BROADCAST engineering

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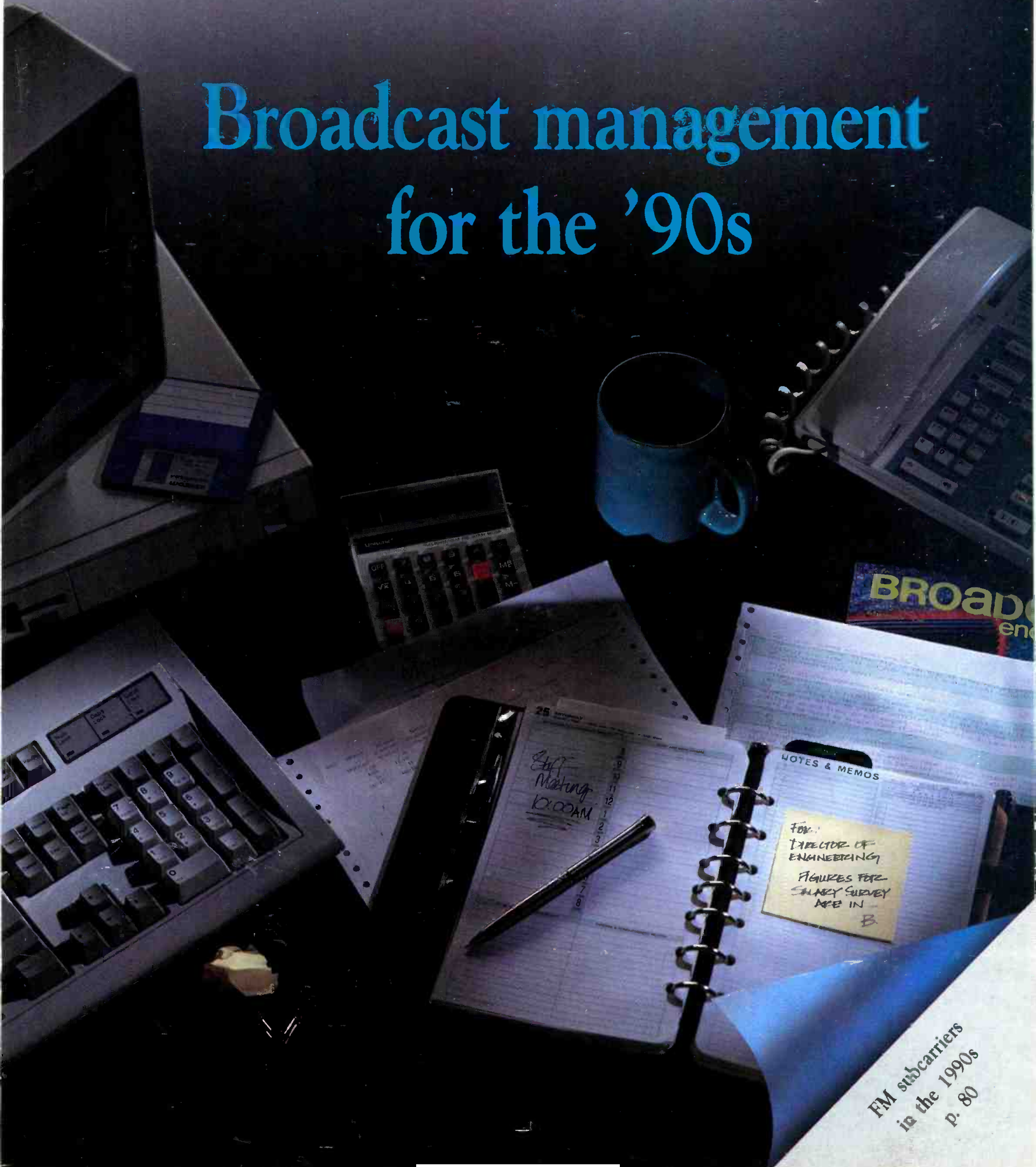
Broadcast management for the '90s



FM subcarriers in the 1990s p. 80

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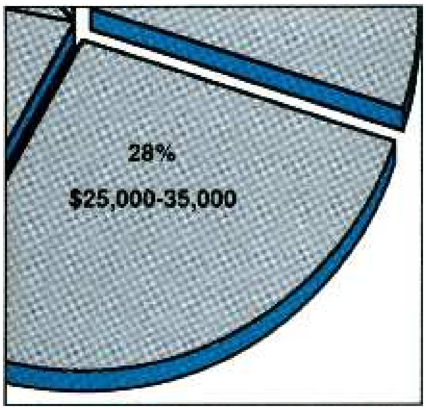

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BROADCAST MANAGEMENT FOR THE '90S

Today's successful technical manager must wear many hats. It's no longer enough to be able to fix equipment. You must also be able to lead your facility toward more efficient operation and higher profits through modern technology. Those who succeed in this task will be highly rewarded, as our salary survey shows. Yesterday's engineering skills required screwdrivers, soldering irons and pliers. Today, the primary tools of the successful technical manager include the computer, sophisticated engineering and management software and a desire to lead the station or post facility to higher performance (and profit) levels.

FEATURES:

OTHER FEATURES:

DEPARTMENTS

ON THE COVER

As the successful engineers adapt to new challenges, so to must the tools used to perform the job. The computer and "business smarts" are now of critical importance to any engineer who wants to be a successful technical manager. (Cover credit, Stephanie Chiles, *BE* graphic designer.)

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By Dawn Hightower, senior associate editor

CDRB opens participation to broadcast industry

The Committee for Digital Radio Broadcasting (CDRB) voted to formalize its structure and to open participation to the entire broadcast industry. The committee also will investigate the future viability of radio broadcasting in the United States and explore the development of a digital radio broadcast system.

The CDRB was formed last April on an ad hoc basis. Its goal is to provide the listening public with radio broadcasts that have a sound quality comparable to compact discs in a cost-effective manner.

The committee heard an evaluation of digital audio compression techniques by the International Standards Organization (ISO) and other technical aspects of digital radio broadcasts. Also, there was a discussion of digital radio applications pending at the FCC, the WARC advisory committee process on spectrum allocation, the Canadian demonstrations of the Eureka DAB system, and the FCC Notice of Inquiry on digital audio.

Broadcasters invite proposals for TV ghost-canceling systems

The National Association of Broadcasters (NAB) is inviting interested parties to submit proposals for TV ghost-canceling systems to be evaluated by participating broadcasters in a standards-setting process.

In late June, NAB's TV board of directors announced its support for a "voluntary, single standard" for new technology that would remove ghosts from consumer TV reception. NAB said the standards-setting group will field test all systems available for such testing, and then recommend a ghost-canceling training signal as a voluntary NAB standard for TV broadcasting. Deadline for all proposals is the end of this month.

To implement ghost-canceling in over-the-air TV reception, changes are required in transmission and reception equipment. Ghost-canceling systems work using a specialized training signal that is embedded in broadcast transmission. This signal is later analyzed and processed at the receiving end to reduce the effects of multipath.

In its Request For Proposal (RFP), NAB stressed that only a ghost-canceling training signal for transmission needs to be standardized. Receiver manufacturers then could choose to process the signal in any desired way, designing a final product that would balance costs with consumer needs. Although the standards that NAB is seeking to set will be voted on by

Continued on page 116

Broadcast Engineering

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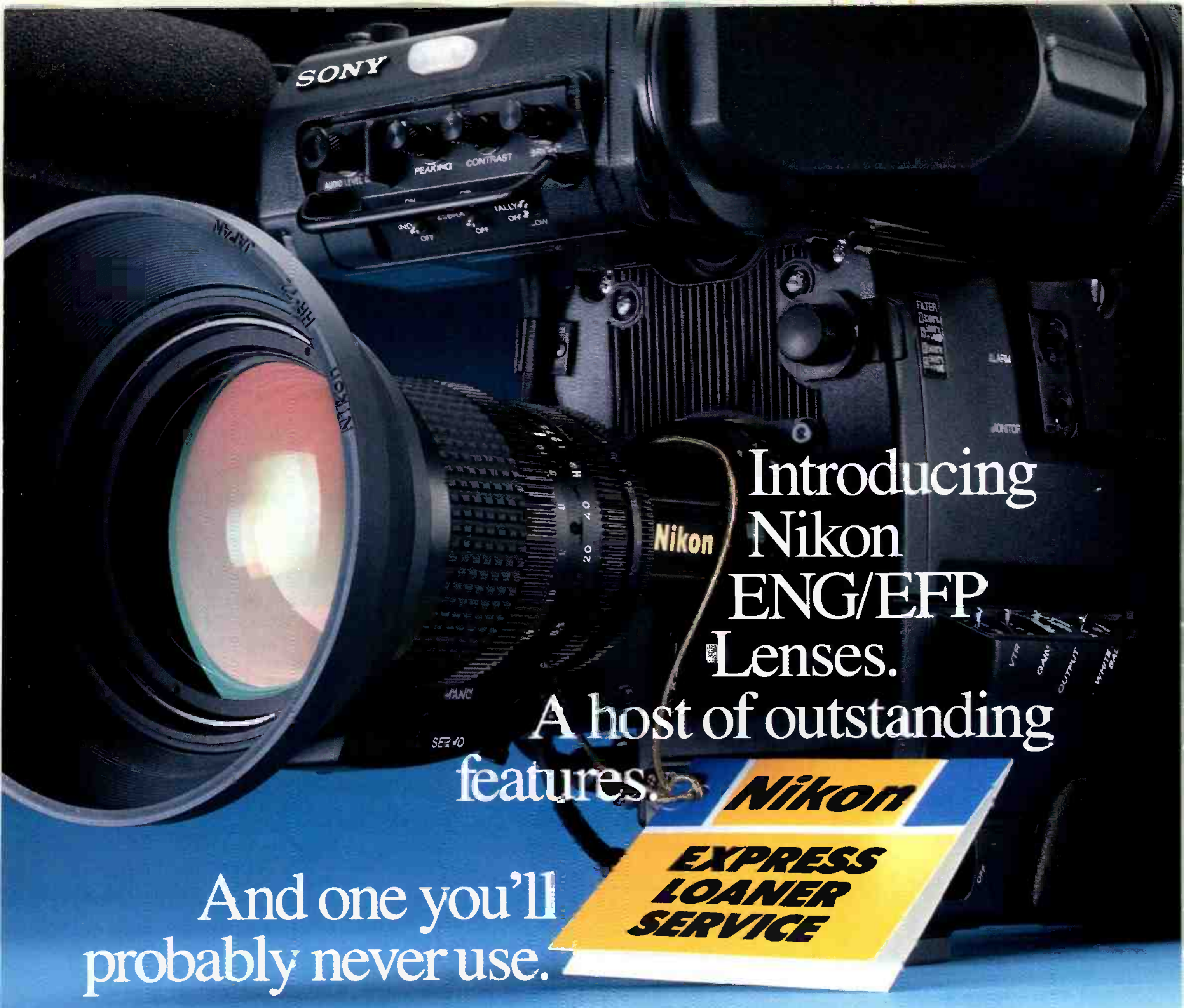

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Farewell to a friend

Blair Benson died quietly on Sept. 4 en route from New York to Washington, DC, to attend the annual IEEE Broadcast Symposium.

If you ever met Blair, you'll never forget him. He was a broadcast engineer in the classic sense, a by-the-book man who never settled for anything but the best from colleagues and equipment under his charge. He was stubborn and had an opinion on almost every technical topic. You always knew where you stood with Blair. He never had time for office politics.

Even if you never had a chance to meet Blair Benson, you probably know of his work. In 1956, Blair, who was then working for CBS, played a key role in bringing the videotape recorder into existence. He was known by Ampex veterans as the guy from the network who was never satisfied with their off-tape VTR pictures. He pushed Charlie Ginsburg's crew for the last line of resolution, and the last decibel of signal-to-noise. The VTR wasn't good enough until Benson said it was good enough.

Blair accomplished a great deal during his career, which spanned nearly 50 years. Highlights include:

- Emmy Award for Best Engineering, 1954, (shared with Charles Ginsburg) for the development of videotape recording.
- Key technical positions at CBS spanning a 25-year period. He joined CBS in 1948 as a senior project engineer for the network's first broadcast center at Grand Central Station. In 1961, as manager of audio and video systems for CBS, Blair was instrumental in the design of the CBS Broadcast Center on West 57th Street, which is still in use today.
- Fellow of the SMPTE and served on the JCIC/SMPTE ad hoc committee for color TV standards.
- Instrumental in the development of the VIR signal.
- Director of A/V engineering, Goldmark Communications.
- Vice president of engineering, Video Corporation of America.

Book credits include:

1. Editor: *Television Engineering Handbook* (McGraw-Hill).
2. Editor: *Audio Engineering Handbook* (McGraw-Hill).
3. Co-author: *Television and Audio Handbook for Engineers and Technicians* (McGraw-Hill).
4. Co-author: *Advanced Television for the 1990s* (McGraw-Hill).

Blair was one of a disappearing breed of pioneers in the broadcast industry. He and his contemporaries lay the groundwork for the business that we enjoy today. The problems facing broadcasters in the early days were different from the ones faced today. It was challenging enough to get television to work at all, let alone to work out the finer details of cost-vs.-performance assessments.

In Blair's day, broadcast engineering required you to be a pragmatic problem solver with the imagination to accomplish the needed task with the materials at hand. This type of engineer is rapidly disappearing from the field.

The business of broadcast engineering has shifted from hands-on equipment people to "systems planners" who are more comfortable with a board room discussion of return on investment than the nitty-gritty details of what makes a piece of equipment tick. One type of engineer is no better than the other. The change is a reflection of the times. However, we must remember that people like Blair Benson made it possible for the technical managers of today to focus on climbing the corporate ladder.

We at *Broadcast Engineering* are saddened by Blair's death. He was a consultant to the magazine for as long as anybody can remember. He authored numerous articles over the years, and provided valuable advice on developing trends in the business. If any of us can accomplish in a lifetime one-fourth of what K. Blair Benson did, we should consider our professional lives a success.

Blair left behind Dolly, his wife of 46 years, four children and four grandchildren.

Blair was a pioneer broadcast engineer who loved his work and his family. He was also a friend. The broadcast industry will miss Blair, but it will not forget him.

Jerry Whitaker,
associate publisher

FCC studies digital audio radio service

By Harry C. Martin

The FCC is seeking public comments on how to develop and implement a new digital audio radio service. The new service would use digital modulation techniques to provide compact disc-quality audio. The most important issues to be decided concern the impact digital radio would have on existing audio broadcast service, how to accommodate the spectrum needs of digital audio, and what regulatory structure should be used to ensure that the public benefits of digital audio are most efficiently realized.

Impact on existing service

In considering the impact on existing radio services, the FCC notes that the United States presently has a strong, competitive radio broadcast service with more than 10,000 commercial and non-commercial stations providing service.

Among the regulatory alternatives being considered is whether existing terrestrial audio broadcasters would be provided with a transition in the process of selecting digital audio service providers.

Spectrum use

The FCC is also seeking comment on the amount of spectrum required for such a service, the potential frequency bands where such services could be accommodated, and the impact that digital radio allocations may have on the availability of spectrum for other services. Other issues to be decided are whether provision should be made for satellite and terrestrial operations within the same frequency band or in separate bands, and, if digital audio is provided on a terrestrial basis, how many digital radio channels should be provided in various markets.

Regulatory issues that must be considered include whether digital radio services should be permitted on a subscription or free-of-charge basis, and whether broadcast ownership restrictions should apply to digital radio services.

Pending applications

The FCC presently has three pending requests for authorizations to provide digital audio broadcasting services. Under one of these proposals, existing AM and FM broadcasters and others seeking to provide nationwide programming to subscription customers would be permitted to purchase transponder capacity to provide service in the 1,470MHz-1,530MHz band.

Sixty-six channels of satellite service could be provided. This first system would also include a terrestrial component under which frequencies in the 1,460MHz-1,470MHz band would be made available to existing AM and FM broadcasters for the provision of 34 channels of local radio service.

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

FCC reports to Congress on cable TV

The FCC has submitted a report to Congress on the state of the cable TV industry.

The 1984 Cable Act prevented local governments in most communities from regulating cable rates and services. The legislation was intended to foster the growth of the cable industry and thereby increase the diversity of video programming nationwide. The goal of the FCC's current report is to provide Congress with information on how the cable TV industry has developed in the absence of local regulation.

Some of the commission's most important findings include:

- The cable industry has developed specialized programming services, such as ESPN, CNN, MTV and BET that are usually not duplicated by local broadcasting stations. Competition from alternative multichannel providers, such as second competitive cable systems, wireless cable, SMATV and CBS, is limited at present.
- After sharp rate increases in the year after rate deregulation, average basic rate increases have moderated to the point where they are about equal the rate of general inflation.
- Horizontal concentration and vertical integration in the cable industry have increased significantly since 1984, giving MSOs the ability to deny alternative multichannel video providers access to cable programming in certain instances. Also, MSOs have developed sufficient intermarket power to impose conditions on or to deny access to cable communities by various program services.
- The current compulsory copyright licensing scheme creates an imbalance in the relationship between the broadcasting and cable industries because it unfairly subsidizes cable operators.
- Cable operators' incentives to deny carriage or to provide disadvantageous carriage positions to local broadcast signals creates a market disadvantage that affects commercial broadcasters' ability to compete against cable operators for advertising revenue.
- Redefining the "effective competition" standard so that it might cause the imposition of widespread and extensive rate regulation on the cable industry could unnecessarily undermine the growth in cable services.

In light of the commission's findings, some of the more important recommendations made to Congress follow:

- To encourage more competition in the local video marketplace, Congress should set standards that would prevent local franchising authorities from creating unreasonable barriers against the entry of potential competing franchisees and other multichannel video providers.
- Congress should adopt a must-carry regime to safeguard local broadcast stations as long as the compulsory copyright license for local broadcast programming exists. In the absence of must-carry, Congress should repeal the cable compulsory license so local broadcast stations can bargain for compensation for retransmission of their programming.
- Congress should restrict changes in the channel positions of local broadcast stations and require that adequate notice of any repositioning be provided.
- Congress should promote the emergence of alternative multichannel video distributors by prohibiting any programming service in which a multichannel provider holds a financial interest from unreasonably refusing to deal with any competing multichannel provider.
- Congress should strengthen the authority of local franchising authorities to force reasonable and effective customer service standards.

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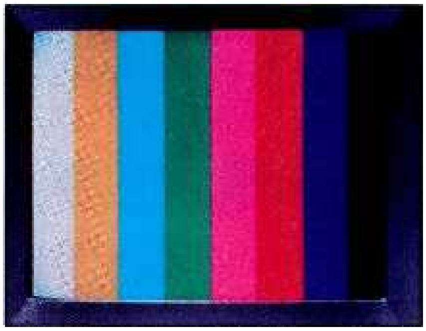

A case for refinement

By Rick Lehtinen, technical editor

Broadcasting was once a glamorous industry. There was plenty of money to spend on elaborate production tools. Having "the latest and greatest" meant more than saving a few dollars here and there. However, changing times have reshaped the economics of broadcasting. Broadcasters now want to be "lean and tough." They want to use fewer tools, and use the ones available to their utmost capacity.

Broadcast equipment manufacturers, by necessity, have followed a similar path. Today's equipment is cleaner, simpler, and more reliable than that offered a few years ago. If it isn't, stations won't buy it.

Consider the automated spot playback machine. It was once a sprawling walrus of a device, built of thick steel plate with gadgets of every kind, from pneumatics to optics, inside of it. To make it run required enormous amounts of electricity, plus vacuum, compressed air and a lot of engineering attention.

In comparison, today's automatic library systems are tame. Modern analog systems not only do more than their predecessors, they do it better and they cost less. Today's digital versions also do more, and they cost about the same as their forerunners, considering inflation.

Less is more

Simplicity is one of the attractions of the new systems. It is only logical that they don't fail as often because there is less to break.

Consider the case of two simple structures built out of steel conduit with flattened ends. (See Figure 1.) Although the rectangle uses more steel and should be stronger, it can deform and disable the system. Unnecessary complexity has added a failure mode. The triangle is not only a simpler system than the rectangle, it is also stronger. The triangle can only fail if one of the conduits fails. It can be the same with equipment.

Don't skimp on parts

Designer's often attempt to cut complexity by reducing component counts. Leaving out a few components, such as temperature compensation circuitry, may increase the chance of circuit failure. Also, this doesn't save a significant amount of money. One-quarter-watt resistors don't cost much more in lots of 100 than they do in lots of 1,000.

