions of high beam current, may be reversible. However, movements caused by mechanical shock during handling and transport are irreversible, as is the displacement or deformation of the shadow-mask assembly and its suspension system during manufacture. The flatter the mask, the more pronounced the mask displacement, hence its effect on color purity.

For optimum color purity, a mask suspension system must meet the following requirements:

- highly stable thermal properties for low mask overall doming and rapid compensation, and for low sensitivity to ambient temperature variations.
- stable mechanical properties for high stability during manufacture and during life.

Thermal stability

The conventional suspension design is characterized by a heavy mask frame suspended by three or four bimetallic springs that are engaged in studs located approximately in the middle of the faceplate walls (see Figure 1). The frame gives strength and rigidity to the assembly and helps to overcome intrinsic weaknesses in the conventional suspension system.

After switch-on, the initial thermal expansion of the mask (caused by a temperature rise of about 50°K) is constrained by the frame, leading to mask doming. The required compensation movement of the frame assembly, brought about by the bimetallic springs, is delayed by the thermal inertia of the assembly and the indirect nature of the compensation process (thermal conduction from the mask to the springs). What's more, because this compensation movement is, in practice, never completely symmetrical, it leads to landing asymmetries between corners.

With the corner-pin suspension design, four mask-supporting pins are embedded in the corners of the faceplate instead of in the middle of the sides (see Figure 2). Because of this more stable arrangement, the heavy mask frame can be replaced by a lightweight diaphragm. This reduces the mass by as much as 1kg, in turn decreasing the thermal inertia of the overall assembly.

In addition, the thermal compensation mechanism relies not on thermal conduction, as does the conventional suspension design, but directly on mechanical movement due to thermal expansion of the

Figure 1. In conventional suspension designs, a heavy mask frame is suspended by three or four bimetallic springs engaged in studs in the middle of the faceplate walls.

Admiraal and Bongenaar are with Philips components division, Eindhoven, the Netherlands.

mask-diaphragm assembly relative to the faceplate. (See Figure 3.)

The corner suspension element can be considered as a hinge turning around the mask pin as the suspension point. Under thermal load, the mask will expand along with the diaphragm which, because of its low thermal capacity, will rapidly reach its steady-state temperature. This expansion in the plane of the shadow mask is transformed by the suspension hinges into the required compensating movement toward the screen by a simple mechanical action.

Figure 3 shows that the mechanism provides optimum compensation for mask expansion for locations where the incident electron beam is orthogonal to the angle of the hinge plate. In practice, the hinge-plate angle is chosen to give optimum compensation for the east/west (E/W) border region rather than for the corners (because the E/W region has the lowest landing reserve).

Figure 4 compares the spot movement of a 66cm (25-inch visible diagonal) corner-pin tube with its conventional counterpart. Stabilization time is halved and, in terms of spot displacement, total transient mask movements are reduced by about 15%. What's more, because of the nature of the compensation mechanism, mask movements are symmetrical, with practically no lateral or rotational components as in conventional systems, so color purity is improved significantly.

Another advantage of the new compensation mechanism is its response to ambient temperature changes. In the conventional system, ambient temperature changes cause expansion or contraction of the glass faceplate relative to the shadow-mask assembly. This movement is not compensated and leads to reduced landing reserve.

Furthermore, if ambient temperature change is transmitted to the bimetallic strips, it is interpreted as a change in the thermal load of the mask and leads to unwanted movement of the mask-frame assembly (about 0.8m/K° in a 37cm, 14-inch color monitor tube). This spurious response does not occur in the corner-pin suspension system because any relative movement between mask assembly and

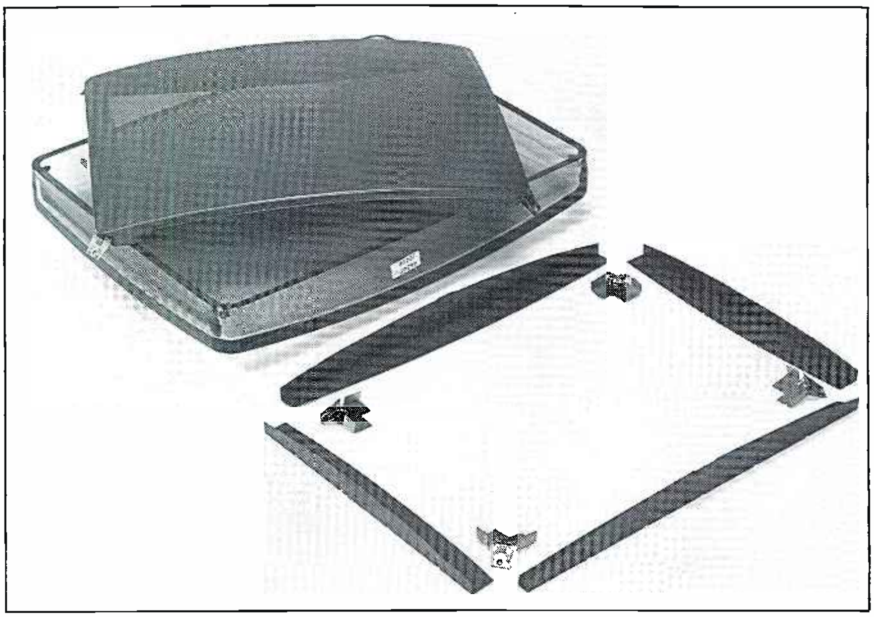


Figure 2. In the corner-pin suspension design, four mask-supporting pins are embedded in the corners of the faceplate.

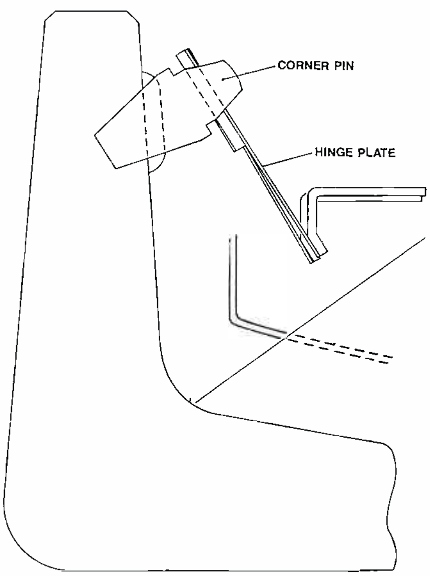


Figure 3. The thermal compensation mechanism relies, not on thermal conduction as with the conventional suspension design, but directly on the thermal expansion of the mask-diaphragm assembly relative to the faceplate.

screen is compensated for automatically.

Although mask-suspension systems have no influence on the localized doming behavior of a shadow mask, the lightweight construction of this new suspension system means that it can be produced using low-expansion alloys (such as invar), whose high prices have prohibited their use with previous, heavier systems.

High mechanical stability

Two areas of mechanical stability are important to a mask-suspension system:

- immunity from irreversible deformation and displacement during tube manufacture.
- resistance to mechanical shock and vibration (microphony) during tube life.

In tube manufacture, the major causes of degradation in mask-to-screen registration are the thermal processing cycles of frit sealing and pumping. For conventional suspension systems, the high processing temperatures and/or temperature gradients may lead to irreversible movement of the mask relative to the phosphor pattern. The reasons may be:

- Relaxation of residual stresses in the mask assembly. To reduce this effect, elaborate processing control procedures (such as dummy baking of the mask assembly) are required before screening.
- Plastic deformation of the bimetallic springs and mask frame due to high

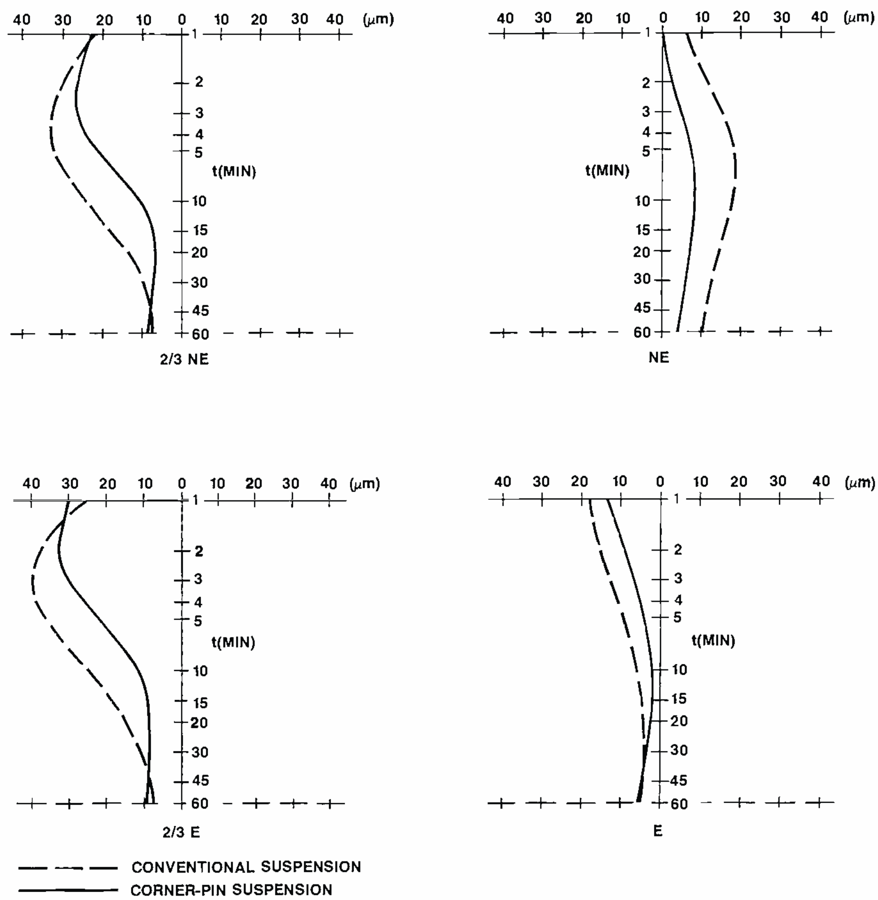


Figure 4. Spot displacement vs. time of a 66cm corner-pin tube (shown by solid lines), compared with its conventional counterpart (depicted by dashed lines).

temperatures and stresses generated by expansion mismatch between glass and metal components.
• Screen deformations (mainly twisting) that are not followed by the mask assembly.
• Isotropic contraction of the faceplate glass, depending on its thermal history.