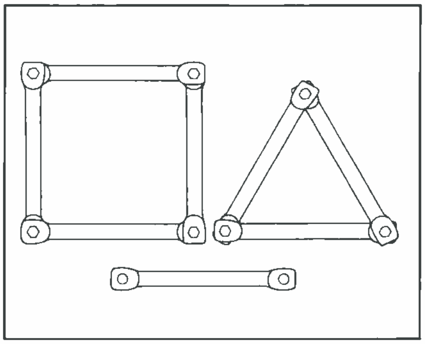

Figure 1. *Two simple structures show the importance of refinement in design. Although the rectangle has more steel, it is not stronger. In fact, it is more likely to fail, because the structure may deform.*

Manufacturers will achieve greater savings by re-evaluating the way that they package their equipment. For years, manufacturers have operated sheet metal shops to build chassis. As finances have tightened, some manufacturers have eliminated their chassis work to save money.

There may be a better solution. For years, the computer industry has used a "shopping basket" chassis. This is constructed out of pieces of stiff wire, cut to size and welded into shape. It is lighter, stronger and less expensive than sheet metal. If you design carefully, some of the wires can double as edge-guides for the printed circuit boards. The pennies saved by eliminating a resistor or decoupling capacitor are nothing compared to the dollars saved by eliminating the chassis. However, in spite of almost two decades of success with this technology in the computer industry, few broadcast equipment designers have adopted it.

Operator controls offer even more savings. Many routing switchers use push-buttons that resemble those on a touch-tone phone or a switcher. These are costly and difficult to replace. Why not use premanufactured elastomeric switches that install in a fraction of the time taken by push-buttons? A pad of 16 switches typically costs less than a single push-button.

Premanufactured power supplies are also economical. Some TV equipment has several jumpers used to select the correct line voltage and frequency for the power transformer. The computer and home entertainment industries don't have time for this. Instead, they use universal supplies that will operate from most of the world's power mains. Any surcharge for this type of supply is compensated for by reduced overhead and inventory. However, this type of supply is usually cheaper from the start.

More refinement

Other potential areas for savings include:

- Use computers as platforms. Manufacturers should squeeze a product onto a computer PC card if they are able to do so. The computer's power supply can power the card and the computer can form the control panel. A typical PC clone costs less than most routing switcher control panels.
- Use microprocessors. Once a significant part of the product becomes software, it's economical to produce upgrades because there is nothing more to build. The card only needs to be manufactured once.
- Use more plastics. Modern plastic cases yield ergonomic operator interfaces at greatly reduced cost. One broadcast manufacturer replaced $80 worth of metal with $2.50 worth of plastic and improved its panel in the process.
- Standardization between manufacturers. DA cards made by different manufacturers can fit into the same racks and be plug-compatible, as is the case with similar devices in the computer world. This would simplify the station engineer's job. It would also increase sales, because the purchase of individual cards would become separate from the purchase of rack trays and power supplies.

Acknowledgment: The author wishes to thank Tom Meyer, vice president of engineering, Dynair, San Diego.

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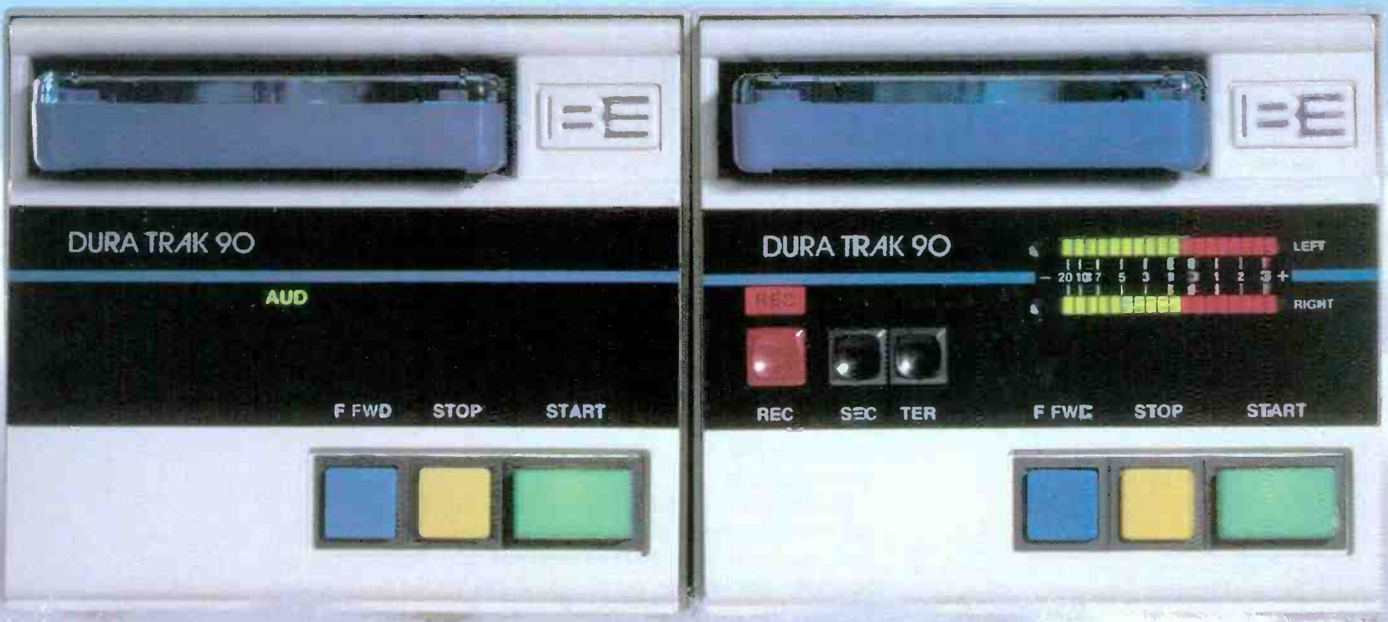

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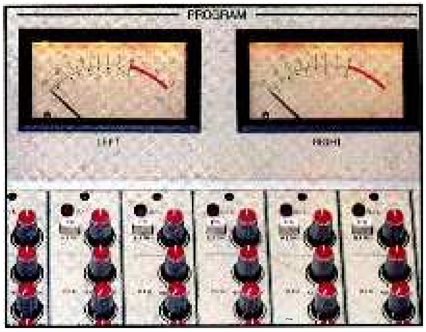


Tubes and modulation

By John Battison, P.E.

During my travels, I have encountered a surprisingly large number of engineers who grew up with transistors and who have little knowledge or understanding of tubes.

Because of the intense interest now being taken in amplitude modulation in relation to NRSC, I thought some discussion of modulation principles as well as RF power amplifier and modulating tubes might be interesting.

Modulation and bandwidth

The AM broadcast signal consists of a carrier and upper and lower sidebands. These sidebands are composed of the carrier frequency plus and minus the modulating frequency. For example, in the case of a 560kHz carrier with 2,000Hz modulation, we can expect to find sidebands at 558kHz and 562kHz. This should be all, except for the carrier. If there are no other frequencies present in the modulator, our expectations will be met. However, any hum or overtones present in our modulating signal will produce their own sidebands. If a non-linear condition exists during this modulation process, we can expect to find intermodulation products from the beating of the various modulating signals. The maximum bandwidth transmitted is twice that of the highest modulating frequency.

The maximum bandwidth produced by all these modulation effects can extend far beyond the FCC's old bandwidth limits. One of the purposes of the new NRSC filter is to cut these off, which is another benefit of the new rules.

Most program directors insist that their stations have the loudest signal in the market. This usually means running the modulation at +125% and −99.9%. The commission frowns heavily on 100% negative modulation.

With 100% modulation, the amplitude of each sideband is half that of the unmodulated carrier. This value applies to voltage, current or field intensity. Because power is proportional to the square of the amplitude, each sideband contains power that is one-quarter the power of the unmodulated carrier.

The energy at the carrier frequency is not changed by modulation, but the total power radiated at 100% modulation — consisting of the carrier plus the sidebands — is 1.5 times the power of the unmodulated carrier. Antenna current (rms) will increase by the square root of 1.5 (or by a factor of 1.225) with 100% modulation.

At the peak of 100% modulation, the RF current and voltage are twice that of the unmodulated carrier. Therefore, the *instantaneous* power developed is four times that required by the carrier. So your 30-year-old, 500W transmitter is now being required to hit 2,000W on 100% modulation peaks. Is it any wonder that the waveform flattens, and you get carrier shift and other distortion when it is cranked up to +125%?

For one thing, the power supply was never designed to meet the demands of a consistently high modulation level of 100%, let alone 125%. At 125% modulation, the instantaneous power developed is 1.275 times that of the unmodulated carrier. Even if the rectifier tubes could supply the sudden demand, the filtering circuits in the power supply often have difficulty in meeting the call for power. Some engineers have overcome this problem by building new power supplies designed to handle these high power demands. Such a power supply for the final stage is not expensive for lower-power stations, and it can be a good way to keep an old transmitter productive.

Modulation techniques

Today, most transmitters use plate modulation, or a modification of it. Some use combinations of suppressor or control grid and plate modulation with a modulation transformer. One of the earliest modulating methods was to insert a carbon microphone in the RF circuit and allow its resistance to modulate the carrier's amplitude.

Basically, the audio voltage is inserted into the plate supply of the RF power tube. It drives the voltage down to zero and up to twice the unmodulated value with 100% modulation. In order to maintain efficiency, the stage needs to be kept in a saturated Class C condition at all times. To do this, negative bias of approximately four times the plate cutoff for zero modulation is required. Thus, when the plate voltage doubles at modulation peaks, bias is still approximately twice cutoff.

Modulation power requirements

It is sometimes hard to appreciate just how much power is required for Class C amplifier operation. Let's assume a DC input of 2,000V at 500mA (i.e. 1kW). According to Ohm's law the load impedance is 4,000Ω (2,000/0.5). This DC is passed through the modulation transformer. We need 100% modulation, so we add 2,000 peak volts of audio.

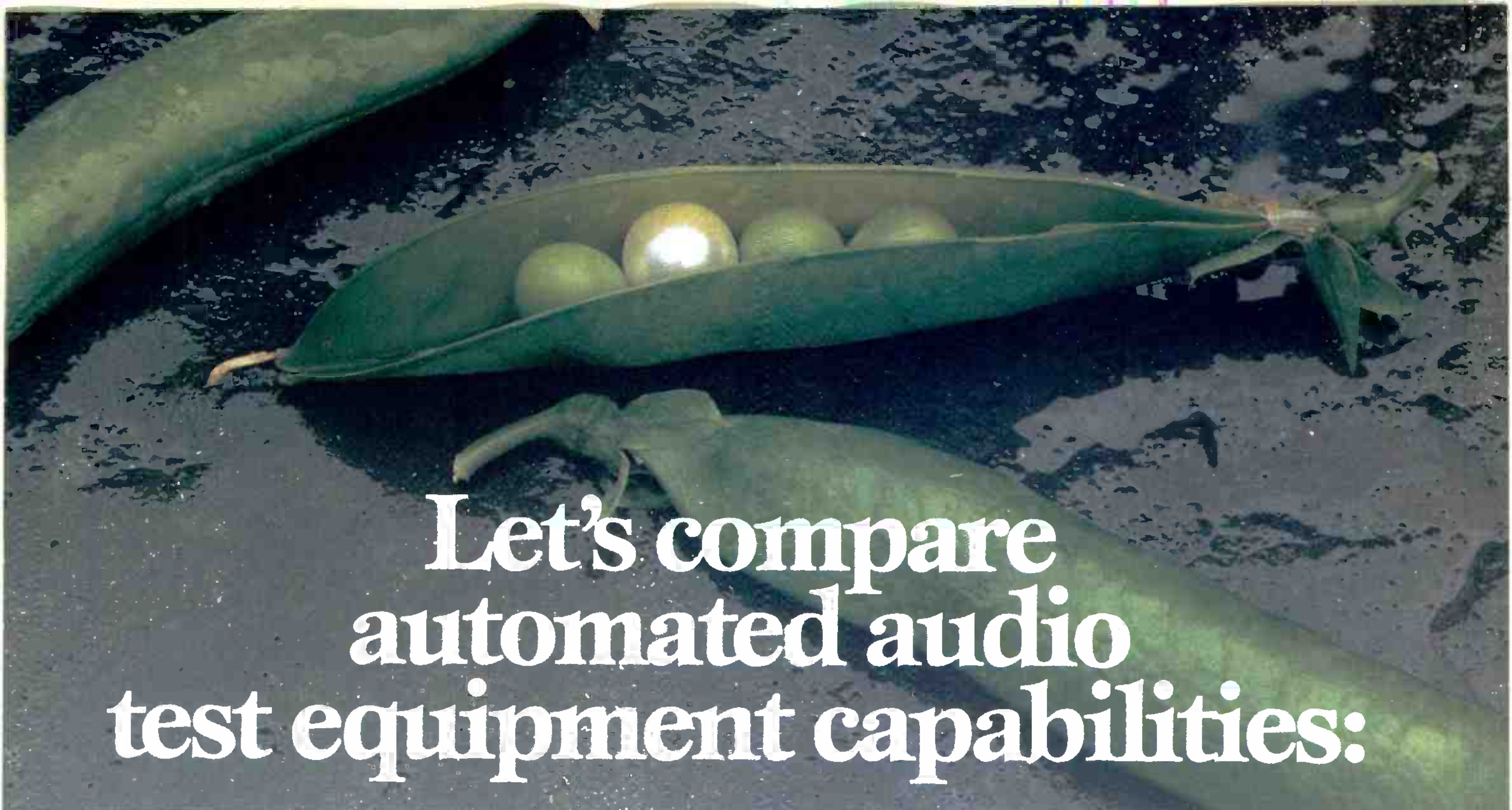
The rms value of the audio is 0.707× 2,000, or 1,414V. The RF amplifier plate impedance of 4,000Ω has this voltage impressed upon it. Using Ohm's law again, we find from E^2/R that $(1,414)^2/4,000$ equals 500W of audio. It is important to notice that this is half the tube's DC plate voltage.

With 100% modulation we have 1.5kW rms into the RF output tube. However, remember that the plate voltmeter and ammeter are averaging meters. This means they do not indicate rms and will not respond to audio. So we read a total of 1kW DC power.

With 75% efficiency, this 1kW becomes 750W of RF without modulation. With 100% modulation, the 500W of audio are also converted into RF at 75% efficiency. This produces an additional 375W of RF. Our total output power is 1.125kW with 100% modulation. A quick calculation shows that this is 1.5 times the unmodulated RF.

As a final thought, consider that the audio stage efficiency is approximately 70%. Therefore, DC input to the modulator will be around 715W. The total modulator and final RF stages will require a total of 1.715kW.

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



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Selective amplitude	YES	NO	NO	NO
Dual input/output	YES	NO	YES	NO
Simultaneous 2-channel ampl. meas.	YES	NO	NO	NO
Real time ratio/crosstalk meas.	YES	NO	NO	NO
THD + N	YES	YES	YES	YES
SMPTE IMD	YES	NO	YES	YES
CCIF IMD	YES	NO	NO	YES
Transient IMD	YES	NO	NO	NO
Wow & flutter	YES	NO	YES	NO
Phase measurement	YES	NO	YES	NO
Frequency measurement	YES	YES	YES	NO
Squarewave	YES	NO	YES	YES
Sine burst	YES	YES	YES	YES
Pink/white/USASI noise	YES	NO	NO	NO
PRICES (U.S. DOMESTIC)				
Computer-interfaceable instrument	$7350-$10350[1]	$6250	$10280-$12635	$9795-$10205
Software package	included	none available	$595-$2580	none available
Typical controller	$600-$3000[2]	$6080[3]	$1000-$3400[4]	$1000-$3400[4]

[1] *DSP spectrum analyzer/waveform capture option also available starting at $3500.*
[2] *Personal computer. Interface card included in instrument price.*
[3] *H-P Model 332MMA IEEE-488 compatible.*
[4] *Personal computer plus IEEE-488 interface card.*
Competitive data compiled from H-P 1990 catalog, S-T data sheet 3000A 1987, price list 1989 Tektronix 1990 catalog.

For a much more complete comparison of these and other audio test sytems, call or write Audio Precision.

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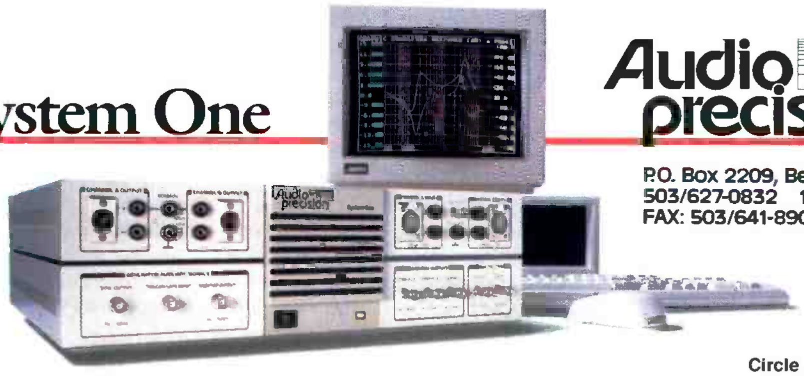

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Financial future looks bright

By Bob Van Buhler

The Society of Broadcast Engineers' (SBE's) first professional association manager and paid executive director, Steve Ingram, was hired June 1. Since that time he has made significant organizational and financial advances in the society's operation.

Ingram has specialized skills in generating revenue and reducing costs. In his first month, he saved the SBE more than $6,000 in annual financial auditing fees. Through careful analysis and the issuance of request for quotations, he introduced competitive bidding to the process, which produced the significant savings. Saving money was not Ingram's only early contribution to the society bottom line. By July Ingram had solicited enough new and renewed sustaining members to pay for a third month of his salary.

Ingram's stated goals, developed in cooperation with the board of directors, are the criteria by which his performance will be judged in the next year. These include coordinating strategic planning, recruiting and retaining regular and sustaining members, supervising the SBE convention, and improving relations and support for local chapters. He will also focus on new member services, increasing revenue and reducing expenses.

Proposals for hiring a professional association manager were presented to the executive committee earlier this year. One, presented by Andy Butler, involved spending $155,300 for an executive director. That proposal would have raised member dues to $50, eliminated chapter rebates and made up the shortfall by withdrawal of $41,000 from the SBE savings accounts. The proposal was rejected as excessively expensive and proposed no new benefit to the members or the society.

Most of the previously explored options involved hiring a high-profile broadcast engineer to become the executive director, which was often the individual pressing for adoption of the individual proposals. Although such an individual might be conversant with the industry's issues and even know influential people in Washington, a simple examination of the job description determined that SBE did not need a lobbyist or a Washington liaison as much as someone to manage the society's day-to-day business.

Taking its cue from other professional groups, the board and officers decided that SBE needed the skills of a professional association manager rather than someone with broadcast-related qualifications. An individual experienced in increasing membership, serving the member's needs and raising money to operate the society were identified as key requirements. On this basis, seeking a professional association manager was determined to be the correct direction to take.

Member survey

A survey of the SBE membership was conducted during March and April. Of 5,527 survey forms sent to active members, 1,006 responses were received. The survey results provide important demographic information on SBE members and what they want from the society. Following is a brief review of the results.

Approximately 53% of the members make their living in radio, and approximately 34% work in television. The remainder are in other related fields. Chief engineers make up about 30%, another 15.6% call themselves technical managers and 32.2% are staff engineers. More than half of the respondents, 55.9%, are SBE-certified with nearly 70% paying their own certification fees. About a quarter of SBE's members are certified as broadcast technologists, 30% at the radio or TV broadcast engineer level and another one-third are senior radio or TV broadcast engineers. A total of 8.3% are certified as SBE professional broadcast engineers.

Two-thirds of SBE's members have never attended the SBE convention, mostly because of distance (43.4%) or expense (29.8%). The reason becomes clear when asked how much of the convention expense is paid by the employer. The survey shows that 53.5% of the members receive no support from their company for convention attendance. Some 21.4% say that their company pays for all of their convention expenses, while the remainder receives some company support. Most respondents, by a 3:1 ratio, prefer to have the convention location rotated around the country, rather than keeping it in the Midwest.