In the corner-pin suspension system, these sources of permanent misregistration are either less critical or completely compensated for. For example:
• Subcomponents and assembly procedures have been designed to introduce minimal mechanical stress into the product. This reduces movement caused by stress relaxation in the frit seal and eliminates the need for dummy baking.
• The lightweight assembly allows the spring force of the suspension elements to be much lower than in conventional systems, about 3N (newtons) compared with 15N. Combined with the constant spring force and flat characteristic of the "mousetrap" spring, this prevents plastic deformation of the suspension elements.
• Any twisting of the screen is transmitted to the mask assembly via the corner pins, greatly reducing misregistration in the corners.
• Faceplate contraction (about 150ppm) is compensated automatically by the hinge mechanism in the same way it is for thermal expansion of the mask.

At an early stage in the development of this corner-pin suspension system, experiments showed that a straight hinge plate, thanks to its high in-plane rigidity, was most resistant to shock and vibration. (See Figure 5.) The use of conical-head pins, with their axes orthogonal to the hinge plates, gave optimum insertion repeatability (relocation of the mask upon repeated extraction and insertion during the screening/exposure cycle) with no displacement of the hinge plate from its functional angle (the angle that provides optimum temperature compensation).

Although bent-pin designs are possible for maintaining orthogonal pin insertion in the faceplate wall, the simplest solution proved to be a straight, conical-head pin inserted at an angle. This, however, required parallel development of new pin-insertion techniques by the company's glass division. A new mechanism, developed to work in the awkward corner regions of the faceplate, now provides processing speeds and yields comparable to those of conventional picture tubes. (Note: A ball-head pin design has been perfected that allows orthogonal insertion into the faceplate wall and provides the same contact area with the mask-suspension element as the conical-head pin.)

Another factor contributing to the system's mechanical stability is the absence of mechanical interaction between the mask assembly and the internal magnetic shield (IMS), which is supported independently on the corner pins and not fixed to the mask assembly, as in conventional tubes (see Figure 6). Good magnetic shielding is, nevertheless, maintained by optimizing the form and overlap of the IMS skirt and by closely controlling the air gap between the IMS and the mask assembly.

Drop tests on properly adjusted tubes have demonstrated the mechanical stability of the system by showing no permanent color impurity for accelerations up to 60G. Microphony behavior has been shown to be superior to that of the conventional mask assembly.

Laser manufacturing methods

The suspension subcomponents have been designed to allow relatively simple assembly procedures adaptable to full-scale mechanization. For flat-square tubes with their rectangular phosphor outline and almost straight-edged mask surround, the diaphragm sections are straight, L-

Circle (95) on Reply Card

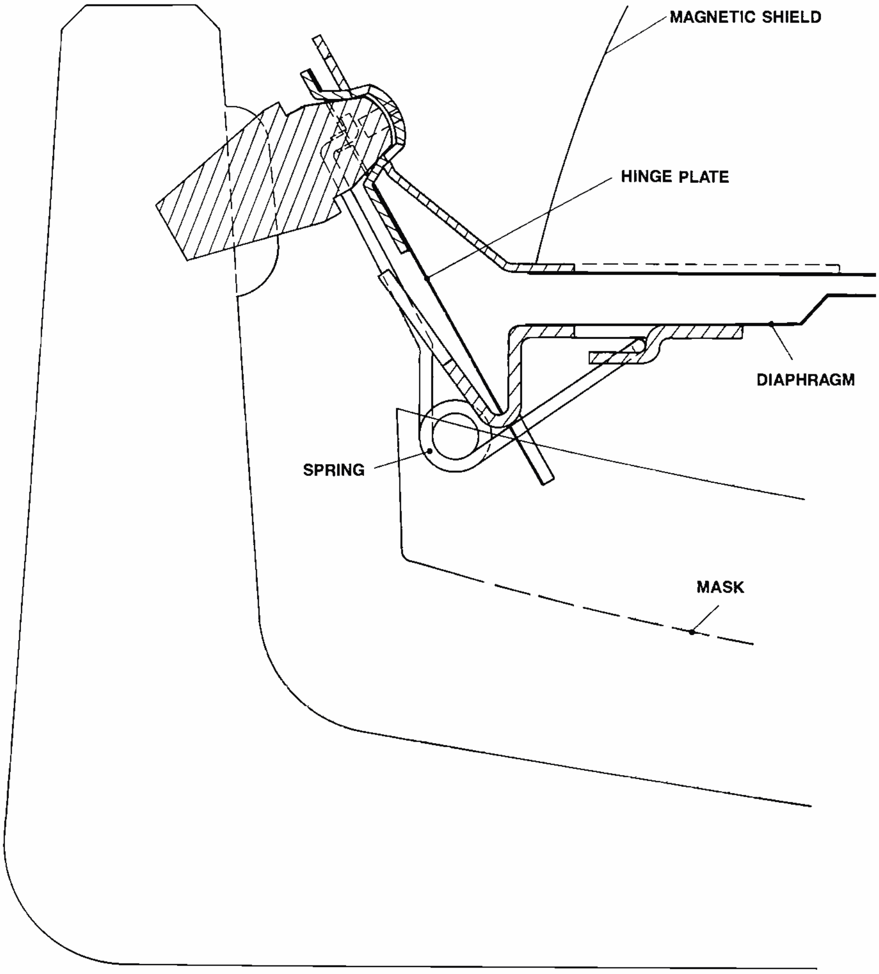
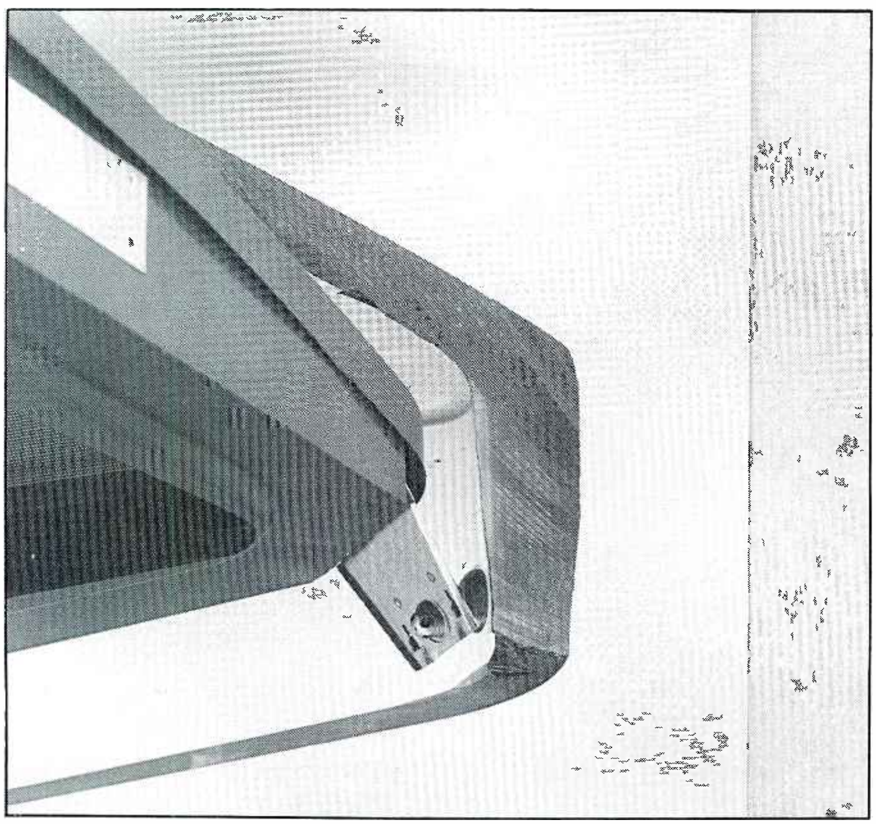


Figure 5. The lightweight assembly allows the spring force of the suspension elements to be much lower than in conventional systems (about 300G, compared with 1,500G).



shaped profiles. Together with the suspension elements, these profiles are welded into a rigid framework that's an extremely close fit with the mask. Welding this framework to the mask has little influence on the mask's curvature.

Early investigations of this design indicated some sensitivity to E/W movements of the mask assembly. This was overcome by employing a laser-welding technique to fix the mask assembly to the corner pins.

Besides providing the necessary rigid connections to the corner pins, the system also is considerably faster than conventional welding systems, taking less than a second to weld the four pins of each mask (with four welds per pin). This minimizes stresses on the mask and allows a high throughput (more than 200 masks per hour). The whole welding operation can be performed without any direct contact with the mask, further reducing stresses on the mask and the chance of damage.

The invention of the flat-square picture tube provided an excellent opportunity to introduce a completely new corner-pin suspension system. Although the development of the system was stimulated by the critical requirements of flat-square mask assemblies, advantages such as reduced microphony and lighter construction have resulted. The lighter construction has not only reduced the weight of the picture tube, but also allows the mask assembly to be manufactured more economically, with relatively inexpensive, low-expansion materials such as invar. Already, other manufacturers are moving to corner suspension. A major switch to this new system is likely in the next few years.

Figure 6. The system's mechanical stability is due, in part, to the absence of mechanical interaction between the mask assembly and the internal magnetic shield, which is supported independently on the corner pins and not fixed to the mask assembly.

Continued from page 4

band currently experienced by other radio stations and the listening public.

In establishing standards for the expanded AM band, the NAB emphasized that the commission should provide for high-quality radio service. The association opposes widespread use of directional antennas and other allocations tools that have contributed to the technical interference problems on the existing AM band.

NAB speaks out on FM translators

The National Association of Broadcasters has urged the FCC to issue a Notice of Proposed Rulemaking to terminate FM translator abuses, thereby restoring the service to its original purpose of providing fill-in service to unserved areas.

The comments were filed in response to an FCC Notice of Inquiry containing proposals seen by the NAB as having the potential to transform the FM translator service into a spectrum-inefficient and local-service-damaging "low-power FM service," thereby undermining its original intent as a supplemental, non-profit service.

In its filing, the association urged that technical standards be increased to ensure that FM translators continue to provide localized supplemental service that does not interfere with full-service stations. Accordingly, the NAB asked the commission to devise rules that would place the burden on the translator applicant to demonstrate a need for the FM translator. It also asked for limits on the number and location of translators and the amount and type of program origination, thereby eliminating FM translators in areas where they are used to generate profits, rather than to provide FM radio to unserved markets.

AFN in Europe upgrades broadcast equipment

Two West German companies, Detecon and Fuba, have won a bid to install satellite-receiving equipment for the American Armed Forces (AFN) in Germany and Belgium. The German Bundespost will provide one of its Intelsat V-F12 transponders. The AFN is currently upgrading its radio and TV transmission network in Northern Europe.

Broadcast '89 changes dates

The Broadcast '89 trade show has been rescheduled to coincide with the International Marketing Services fair for media, marketing and communication managers. The fair will be held in Frankfurt, Germany, Oct. 24-28, 1989. It had originally been scheduled for Oct. 4-7.

Norway introduces commercial TV

The Norwegian government has decided to introduce commercial television in Norway by early 1989. The revenue expected from advertising is to be used to create a second national TV channel. Previously, Norway's government had taken a strict stand against commercial television. The recent success of foreign satellite channels operating in the country, however, prompted the government to reconsider its stand. Britain's Sky Channel and Super Channel, which can be received by one in four Norwegian homes either by dish or cable, were joined last year by TV 3, a service produced in London specifically for the Scandinavian market.

Hungary looks into commercial TV

A successful experiment in commercial television has been completed in Hungary. According to the official news agency MTI, Hungarian television's MTV-plus recently

Continued on page 162

Awards bestowed in Denver

By Bob Van Buhler

Two new Fellows were elected at the annual membership meeting in Denver. The award of SBE Fellow was bestowed upon Richard Rudman and Jerry Whitaker.

Rudman, immediate past president, was awarded a fellowship for his long and faithful service to the society and to the broadcast industry. He is recognized as an authority on industrywide frequency coordination and is responsible for the SBE's success in national frequency coordination activities. Rudman served one term as director, one term as vice president and two terms as president.

Whitaker, who received the second fellowship, is Intertec Publishing's editorial director of **Broadcast Engineering** magazine. An experienced broadcast engineer as well as magazine executive, Whitaker has devoted many hours of service to the organization as editor of the "SBE Signal." He has played a key role in the success of the national conventions.

Chapter awards presented

The national convention in Denver also was the setting for the announcement of several other awards. According to awards chairman, Tom Weems, the *Best Chapter Newsletter* was the toughest category to judge because so many good newsletters are being produced by the chapters. The decision came to a tie between Chapter 28 of Milwaukee and Chapter 16 of Seattle. Individual honor for the best newsletter editor went to John Forbes of the Seattle chapter.

Seattle also received the award for *Best Regional Convention or Conference*. Selection was based upon attendance and the quality of exhibits and seminar content.

In the category of *Best Local Frequency Coordination Committee*, the award was presented to the Milwaukee chapter. The decision was based on accuracy of data, the local committee's information dissemination skills and its local and out-of-town liaison skills.

Because she is the primary contact between local chapters and the national office, Helen Pfeifer, national executive secretary, selects the chapter that relates best with the national office. This year the award went to Chapter 44 of Los Angeles.

The *Most Certified Members* award went to Chapter 50 of Fort Collins, CO. In that chapter, 86% of the members are SBE-certified.

The awards committee bestowed the *Highest Membership Attendance* award to Chapter 94 of High Plains, KS. *Fastest-Growing Chapter* was awarded to Chapter 79, Austin, TX.

Professional licensing and certification

The board of directors is reviewing the issue of state-regulated broadcast engineering licensing. Now that federal licensing is no longer a requirement, at least two states believe that broadcast engineering calls for state involvement.

Alaska and Texas, in particular, have shown an interest in becoming involved with the broadcast industry by proposing state-regulated professional certification for practicing broadcast engineers. If successful, this process would have a wide-ranging impact on the entire industry.

The licensing procedures could cause difficulties for the broadcast engineer and could be an expensive proposition for management. In some cases, stations may have to pay higher wages to attract the services of a state-licensed broadcast engineer to do the job normally performed by someone with SBE certification or the field credentials earned through years of experience and/or education.

The board is interested in the views of SBE members and requests that their comments on state regulation of broadcast engineering be mailed to the national office. The comments will be compiled and forwarded to the board members researching the topic. The board is particularly interested in identifying any direct experiences members might have with this potential problem.

When considering this issue, ask yourself the following questions:

- Has interest been expressed in your state legislature concerning the regulation of broadcast engineering? If so, what type of regulation has been discussed? Is it aimed at the consulting engineer's tasks, those of the field contract engineer or the full-time chief engineer? Is operator/maintenance licensing being contemplated?
- What is your reaction to this issue? Do you feel threatened by this trend? Do you think this type of regulation would be helpful in controlling unqualified contract engineers who undertake consulting engineering tasks that are beyond their skills?
- At what are these legislative efforts aimed? Is the generation of revenue through licensing fees an issue?
- What does your employer think about this issue?
- Has your state broadcasters' association taken a position on state regulation? Have its legislative action committees been active in this issue?
- Do you think that state-regulated action would have a positive effect or a negative impact on the SBE certification program? Is this an issue that you would like to see the society address at the national level?

Please address your general comments and your answers to these questions to: Engineering Regulation, c/o SBE, P.O. Box 20450, Indianapolis, IN 46220.

Convention review

After the convention each year, it is important to determine what went well, and what didn't. Following the closing session, the *Convention Core Committee* and the *Exhibitors Committee* meet to review the convention and discuss how to do a better job next year.

The committees evaluate all areas of the show with a focus on identifying and solving any problems. The purpose is to resolve even the minor irritants that detract from a smooth and businesslike atmosphere.

The floor traffic, exhibit hall arrangements and policies are examined to ensure that any problems are prevented from recurring next year. This meeting is perhaps the most important one of the entire convention, because it gauges exhibitor and attendee satisfaction. Also, it becomes the first planning session for the following convention, ensuring that each convention is an improvement on the previous year's show.

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

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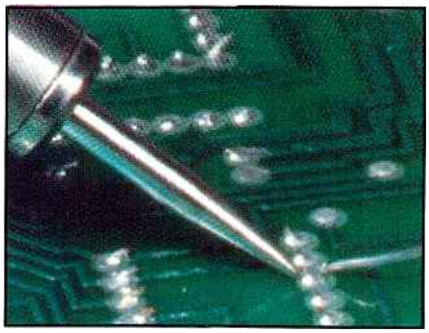


Auto-start circuit can save the day

By Carl Shelenberger

If your station uses emergency generator power, and you don't have an auto-start device, this circuit may be of help. When commercial power fails, the operator on duty may be in the dark during the time it takes to start the emergency power generator and throw the transfer switch. The time off the air will vary, depending on how long it takes the operator to become oriented and to find the proper command sequence to start the generator and make the switch.

At WFTW-AM/FM, a remote start switch is located in the transmitter room. Although this saves the operator from having to go outside to start the generator, an automatic-start circuit is even better.

Auto-start circuit

With the circuit shown in Figure 1, the generator is started automatically upon the loss of commercial power. Although the circuit is practically foolproof, it won't start an improperly maintained generator. Auxiliary power systems should be checked weekly, preferably under normal loading conditions.

Shelenberger is technical director for WFTW-AM/FM, Ft. Walton Beach, FL.

The reason to install the auto-start circuit is twofold: the circuit reduces off-air time, and it ensures that the start sequence is used properly. (You'd be amazed how easy it is for an operator to lean on the start button and drain the battery.)

Our station relies on a manual power-transfer switch. This means the generator must be on and running to provide emergency lighting so the operator can find the switch.

The circuit tries three times to start the generator. If the generator won't start by then, something more serious is wrong, and it's time to call for help. The basic timing sequence is simple and relies on the charge from C1 to maintain the relays and timer IC1. Once the voltage from C1 falls below a certain point, the 555 timer no longer works, thereby stopping the start circuit. This is a safety provision that protects the generator battery from being drained by overcranking.

I modified our logs so the operators could record each time the generator started. To my surprise, I discovered that the commercial power often was dropping out. Since, I have installed both line protection and line-conditioning equipment.

Principles of operation

The manual remote start switch (SW2) is normally in the off position. Exercising this switch for weekly generator tests will not affect the rest of the circuit. The auto-start circuit may be tested by simply unplugging the ac feed to RY1, T1. After the circuit is installed, RY1 must be set initially by operating momentary action switch SW1.

Capacitor C1 charges to the peak of T1 secondary voltage while commercial power is available. If the power fails, relay RY1 opens. Contacts 1 and 4 close, 6 and 7 open, and 8 and 11 close. Relay RY2 contacts 6 and 7 also close. Remote cranking is provided by RY1 contacts 1 and 4 through RY2 contacts 6 and 7. The timer also begins via contacts 8 and 11 of RY1.

If the generator fails to start within approximately 10s, the timer relaxes RY2, which, in turn, opens the remote cranking circuit. After approximately 6s, cranking resumes via RY2.

This action continues until C1 is discharged below the voltage necessary to run the 555 timer and relays. If the generator starts, RY3 contacts close, providing a locking path for remote cranking. Then, because contacts 6 and 7 of RY1 are open, the generator cannot be shut down until commercial power is restored. To reset the circuit, press SW1 after power is restored.

The circuit has been dependable and has helped our staff in times of power outages. It can be adapted easily to work with almost any type of generator. And you may want to provide more features for your application.