The survey also ranked the various member program services and publications for importance and satisfaction. The SBE certification program was ranked as the most important and members expressed their highest degree of satisfaction with it. Chapter meetings were important, with a somewhat lower level of satisfaction. Frequency coordination ranked next in importance and satisfaction, followed by the SBE *Proceedings*.

The survey asked what kind of information the members wished to receive from and about SBE. FCC news was ranked as most important, followed, in order of importance, by society news, industry news, technical articles, frequency coordination news and certification news.

The survey results were contained in the July/August issue of the SBE *President's Newsletter*. Copies are available from the SBE office.

Membership campaign

The society's first national membership campaign, complete with incentives for member recruiters, closed on Sept. 15. The contest provided the top recruiter with free SBE convention registration, banquet tickets and SBE *Proceedings*. The presentation was made at the October SBE convention in St. Louis. Although the program ran only from July 15 through Sept. 15 and received little publicity, it stimulated a lot of local chapter activity.

Enterprising local chapters sometimes develop their own incentive programs, and can do so with the help of vendors and manufacturers. Chapter 9 in Phoenix adopted an incentive program supported by a local broadcast equipment supplier. Each member of Chapter 9 who signed a new recruit received a special prize provided by the vendor. Such cooperative ventures benefit the SBE and the local chapter. In addition to the added benefit of more members, the chapter also receives a $5 rebate for each new member. Be sure to include your name on the new member application form so your chapter receives proper credit.

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

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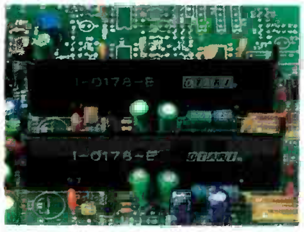

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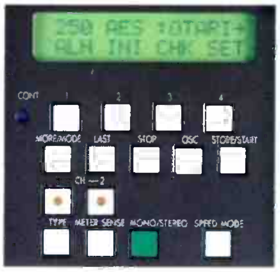

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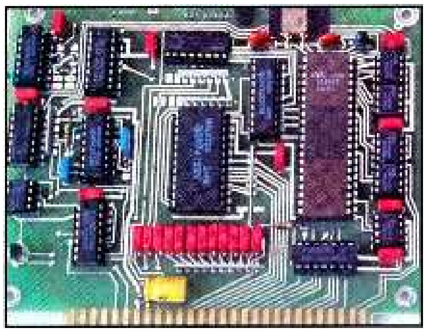

Use microcontrollers for station projects

By Gerry Kaufhold II

There are twelve parts to designing projects using microcontrollers:

1. Select an easy-to-use microcontroller.
2. Study the documentation on the microcontroller.
3. Connect a power supply.
4. Choose the crystal for the operating frequency.
5. Interface to EPROM and RAM memory.
6. Interface to a serial communications link.
7. Study the documentation of the equipment to be controlled.
8. Interface to the external equipment to be controlled.
9. Write the software and load it into EPROM.
10. Debug the project step-by-step.
11. Shield the circuit to prevent EMI/RFI.
12. Test, verify and document the project.

You need to do the first six steps only once for each microcontroller. This gives the process of learning about single-chip microcontrollers a good payback ratio. Before too long, you will have developed a "library" of circuit designs, software routines and documentation techniques that can be applied to a variety of projects.

Selecting the controller

For this series, we will use the Z-8 microcontroller. The Z-8 comes with a variety of features and packaging configurations. It is also available in low-power CMOS, for portable battery-operated circuits.

The Z-8 has been in use since 1980, so a wealth of technical materials and application notes are available. This choice is not meant as an endorsement, it's just that I have used this chip for several years, so it is a convenient choice for this series.

The Z-8 is an 8-bit device, so it can be driven from a single 8-bit EPROM, and connected to a single 8-bit RAM. This makes possible a low-cost circuit, with the minimum number of interconnections. The simple 8-bit interface makes it possible to wire-wrap the first prototype without too much eyestrain. Afterward, a printed circuit implementation will fit on a single board.

Our examples will use the Z-8681 ROMless series of parts, which are specifically provided for low-volume prototyping work where low cost and design flexibility are of primary importance.

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

Power supply

During the construction phase of a microcontroller project, you will likely use a bench-type power supply. Although this is convenient during the project's development stages, it is wise to design ahead for the time when the embedded controller has to stand alone. Modular 5V supplies are readily available from your normal component supplier. The current rating must meet or exceed the system's expected worst case requirements. It will need to be fuse-protected against short circuits. Provide adequate ventilation to avoid overheating.

If you use a modular supply, it will require 120VAC to be present on the chassis. Make sure that it is not easy to inadvertently come in contact with this voltage while building and servicing the equipment. Use good construction practices. Consider installing a plastic shield over the high-voltage section. Provide voltage test points to aid future troubleshooting. Label the power supply area clearly.

Using calculator supplies

Sometimes, it is easier to use a universal 9V to 12V calculator power supply. These are overload protected, mount external to the microcontroller board so there are no heating problems and they have UL approval, which appeals to station management for insurance reasons.

If a universal type supply is used, a simple step-down voltage regulator circuit, such as the one shown in Figure 1 will provide the correct regulated voltage for the circuit. The 7805 regulator can often be adequately heat sinked to the project chassis, saving the cost of a separate heat sink and eliminating the need for air vents.

If the design calls for connection to an RS-232 serial communications port, a negative voltage reference will be needed. Figure 1 shows how to use a 7660 voltage inverter to generate the −5V from a +5V supply.

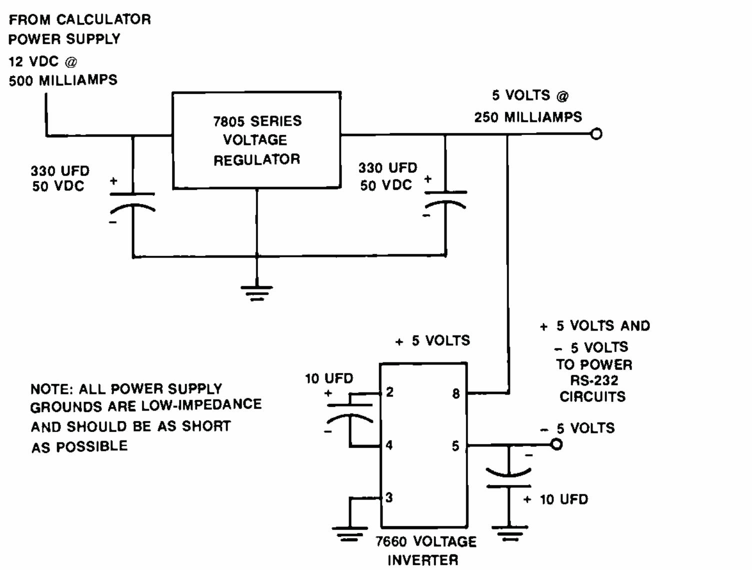

Figure 1. Voltage regulator modules can transfrom the output of "universal" 12V power supplies into the +5V required by microcontroller projects, and the −5V required for RS-232 communications.

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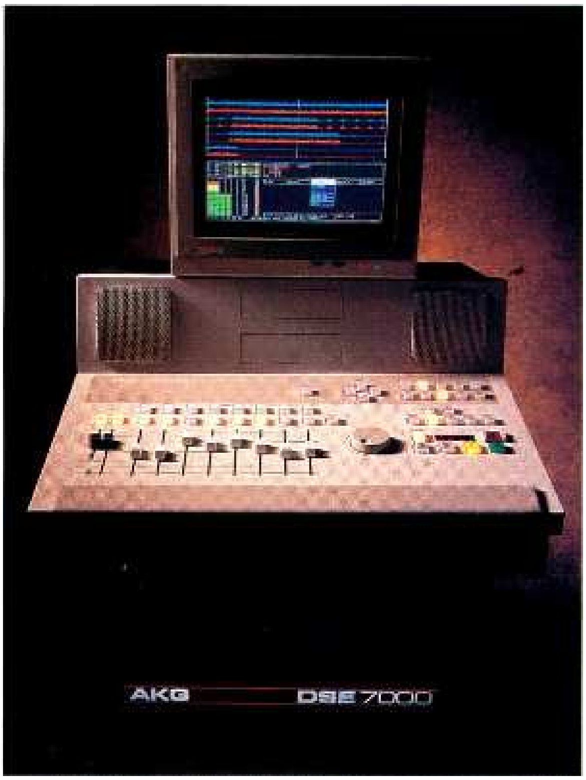

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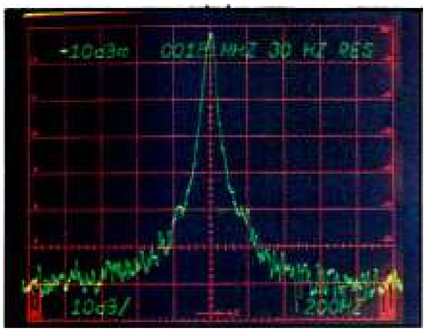

Servicing your klystrons

By Colin Erridge

The high-power levels of present-day microwave tubes require that careful attention be given to the design and operation of cooling systems. In some cases, inadequate or improper cooling because of scale or corrosion may be the limiting factor in tube life. Scale is formed as a deposit upon the wetted surface of the tube coolant system. It results from the conversion of a coolant-soluble salt into an insoluble compound because of a chemical reaction in the coolant. Corrosion is the result of chemical-reaction products on some portion of the wetted surface.

The liquid-cooled klystron generally is wetted with two cooling paths, one for the collector, the other for the tube body. Other elements of the system, which are usually liquid-cooled by the same heat-exchange system, include the electromagnet focusing coils, RF dummy load and some microwave transmission components between the tube and antenna.

In some klystrons, as much as 2kW of heat per square inch must be transmitted through the collector wall and dissipated into the coolant. Frequently, the heat flux in the collector is not uniformly distributed. At high values of heat dissipation, a small amount of scale can cause a large rise in temperature in some portion of the collector, thus greatly increasing the possibility of premature tube failure.

Coolants

Distilled water, which is chemically stable and has high heat transfer capability, is preferred over antifreeze mixtures as a tube coolant. If protection against low temperatures is required, draining a system or using electric water heaters during non-operating periods will avoid the problems caused by antifreeze.

If a freezing-point depressant is necessary, a closed cooling system complete with purification loop can be used with an uninhibited solution of ethylene glycol and water as the coolant. However, because antifreeze mixtures have lower cooling capabilities than water, tube ratings established for water may not apply if antifreezes are used.

Erridge is product manager, Varian Associates, Palo Alto, CA.

Cooling system design

Continual purification of the coolant is desirable whether water or antifreeze is used. The cooling system usually includes the features needed to do this, such as a purification loop. The purification loop processes a small amount of coolant from the main recirculating loop by removing soluble salts by ion-exchange, dissolved oxygen and carbon dioxide, small particulate matter and other contaminants. If a mixture of ethylene glycol and water is used, organic breakdown products of the glycol must be removed. Packaged purification systems suitable for this purpose are available.

Tubing, fittings, pumps and other material that will be in direct contact with the coolant should be selected to minimize galvanic action. It is best to use only metals and alloys at the "noble" end of the electromotive force (EMF) series, such as copper, nickel, bronze and Monel. The EMF differences between these metals/alloys and the copper collector are small. Metals, such as steel, cast iron, galvanized iron, aluminum and magnesium should not be used in direct contact with the coolant; and brass should be used sparingly.

In addition to the deterioration of the piping, manifolding, and radiator because of electrolysis between dissimilar metals, oxidation of the copper material of the tube can cause corrosion in the coolant system. This happens in areas of high heat transfer to the coolant, primarily in the collector. The corrosion rate is directly related to the amount of dissolved oxygen in the coolant, and the temperature of the copper collector core, such as the collector power dissipation. Corrosion-free operation can only be attained by holding the dissolved oxygen level to 1.25 parts per million or less. This means that measurements of the oxygen level must be made frequently.

Cooling system operation

All contaminants, such as oils, grease and particulate matter, should be removed from the system because they might deposit on the heat-exchange surfaces inside the tube and reduce the heat transfer capability. The cooling loop should be degreased with a solvent or detergent, followed by a number of clean water flushings. Also, no soluble oil inhibitors or stop-leak compounds should be added to the coolant because they may cause foaming.

In a system being operated for the first time, special precautions must be taken to remove pipe compound, solder salts, teflon pipetape thread seal and bits of solder. With all the main cooling loop filters in place, and with the tube, magnet, and other components replaced with jumpering connections, thorough flushing procedures should be carried out. After cleaning and replacing filters and ensuring the tube and other components are in place, the system can be operated in the normal mode.

A cooling system check list

Although the manufacturer's recommendation should be followed in maintaining the cooling system as a whole, the following list of adjustment and routine maintenance items may help provide the longest possible tube life:

- Keep the coolant temperature constant and as low as ambient weather conditions and other total system requirements will allow.
- Use clean, distilled water for original flushing, final filling and make-up.
- Use ethylene glycol only. Do not use automobile radiator antifreeze.
- Monitor the condition of the ion-exchange cartridge. Rapid exhaustion of the cartridge may indicate a source of contamination, electrolysis, the use of inhibited glycol, or that the purification loop lacks sufficient capacity for the bulk coolant being processed.
- Keep the main loop and branch filters clean by routine inspection.
- Keep the system free of dissolved oxygen or flush the tube when the collector differential pressure increases by 25% above the original value at the equivalent flow rate.
- Follow the purification loop manufacturer's instructions with respect to replacement procedures for filter membranes and cartridges.

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Project management for engineers

By Judith E.A. Perkinson

Designing studios and installing transmitters and new graphics systems seems to come naturally to some engineers. Others find such projects exciting but filled with frustration and delays.

Over the next five "Management for Engineers" columns, Judith Perkinson will outline the process used by successful engineering managers to complete projects. The methods that bring impressive results are not a mysterious secret, but rather an organized approach to problem solving. By using the methods Perkinson will discuss, you too can become successful in managing technical projects. Part II of this 5-part series will appear in the November issue.

So you think you are a good manager. Do you ever find that special projects, such as equipment changes, seem to take longer than you thought, end in a state of confusion, or consume your time until you are behind with your normal work? This is because project management requires a set of skills that we do not normally use.

The organizational structure that makes managing our routine duties easy is already in place. You must remember to use this structure when you manage a project, big or small. Successful project managers never forget that they must go back to the basics each time.

Develop the plan

The first and most important component of project management is the plan. Trying to run a project without a project plan would be like trying to build a piece of equipment without a schematic. It can be done, but it doesn't make much sense to try.

Your plan needs to be put in writing. It doesn't make any difference how good you are, no one is good enough to keep everything in his head.

Your written plan should contain the following five basic pieces of information:

- *Goal.* The project that needs to be accomplished.
- *Steps.* How the project work will proceed.
- *Time lines.* When the work will be finished.
- *Dependencies.* What has to be done before something else can be started.
- *Responsibilities.* Who is going to do what.

Perkinson is a senior member, the Calumet Group, Inc., Hammond, IN.

The goal

There are many different types of projects. Some common projects include equipment installations, changes or modifications; procedural changes; fact finding or problem solving; and quality improvement. Whatever the purpose of the project, you should begin by writing down what it is that you hope to accomplish. It should be something specific, such as "install and have operational a new edit suite by January 1."

The steps

All projects have a defined beginning, middle and end. Identify the basic steps from beginning to end. When you write down the steps, it is sometimes easier to start from the end result and work backward. Here is how a list of steps might appear if you were working from the end result:

1. Open suite for production use.
2. Train people to operate equipment.
3. Complete equipment installation.
4. Install equipment.
5. Have equipment delivered.
6. Order equipment.
7. Get approval for purchase.
8. Select equipment.
9. Complete system design.
10. Identify need.

Once you have written down the basic steps, fill in the details under each step. The amount of detail will depend upon the size and type of project you are managing. Remember, the more specific you are now, the fewer surprises you will have to deal with later. However, don't overburden yourself with details. Deciding what color of buttons to use at the system design phase is unnecessary tedium.

Once you have all your steps listed, arrange them on a continuum. Be sure that you sequence the steps according to what has to be done before another step can be completed.

Time line

A time line can be approached two ways. You can assume there is a set time by which the project has to be finished or you might assume there is no deadline and calculate the time needed to complete the job.

The second alternative allows you to set the completion date by determining how much time is needed to finish the work. Once you have done this, you can determine your start and finish dates. In this instance, time is the variable. The cost, personnel and resources become more fixed.

Dependencies

Examine the steps in your time line. Identify clearly what step or activity is dependent upon the completion of another. With the dependencies identified, you may need to redefine your time line. Remember, just because task C must be done before task D can take place, it doesn't mean that task C must be done immediately before the next step. Allow for a range of time when work can be done. This will give your schedule flexibility and the freedom to respond to the unexpected.

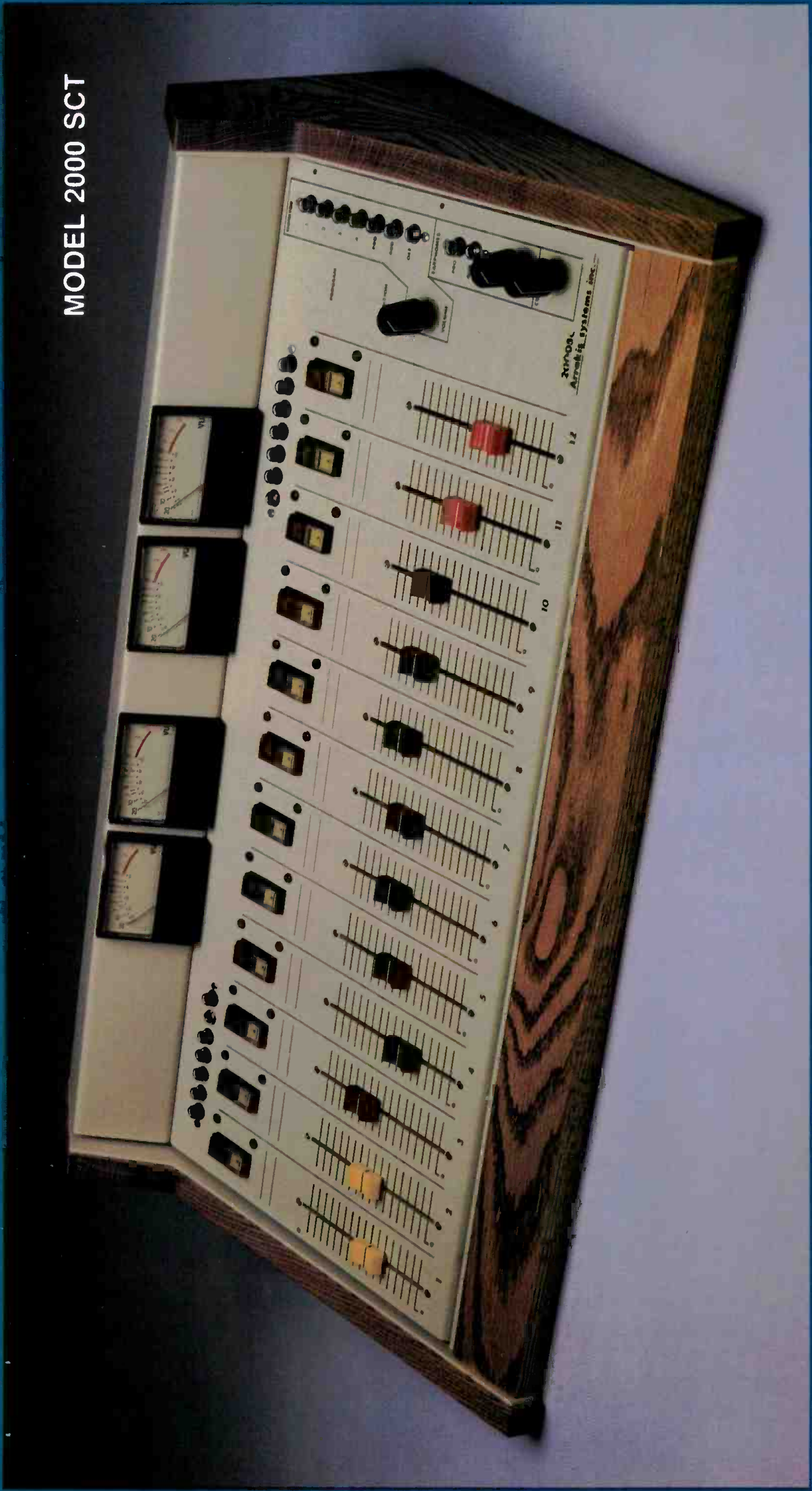
In technical projects, dependencies are often a function of vendor delivery times. Careful coordination with the vendor will help you know before you start where problems might occur. Allow for potential delays by scheduling other work to proceed at the same time whenever possible.

Responsibilities

Last, identify who will be responsible for what during the life of the project. This is not just a case of assigning jobs. For each step, identify:

- Who will be responsible (R).
- Who has authority over the step (A).
- Who needs to know what about the step (I).

When this is complete, you will have all the information needed to assign work and responsibilities, schedule activities, and design the communication necessary to ensure that the project is completed on time and with the minimum amount of difficulty.



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Moving from the back room into the front office.

By Brad Dick, editor

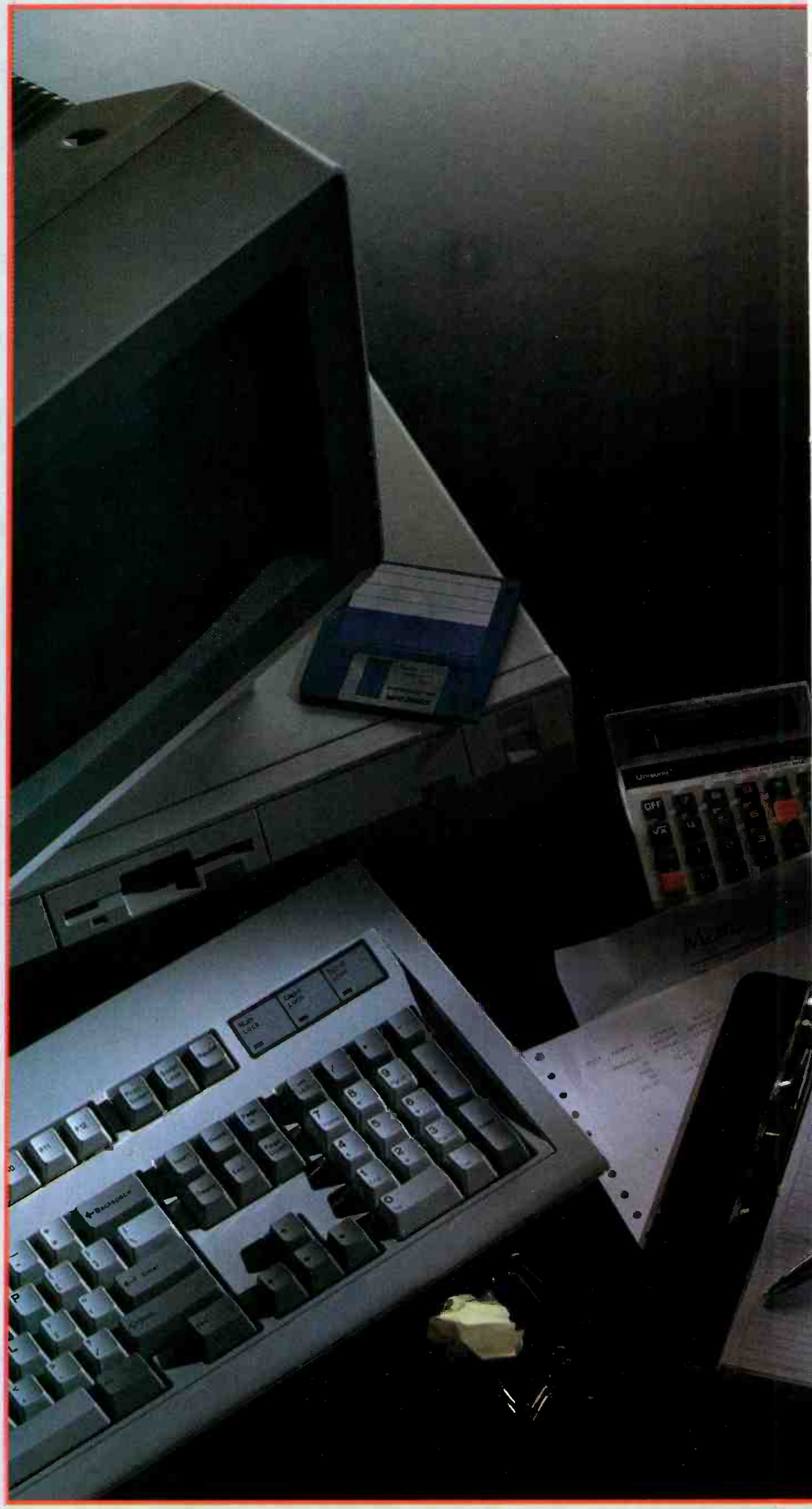
After writing the article "The 1990 Salary Survey: Dividing the Pie," it's tough to find much more to say about the state of broadcast engineering management. We've all heard the bad news and are tired of hearing it repeated. Is there any good news about today's and tomorrow's broadcast technical experts?

Yes, I believe there is. We've finally reached the knee of the change curve and things are about to level off. We've all seen, or experienced, a loss in engineers employed at our stations. Television has seen a 46% drop in the number of engineers in stations in the past four years. Radio now shows a median value of two engineers per station. The only reason the number is that large is that many of the top market stations still require big staffs to support the many remotes and newscasts that are common.

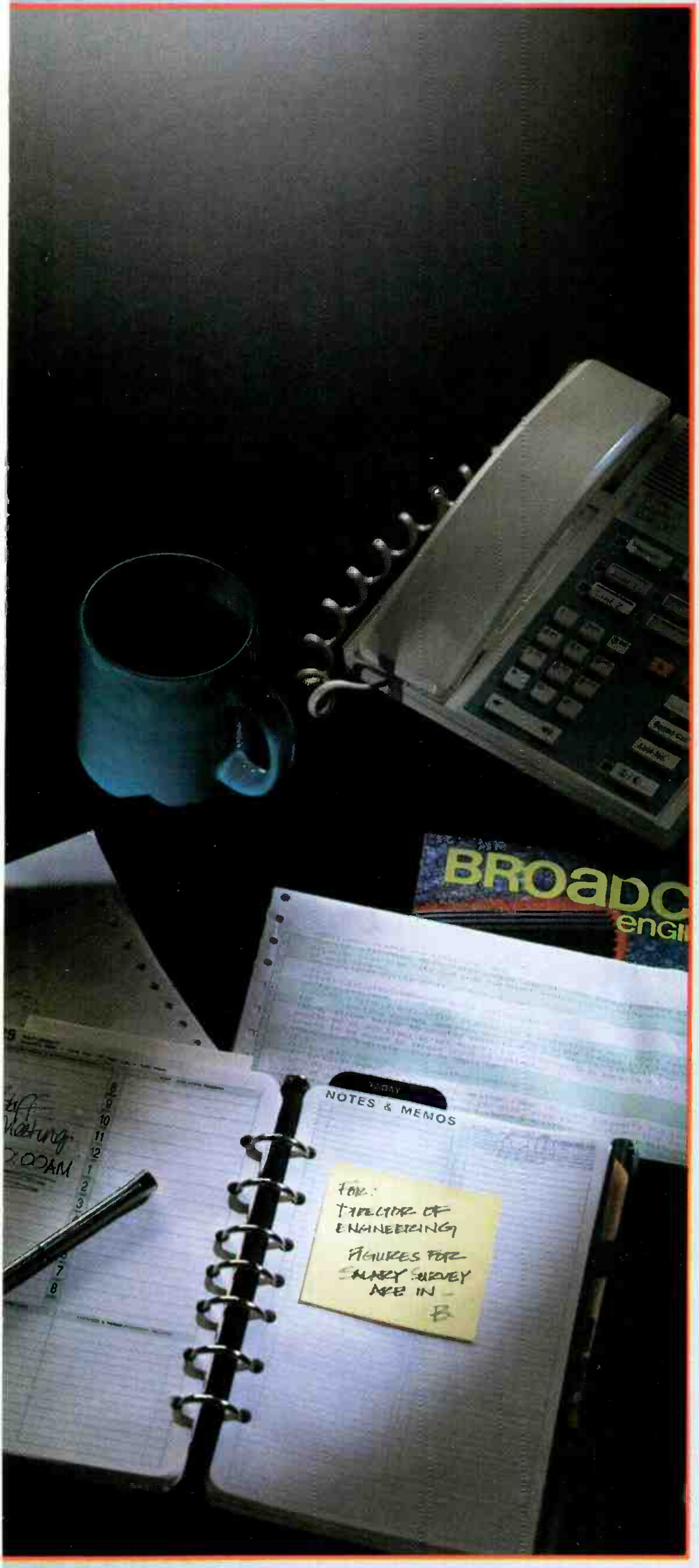
Another, and even more important, shift has taken place in recent years. For the first time, engineers are moving from the back rooms and into the front offices of their stations. It's almost as if broadcast engineering has finally become respectable.

Recall the struggles between engineering and the rest of the world? We engineers were often guilty of saying, "No, it can't be done," when the answer should have been, "Let's see if we can do it." Today's economics and competition won't allow for such single-minded approaches.

Engineers are now more supportive of other department needs. Whether



Broadcast management



for the '90s

it's the news department that needs additional satellite feeds or the program director who wants to do a remote from the top of a flag pole, today's broadcast engineers have adopted a "can do" attitude and that's making a difference.

Today's engineering managers are dressing more professionally. They may have an office instead of a "shack" where business is conducted.

These are examples that engineering has changed. Technical management is no longer the exclusive territory of electronic gurus who speak in techno tongues, which often confused others. Do these changes mean that engineering is less important or that non-technical staffs are making all of the technical decisions?

Of course not. It means that technical management has grown up. Engineers are recognizing that an important part of their responsibility is to help their stations become profitable. Effective technical managers must become part of the station's management team. Engineers look for answers; they don't complain about problems. The most successful engineers I know all share at least one common trait. They understand far more about the business side of broadcasting than those less successful engineers.

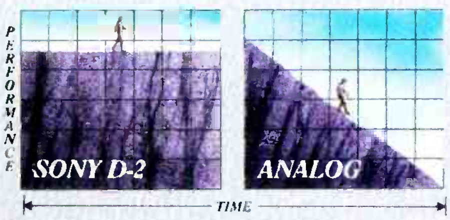
If you want to be in the successful group, put down that screwdriver and turn on your computer. Troubleshooting skills aren't enough to guarantee success today. You have to be a manager, much like your station manager. The primary difference is that the station manager focuses on the efforts of the several departments, and you focus on the performance of your staff and equipment. In today's competitive environment, smart engineering can mean the difference between a profitable operation and one that struggles to remain alive.

This month, our features highlight some of the skills that you'll need to become that successful engineering manager.

While your video tape reco
you can only go as far as

Most broadcasters have become attached to their analog video tape recorders. Which makes perfect sense. After all, they've never had any other choice. Not to mention the fact that analog VTRs do seem to get the job done.

But while those machines may still be working quite well, their technology isn't. Fact is, analog VTRs are full of limitations. And



Over time, analog's performance tends to go downhill. D-2's doesn't.

those limitations can really hold you back.

To begin with, an analog VTR's performance will always deteriorate over time. A fact that results in two troublesome limitations:

First, you have to continually adjust and tweak an analog VTR just to maintain an acceptable level of performance.

Second, depending on how old your VTRs are and how well they've been maintained, some will undoubtedly perform better than others. Which means some will also perform worse.

With Sony D-2 Composite Digital™ VTRs, none of this is true. Because a D-2

With analog you're restricted by the condition of your video tape.

rder may be quite advanced, its technology will let you.

VTR performs consistently over time and minimizes the need for adjustments.

Another limitation of analog video is something called tape dependency. Which means that the quality of your video can only be as good as the condition of your video tape.

Compared to D-2, the sound quality of analog seems rather archaic.

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BROADCAST PRODUCTS

The 1990 salary survey: Dividing the pie

Although good news is in short supply, opportunity awaits engineers with the right skills.

By Brad Dick, editor

Snoopy, the Peanuts cartoon character, often begins writing his stories with the phrase, "It was a dark and stormy night." That pretty well describes the mood of some broadcast engineers as they discuss their salaries and working conditions.

The 1990 *Broadcast Engineering* salary survey contains little good news for engineers. Radio engineering salaries are only down a little, less than 1%. And although the median TV engineering salary increased by 3%, they were, for the first time, surpassed by the salaries paid to operators. Operator salaries went up by almost 11%.

About the best that can be said for the overall salary situation is that it's flat. That shouldn't surprise anyone. With the dramatic changes seen in broadcasting, we shouldn't have expected the glory years of the mid-'60s to last.

Tabular results

The survey results are summarized in Tables 1 through 7. Tables 1 through 3 contain the major portion of the data collected in the survey. Use them to make detailed comparisons for your particular situation.

Tables 4 and 5 summarize the median salary information for television and radio across all markets for the past two years. If you want to skip the details, the grim picture is summarized in Figures 1 and 2.

Keep in mind that the data represents *median* values. The median value is quite different from the *average* value used in some surveys. The median value is the midpoint, with half of the responses above that value and half below.

The 1990 *BE* salary survey was conducted scientifically by the Marketing Research Institute. A total of 3,777 questionnaires were mailed to *BE* readers. As of July 3, 1,038 usable questionnaires had been returned, representing an overall response rate of 27.5%. The data contained in this report is based on those responses.

Radio moves upward

Figure 1 plots the median salaries for TV engineers from 1983-1990 as measured across all markets. Although the period 1983-1986 saw upward movement for engineers, the past four years shows little improvement. When inflation was running double digits, TV engineers suffered a real loss in purchasing power.

Since 1988 there has been a trend for operator salaries to increase at a faster rate than engineer salaries. We sounded a warning that the trend would result in operator salaries surpassing engineering salaries in 1990. Unfortunately, that's happened. For the first time, TV operator salaries have surpassed TV engineering salaries. After reading several hundred reply comments from the survey forms, that's not a surprise. Readers noted that operators were taking over more of what used to be engineering duties at TV stations. Furthermore, the tasks and skills required of TV engineers has changed. We'll look more closely at this phenomenon later. These factors, combined with pressures to lower operating costs, have kept TV engineering salaries from rising at rates comparable with the other categories.

One curious fact was discovered by close examination of the last few years of TV salary data. The median engineering salary dips slightly about every other year. It may be that because the overall change has been so flat, even a small decrease in the median value ripples through the results.

Figure 2 summarizes the salary data for radio engineers. Radio engineering salaries fared somewhat better than did TV salaries. There has been a gradual increase in median radio engineering salaries over

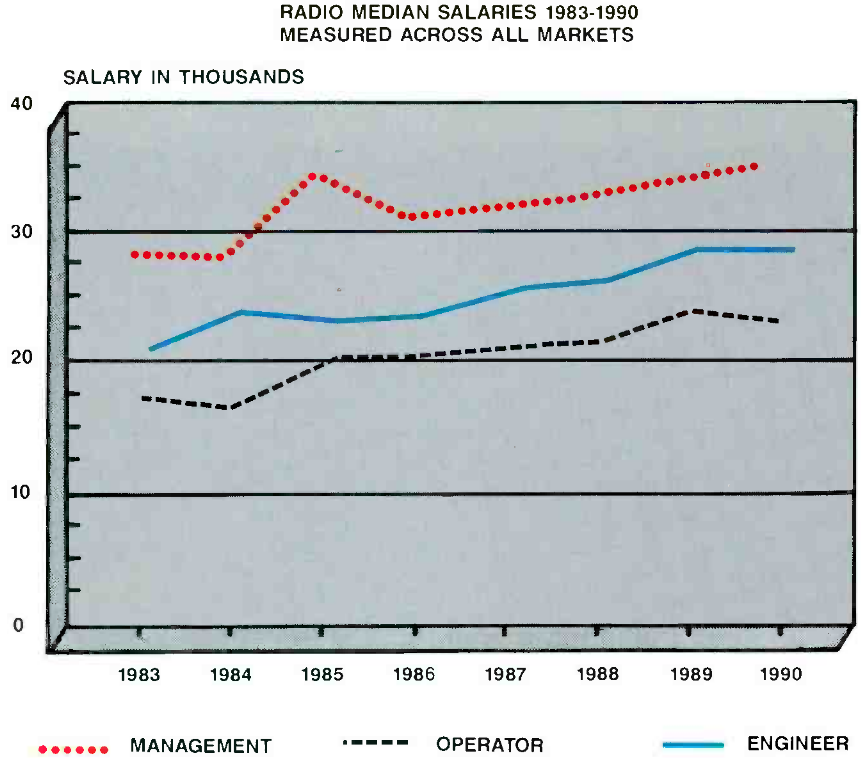

Figure 1. Radio's median salaries measured over all markets for the period from 1983-1990.

the 1983-1990 period. Although the increases have not been dramatic, the movement is still in the right direction.

Market size analysis

Looking at all three categories — engineering, operations and management — the percent of increases given to employees was similar. Measured over all markets and categories for radio and television, the median salary increase was 5%.

TV management salaries increased by 6% across most markets. Commercial TV station managers in the below top 100 TV markets received an 8% increase.

Radio station managers fared even better. The median increase for commercial radio station managers was 9%. Even the below top 100 market radio managers did well with a 10% increase. The top 100 radio market managers received 8% increases and the non-commercial and top 50 market managers received 5% increases.

Engineers didn't do so well. With responses measured over all markets for radio and television, engineers received 5% salary increases. That dropped to as low as 4% in the total commercial and top 50 TV markets. The top 50 radio market salaries increased by 6%. All other categories showed a 5% salary increase. This is nothing to write home about, but it's still movement in the right direction.

TV operator salaries were uniform at 5% increases. Radio operator salary increases were similar, but there were a few notable exceptions. Operator salaries in the total radio, top 100 and non-commercial categories increased 6%. The commercial radio top 50 market operator salaries went up a nice 12%.

Benefits package

As times become tougher, the type of benefits offered by a station become even more important. This is one area where the size difference between radio and TV stations is quite clear. The larger stations can offer better health and life insurance plans. Also, TV stations are often part of a larger corporation that can provide more benefits, such as stock purchase options, which many radio stations cannot. Fewer than 8% of any of the radio stations offered any stock purchase option. At the same time, no less than 13% and as many as 33% of the TV stations offered stock purchase plans for their employees.

Profit sharing was more common for radio stations than stock purchase plans. Even so, more TV stations than radio stations offered any type of profit sharing plan to the engineering staff.

Pension plans were twice as likely to be available at TV stations than they were at radio stations. Over all market sizes, only 27% of the radio stations provided a pen-

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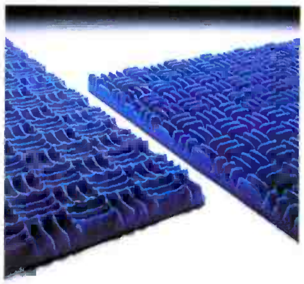

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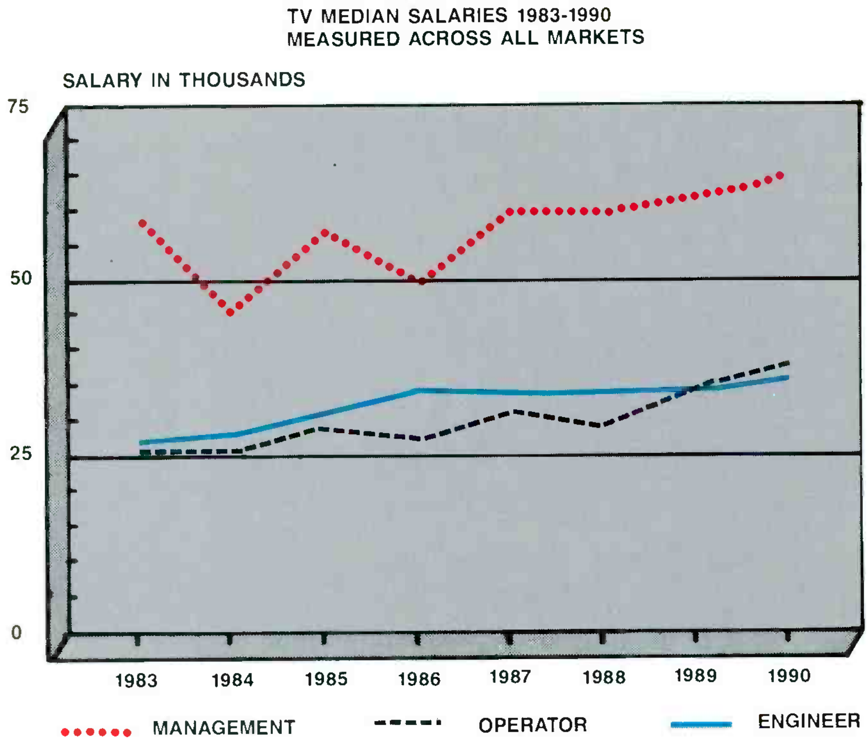

Figure 2. TV's median salaries measured over all markets for the period from 1983-1990.

sion plan. The same comparison for television shows that 54% of those stations have some form of pension available to employees. It's the technical staffs at small radio stations that suffer in this category. As few as 3% of the radio stations (top 100 markets) provided any type of pension plan to their staffs.