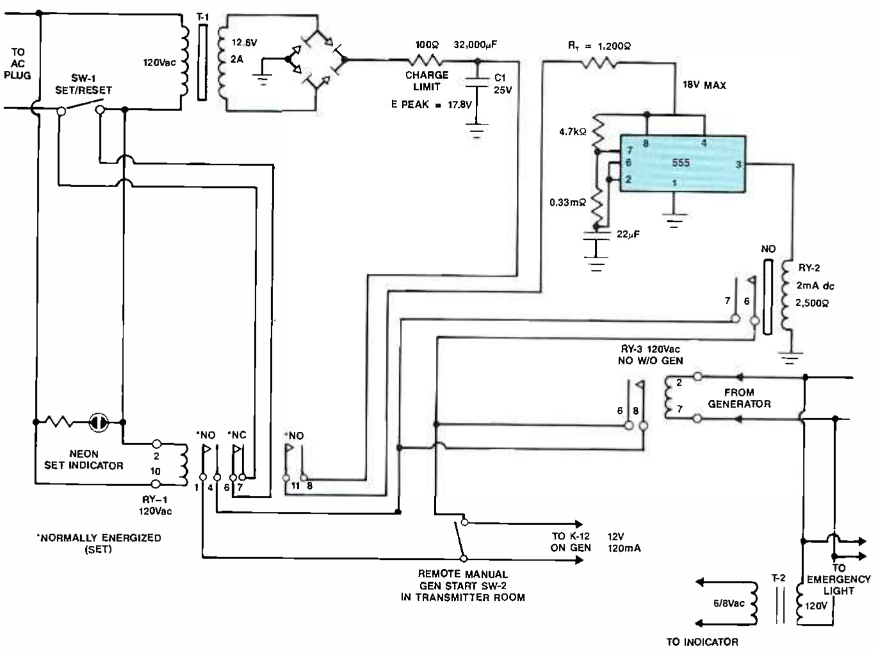
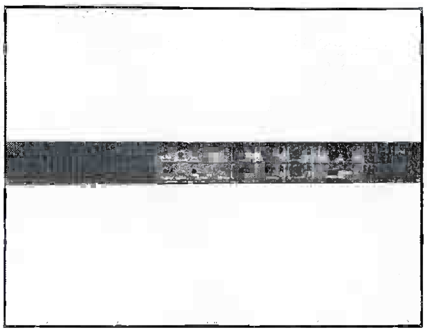


Figure 1. The auto-start circuit can make the transition from commercial power to generator power much easier for the operator.

Fortel Turbo 2 TBC



By John Collinson

If you thumb through any video supplier's catalogue, it will reveal a multitude of time base correctors, frame synchronizers and combinations of the two. Making the best choice involves careful matching of the application to the features offered by each unit. Prices vary widely, so it is important to anticipate all possible needs for the unit. But don't be dazzled by features you'll never use.

Collinson is chief engineer, WDAF-AM/KYYS-FM, Kansas City, MO. He was chief engineer at KYFC-TV, Kansas City, when he prepared this report.

Performance at a glance

- *Infinite window*
- *Y-688 dub input/output*
- *Heterodyne or coherent color*
- *Frame- or field-freeze*
- *Dropout compensation*
- *Bandwidth 4.2MHz (–3dB) dub mode 2.2MHz (–3dB) encoded mode*
- *Differential gain <1%*
- *Differential phase <1%*
- *Signal-to-noise ratio 57dB*
- *Residual time base error: ±15ns luminance ±2° chrominance*

Starting over

When the KYFC-TV studio was destroyed by fire in May 1986, we were faced with refurnishing the entire studio facility with almost all new equipment. The decision to use ¾-inch machines for playback of break material demanded a good, hard look at what was needed to achieve the best possible playback quality. Because Sony VO-5800 machines already had been purchased, our criteria were based on the use of these machines.

An infinite-window TBC was required

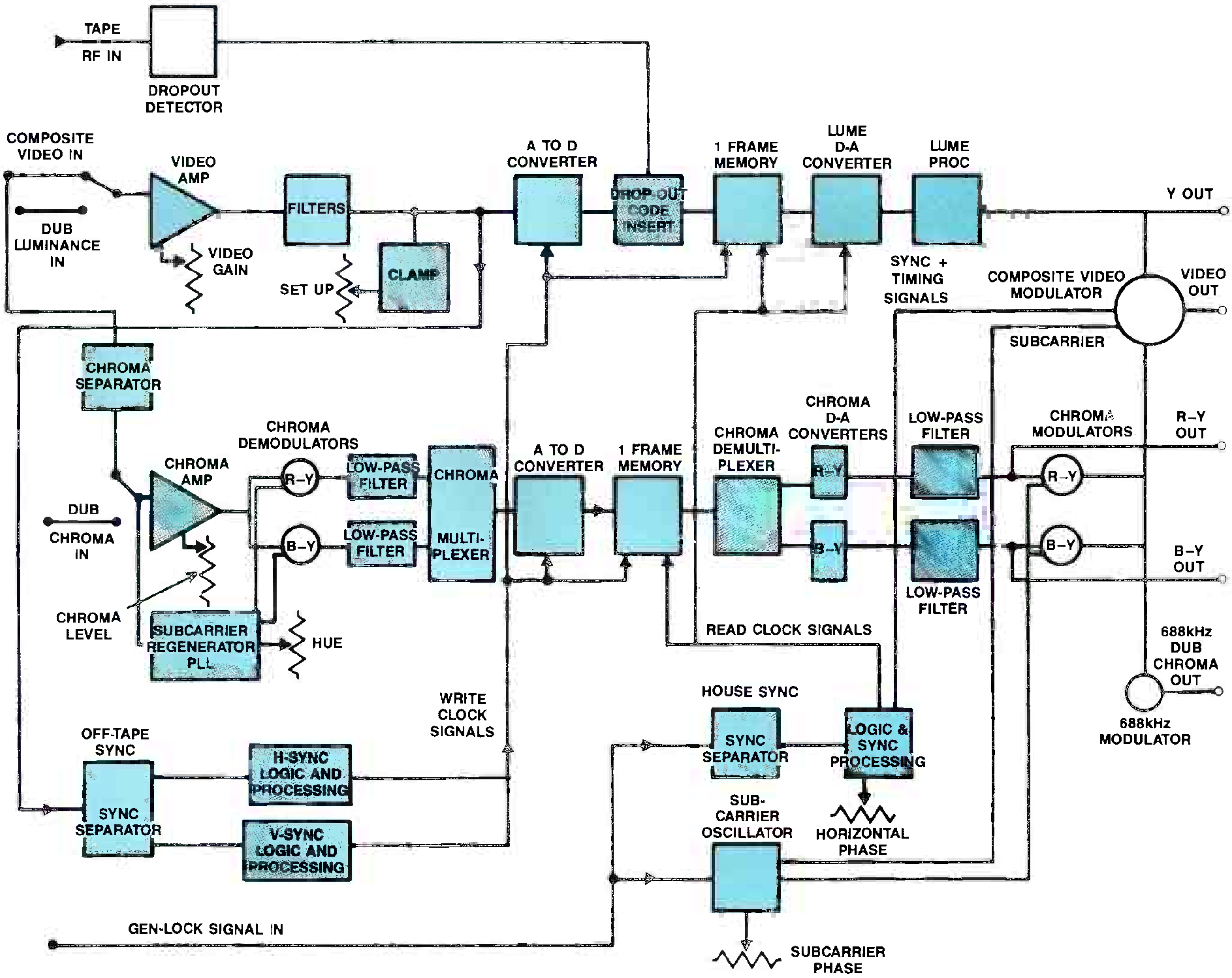


Figure 1. *The Turbo 2 provides sophisticated signal processing in a compact package.*

because the VO-5800s did not have an advance sync input. The biggest drawback to ¾-inch was its poor resolution due to limited frequency response in the luminance channel.

The Fortel Turbo 2 is an infinite-window TBC that can directly accept the Y-688 dub output from many VTRs, bypassing some of the bandwidth limitations inherent in recombining the composite video before feeding it to the TBC. An internal switch compensates for the differences between the Sony and the Panasonic dub signal standards.

The Turbo 2 also will accept a standard composite video signal, and it can be used as a frame synchronizer or TBC in this mode. However, the bandwidth on an encoded input is limited to 2.2MHz at the 3dB points, so some loss of detail may be expected. The TBC has no provision for automatic freeze-framing when it detects bad video. Fortel does not claim its application as a frame sync, but it is nice to know it could be used as one.

The circuit

Because of all the features in this unit, the circuitry is rather extensive. Fortunately, the basics are fairly straightforward. The 8-bit processor operates at a sampling rate of 13.5MHz. (See Figure 1.) Incoming composite video is filtered to separate luminance from chrominance information. With the dub input, this information already is separate. The two signals are processed separately all the way through to the output.

Write clock signals are developed from off-tape sync for clocking the unstable video into memory. The chroma and luminance signals are separately digitized and clocked into their respective full-frame memories. Color black (or other composite video) is separated, processed and used to derive the read clock signals to clock the video back out of the memory as stable, time-base-corrected video.

Chroma modulators remodulate the chroma into composite to drive the 688kHz modulator, the dub output and the regular composite NTSC output. The R−Y and B−Y from the low-pass filters also are available as component outputs. Luminance is fed out directly for either the dub or component outputs, as well as encoded for the composite output.

Installation

Rack rails are standard equipment and their use is almost mandatory. Gen-lock, video input and output connections all are conventional. Video output No. 1 is relay-switched so that, in bypass, the composite input becomes a loop-through to the output.

An advanced sync output and a dropout compensator RF input are provided for machines that have those capabilities. A standard 7-pin male connector accepts the Y-688 dub input, with a corresponding female for the output. An 18-pin connector also is provided for interfacing with the Sony BVU series machines to allow clean slow-motion and freeze-frame capability.

Although it's a minor complaint, we had a problem with noise caused by the two small fans in the back of the unit. We installed two Turbos together in the master control room and found the noise somewhat annoying until the racks were filled with other equipment. After that, the noise wasn't noticeable during normal operation.

User-friendly

Operation of the unit is straightforward and simple, even for non-technical operators. Video gain, setup, hue and chroma gain have adjustable presets with toggle switches to select preset or variable parameters. Because of the infinite window, there is no vertical phase to adjust. A green "servo lock" LED indicates when the VTR is completely locked up and the TBC is locked to the VTR video.

Push buttons provide freeze-frame or freeze-field modes. In the freeze-field mode, the output video is an interpolated field derived from the frame of video frozen in the memory. This interpolation feature also can be used with U-matic machines that have tracking schemes, which allow for variable-speed or still-frame playback.