Radio station engineers did well in the travel category. From 23% to 47% of the radio stations provide support for engineers to attend trade shows and conventions. For TV stations, those numbers drop to the range from 18% to 36% for supported show attendance by engineers.

Cars are often used as part of a benefits package. You're about twice as likely to be provided with a car if you work in radio than if you work in television.

However, when it comes to being cheap, radio takes the cake. Fewer than 6% of the TV station engineers reported that their stations provided no benefits. However, radio engineers saw just the opposite. In the below top 100 markets, 22% of the stations provide no benefits to their radio engineers. Even when measured over all markets, more than 12% of the radio stations fail to support their technical staffs with any type of benefit program.

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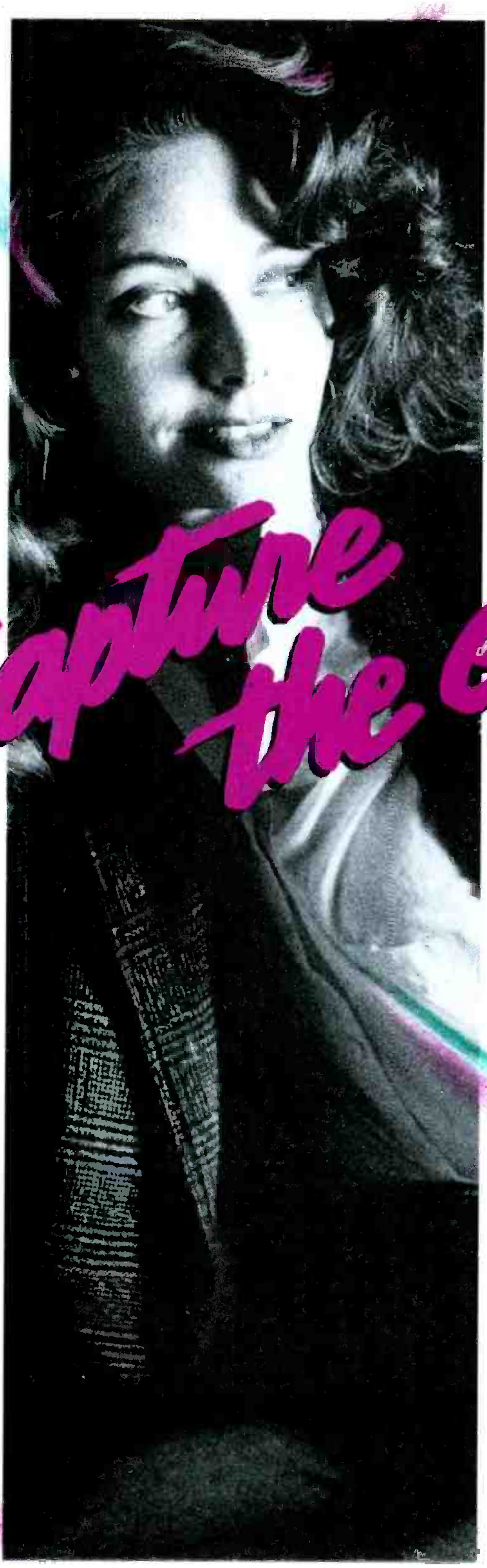
TABLE 1. — MANAGEMENT STAFF PROFILE*

Management	ALL MARKETS Total %	TELEVISION Total TV %	Top 50 %	Top 100 %	Below Top 100 %	Non-Comm. %	RADIO Total Radio %	Top 50 %	Top 100 %	Below Top 100 %	Non-Comm. %
Salary Level											
Less than $15,000	11.2	1.1	3.6	....	....	....	18.5	7.7	33.3	21.2	15.4
$15,000 to $24,999	7.4	4.4	3.6	10.0	....	8.3	9.7	15.4	....	12.1	5.1
$25,000 to $34,999	14.4	5.5	7.1	....	....	12.5	21.0	7.7	33.3	19.7	25.6
$35,000 to $49,999	23.3	17.6	....	20.0	20.7	33.3	27.4	....	16.7	24.2	43.6
$50,000 to $74,999	22.3	30.8	17.9	30.0	41.4	33.3	16.1	38.5	16.7	15.2	10.3
$75,000 or more	20.5	39.6	64.3	40.0	37.9	12.5	6.5	30.8	....	6.1	....
No response	0.9	1.1	3.6	....	....	....	0.8	....	....	1.5	....
Median =	$45,500	$66,964	$89,286	$66,667	$66,667	$48,125	$35,000	$60,000	$30,000	$32,692	$35,882
Received Salary Increase During Past Year	51.2	63.7	78.6	30.0	55.2	70.8	41.9	46.2	33.3	24.2	71.8
Percentage of increase											
Less than 3%	1.4	1.1	....	....	....	4.2	1.6	....	....	....	5.1
3% to 4%	6.0	6.6	14.3	....	3.4	4.2	5.6	15.4	....	....	12.8
5% to 9%	27.0	33.0	35.7	20.0	24.1	45.8	22.6	15.4	16.7	12.1	43.6
10% to 14%	10.2	14.3	10.7	10.0	17.2	16.7	7.3	15.4	16.7	7.6	2.6
15% or more	4.2	5.5	10.7	....	6.9	....	3.2	....	....	4.5	2.6
No response	2.3	3.3	7.1	....	3.4	....	1.6	....	....	....	5.1
Median =	6.0	6.0	6.0	6.0	8.0	6.0	6.0	5.0	8.0	10.0	5.0
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	76.7	81.3	78.6	100.0	82.8	75.0	73.4	92.3	83.3	68.2	74.4
Dental insurance (paid)	41.4	49.5	57.1	30.0	37.9	62.5	35.5	46.2	66.7	21.2	51.3
Life insurance (paid)	62.3	72.5	78.6	60.0	75.9	66.7	54.8	61.5	50.0	47.0	66.7
Sick leave	72.6	82.4	89.3	80.0	82.8	75.0	65.3	69.2	33.3	56.1	84.6
Vacation	84.7	89.0	92.9	100.0	93.1	75.0	81.5	100.0	100.0	75.8	82.1
Stock purchase plan	11.2	19.8	35.7	30.0	10.3	8.3	4.8	15.4	16.7	4.5	....
Profit sharing plan	17.2	25.3	35.7	30.0	27.6	8.3	11.3	15.4	16.7	16.7	....
Savings plan	14.9	26.4	57.1	20.0	13.8	8.3	6.5	15.4	....	....	15.4
Pension plan	38.6	49.5	57.1	50.0	41.4	50.0	30.6	23.1	33.3	4.5	76.9
Bonus	32.1	46.2	67.9	50.0	55.2	8.3	21.8	30.8	33.3	30.3	2.6
Trade show/convention/ seminar expenses paid	49.3	61.5	75.0	70.0	62.1	41.7	40.3	61.5	33.3	34.8	43.6
Tuition refund plan	23.3	24.2	28.6	20.0	13.8	33.3	22.6	23.1	....	4.5	56.4
Automobile furnished	36.3	44.0	50.0	70.0	48.3	20.8	30.6	30.8	33.3	45.5	5.1
No benefits	8.4	6.6	7.1	....	....	16.7	9.7	....	....	13.6	7.7
Other	2.8	3.3	3.6	10.0	....	4.2	2.4	....	....	....	7.7
No response	2.8	2.2	....	....	3.4	4.2	3.2	....	....	4.5	2.6
Years in Present Job											
1 to 2	21.9	14.3	10.7	10.0	10.3	25.0	27.4	7.7	16.7	30.3	30.8
3 to 4	12.6	16.5	28.6	....	3.4	25.0	9.7	7.7	16.7	6.1	15.4
5 to 9	26.0	33.0	28.6	40.0	41.4	25.0	21.0	30.8	....	24.2	15.4
10 to 14	19.5	17.6	10.7	30.0	17.2	20.8	21.0	7.7	50.0	21.2	20.5
15 to 24	12.1	8.8	10.7	20.0	10.3	....	14.5	23.1	16.7	13.6	12.8
25 or more	6.5	7.7	7.1	....	13.8	4.2	5.6	23.1	....	3.0	5.1
No response	1.4	2.2	3.6	....	3.4	....	0.8	....	....	1.5	....
Median =	7.0	7.0	5.0	10.0	8.0	5.0	7.0	12.0	10.0	7.0	5.0
Years in Broadcast Industry											
Less than 5	7.0	7.7	10.7	....	....	16.7	6.5	....	....	1.5	17.9
5 to 9	6.5	4.4	3.6	....	3.4	8.3	8.1	7.7	....	6.1	12.8
10 to 14	9.8	3.3	3.6	....	....	8.3	14.5	7.7	16.7	13.6	17.9
15 to 24	32.1	28.6	32.1	40.0	24.1	25.0	34.7	15.4	50.0	39.4	30.8
25 or more	44.2	54.9	50.0	60.0	69.0	41.7	36.3	69.2	33.3	39.4	20.5
No response	0.5	1.1	....	....	3.4	....	....	....	....	....	....
Median =	23.0	27.0	25.0	25.0	31.0	20.0	21.0	28.0	22.0	22.0	15.0
Do Part-Time or Free-Lance Work											
Yes	33.0	28.6	25.0	....	13.8	62.5	36.3	23.1	33.3	34.8	43.6
No	66.0	70.3	75.0	100.0	82.8	37.5	62.9	76.9	66.7	63.6	56.4
No response	0.9	1.1	....	....	3.4	....	0.8	....	....	1.5	....
Education											
High school	8.8	7.7	3.6	10.0	6.9	12.5	9.7	7.7	....	16.7	....
Some college	27.9	23.1	28.6	20.0	24.1	16.7	31.5	46.2	50.0	37.9	12.8
College grad (bachelor's degree)	34.9	39.6	39.3	50.0	41.4	33.3	31.5	30.8	33.3	36.4	23.1
College grad (master's, Ph.D.)	26.5	26.4	25.0	10.0	17.2	45.8	26.6	15.4	16.7	9.1	61.5
Technical school	10.7	9.9	3.6	20.0	13.8	8.3	11.3	15.4	....	15.2	5.1
Other	....	....	....	....	....	....	....	....	....	....	....
No response	3.3	3.3	3.6	....	6.9	....	3.2	....	....	3.0	5.1
Age, Years											
Under 25	2.8	1.1	....	....	....	4.2	4.0	....	....	....	12.8
25 to 34	9.3	8.8	7.1	....	....	25.0	9.7	7.7	....	10.6	10.3
35 to 44	30.2	17.6	17.9	40.0	10.3	16.7	39.5	38.5	16.7	40.9	41.0
45 to 54	33.0	41.8	42.9	40.0	37.9	45.8	26.6	7.7	50.0	27.3	28.2
55 to 64	17.7	20.9	25.0	10.0	31.0	8.3	15.3	46.2	16.7	13.6	7.7
65 or over	5.6	6.6	7.1	....	13.8	....	4.8	....	16.7	7.6	....
No response	1.4	3.3	....	10.0	6.9	....	....	....	....	....	....
Median =	47.1	50.0	50.8	44.9	54.1	45.9	44.2	44.9	51.7	44.6	41.3

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

Continued on page 36



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Panasonic Field Recording

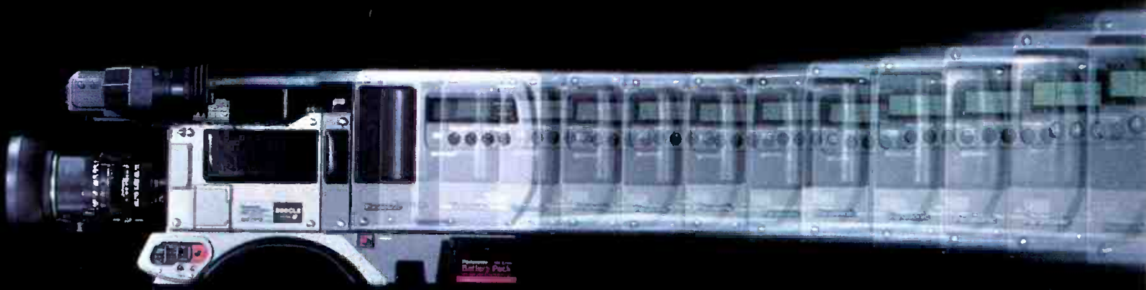

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TABLE 2. — ENGINEERING AND TECHNICAL STAFF PROFILE*

Continued from page 32

	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	8.2	3.2	0.7	2.0	11.3	2.9	15.5	5.6	10.0	21.7	26.2
$15,000 to $24,999	18.6	15.6	4.3	20.0	30.2	24.3	23.0	8.3	26.7	39.1	19.0
$25,000 to $34,999	29.6	29.9	19.1	46.0	34.0	37.1	29.1	23.6	36.7	27.5	35.7
$35,000 to $49,999	23.9	25.8	31.9	24.0	15.1	22.9	21.1	33.3	23.3	10.1	16.7
$50,000 to $74,999	17.5	22.3	38.3	4.0	9.4	12.9	10.3	26.4	3.3	1.4	2.4
$75,000 or more	2.1	2.9	5.7	2.0	....	....	0.9	2.8	....	....	....
No response	0.2	0.3	....	2.0	....	....	....	....	....	....	....
Median =	$32,821	$35,556	$47,000	$30,652	$27,222	$31,154	$28,871	$40,625	$28,636	$22,153	$26,333
Received Salary Increase During Past Year	73.2	82.5	86.5	84.0	69.8	82.9	59.6	75.0	60.0	40.6	64.3
Percentage of increase											
Less than 3%	4.4	5.1	6.4	6.0	5.7	1.4	3.3	1.4	6.7	2.9	4.8
3% to 4%	26.9	35.0	39.0	36.0	24.5	34.3	15.0	18.1	6.7	11.6	21.4
5% to 9%	29.4	31.5	31.2	38.0	26.4	31.4	26.3	37.5	30.0	10.1	31.0
10% to 14%	7.4	6.7	8.5	2.0	7.5	5.7	8.5	9.7	10.0	8.7	4.8
15% or more	4.2	3.5	1.4	2.0	5.7	7.1	5.2	8.3	3.3	4.3	2.4
No response	0.9	0.6	....	....	....	2.9	1.4	....	3.3	2.9	....
Median =	5.0	5.0	4.0	5.0	5.0	5.0	5.0	6.0	5.0	5.0	5.0
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	80.3	83.4	86.5	76.0	67.9	94.3	75.6	83.3	83.3	65.2	73.8
Dental insurance (paid)	52.0	60.5	63.1	54.0	43.4	72.9	39.4	61.1	26.7	17.4	47.6
Life insurance (paid)	61.3	67.5	73.8	54.0	56.6	72.9	52.1	72.2	53.3	31.9	50.0
Sick leave	82.9	90.8	91.5	86.0	86.8	95.7	71.4	83.3	73.3	60.9	66.7
Vacation	90.3	96.2	98.6	94.0	90.6	97.1	81.7	88.9	90.0	72.5	78.6
Stock purchase plan	15.0	21.0	32.6	24.0	13.2	1.4	6.1	8.3	10.0	5.8	....
Profit sharing plan	15.2	18.2	22.0	24.0	26.4	....	10.8	13.9	10.0	14.5	....
Savings plan	23.9	30.3	41.8	26.0	22.6	15.7	14.6	33.3	6.7	1.4	9.5
Pension plan	42.7	53.5	58.9	44.0	22.6	72.9	26.8	38.9	3.3	8.7	52.4
Bonus	10.2	9.6	12.8	8.0	11.3	2.9	11.3	16.7	10.0	10.1	4.8
Trade show/convention/ seminar expenses paid	31.7	28.7	35.5	18.0	28.3	22.9	36.2	47.2	33.3	26.1	35.7
Tuition refund plan	30.2	37.6	46.1	28.0	20.8	40.0	19.2	26.4	....	5.8	42.9
Automobile furnished	15.0	11.8	8.5	12.0	24.5	8.6	19.7	27.8	16.7	20.3	7.1
No benefits	5.5	1.6	0.7	2.0	5.7	....	11.3	6.9	3.3	21.7	7.1
Other	2.7	2.2	1.4	6.0	....	2.9	3.3	2.8	6.7	4.3	....
No response	0.8	0.3	0.7	....	....	....	1.4	1.4	....	....	4.8
Years in Present Job											
1 to 2	19.9	19.4	15.6	22.0	34.0	14.3	20.7	22.2	26.7	18.8	16.7
3 to 4	18.0	16.6	14.9	22.0	17.0	15.7	20.2	19.4	20.0	21.7	19.0
5 to 9	24.5	20.4	21.3	14.0	15.1	27.1	30.5	26.4	30.0	31.9	35.7
10 to 14	15.4	18.8	19.1	24.0	7.5	22.9	10.3	11.1	6.7	10.1	11.9
15 to 24	13.3	13.7	14.2	14.0	9.4	15.7	12.7	13.9	10.0	11.6	14.3
25 or more	7.8	9.9	14.2	2.0	15.1	2.9	4.7	5.6	3.3	5.8	2.4
No response	1.1	1.3	0.7	2.0	1.9	1.4	0.9	1.4	3.3	....	....
Median =	6.0	7.0	9.0	5.0	4.0	8.0	5.0	5.0	5.0	5.0	5.0
Years in Broadcast Industry											
Less than 5	6.1	5.7	3.5	8.0	11.3	4.3	6.6	4.2	10.0	5.8	9.5
5 to 9	14.8	14.3	12.1	12.0	17.0	18.6	15.5	11.1	20.0	14.5	21.4
10 to 14	17.3	17.5	14.9	18.0	15.1	24.3	16.9	12.5	10.0	21.7	21.4
15 to 24	34.7	32.5	34.0	48.0	22.6	25.7	38.0	48.6	40.0	33.3	26.2
25 or more	26.2	28.7	34.8	12.0	32.1	25.7	22.5	23.6	16.7	24.6	21.4
No response	0.9	1.3	0.7	2.0	1.9	1.4	0.5	....	3.3	....	....
Median =	17.0	18.0	20.0	16.0	16.0	17.0	17.0	19.0	17.0	17.0	13.0
Do Part-Time or Free-Lance Work											
Yes	45.0	34.4	31.2	26.0	30.2	50.0	60.6	59.7	66.7	65.2	50.0
No	53.9	64.0	68.1	72.0	66.0	48.6	39.0	40.3	30.0	34.8	50.0
No response	1.1	1.6	0.7	2.0	3.8	1.4	0.5	....	3.3	....	....
Education											
High school	19.0	22.6	20.6	14.0	39.6	20.0	13.6	15.3	13.3	15.9	7.1
Some college	42.5	42.0	43.3	48.0	39.6	37.1	43.2	41.7	60.0	42.0	35.7
College grad (bachelor's degree)	27.7	27.4	29.1	26.0	17.0	32.9	28.2	31.9	10.0	23.2	42.9
College grad (master's, Ph.D.)	3.4	3.2	4.3	....	....	5.7	3.8	5.6	3.3	1.4	4.8
Technical school	39.8	42.7	46.1	38.0	45.3	37.1	35.7	31.9	46.7	37.7	31.0
Other	0.4	0.6	....	2.0	1.9	....	....	....	....	....	....
No response	0.9	1.3	0.7	2.0	1.9	1.4	0.5	....	3.3	....	....
Age, Years											
Under 25	2.5	2.2	2.1	4.0	1.9	1.4	2.8	2.8	....	2.9	4.8
25 to 34	23.1	22.6	18.4	26.0	32.1	21.4	23.9	25.0	36.7	14.5	28.6
35 to 44	37.8	35.0	36.9	46.0	22.6	32.9	41.8	43.1	33.3	44.9	40.5
45 to 54	22.2	24.8	27.7	16.0	18.9	30.0	18.3	19.4	13.3	18.8	19.0
55 to 64	10.2	12.7	12.8	6.0	20.8	11.4	6.6	5.6	10.0	7.2	4.8
65 or over	3.2	1.3	1.4	....	1.9	1.4	6.1	4.2	3.3	11.6	2.4
No response	0.9	1.3	0.7	2.0	1.9	1.4	0.5	....	3.3	....	....
Median =	41.3	42.0	42.9	38.9	41.7	42.8	40.5	40.2	38.0	42.1	39.1

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

Consider your salary

Just comparing your salary against the median is not sufficient. You need to also consider where your salary falls within the six ranges of salaries.