To prevent the familiar vertical shift during playback at other than normal speed, the interpolator generates each line as an average of two adjacent lines. Some loss of vertical detail occurs, but this is often less objectionable than the vertical shift.

A couple of controls that are not common to TBCs are the *horizontal enhancement* and the *luminance noise reduction*. The enhancement feature is particularly useful for feeding composite video through the unit when the signal has limited bandwidth. By careful use of enhancement, some of the lost detail can be restored. Excessive amounts of enhancement can, however, lead to increased noise.

Luminance noise reduction is a variable-coring circuit, which provides a definite improvement in some signals. Too much noise reduction, however, also reduces detail. Because these two controls work somewhat in opposition to each other, they must be adjusted subjectively to the program material being processed. Each feature has its place and can be a useful tool to improve the video quality.

Learning curve

Shortly after the units were placed in service, a strange phenomenon appeared. Occasionally, and for no apparent reason, the output video would jump to a "quad split" or "pulse cross" type of effect, usually lasting for only one frame each time. The effect was more likely with certain material, but it usually occurred at random and would not repeat at the same place on a given tape. The factory sent an engineer to check it out, but no logical cause could be found.

Tapes that exhibited the problem were sent to the factory, where it was discovered that certain disturbances in the vertical block coming off the tape could cause the effects. After a number of software revisions, the factory sent two new units in exchange for the originals.

Since that time, there have been no documentable cases of the problem except, possibly, on a tape of such poor quality that it probably wouldn't have been aired anyway. To the company's credit, the factory engineering personnel and the local representative were interested in solving the problem, and they persisted until things were made right.

Maintenance

With a full frame of memory and associated circuitry all crammed into a 1-rack-unit box, things are predictably tight. All of the main circuitry is contained on two large boards that are removable from the front. The unit is designed so that either board may be inserted in the top slot. There is no extender board; for a unit such as this, the board would be heavy, complex and expensive. Instead, the TBC slides out on the rack rails, and the top comes off with a few quarter-twist fasteners. Access to the top board is then easy. If the lower board needs service, just swap them so that the lower board is in full view. Although the boards are quite full, they are well-screened and well-laid-out.

A number of internal adjustments and jumpers customize the operation for a particular type of VTR and the desired operating parameters. After nine months of use, none of the internal pots have needed any adjustment. It is safe to say that the unit is quite stable.

Support material

The instruction manual is a masterpiece. Schematics are easy to read, and the functions of all controls are printed clearly on the schematic. Timing diagrams are provided, as are mechanical drawings and a thorough parts list. The circuit description is well-written and categorized for easy location of any section.

The only thing that is missing is a parts layout drawing, but with boards as full as these, it might be too cluttered to be readily usable. The way the boards are laid out, these drawings are unnecessary anyway. All components are laid out in rows and columns like a street map. The component designation gives away its location on the circuit board.

Aside from the few problems that occurred early on, these units have provided excellent service. In the rare instance of a problem with video quality, the blame appears to fall more with the VTR than with the Turbo 2. Garbage in, garbage out still applies, so don't expect a TBC to cover up for a bad VTR. Obviously, ¾-inch is not the ultimate choice for quality video, but if that is the requirement, a Turbo 2 married to a machine via a Y-688 dub cable is a good way to go.

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

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

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

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

The Shure M267 has become one of the most well-known and widely used mixers in the broadcast industry. One look at it will tell you why.

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

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For more information, call or write Shure Brothers Inc., 222 Hartrey Avenue, Evanston, IL 60202, (312) 866-2553.

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Circle (152) on Reply Card

Continued from page 42
creases, common in many categories only two years ago, are no longer being seen. In all fairness, inflation has slowed too, thereby reducing the pressure for large salary increases.

Two years ago, TV engineers saw a nice increase of 11% while radio engineers received only a 3% increase, measured across all markets. Last year was radio's turn. Radio engineering salaries rose by 9%, and TV engineering salaries fell by 2%. This year the trend continued, with radio engineering salaries increasing by 3% and TV engineering salaries by 1%.

Feedback

If you believe some of the responses, radio is dying. A hard-core group (of not necessarily older respondents) wants to turn back the clock 20 years. Some respondents went to great lengths to claim the loss of the first-class license as a major cause for radio's engineering dilemma. This industry's basic problem, in their eyes, is low pay.

Yet, the number of doomsayers in this survey was smaller than in previous years. One respondent noted that if you're a qualified engineer, you can "practically name your price" when it comes to radio engineering consulting. Another said that skilled engineers are "in the driver's seat."

Engineers and managers noted the problems brought on by increased competition. Those working at AM stations complained about the increased number of FM stations. Those working in TV lamented the increased competition from cable and satellite-delivered services.

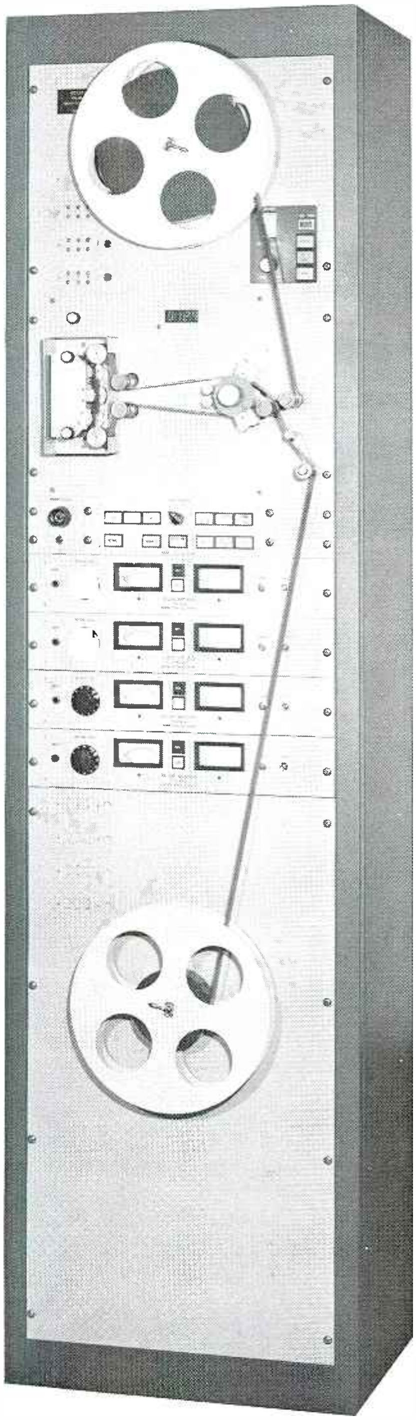
One new class of comments was common this year: lack of advancement. A number of respondents spoke of being unable to move up in their positions or on to larger markets. Reasons listed included the increased use of part-time and freelance employees as well as job cutbacks and robotics. A few people claimed that the industry discriminates against minorities and women in terms of promotion and job advancement.

Overall, however, this year's survey reflected a more matter-of-fact attitude toward the industry. Apparently, the changes brought on by deregulation are being identified more as challenges and less as threats.

Now, everyone seems to be more aware of the need to improve service and to be more efficient. Unfortunately, in some cases, this results in the loss of jobs or the use of non-union and part-time personnel. Although this may not be the optimum situation for those who must operate and maintain the equipment, recognition of these new "facts of life" is becoming more widespread.

Those broadcasters who recognize the challenge offered by these changes see the future as exciting. The few who lament and cry for the "old days" are going to be bypassed. As one respondent put it, if you are willing to accept the challenges, the "opportunities are vast."

M T E



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Circle (106) on Reply Card

New products

News

Continued from page 151

broadcast 110 hours of news, feature films, quiz programs and other reports. Operating costs were covered by income from Hungarian and foreign advertisers. Participating in the project were Sony, IKEA (a Swedish furniture house) and Pierre Cardin (the French fashion company). The Hungarian government is considering the possibility of a permanent commercial channel.

Demands increase for broadcasting equipment in Europe

The trend toward commercialization in European broadcasting is expected right up to the start of the 1992 internal European market, according to a market study conducted by Frost & Sullivan.

The study reports that sales of broadcasting equipment totaled $21.1 million in 1987 and are estimated to reach $27.8 million by 1992. Although only 2,660 UKW radio stations (without relay stations) were operating in Western Europe in 1987, 3,275 are expected to be operating by 1992. Much of the growth is expected to come from Spain and Portugal, whose combined stations totaled approximately 440 in 1987 and are expected to reach 715 by 1992. According to the report, the number of European TV stations will increase from 1,620 in 1987 to 1,905 by 1992.

European state-run TV networks agree to cooperate

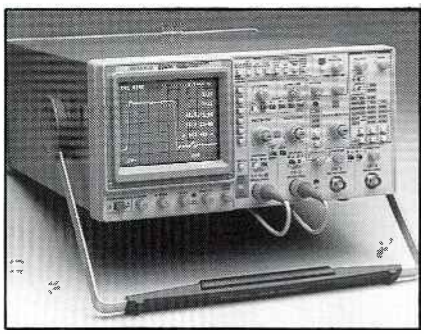
Twelve European public-service TV networks agreed in Antwerp, Netherlands, to increase cooperation in preparation for the planned European internal market in 1992. The group, DAVID (Development of an Audio-Visual Identity) comprises networks from Belgium, Denmark, Finland, Greece, Ireland, Holland, Norway, Austria, Portugal, Sweden and Switzerland.

Austria gets go-ahead for radio

Eight private regional radio stations are to be set up in Austria. Based in Vienna, Linz, Salzburg, Innsbruck, Bregenz, Klagenfurt, Graz and St. Polten, the radio stations will be operated by local publishers, who also will be responsible for journalistic content. The stations will be financed through advertising. Technical support and equipment are being supplied by the Austrian radio network ORF.

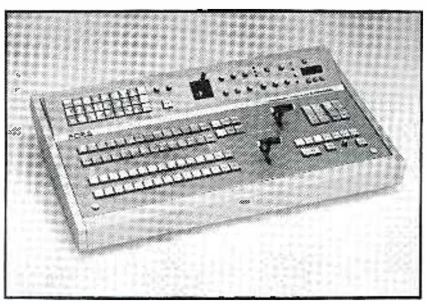
Portable oscilloscope

Tektronix has introduced the 2247A, a portable oscilloscope featuring a counter/timer, automatic rise/fall time and propagation delay measurements. The oscilloscope is a 100MHz, 4-channel oscilloscope made for digital design and field service use. It provides auto setup, on-screen cursors and up to 20 preprogrammed measurements. The oscilloscope has a wide range of automatic time measurements including rise/fall time, propagation delay time, delta time, gated counter measurements and frequency ratio measurements. Other features include 100MHz bandwidth; four channels; time and voltage cursors; on-screen readouts; 1-button front-panel setups; SmartCursors to track changes in the voltage, trigger and ground level of the displayed waveform; and menu-driven operation.



Circle (350) on Reply Card

Component video switcher

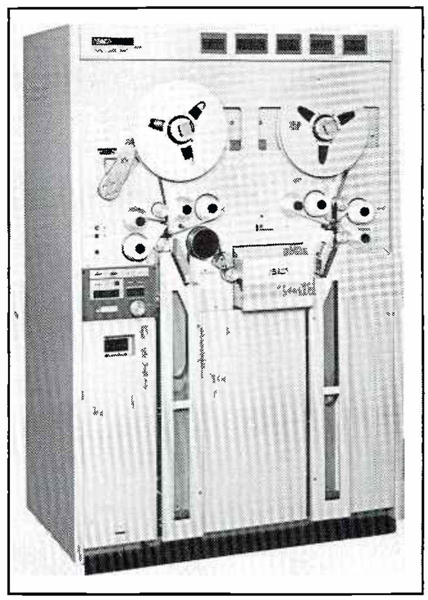


For-A has introduced the CVM-600 component video switcher. The switcher provides 12 inputs and black and color background for editing. The unit has fully independent transcoding capabilities for each component input and output. RGB or $Y/P_R/P_B$ may be set at each interface and scaled $Y/P_R/P_B$ component signals are processed internally. The switcher features four buses; 24 wipe patterns with modulation; built-in downstream keyer; auto transitions for program, effects, DSK and fade-to-black; two M/E key inputs with component insert video; built-in edge functions for M/E and DSK inputs; colorizers for background, border and DSK; and three reference blackburst outputs.

Circle (351) on Reply Card

Tape evaluator/cleaner

Asaca/Shibasoku Corporation of America has introduced the ADC840 series tape evaluator/cleaners. The machine can be controlled by the IBM AT and is fully automated. The series can handle 10m of tape per second in the evaluation mode and 12m per second in the cleaning mode. It incorporates two parallel 24-channel heads in the evaluation stage. Seventy percent of temporary dropouts can be removed by the dual-action cleaning system that combines a sharpened ceramic blade to scrape the tape and a tissue to remove oxidation.



Circle (352) on Reply Card

Digital thermometers, temperature adapter and replacement thermocouples

Philips ECG has added to the test equipment and accessories line with the following products:

• The model DT-210 digital thermometer features dual thermocouple inputs that allow readings to be taken at two different zones. The thermometer has switch-selectable Fahrenheit/Celsius scales and a 3-digit LCD. It offers 0.3% accuracy and 1° resolution when measuring temperatures from −58°-2,000°F and −50°-1,300°C. The thermometer comes with a

9V battery, two TC-50P K-type thermocouple bead probes, instruction manual and carrying case.

• The DT0215 digital thermometer has dust-proof touch pad controls. It provides 0.2% accuracy and switch-selectable resolutions from 1°-0.1°. The thermometer also has switch-selectable F/C scales and 3-digit LCD, a 9V battery and one TC-50P K-type thermocouple bead probe.

• The DT-205 is a lightweight, pocket digital thermometer. It has a built-in 3-inch thermocouple probe that retracts into the case and a switchable temperature scale ranging from −58°-302°F and −50°-150°C with accuracy of ±1°C and ±2°F. The unit has a 3-digit LCD, a range indicator, 9V battery, instruction manual and a carrying case.

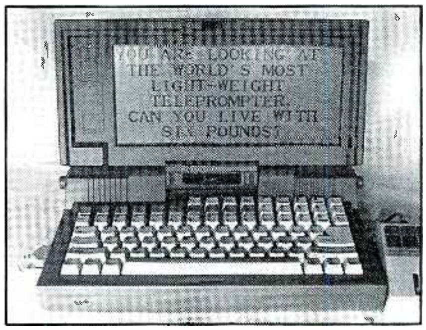
• The DT-200 temperature adapter is a temperature-to-voltage converter with a linear 1mVdc/degree output. It converts any digital multimeter with a 2Vdc scale and an input resistance of no less than 10m into a direct reading thermometer. The temperature adapter has three output jacks on both the top and back to ensure plug-in compatibility with multimeters that have standard banana input jacks. The adapter offers resolution of 0.1° with a digital multimeter scale of 200mVdc and 1° at 2V. It has switch-selectable F/C measurements from −58°-2,372°F and −50°-1,300°C with ±.5% accuracy. The adapter comes equipped with a 9V battery, TC-50P K-type thermocouple bead probes, two banana plug connectors, instruction manual and carrying case.

• The models TC50-P and TC-50 are replacement K-type thermocouples. The TC50-P is a thermocouple bead probe assembly with connector. The TC-50 is a thermocouple wire with bead. Both models are four feet in length.

Circle (353) on Reply Card

Computerized teleprompter

Computer Prompting has announced that the CPC-1000 teleprompter software now runs on IBM PC compatible laptop computers. The software allows scripts to be downloaded and scrolled from any word processor. Scroll speed and direction are controlled by a reconfigured mouse-type control that is connected to the serial port of the laptop. The scroll also can be controlled from a conventional mouse or keyboard. The teleprompter features nine fonts and more than four hours of continuous scrolling. It provides hard copy with line numbers corresponding to the built-in text editor line numbers.



Circle (354) on Reply Card

Antenna distribution system

HME has introduced the DN100 antenna distribution system. The system allows four RX520 switching-diversity receivers to be operated using only two antennas. The system speeds setup time of multicompatible systems and comes with an ac adapter, adapter lock and eight BNC to BNC coax cables.

Circle (355) on Reply Card

Modular building

Enviro-Buildings has introduced an easily-assembled modular building designed for controlled-environment applications. The control options include ventilating, heating, air conditioning, dust control and humidifying systems. The buildings range in size from a telephone booth to warehouse models. The cam-type lock permits assembly with only an Allen wrench. The buildings come packaged for easy transportation. The walls and the ceiling of the building are filled with high-density structural foam insulation and there is no wood in the framework or floor. The exterior metal may be aluminum or galvanized steel and a stainless steel skin is optional.

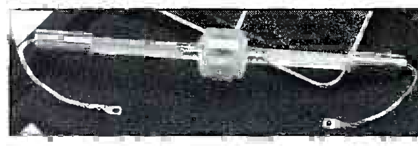
Circle (356) on Reply Card

MEI lamp

GEC has introduced the following 12kW MEI lamps:

- The 160V low-voltage lamp has open-ended caps to ensure reductions in temperature at the lamp seal ends. It features nickel-plated caps and leads.
- The 180V lamp has supercool leads. It provides lighting for high-speed photography when used with flicker-free square wave electronic ballasts. The lamp also has ceramic heat shields.

Both lamps are made from quartz envelope and tungsten is used for the electrodes. They both feature 250 hours of life, a color temperature of 6,000°K and a color rendering index of Ra 90 or greater.



160V low-voltage lamp

Circle (357) on Reply Card

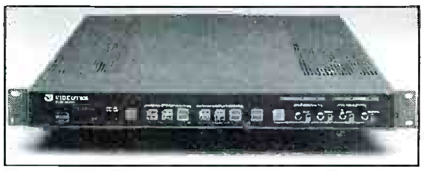
Audio-level meter

Solutec has introduced the Sol-20/20, an audio-level meter color-keyed in video. The meter inserts a stereo audio-level meter in a video image in the form of three bar graphs. The left and right bars are used to display the corresponding channel levels, and the center bar is used to display the level of either the sum or the difference. The features include stereo or mono switch-selectable; VU or PPM switch-selectable; vertical and horizontal positioning; luminance and chrominance level adjustment; and alarms for audio loss, overload and out of phase.

Circle (358) on Reply Card

Line select

Videotek has added a line select feature to the VDP-8000 frame store/synchronizer. It can be programmed to view a single line of a particular field of video. The feature also offers jitter-free lockup of noisy feeds from satellite, microwave, ENG and remote broadcasts; freeze-field capability allowing storage in one or two different fields without interrupting live video synchronizing; and a composite blackburst output for use as a stand-alone sync generator.



Circle (359) on Reply Card

Video editing controller

FutureVideo Products and *Horita* have announced the joint development of a FutureVideo Products video editing controller using SMPTE time-code equipment from Horita. The time-code unit is modular and self-contained and is designed to be incorporated into the editing system at any time. This permits the user to expand the basic system to a SMPTE time-code system as needed. The use of SMPTE time-code equipment allows the user of the edit controller to read and generate SMPTE time code as well as to make window dub copies.

Circle (360) on Reply Card

Guy-line protector

Hughey & Phillips has introduced a device that shields the preforms on guyed towers from ice damage and vandalism. The Guyline Guardian bolts around the guy-line preform and splits ice that slides down guy-lines, directing the ice away from the preform. The guardian has self-locking bolts that make it difficult for vandals to undo preforms. The bolts also provide a convenient method of grounding. The guy-line protector is available in guy sizes ranging from 5/16 of an inch to one inch.

Circle (361) on Reply Card

Digital audiotape deck

Tascam has introduced the DA-50 DAT recorder/player. It uses zero distortion (ZD) circuitry to maximize sonic performance. The four ZD circuits add and subtract digital dither in the conversion processes to reduce granulation noise. Internal boxes shield the five main sections to prevent electrical interference, external vibrations and resonance from reaching each circuit. The deck uses four direct-drive brushless motors and seven power supplies that have independent transformers for digital and analog circuits. Features include 38-key full-function hardwired remote, 25-segment/3-color level meter, blank search and remote-controlled motor-driven front-shielding panel.