Figure 3 shows the percentage of management salaries reported in each of the categories. Similar results are shown for engineering salaries in Figure 4 and operator salaries in Figure 5.

There was an increase in the percentages of management salaries in the top and bottom end of the scale. Last year, approximately 14% of the management respondents said they earned between $15,000 and $25,000. That figure fell to 7% this year. However, the number of managers making less than $15,000 increased. That was primarily based on low salaries paid to radio managers.

Fewer managers (a drop of 8%) reported salaries in the $25,000 to $35,000 category. There was an increase in each of the higher- paid categories of the management salaries. The largest change was in the greater than $75,000 category. Last year, 16% of the respondents indicated their salary was in this category. This year, that category increased to 21%.

Last year, 75% of the engineering salaries fell in the three brackets between $15,000 and $50,000. This year, those three brackets accounted for 73% of the respondents' salaries. The difference was in the higher bracket salaries. Five percent more (18%) of the respondents said their salaries were in the $50,000 to $75,000 category. For the first time, more than 2% of the respondents said their salaries were above $75,000.

Older engineers

Another interesting fact was evident from the survey results. Broadcast engineers are getting older. The median age for engineers last year was 39.9. This year, that number jumped to 41.3. Paralleling that fact is that the median number of years in the industry for engineers is increasing. The median number of years working in the broadcast industry for engineers has increased at the rate of 0.5 years per year since 1987. If younger engineers were replacing those who retire, that number would not consistently climb. Look around. How many young (less than 30 years old) engineers are working in your station?

Conversely, we see a drop in the median age of management and operators. Paralleling this change is a decrease in the number of years in the industry and number of years in their present job. This may mean that younger people are entering these two job areas, but are not entering the technical field.

SBE certification gains

SBE certification continues its growth as

Continued on page 42

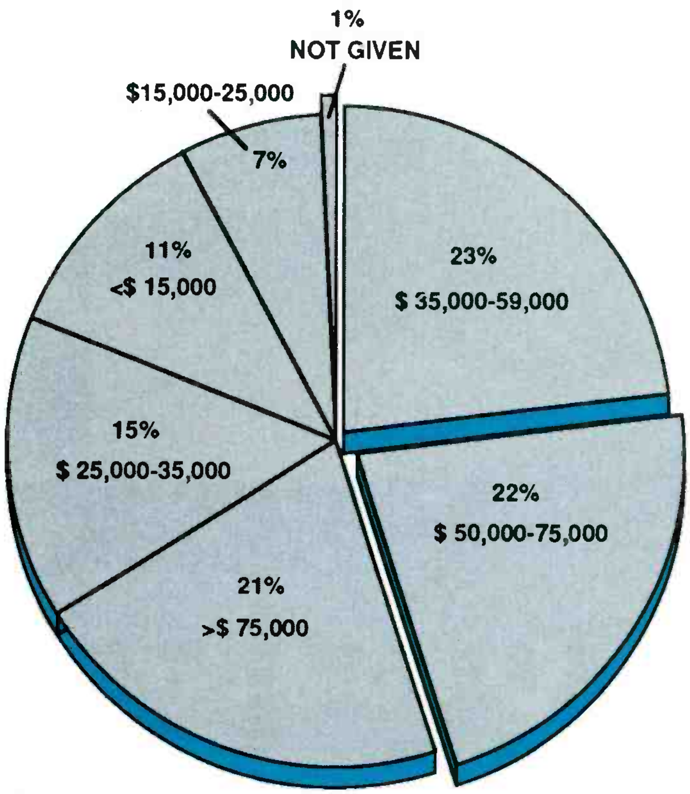

Figure 3. *Percentage of management respondents listing a salary within the categories shown.*

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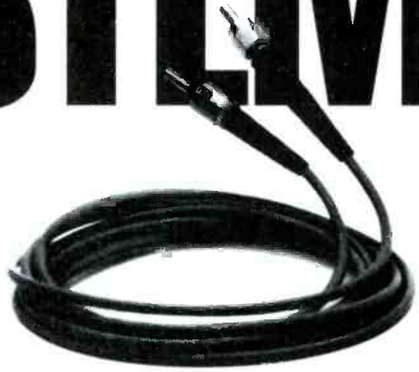

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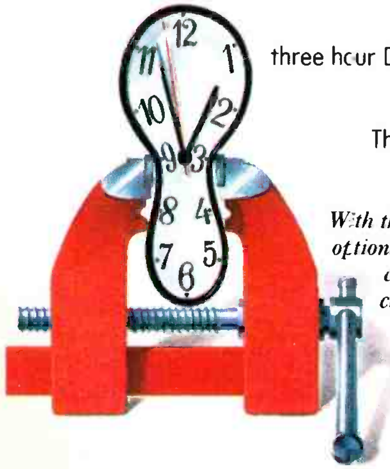
Circle (22) on Reply Card

D-2 has expanded the li
Now it can co

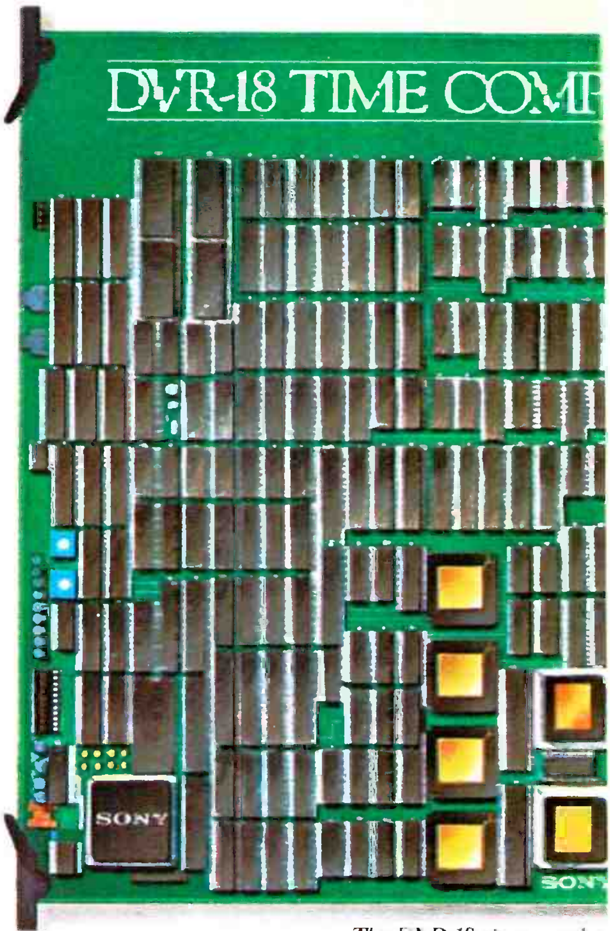
It was only a matter of time. Now Sony D-2 composite digital video offers broadcasters something they've been waiting for. Time compression. It's an option now available on the DVR-18, Sony's three hour D-2 VTR.



With the DVR-18's optional time compression, you can squeeze more out of the time you've got.

The DVR-18's time compression and expansion feature is remarkably advanced. A single plug-in module provides full audio data recovery as well as precise digital pitch correction for two stereo pairs of audio signals at the same time. For example, your main audio channels and your SAP. All without the need for any external equipment.

Plus, the DVR-18 gives you Sony's advanced picture processing for the highest quality video playback. And since it's digital, you'll get a time



The DVR-18 gives you the

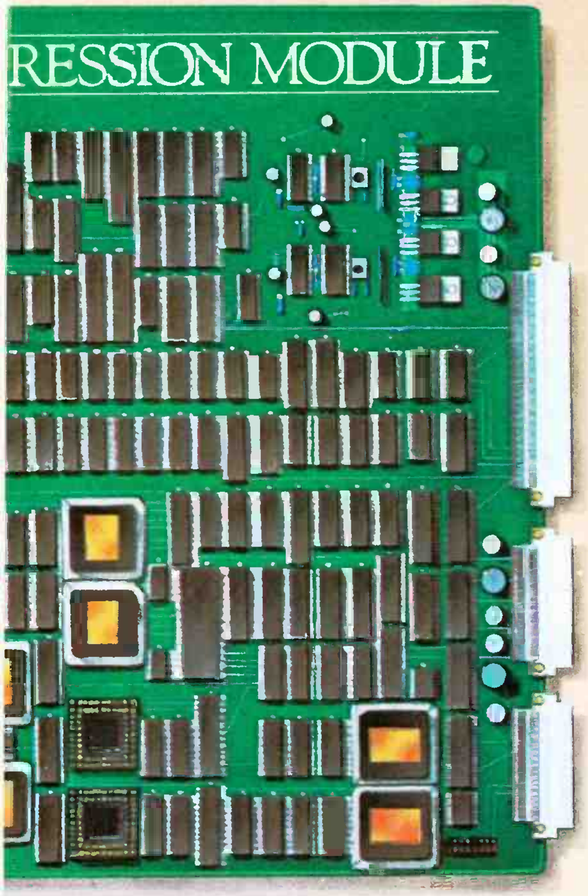
compressed program without losing a generation.

Of course, the DVR-18's time compression

The DVR-18's pitch correction makes it easy to keep your audio in tune, without the need for external equipment.

and expansion isn't the only reason why broad-

mits of video and audio.
mpress them.



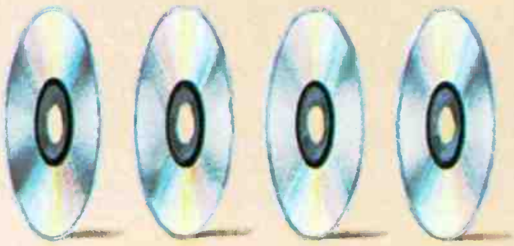
ption of time compression.

casters should consider D-2. The DVR-18 offers recognizable color pictures at shuttle speeds up to 100X play speed. It can also accommodate all three D-2 cassette sizes. So it can give you a full three hour capacity. And it can pre-stripe tape stock at three times normal speed for insert editing.

The DVR-18 also has an optional serial digital interface. Which means simple, convenient connection to other digital equipment.

When you compare the size of a Sony DVR-18 to a regular 1-inch video tape recorder, you'll find the DVR-18 to be about three times smaller. That's a pretty big advantage to a TV station, where space is always at a premium.

To find out more information about the



The DVR-18 lets you compress four audio signals at the same time.

DVR-18, call 1-800-635-SONY.

Because if you haven't thought about what Sony D-2 technology can do for your station, maybe now is the time.

SONY.

BROADCAST PRODUCTS

D-2

D-2

Continued from page 38
the industry evaluation standard. There has been a 7% increase in the median number of radio and TV engineers holding SBE certification in only one year. The number of TV engineers with SBE certification grew by 3%. The most dramatic increase was seen in the top 100 TV markets with almost 21% of the TV engineers claiming SBE certification.

The radio situation remains relatively unchanged with one exception. Over all markets, 24% of the respondents claimed SBE certification. That's the same number as last year. However, in the below top 100 markets, the number of engineers with SBE certification fell from 23% to 16%.

At first I thought that the difference might be accounted for by new, younger engineers entering the field. Being new, they might not have had time to obtain their SBE certification. That assumption proved to be incorrect.

A look at the median age by market size shows that the oldest engineers work at the smallest stations. The median age for radio engineers in the below top 100 markets is 42.1 years. That number jumps to 42.9 years in the same-sized TV market. The youngest engineers in radio and television are in the top 100 markets.

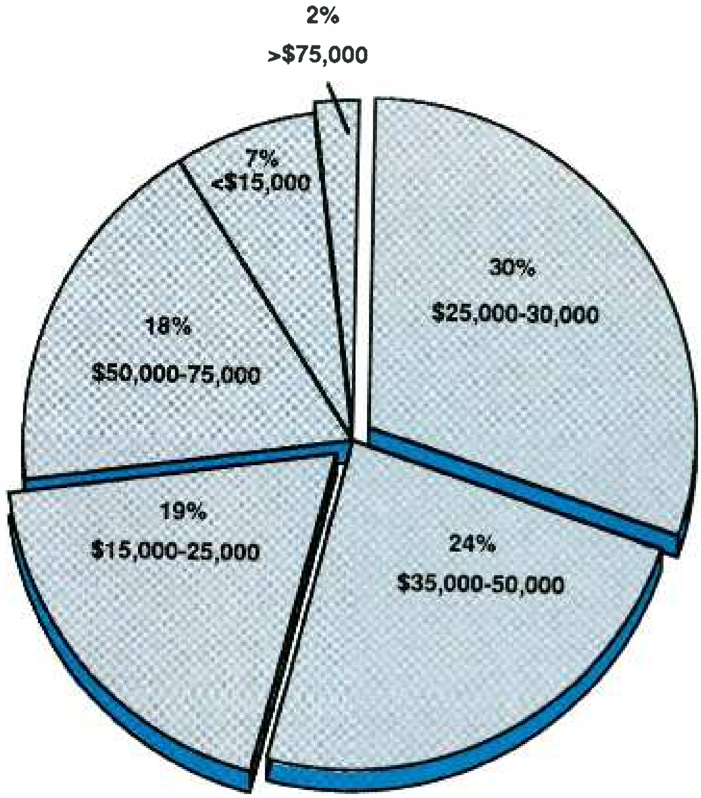
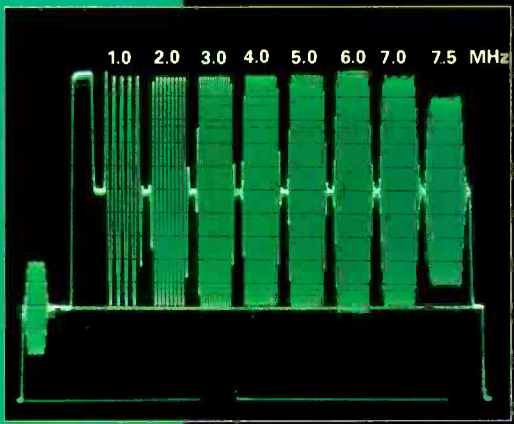
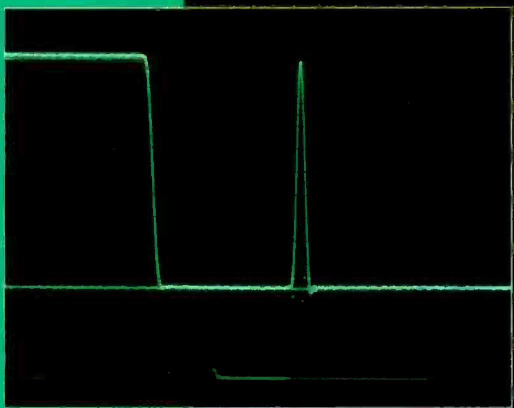


Figure 4. *Percentage of engineering respondents listing a salary within the categories shown.*

The best just got better! Announcing the 7.5 MHZ Series of Time Base Correctors and Synchronizers.



Flat at 7 MHz, the 7.5 MHZ Series shows ultra stable signal response at a full 7.5 MHz with little or no degradation.



The 7.5 MHZ Series faithfully produces a 2T K factor of less than 0.25%.

These photos show actual waveform outputs produced by an off-the-shelf 7.5 MHZ unit.

Now, Prime Image brings you the 7.5 MHZ Series, the latest in sophisticated time base correctors and synchronizers for superior bandwidth signal handling: 7.5 MHz with impulse response of 0.25%.

The 7.5 MHZ Series also provides variable noise reduction up to 20 dB, passes VITS and VIRS, and transcodes between Y/C, Y/688, Y/R-Y/B-Y, and composite—all outputs available with any input type. Time base correction for 1/2" and 3/4" VCRs in Betacam, Betacam SP, MII, U-Matic, U-Matic SP, Hi-8, S-VHS, and ED Beta formats.

Ideal for down-link cable and wide bandwidth broadcast applications, 7.5 MHZ products feature the same reliability and high operating standards as all Prime Image TBCs and Synchronizers.

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Circle (25) on Reply Card

TABLE 3. — OPERATIONS STAFF PROFILE*

	ALL MARKETS	TELEVISION					RADIO				
Operations	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	10.1	3.6	2.6	5.1	....	6.3	22.8	....	16.7	45.5	18.5
$15,000 to $24,999	30.4	27.7	14.5	17.9	50.0	41.7	35.6	50.0	33.3	36.4	33.8
$25,000 to $34,999	28.0	28.7	25.0	38.5	31.3	25.0	26.7	25.0	33.3	18.2	29.2
$35,000 to $49,999	19.9	23.6	25.0	28.2	15.6	22.9	12.9	12.5	16.7	....	16.9
$50,000 to $74,999	9.8	13.8	27.6	7.7	3.1	4.2	2.0	12.5	....	....	1.5
$75,000 or more	1.7	2.6	5.3	2.6	....	....	....	....	....	....	....
No response	....	....	....	....	....	....	....	....	....	....	....
Median =	$28,373	$37,429	$39,737	$31,667	$25,000	$25,833	$22,750	$25,000	$25,000	$16,667	$24,091
Received Salary Increase During Past Year	77.0	81.0	84.2	82.1	71.9	81.3	69.3	50.0	83.3	54.5	75.4
Percentage of increase											
Less than 3%	5.7	6.7	5.3	....	15.6	8.3	4.0	....	....	4.5	4.6
3% to 4%	21.3	23.6	26.3	25.6	18.8	20.8	16.8	....	....	22.7	18.5
5% to 9%	39.5	41.5	44.7	43.6	31.3	41.7	35.6	25.0	66.7	22.7	38.5
10% to 14%	3.4	3.1	3.9	5.1	....	2.1	4.0	....	....	4.5	4.6
15% or more	6.1	4.6	2.6	5.1	3.1	8.3	8.9	25.0	16.7	....	9.2
No response	1.0	1.5	1.3	2.6	3.1	....	....	....	....	....	....
Median =	5.0	5.0	5.0	5.0	5.0	5.0	6.0	12.0	6.0	5.0	6.0
Fringe Benefits Received (Adds to more than 100% due to multiple answers)											
Medical insurance (paid)	79.7	81.0	78.9	82.1	75.0	87.5	77.2	87.5	83.3	59.1	81.5
Dental insurance (paid)	51.7	56.9	56.6	51.3	56.3	62.5	41.6	62.5	33.3	13.6	49.2
Life insurance (paid)	62.5	67.7	68.4	66.7	59.4	72.9	52.5	62.5	33.3	45.5	55.4
Sick leave	88.9	93.8	90.8	97.4	100.0	91.7	79.2	100.0	100.0	54.5	83.1
Vacation	94.3	97.9	96.1	100.0	100.0	97.9	87.1	100.0	100.0	81.8	86.2
Stock purchase plan	12.8	17.4	27.6	20.5	9.4	4.2	4.0	37.5	....	....	1.5
Profit sharing plan	14.9	20.0	25.0	28.2	25.0	2.1	5.0	....	16.7	9.1	3.1
Savings plan	22.6	28.7	47.4	30.8	12.5	8.3	10.9	37.5	....	4.5	10.8
Pension plan	47.0	50.3	55.3	41.0	46.9	52.1	40.6	12.5	16.7	9.1	56.9
Bonus	15.9	18.5	25.0	25.6	15.6	4.2	10.9	25.0	33.3	18.2	4.6
Trade show/convention/ seminar expenses paid	33.4	31.8	31.6	30.8	28.1	35.4	36.6	25.0	50.0	13.6	44.6
Tuition refund plan	27.0	29.2	39.5	20.5	15.6	29.2	22.8	25.0	....	....	32.3
Automobile furnished	4.4	6.2	5.3	7.7	15.6	....	1.0	....	....	....	1.5
No benefits	3.0	1.0	2.6	....	....	....	6.9	....	....	13.6	6.2
Other	2.4	2.1	1.3	....	6.3	2.1	3.0	....	....	4.5	3.1
No response	0.3	....	....	....	....	....	1.0	....	....	....	1.5
Years in Present Job											
1 to 2	29.7	27.2	27.6	41.0	12.5	25.0	34.7	50.0	33.3	40.9	30.8
3 to 4	20.3	21.0	23.7	12.8	25.0	20.8	18.8	12.5	50.0	9.1	20.0
5 to 9	29.7	32.8	26.3	43.6	37.5	31.3	23.8	25.0	16.7	22.7	24.6
10 to 14	11.8	10.3	13.2	2.6	9.4	12.5	14.9	....	....	13.6	18.5
15 to 24	5.4	7.2	6.6	....	12.5	10.4	2.0	....	....	4.5	1.5
25 or more	1.4	....	....	....	....	....	4.0	....	....	9.1	3.1
No response	1.7	1.5	2.6	....	3.1	....	2.0	12.5	....	....	1.5
Median =	4.0	5.0	4.0	4.0	6.0	5.0	4.0	2.0	4.0	4.0	4.0
Years in Broadcast Industry											
Less than 5	7.8	6.7	5.3	5.1	6.3	10.4	9.9	....	....	9.1	12.3
5 to 9	19.9	18.5	15.8	20.5	15.6	22.9	22.8	25.0	16.7	13.6	26.2
10 to 14	24.3	24.6	17.1	35.9	34.4	20.8	23.8	....	33.3	22.7	26.2
15 to 24	34.5	37.9	46.1	30.8	34.4	33.3	27.7	37.5	50.0	31.8	23.1
25 or more	11.8	10.8	13.2	7.7	6.3	12.5	13.9	25.0	....	22.7	10.8
No response	1.7	1.5	2.6	....	3.1	....	2.0	12.5	....	....	1.5
Median =	14.0	14.0	16.0	14.0	14.0	14.0	13.0	20.0	15.0	15.0	12.0
Do Part-Time or Free-Lance Work											
Yes	44.6	46.2	47.4	33.3	40.6	58.3	41.6	62.5	33.3	31.8	43.1
No	53.7	52.3	50.0	66.7	56.3	41.7	56.4	25.0	66.7	68.2	55.4
No response	1.7	1.5	2.6	....	3.1	....	2.0	12.5	....	....	1.5
Education											
High school	11.5	10.8	7.9	12.8	21.9	6.3	12.9	37.5	33.3	27.3	3.1
Some college	26.7	28.7	25.0	25.6	43.8	27.1	22.8	12.5	16.7	27.3	23.1
College grad (bachelor's degree)	50.0	52.3	59.2	51.3	34.4	54.2	45.5	37.5	33.3	40.9	49.2
College grad (master's, Ph.D.)	11.8	9.2	6.6	12.8	....	16.7	16.8	....	16.7	9.1	21.5
Technical school	12.5	11.8	13.2	10.3	9.4	12.5	13.9	12.5	....	27.3	10.8
Other	....	....	....	....	....	....	....	....	....	....	....
No response	2.4	2.6	2.6	2.6	6.3	....	2.0	12.5	....	....	1.5
Age, Years											
Under 25	7.4	4.6	3.9	2.6	3.1	8.3	12.9	12.5	....	18.2	12.3
25 to 34	32.8	33.8	30.3	41.0	37.5	31.3	30.7	12.5	66.7	31.8	29.2
35 to 44	42.2	43.6	48.7	43.6	46.9	33.3	39.6	50.0	33.3	31.8	41.5
45 to 54	11.1	12.3	11.8	10.3	....	22.9	8.9	12.5	....	18.2	6.2
55 to 64	3.7	3.1	2.6	....	6.3	4.2	5.0	....	....	....	7.7
65 or over	0.3	....	....	....	....	....	1.0	....	....	....	1.5
No response	2.4	2.6	2.6	2.6	6.3	....	2.0	12.5	....	....	1.5
Median =	37.0	37.4	38.0	36.2	36.3	38.1	36.3	37.5	32.5	34.9	36.9