Circle (362) on Reply Card

Patchbay console

Trident Audio USA has introduced a patchbay version of the Trident series 24 console. A 364-point TT patchbay is available on the 28-input mainframe and a 468-point TT patchbay on the 36-input mainframe. The series features a console with 4-band high and low mid-sweepable EQ with variable high-pass filter; balanced mic and line inputs that have separate gain controls and phase reverse; eight auxiliary sends with pre-post switching in pairs; 24 subgroups with direct mix assignment; 24-monitor/FX returns with 2-band EQ and fader reverse; four echo returns; stereo; auto muting bus; 48V phantom power; balanced outputs; and 24-track metering.

Circle (363) on Reply Card

Coaxial transfer switches

Micro Communications has introduced coaxial transfer switches that will switch two signal sources between loads, as 4-port transfer switches. When used as SPDT switches, complex switching matrices can be assembled easily. The coplanar port configuration allows more compact layouts. The switches can be controlled in groups, singly from remote locations or integrated into computer-controlled logic systems. If loss of control power occurs, the switches can be operated manually.

MCI has also introduced the high-power VHF switchless combiner. It combines and switches two transmitter inputs to one or both of the combiner outputs. Switching is done using full power without interrupting the programming. The single motor drive is controlled by a microprocessor

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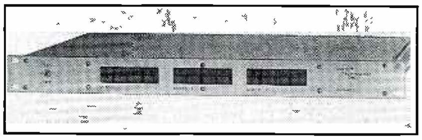
controller with momentary push-button user contacts and full-status interlocks.

Circle (364) on Reply Card

Audio-video switcher

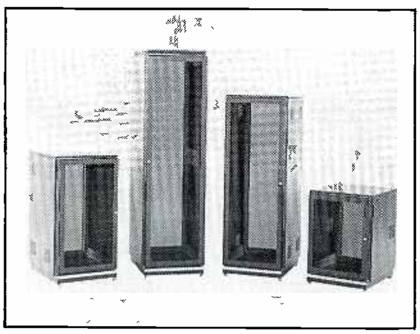
Target Technology has introduced the model AVS-403. It combines one video and two audio 4 × 1 switchers in a one-rack-unit package. The unit allows audio follow video or separate operation. The vertical interval video switcher features a bandwidth of >40MHz, computer graphics, HDTV applications and XLR connectors. With the use of CMOS gates, click-free audio switching may be obtained.



Circle (365) on Reply Card

Plexiglas doors

Winsted has introduced locking Plexiglas doors to protect electronic equipment from dust, dirt and tampering. The doors have smoke-tinted Plexiglas panels, allowing see-through viewing of the systems. Constructed with formed and welded steel frames, the doors can be mounted for right- or left-hand openings. The doors are recessed 1½-inches for offsetting electronic control knobs and switches.



Circle (366) on Reply Card

Digital telephone interface

Symetrix has introduced the model 111 adaptive hybrid, a fully automatic digital telephone interface for radio and television. It may be used as a stand-alone unit or with any telephone system. The interface features host level, caller level, caller override and audio-on-hold and all are front-panel adjustable. The interface uses an adaptive digital hybrid to match phone lines of any impedance and creates the best possible trans-hybrid loss under all conditions. Host audio may be input at the mic or line level, balanced or unbalanced.

Circle (367) on Reply Card

Frame-capture camera

JVC has introduced the TK-F7100OU RGB frame-capture camera designed to act as a high-resolution input device to a personal computer-based graphics system. The camera produces an image of 1,024×1,024 pixels. It features a capture time of only 0.4 seconds and has no registration error. The TK-F7100OU provides auto-white balance and can be used in normal or low-light situations.

The camera output is not a standard NTSC video signal so it cannot be connected to a video monitor. The camera works through a PC-AT or compatible computer equipped with an image-capture board. In this way, analog images are converted to digital images. The requirements for use of the camera include an IBM PC-AT (or compatible computer), Vista board, multiscan monitor, composite focusing monitor, C-mount lens, copy stand or tripod, video light and software. The TK-F7100OU is equipped with an ac power unit, power cable, a cable to connect the camera with a Vista board, a jumper for the Vista board and utility software.

Circle (368) on Reply Card

Videotape

Ampex has introduced to the European market the following videotape products:

• Ampex 297 master broadcast grade U-matic videotape is specially formulated for the higher energy requirements of the U-matic SP format. It features the Ampex red cassette shell, and meets the stringent drop-out standards when used with U-matic SP recorders.

• Ampex 319 D2 digital videotape features 1,500Oe metal particle videotape. It is available in 32-, 90- and 208-minute sizes. The videotape has ABS anti-static plastics, a textured finish, a hub spindle that mounts directly on the cassette shell, a positive lock mechanism, Teflon-impregnated plastic flanges, a clam shell design lid, captivated lock buttons and the Ampex labeling system.

Circle (369) on Reply Card

Speakers

Clear-Com has introduced two amplified monitor speakers. Models 1020 and 1020M are self-contained 2-channel audio monitoring systems requiring only one 19-inch rack space. Both feature audio frequency response range of 100Hz-12kHz, XL-3-type balanced line-level inputs and RCA phone-type unbalanced inputs. Model 1020 is a bi-amplified unit combining the low-frequency information of both channels into a single amplifier and specially baffled speaker.

Circle (370) on Reply Card

TBC, S-switch

Prime Image has introduced the following products:

• The HR600+ is a high-resolution TBC with more than 600 lines of resolution and 7.5MHz bandwidth. It time base corrects and transcodes between true component

(U-matic and U-matic SP; Betacam, Betacam SP and M-II; S-VHS) and composite (½- and ¾-inch VCRs).

• The S-switch is a true component video production switcher. The unit accepts Y/C, Y/688 and composite inputs, transcodes between formats and provides output in any of these modes. It provides 16 video transition effects, 6 video inputs and 7 stereo audio follow video inputs.

Circle (371) on Reply Card

Tape degausser

Research Technology International has introduced the VRS-V90 degausser. Designed for continuous operation, it can erase up to 50 1-inch reels or 200 cassettes per hour. The degausser can erase tapes with a coercivity rating of up to 1,500 Oe. It can achieve 90dB erasure of conventional oxide videotapes and 75dB erasure of metal tapes without a harmful build-up of heat. The unit runs on 220Vac-240Vac, 60Hz.

Circle (372) on Reply Card

Master videotape

3M has released a new brochure describing its products. Featured in the brochure is an improved version of the 480 master broadcast videotape that offers lowered dropout averages, better audio uniformity and improved consistency. It is designed for type C 1-inch helical videotape recorders that meet PAL, SECAM and NTSC standards. The 480 offers a smooth surface and exclusive backside coating that reduces static and debris.

Circle (373) on Reply Card

Antenna tuner

MFJ Enterprises has announced the availability of the MFJ-986 3kW roller inductor differential-T antenna tuner. The T-network tuner uses a single differential capacitor instead of two variable capacitors allowing a broadband response that eliminates constant returning. The black aluminum cabinet measures 10¾″×4″×15″ and is roomy enough to mount the silver plated roller inductor away from metal surfaces for highest Q and for maximum power into your antenna. The 6-position antenna switch allows the user to select two coax lines and/or random wires, balanced line and external dummy load.

Circle (374) on Reply Card

Microphone

The D-37 dynamic cardioid microphone has been introduced by *Milab*. The microphone, constructed of solid brass, is designed to withstand rugged use. It features a heavily shock-mounted moving coil element for minimum handling noise and a built-in pop protection. The D-37 has a frequency response of 50Hz to 20kHz.

Circle (375) on Reply Card

Studio monitors

Digital Designs has introduced a series of close-field studio monitors.

• The model LS-161 is a 2-way acoustical suspension loudspeaker system. It has a 6½-inch polypropylene woofer with a textured semihyperbolic cone, a ventilated nomex voice coil former, 4-layer high-temp wire and a closed cell polyurethane foam surround with precise edge termination properties. Also featured on the LS-161 is a 1-inch phase-corrected ferro-fluid-cooled polymer dome tweeter that provides transient response and dampens the fundamental resonance. The woofer and tweeter are time corrected and produce a point source for image localization.

The monitors feature frequency response of 59Hz-20kHz and a sensitivity of 90dB. Power handling capability is 60W. The system is magnetically shielded for post-production applications.

• The LS-261 2-way acoustical suspension loudspeaker system contains two 6½-inch woofers and a tweeter. It features a frequency response of 55Hz-20kHz and a sensitivity of 90dB.

Circle (376) on Reply Card

Replacement cable

Alpha Wire has introduced coaxial replacement cable that is capable of taking the place of 18 coaxial cables. It is designed specifically for interconnecting high-speed computers and peripherals operating at three megabits per second with a system impedance of 82Ω. The cable is for point-to-point interconnect where bundled coax may have been used. The flexible, shielded, dual-foam cable weighs 50% less than coaxial cable to allow for easy handling. There is no need to work with a composite shield with replacement cable. Coaxial replacement cable is UL listed type CL2 for power limited signaling applications and is UL recognized AMW style 20431.

Circle (377) on Reply Card

Power line monitor

Dranetz Technologies has introduced the model 646-1 power line monitor. The 646-1 monitors sags, surges, impulses, over- and under-voltages and frequency changes for single-phase and neutral-to-ground installations. The unit includes a separate independent dc channel for correlation of dc voltage aberration to the ac disturbances. The model 646-1 features one-line display and menu driven controls; an environmentally protected membrane keypad for the front panel; a built-in thermal printer, for on-site data collection; and an RS-232C communications port. A UPS and built-in modem are available options.

Circle (378) on Reply Card

Digital effects system

GML Grove has introduced the X-Calibre II, a dual-channel frame-synchronizing, zoom and trajectory digital-effects system. The system has full keyframe control of both A and B channel effects. It features an integral floppy-disk storage unit, assignable proc-amp controls, picture-edge cropping and an extended range of spin and tumble effects.

Circle (379) on Reply Card

Circle (118) on Reply Card

Circle (120) on Reply Card

Circle (122) on Reply Card

People

Steve Johnson, **Michael Costanza**, **Robert Elman**, **Joseph Fusco**, **John Ward** and **Terry Younce** have been appointed to positions with Sony, New York. Johnson was named to the new position of promotions manager. He is responsible for creating and managing promotions for consumer tape, professional tape and floppy disk products. Costanza is national accounts manager. He is responsible for all sales to national and key accounts of consumer audiotape and videotape, professional audiotape and videotape and floppy disk products. Zone manager positions have been filled by Elman, Fusco and Ward. Elman has the Midwestern zone; Fusco serves the Eastern zone; and Ward covers the Western zone. Younce has been named Midwest regional sales manager for the broadcast products division.

James Wuest has joined Barco Industries, Nashua, NH, as Midwest regional sales manager for broadcast products. He will be responsible for territory in Minnesota, Wisconsin, Iowa, Illinois, Missouri, Michigan, Indiana and Ohio. Wuest will work with the Barco Dealer network and provide end-user support for high-performance professional broadcast TV monitors.

William J. MacDonald has been appointed manager of external services for Quanta, Salt Lake City, UT. He will direct customer service and demo and trade show support.

Ron J. Ritchie has been appointed vice president and division manager of the recording systems division for Ampex, Redwood City, CA. **Douglas M. Rowan** has been named vice president of the worldwide marketing sales and service organization.

Brian J. Akehurst has been promoted to the position of marketing manager for Varian TVT, Cambridge, U.K., a division of Varian Associates, Palo Alto, CA. Akehurst will direct the marketing of the complete line of UHF, VHF and FM broadcast products. His duties will include market planning and research, pricing, product specifications, bid and proposal production, distribution and promotion.

Johann Safar has been named chief engineer for Panasonic Broadcast Systems, Secaucus, NJ. He is responsible for quality control, engineering and service operations.

Dr. R. Douglas Hogg, **Jamal Hamdani** and **John Primeau** have been appointed to positions at Moseley Associates, Santa Barbara, CA. Hogg, former vice president and director of engineering, has been named president and will be responsible for research and development. Hamdani, former international marketing director, has been promoted to vice president of marketing. He will manage the systems engineering department, which implements broadcast and control networks. Primeau has joined the company as director of manufacturing, and will assume line and administrative duties.

William Liento Jr. has rejoined Lee Colortran, Burbank, CA, as senior vice president of sales and marketing.

Greg Schreiner and **Leslie Bills** have been promoted to new positions with EECO/Convergence, Santa Ana, CA. Schreiner is field sales manager. He performs a liaison function between the company and its master distributors, including all technical and sales managers. He is responsible for sales and maintenance of the computerized videotape editing systems. He also will conduct technical and operational seminars. Bills is telemarketing manager. She is responsible for day-to-day communication with the master distributors, dealers and end-users to inform them of new products, sales specials, training programs and sales leads. She also will handle overall customer service.

Alphonse Criscuolo has been appointed manager of sales and marketing for Cablewave Systems, North Haven, CT. He is responsible for overseeing all the advertising, sales and marketing activities for product lines such as Flexwell air-dielectric coaxial cable, Cellflex foam dielectric coaxial cable, Flexwell Elliptical waveguide, parabolic microwave antennas and system, FM broadcast antennas and the rigid coaxial transmission line.

Joerg D. Agin has been appointed corporate vice president and general manager of the motion picture and audio-visual division of Eastman Kodak Company, Rochester, NY. He will be in charge of worldwide operations for research and development, manufacturing, marketing and distribution of professional motion pictures, videotape and presentation technology products.

Tom Irby has been named advanced technology product manager for Harrison Systems, Nashville, TN. He will be responsible for the SeriesTen, MR-20 and other advanced-technology music recording products and related audio console products. Irby is the former owner of Studio Supply Company.

Tore B. Nordahl has been appointed vice president and general manager in charge of operations at Studer Revox America, Nashville, TN.

Bob Low has transferred to the position of national sales manager of the Broadcast Lens Division at Canon USA, Jericho, NY. He was previously the division's West Coast regional manager.

Vincent J. Hewitt Jr. has been named president of the Display Products Group of Conrac, Duarte, CA. He will be responsible for all operations of the group, which manufactures high-resolution display monitors.

NEC America expands service

NEC America, Wood Dale, IL, has opened two regional service centers to expand the service capabilities of the Broadcast Equipment Division. The centers will serve the NEC video equipment users in the Western and Eastern Seaboard states. The East Coast office is located at 373 Route 46 West, Building D, Fairfield, NJ 07006; 201-882-8998. The address for the West Coast office is 4936 Rosecrans Avenue, Hawthorne, CA 90250; 213-973-2071.

Northlake Audio relocates

Northlake Audio has moved to new headquarters, in Angie, LA. The mailing address is P.O. Box 161, Angie, LA 70426-0161. Among the services provided by Northlake are audio-video production, promotional consulting, electrical engineering, facility design and construction, public relations, evaluation and acquisition.

Carillon acquires business operations

Carillon Technology, San Bruno, CA, has acquired the business operations of dbx/ADC and BSR (Japan) Ltd. A restructuring of dbx/ADC has been announced. dbx production and manufacturing facilities will be moved to the West Coast and other locations, while operations, including marketing, sales and engineering will remain in the Boston area. ADC has been organized as a separate company, Audio Dynamics Corporation. Its operations are being moved to San Bruno, CA. dbx engineers will continue to design and engineer products for the ADC and Audio Dynamics brands.

Dynatech acquires Alta

Dynatech, Burlington, MA, has acquired the Alta Group. In joining the Dynatech organization, Alta becomes part of the communications product group that includes Utah Scientific, Colorgraphics, Newstar and Quanta. Alta will continue to operate as an independent entity and its products will complement the existing mix of broadcast products in the Dynatech line.

Bryant Electric moves to new headquarters

Bryant Electric has relocated its headquarters operation. The new address is Milford Place Corporate Center, 185 Plains Road, Milford, CT 06460-2465; telephone 203-876-3600; fax 203-876-3675. Toll-free 800-number service has been added to the fax machines at the three customer support centers: Milford, CT, 800-543-0538; Chicago, 800-543-1853; Anaheim, CA, 800-543-6456.

Sony receives Emmy

Sony, New York, has been awarded an Emmy by the Academy of Television Arts and Sciences. "The Outstanding Achievement in Engineering Development Award" was presented in recognition of the component digital format video recording system, DVR/DVPC-1000 D-1, developed by Sony. Sony engineers also were awarded an Emmy in recognition of the engineering skill involved in the development of the format.

Audiopak expands service and sales

Audiopak has opened a West Coast sales office and has established a toll-free telephone number for dealers, distributors and customers. The office is located at 100 N. Brand Boulevard, Suite 200, Glendale, CA 91203; telephone 818-240-0282. The toll-free number is 800-522-CART. Audiopak dealers and distributors can place orders between 8 a.m. and 5 p.m. Eastern time. Customers also can make use of the number to get technical advice directly from the company's engineering and design staff.

Faroudja forms research center

Faroudja, Palo Alto, CA, has announced the formation of a separate company devoted to the research and development of the Super NTSC system. The company, Faroudja Research Enterprises (FRE), is located at 675 Palomar Avenue, Sunnyvale, CA.

With the advent of Super NTSC and the proposal to the ATSC that it be considered as a future standard for an advanced TV system (to be used for public broadcasting in the United States), it was decided the research and development activity should take place independently from Faroudja's regular commercial work.

The objective of FRE is to produce a completely compatible Super NTSC system that meets the performance characteristics outlined in the ATSC proposal.

BTS receives Emmy

BTS Broadcast Television Systems, Salt Lake City, has received a 1988 Emmy from the Academy of Television Arts and Sciences. The award for "Technical Achievement in 3-D Computer Graphics Technology" was presented to BTS for its work in developing and expanding the capabilities of the FGS-4000 animation network.

American Broadcast Systems is formed

American Broadcast Systems, Austin, TX, has been established to manufacture and market the Americart line of TV VTR automation systems. This line includes the DC-80 automatic video cart system and the microcart VTR automatic control system.

Leonardo upgrading and on the move

Leonardo Software has relocated its base of operations to 10378 Holman Avenue, Los Angeles, CA 90024; telephone

213-277-5161. The company develops software programs that enable computerized search and playback of CD sound-effects and production music libraries. The facility provides additional office and lab space.

CMX Laser Systems and The Post Group form joint venture

CMX Laser Systems, Santa Clara, CA, and *The Post Group*, Hollywood, CA, have entered into a joint venture. CMX will open a training center to teach the techniques of random-access electronic post-production at the facilities of The Post Group. CLSI will combine the full-service random-access editing capabilities, including CMX 6000 rentals, disc-making services, systems maintenance and training and system sales. The program is designed for the training of editors and assistant editors.

CMX has been awarded a patent for Virtual Master, a new editing technique that permits instantaneous electronic splicing and viewing. Virtual Master is an integral feature of the CMX 6000 random-access, laserdisc-based editing system.

Harris acquires equipment distribution

Harris, Melbourne, FL, has entered into an agreement with Allied Broadcast Equipment, Richmond, IN. The radio equipment distribution business of Allied has been sold to and will act as a subsidiary of Harris Corporation, as part of the communications sector. The acquisition includes the international

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distribution of radio broadcast products, the design and installation of radio broadcast systems, the provision of radio broadcast satellite equipment and a commercial printing operation.

Otari installs video duplicator

A T-700 TMD (thermal magnetic duplication) laser-based high-speed video duplicator from *Otari*, Foster City, CA, has been purchased by BASF AG, a chrome tape manufacturer in West Germany. BASF will use the duplicator in the production of chrome TMD tape. The TMD technology is the result of a joint effort between Otari and the DuPont Company.

Gentner acquires Texar

Gentner Electronics, Salt Lake City, has announced the acquisition of Texar, Monroeville, PA. Texar operations will be moved to the Salt Lake City facility and the Monroeville office will be closed. The Utah office also has expanded its operations. The new address is 1825 Research Way, Salt Lake City, UT 84119; telephone 801-975-7200; fax 801-977-0087.

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