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

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Tektronix

This may indicate that the smaller radio and TV stations are relying on part-time, retired or consulting engineers. It's possible that a part-time engineer or professional consultant would have less use or desire to obtain SBE certification.

There is one other factor that indicates the benefits of SBE certification — salary. The data shows that the highest percentage of respondents with SBE certification had salaries in the $35,000 to $49,999 range (33%). Conversely, the highest percentage of respondents without SBE certification had salaries in the $25,000 to $34,999 range (27%). As in years past, SBE certification pays.

The future

It doesn't take a rocket scientist to recognize that broadcast engineering has changed dramatically in the past 15 years. Those left in the industry should realize that things are not going to return to the old days of large technical staffs in radio and TV stations. If you're one of the few who believes that's going to happen, I feel sorry for you.

I was recently invited to speak before the Mexican version of SBE — AMITRA. While in their country, I learned a lot about the Mexican broadcast industry. In

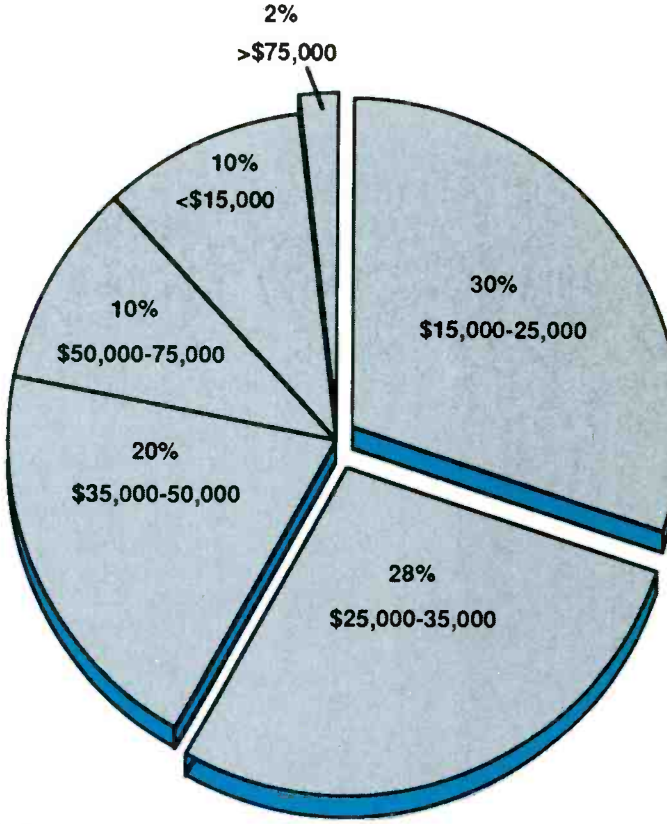

Figure 5. *Percentage of operations respondents listing a salary within the categories shown.*

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TABLE 4. — MEDIAN SALARY SUMMARY FOR 1989 and 1990, TV

	1989 SURVEY					1990 SURVEY				
Category	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial
Management	$63,125	$75,000	$62,500	$72,500	$55,550	$66,964	$89,286	$66,667	$66,667	$48,125
Engineering	$34,500	$45,800	$31,300	$24,250	$32,100	$35,556	$47,000	$30,652	$27,222	$31,154
Operations	$33,850	$45,950	$35,000	$24,150	$30,500	$37,429	$39,737	$31,667	$25,000	$25,833

TABLE 5. — MEDIAN SALARY SUMMARY FOR 1989 and 1990, RADIO

	1989 SURVEY					1990 SURVEY				
Category	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial	All Markets	Top 50	Top 100	Below Top 100	Non-Commercial
Management	$34,200	$62,500	$25,000	$35,000	$33,650	$35,000	$60,000	$30,000	$32,692	$35,882
Engineering	$29,000	$39,650	$29,000	$21,750	$27,000	$28,871	$40,625	$28,636	$22,153	$26,333
Operations	$23,600	$30,550	$25,000	$21,750	$23,750	$22,750	$25,000	$25,000	$16,667	$24,091

TABLE 6. — MEDIAN SALARIES ACROSS ALL MARKETS

	TELEVISION				RADIO			
Category	1987	1988	1989	1990	1987	1988	1989	1990
Management	$61,250	$61,500	$63,125	$66,964	31,900	$33,000	$34,200	$35,000
Engineering	$34,300	$34,700	$34,500	$35,556	$25,800	$26,600	$29,000	$28,871
Operations	$30,900	$28,900	$33,850	$37,429	$20,950	$21,300	$23,600	$22,750

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

	MANAGEMENT			ENGINEERING			OPERATIONS		
Category	1988	1989	1990	1988	1989	1990	1988	1989	1990
Salary Level	$42,500	$42,100	$45,500	$31,000	$31,900	$32,821	$24,200	$28,100	$28,373
Received Salary Increase	56.2%	56.2%	51.2%	74.6%	67.8%	73.2%	69.8%	75.7%	77%
Amount of Increase	7.6%	7.4%	6%	5.9%	5.8%	5%	6.7%	5.7%	5%
Years in Present Job	6.7	7.0	7.0	6.4	7.5	6.0	4.5	4.2	4.0
Years in Broadcasting	21.2	26.0	23.0	16.3	16.9	17.0	13.8	15.4	14.0
Does Free-Lance Work	28.1%	32.1%	33%	47.9%	47.3%	45%	50.4%	56.2%	44.6%
College Graduate	63.8%	64.8%	60.5%	30.5%	32.9%	30.7%	59%	60.6%	60.5%
Age, Years	44.8	53.6	47.1	39.1	39.9	41.3	34.7	37.4	37.0

many ways, I believe they are 10 years ahead of us.

In the United States, we have a median of two engineers per radio station. That's down 26% in only four years. Although we complain vehemently (justifiably so) about the loss of jobs, we need only look to our Southern brothers to see how efficient a station can really be.

In Mexico, there are three radio stations per engineer. No one is suggesting that our industry could, or should, operate with such small staffs. Even so, the difference does suggest that technology and the drive for profits will continue to create pressure for engineers to be more efficient. This may mean smaller staffs. On the other hand, this pressure also creates new opportunities for those who are knowledgeable and want to work.

As technology becomes more complex, the ability for non-technical people to understand it becomes even more difficult. Station managers will increasingly rely on the technical people they trust to make technical decisions for their stations. The high cost of new technology prohibits making purchasing mistakes. Stations can't afford to purchase the wrong equipment. That's where the successful engineers of the '90s come in.

The survey form always asks for comments on trends and issues in the broadcast industry. Although there are plenty of nay-sayers and complainers, this year's

Continued on page 99

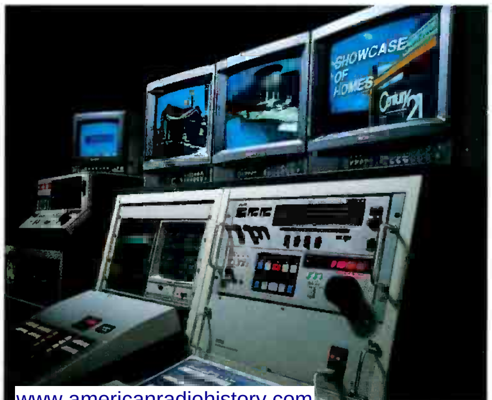
A TRUE HOME SHOPPING NETWORK

Garden Grove, CA—It's among the richest real estate markets in the world. From its modest bungalows to its sprawling mansions, Southern California stands alone. The buying and selling is frenzied. And so is the competition among realtors. To make a difference in that crowded market, you must make a big impression.

For one of the most successful area realtors, Sony video is helping to provide that competitive edge. To showcase more homes more effectively, some two dozen Century 21 offices in the Los Angeles area (including four of the top ten Century 21 offices in the USA) now promote their properties on a cable TV program called *Showcase of Homes*.

"Think of how much time and effort go into one agent's showing one potential buyer a single property," explains David Loveless, general manager of Brighton Communications, the company that produces *Showcase of Homes* for Century 21. "With every nightly broadcast of *Showcase of Homes*," he says, "we help our Century 21 clients spotlight properties to hundreds of thousands of potential buyers." *Showcase of Homes* appears five nights a week on cable systems from Los Angeles to San Diego.

"We get new listings every day from Century 21," Loveless explains, "and we go out with our Sony equipment to shoot the houses, inside and out." Each video provides a full tour of the house and its setting. What's more, Brighton's team also shoots video profiles of neighborhoods throughout the area. "Southern California is so big and so varied," Loveless says, "video is the only way to give potential buyers an in-depth look at neighborhoods they might never even consider otherwise." In short, video helps Century 21 overcome distance, conquer time, expand market potential, and make every agent's in-person sales calls much more meaningful.



Brighton uses Sony equipment from start to finish because it responds to the production company's various needs extremely well. They shoot on Sony Professional Video's top-of-the-line DXC-M7 cameras. Whether recording sun filled back yards or dimly lit studies and dens, the cameras adjust to the many different lighting situations found in the homes. Thanks to the excellent pictures generated by the cameras, the homes look their best, making the realtors' jobs easier. The cam-

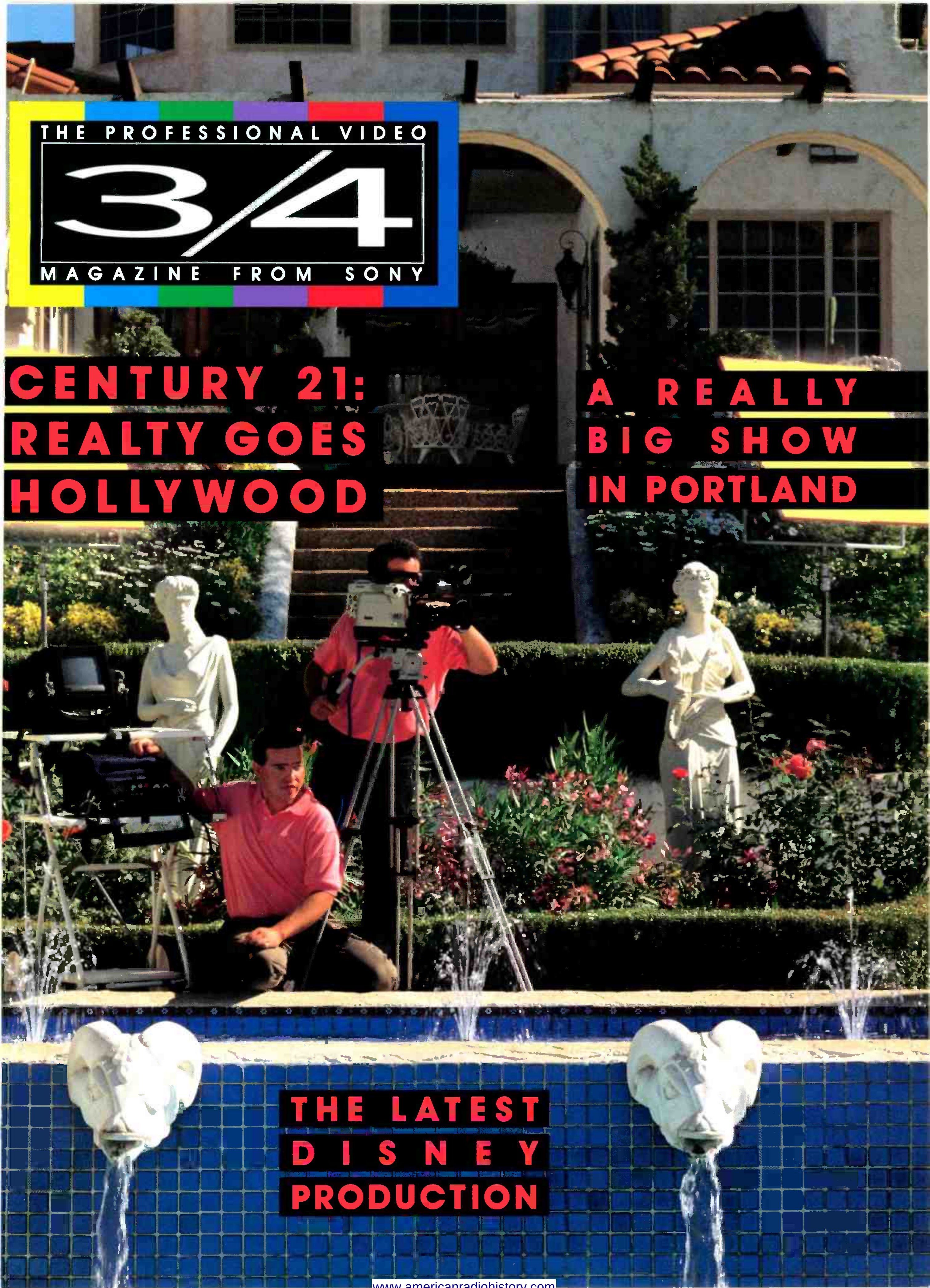
THE PROFESSIONAL VIDEO

3/4

MAGAZINE FROM SONY

CENTURY 21: REALTY GOES HOLLYWOOD

A REALLY BIG SHOW IN PORTLAND



THE LATEST DISNEY PRODUCTION

Developing an engineering budget

Building a technical budget is a valuable process for engineers.

By Ronald F. Balonis

Broadcast engineers and business managers generally have little in common. The engineer is concerned with achieving technical or operational goals, the manager is interested in the costs of achieving them. In today's broadcast world, however, they cannot disagree on the importance of the bottom line, because it supports the structure of any broadcasting entity. Today, broadcasting is a big business, incorporating more than 10,000 radio stations. It's a competitive world, in which each station fights for listeners, and battles other media for supporting revenue.

From a business standpoint, it takes more than the best sound, the glitziest equipment or the most aggressive sales force to achieve a profit and maintain the bottom line. In any competitive business, it takes planning, coordination and control over resources and operations. It requires a budget, a budget-building process, and a shared bottom-line mentality.

A budget is a deceptively simple list of numbers that result from the budgeting process. That process is an effective business tool, because it forces thinking in terms of functions, and sharpens decision-making. It helps locate problems, coordinate activities and facilitate objective, goal-oriented planning and evaluation of the operation.

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

Although operating within a budget may seem like a handicap because of the control and accountability it represents, for the engineer it can become a useful tool for improving maintenance and the overall technical operation. Broadcast engineers are planners, builders and problem solvers. But their electronic and mechanical skills exists within the less-understood business environment. For the engineer, budgets and the budgeting process provide a way to tie the technical and business worlds together to achieve both the technical goals and a solid bottom line.

The budgeting process requires the definition of plans, projects, problems and needs in dollar amounts instead of just operational or technical ones. This requires today's facts and figures to make realistic projections of costs and expenses for tomorrow.

Budgeting is more than a cost-projection process; it is also a planning, scheduling, organizing and future forecasting process. It requires an objective and reflective look at how a station operates, and at how and why things are done. It provides a means of cost/benefit analysis for the technical side of a radio station. It also furnishes a method of charting a technical course or master plan for the facility, rather than just responding to one technical crisis after another.

The budgeting process provides an objective method of self-evaluation for a station's technical operation, systems and equipment. Its documentation lets you know when something needs to be replaced because it's either worn-out, too costly to maintain, out-moded, or too inefficient. The budgeting process can also document the reasons, need, and time for capital expenditure for a technical improvement — a new console, audio-processing hardware, antenna or transmitter. It is an effective way to keep the technical facilities in sync with a station's marketing and programming goals, and with radio's ever-changing technology.

An engineering budget plan

This engineering budget plan represents one generic example of many possible approaches to the budgeting process. The engineering benefit is in the analytical process.

it's invested in your future.

New era

It's been said already, but it's worth repeating: Times have changed and we're not going back to the "good old days." Tomorrow's successful engineer will have a different set of skills. The engineer must be technically competent, just as before, but new skills are required.

The engineer will communicate effectively. Writing and speaking skills won't be foreign skills. Engineers will have to come out of the back room and into the front office.

The professional image projected by tomorrow's successful engineer will be the key. For some, that may require a simple change of clothes or a reorganized office. Others will have a more difficult time making the transition.

The concept of team playing will be important. No longer the guru of the electronic mountain, tomorrow's successful engineer will be the team leader. The engineer will lead the station through the maze of electronic technology, selecting only those devices that improve the station's performance, image and bottom line.

Finally, the successful engineer will never leave school. Because technology is running in fast forward, so too must the people who install, maintain and manage it. Having to understand the operation of discrete transistors will become as obsolete as the RCA tube manual. Continual professional growth will not be an option.

These five levels combined represent the skills needed to be a successful engineer. Remember, these factors are not unique to broadcast engineering. If used effectively, they can make you a winner in whatever field you choose.

Technical schools presently SBE certified:

Department of Communications
University of Wisconsin-Platteville
Platteville, WI 53818
Att. Dave Westerman
608-342-1379

Telecommunications Division
Mercer County Community College
1200 Old Trenton Road
Trenton, NJ 08690
Att. Walt Gradzke
609-586-4800

John Wood Community College
150 S. 48th St.
Quincy, IL 62301
Att. Tim Morrel
217-224-6500

Queensborough Community College
Bayside, NY 11364
Att. J.R. Carver, Ph.D.
718-631-6262

Cayuga Community College
Franklin Street
Auburn, NY 13021
Att. Donald Fama
315-255-1743

Milwaukee Area Technical College
1015 N. 6th St.
Milwaukee, WI 53203
Att. Tom Otavi
414-271-1036

Rogers State College
Will Rogers and College Hill
Claremore, OK 74017-2099
Att. Tom Needham
918-341-7510

Ohio University-Zanesville
1425 Newark Road
Zanesville, OH 43701
Radio-TV Department
Att. Tim Frye
614-453-0762

Mitchell Vocational Technical School
821 North Capital
Mitchell, SD 57301
Att. Dan Muck
605-995-3024

Pasadena City College
1570 E. Colorado Blvd.
Pasadena, CA 91106
Att. Keith Kintner
818-578-7216

Bates College
1101 S. Yakima Ave.
Tacoma, WA 98405
Att. Michael Scott

Virginia Western Community College
P.O. Box 14007
Roanoke, VA 24038
Att. Wayne Michie, chairman
Engineering/Industrial Technologies Division
703-857-7275

AFRTS Technical Training Program
3420th Technical Training Group/
560th Signal Battalion
Lowry AFB, CO 80230
Att. Howard F. Egan
303-370-2794

Technical schools undergoing the SBE certification review process:

Hocking Technical College
Nelsonville, OH 45764
614-753-3591

Navarro College
3200 W. Seventh Ave.
Corsicana, TX 75110
Att. Henry Wooten
214-874-6501

Yuba College
2088 N. Beale Road
Marysville, CA 95901
Att. David Buchla
916-741-6700

Brown Institute
2225 E. Lake St.
Minneapolis, MN 55407-1900
Att. Dick Kruse
612-721-2481

Napa Valley College
Napa, CA 94558
Att. Gary Vann
707-253-3258

Table 1. Technical schools with SBE-certified programs, and schools with programs under review for certification. For the latest information about schools in your area, contact the SBE office.

SBE certification — key to success

The SBE certification program is designed to raise the professional status of broadcast engineers by providing standards of professional competence. The program is the only industry-recognized certification program that was designed by and for broadcast engineers. Following are the four basic levels of certification and their requirements:

Broadcast Technologist:
• Pass a proficiency test. No experience required.
• Show proof of holding an FCC first-class license that has been renewed as a lifetime general-class license, and have two years continuous or three out of five years satisfactory service in broadcast or broadcast-related industry.

Broadcast Engineer:
• Five years experience in a broadcast or broadcast-related industry and pass a proficiency examination.
Separate tests are given for the radio and TV levels.

Senior Broadcast Engineer:
• Ten years experience in a broadcast or broadcast-related industry and pass a proficiency examination. Separate tests are given for the radio and TV levels.

SBE Professional Broadcast Engineer:
• Twenty years experience in broadcast or broadcast-related industry, be recommended by a senior or SBE professional broadcast engineer, and have one additional reference from a certified senior or professional broadcast engineer and a reference from at least one person who has supervised his or her work.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to sound fiscal practices.

Many engineers have never developed a budget, much less followed one. They may or may not have been told how much money is allocated for engineering. If you don't control your budget, schedule a meeting to discuss it. You shouldn't have to go to the manager for permission to purchase most items. However, neither should the manager wonder where the station's money is being spent.

Level V: Professional growth

The uppermost level on our engineering success pyramid is professional growth. When your station is sold, whether you'll be kept depends on many of the things we've discussed. However, in addition to your current skills, one of the factors that may be used to determine your future is evidence of your efforts to grow professionally. A person who takes the time to study and learn new skills is more likely to be retained (or hired) than someone who hasn't.

I'm not saying you have to go back to college and get an advanced degree. What's important is that your skills are kept current to cover new technology.

There are at least four ways to accomplish this task. First, you can attend professional conventions. They offer excellent opportunites to learn. If you can't afford to go, there are alternatives. The SBE convention is extremely cost-effective and provides high-quality technical seminars. This year's show was held in St. Louis earlier this month. Next year's show will be held in Houston. Budget now so you can attend.

The second way to improve yourself is through local SBE meetings. The programs are often presented by manufacturers and others qualified to help you learn new skills.

A third way to grow professionally is through structured training programs. The NAB offers several seminars each year. A popular seminar is the one on engineering management. It teaches engineers about the skills needed to manage people and resources. Contact your local community colleges and trade schools about training. They often have night classes you could attend. A list of technical schools offering SBE-certified programs is shown in Table 1. These schools can provide training in electronics to help build that first level of the success pyramid. Completing the required program can either get you certified or help to build credits toward recertification. Additional schools are currently being reviewed by the SBE. Before you make a decision on where to receive training, call the SBE office for the latest list of schools.

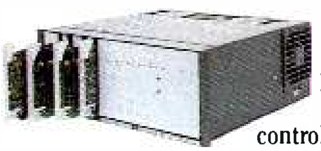
The final way to improve your skills is through SBE certification. The SBE certification program helps you advance your skills and provides rewards for your efforts through an industry-recognized program. Holding SBE certification is proof to the entire industry that you've achieved a certain level of technical competence. A related article, "SBE Certification — Key to Success," pg. 62, describes the four certification levels and minimum qualifications.

SBE certification can also come in handy when you ask for a raise or promotion. Is SBE certification worth the effort? Ask those certified engineers who earn $1,300 to $6,550 more than noncertified engineers. The annual *Broadcast Engineering* salary study (in this issue on page 26) shows that SBE-certified engineers tend to earn more than noncertified engineers.

Ask your station to pay for your education. Your boss should know that you're trying to improve your skills. Besides, the station is more likely to be supportive if

You know you have a need...

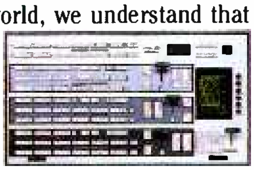
Simple choice?



Some companies would like you to believe that purchasing broadcasting and post-production equipment is a simple choice.

If you have a need for routers, automation, machine control systems, master control systems, production switchers and/or custom applications, include Utah Scientific in your equipment analysis.

Because of Utah Scientific's thousands of extremely satisfied customers throughout the world, we understand that no two customers are alike. We invest heavily in research and development, staff selection, and team training, to keep industry professionals like you on the leading edge of technology and secure from technical problems. In fact, our equipment is so reliable that we have added a 10-year warranty on many of our products. Now, that's *Confidence in Quality.*



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Continued from page 54
probably wearing a suit jacket, dark slacks, white shirt and tie. Before you say these people don't work on dirty equipment, ask yourself the last time you spilled toner on yourself or the floor. I can't think of anything in a radio or TV station that holds more potential for soiling your clothes than the black toning solution used in copiers. Despite this potential for soiling clothes, these companies recognize the importance of their employees looking professional.

Think about what you wear to work. Does your attire project a professional image? If all you've ever worn is jeans and a T-shirt, the change will be difficult. Even so, if you're interested in surviving the turmoil in today's market, consider your image carefully. Remember, the image you project may not fit into the new company's plans.

Level IV: Team member

If you ask 10 engineers to name the goals of their stations, nine of them probably wouldn't know. Engineers, for many reasons, have been the last to be perceived as part of the station's management team. Frankly, that's largely our fault.

Engineers have for years set their own agendas and enjoyed a great deal of independence. I don't know any engineers who punch time clocks or keep rigid office schedules. Therein lies part of the problem. Independence can result in the opposite of team playing. If you are not participating in the everyday decisions made at your station, you're missing a lot of opportunity.

Some engineers don't want to be part of a team. They simply want to be left alone to fix equipment. If this is the case, prepare for the worst.

Station goals

To be an effective team member you have to understand the game plan. This means understanding the goals of your station. You have to know what the manager is trying to accomplish (it's more than just selling air time) and the image that is being projected.

The decisions you make on equipment must reflect the long-range goals of the manager. You may plan on purchasing new audio processing and even have it in your proposed budget. But, what if the manager is planning on a satellite-delivered service that will specify the type of processing to be used? Instead of deciding what to purchase and then trying to figure out how to use it effectively, reverse the process.

First, become familiar with the goals of the station. Discuss the station's plans with the manager and be sure you understand them.

This is the area where some engineers

fail miserably. They can repair almost anything, but they are unable to view technology from the manager's perspective. It probably makes no difference to a manager whether the console has 10 or 12 input channels. But, if that difference would make it easier for the morning announcer to air the commercials and reduce mistakes, then it's an important factor. You must be able to analyze the needs and explain them in terms that are important to the manager.

Now it's time to consult the rest of your team. Many of today's equipment purchases affect multiple departments. For instance, a cartridge-based automation system doesn't affect just the engineering department. The traffic, accounting, operations and maintenance departments are also affected by such a decision. You can't make an informed decision about what to buy if you don't ask others for their input. That's why it's so important to use a team approach.

Technology experts

Engineers are, and always will be, the technology experts. Operators, producers and others may contribute to the decision-making process, but they don't make the final decisions. The equipment used in today's stations is complex. Most important, the equipment usually must interface with a host of other devices. Although the operators may know the value of a specific feature, they are not skilled enough to know whether a particular product will work with other devices within the station. The engineer is the only one qualified to know whether box A or box B will work with the rest of the station's equipment. The engineer will always be the key to an effective and profitable broadcast operation.

Be the team leader. You orchestrate the decision-making process. Recruit the other team members and direct the review process. Then, based on their needs and the station's needs, you decide what to buy. The result will be the best-suited product for the staff and the station. You will be seen as the professional who integrated the entire process.

Fiscal responsibility

In addition to being the technology expert, successful engineers must understand the financial operation of their station. This is also a part of being a team member. Instead of avoiding the use of debt service or return-on-investment (RIO), learn what they mean to your department. Accept your share of fiscal responsibility by showing the manager that your decisions are designed to support the need to make a profit.

Managers want to know what effect the new hardware will have on the bottom line. They understand that it's going to cost something, that's usually not the primary objection. What they want to know is how the new equipment can improve the station's product and reduce expenses.

Today, few managers will buy technology for technology's sake. It's your responsibility to look for ways to use new technology to improve the station's product and to reduce costs. These two criteria are not mutually exclusive. However, buying a product that performs one task at the detriment of another is not a solution either.

If you see a way for the station to make money, tell the manager. Show how the purchase will affect the bottom line. Use financial and technological reasons to justify the purchase. Remember, you are the most qualified person in your station to show how to best use new technology. All you have to do is show how the technology will make money.

Finally, learn how to operate your department on a strict fiscal budget. If you don't have a specific budget, develop one. Review your expenses for the past year and project them for the next year or two. Armed with this information, present an engineering budget to your manager.

Once you've developed a budget, provide the manager with monthly reports. They are useful to you, and they show the manager that you also operate according

Yes, it's true that our new VPR-200 and VPR-250 D2 video recorders are designed and built specifically for broadcast operations. It's also true that they offer the broadcaster superior signal quality. But a much more important consideration is that these machines make *business sense*. Here's how.

You probably amortize your recorders over 5 or 7 years, but the "200" and "250" are built to be around a lot longer than that—you're not going to find any "bent metal" here! Precision-milled castings and pre-aligned guide assemblies not only give you dependable long life, but also low maintenance costs. Replaceable heads and easy access components reduce downtime.

Time-code information, error messages, even audio level bargraphs can be displayed over a separate video output. On-board speakers reduce equipment costs, save rack space, and make installation easier.

We've given your operators some help, too. For example, these are the only D2 machines designed specifically for broadcast that make it easy to change program length. With *program compression*, your operators merely enter the program length required and the machine does the rest. You get no bounce, no blur video, and recovery of all four audio channels! And because all machine selections are clearly displayed and easily changed without cumbersome menus, operator training time and operator errors are significantly reduced.

Streamlined control functions reduce operator errors and cut training costs. All machine selections are clearly displayed and easily changed without cumbersome menus.

Then there's virtually instant lock-up and 60 × shuttle speed to save you time and money,

The VPR-200 mounts all 3 cassette sizes for flexibility from spots to movies. The VPR-250 handles small and medium size cassettes if that's all you need.

plus air lubricated tape guides, and . . . but you get the idea.

You may not have thought of video recorders as "business machines" before, but we think your first VPR-200 or 250 will change your mind. Call **1-800-25AMPEX** for more information.

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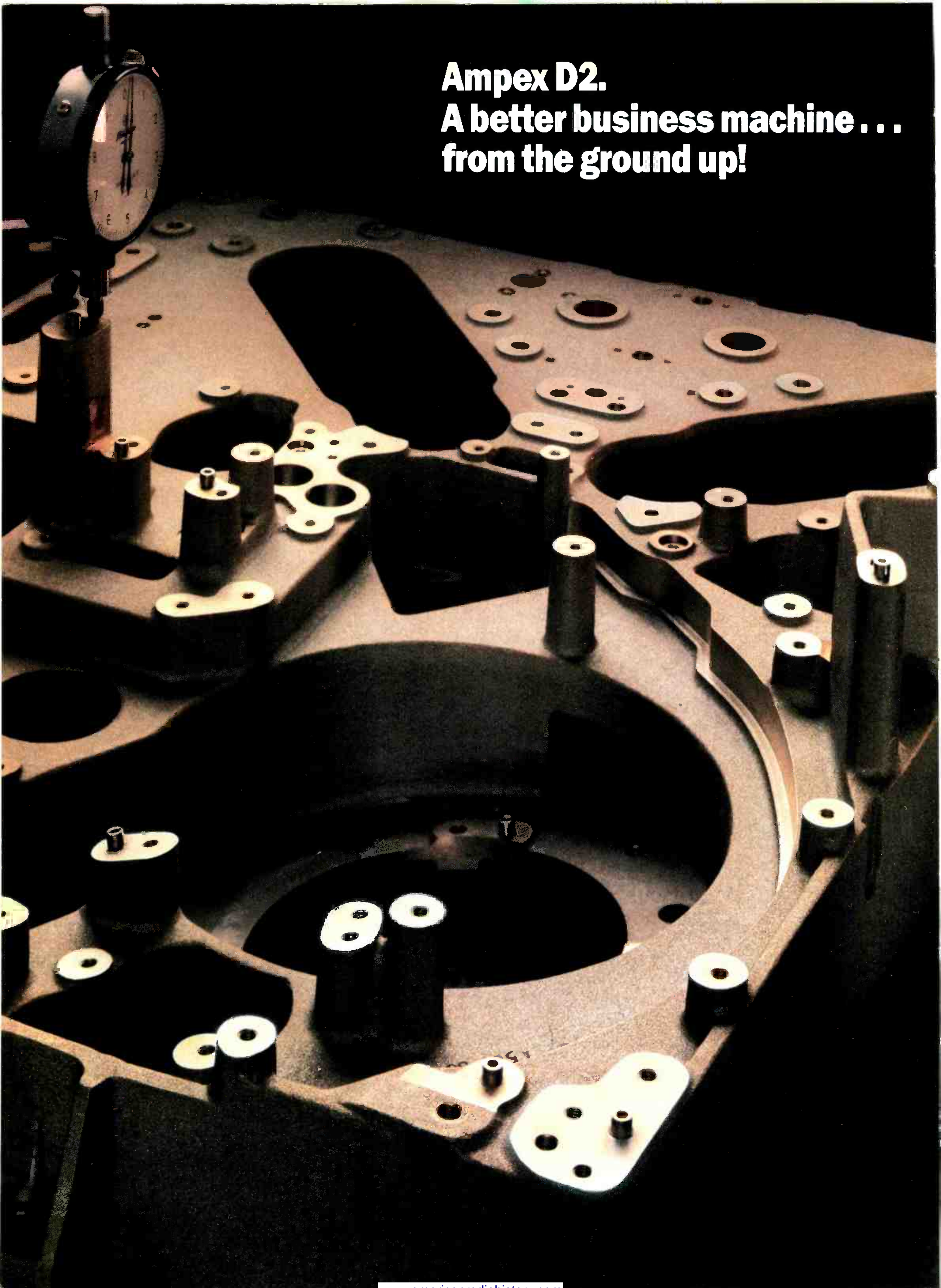
BE-100-V200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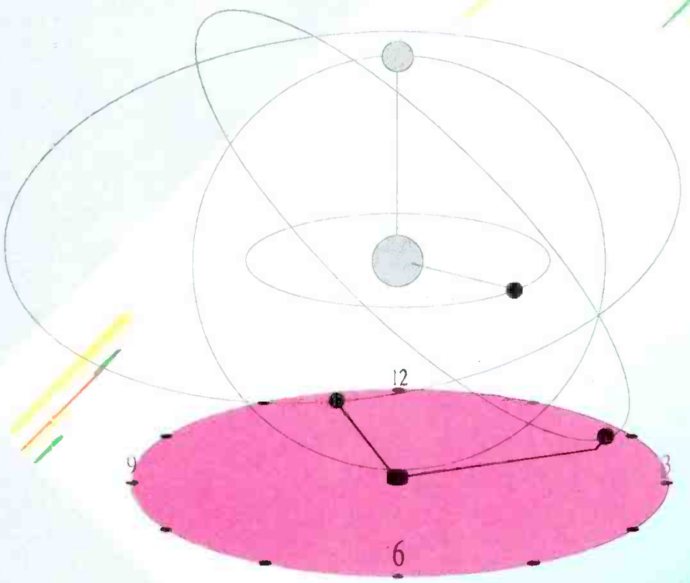

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Circle (32) on Reply Card

I've known a few who were sharp enough to detect problems and suggest solutions before anyone else did. Even if your manager doesn't seem to care about what brand of console you buy or how old the limiter is, you have a responsibility to make that information available. When it comes time to make that big capital request, you want the person who writes the checks to be on your side.

Teach the staff

The station manager isn't the only one you need to talk with about the station operation. The more you talk with others, the better you'll be able to determine needed technological improvements. These days, others are often involved in writing that check for new hardware. The problem is that most of them don't know the front end of a camera from the back end of a tape recorder.

How are you going to convince someone in this position (for instance, a business manager or program director) to support your request for new equipment? Rambling about better signal-to-noise, less blooming and smear won't work. The time to recruit someone to your team isn't on the day of the big game. Start earlier.

Take the business manager to lunch. It may be uncomfortable to use such tactics, but it's important. The fact is, you may need his support in the future, so gain that individual's confidence now.

Set up staff meetings to review the operation of new equipment. Don't assume that everyone read your memo on operating the new remote control. Chances are 80% of them saw the memo, 50% started to read it and perhaps 20% really did read it. That leaves 20% of the staff who may not even know there is a new remote control and 80% who don't understand fully how to use it.

Level III: Image

The image others have of you is based primarily on "looks." Whether you like it, looks matter. This applies to your personal appearance and to your surroundings. Let's look first at your surroundings.

When I began in broadcasting, the engineering office was called a shack, which carried a negative connotation. A shack is defined as a small crude building. If you're using the term, stop it. You don't refer to the program director's or business manager's offices as shacks, so why use it when talking about your work area?

If you don't have a clean, well-organized office, create one. Try to separate your office from the shop or repair area. This accomplishes two things. First, it provides you with a real office atmosphere where you can look and work like your fellow professionals, and it provides a place to conduct business. Second, it prevents your office from becoming a catch-all for equipment and supplies. Let the office be an office — not your shop and vice versa.

The shop area should resemble those seen in computer magazines. You don't see trash, dirt and junk in a computer repair facility, and there are good reasons. Modern broadcast equipment should be handled only in clean areas. Placing that tape head on a bench covered in metal filings is certain to cause trouble.

Also, a clean repair area is important in improving your image as a professional. Suppose you took your $1,200 video camera in to be repaired and the technician placed it on a dirty bench. What if the repair area had broken equipment stacked in the corner and test leads hanging everywhere? Would that repair area instill your confidence in the technician's abilities? Of course not, yet some engineers continue to believe that they can operate a service bench that looks like a combination junk yard and warehouse.

When the manager comes to see how you're doing on the repair of a camera or tape recorder, remember that appearances are everything. If your shop area looks professional, your work will be perceived as professional.

Looks matter

Some of you may not want to hear this, but it's important. How you dress is critical to your success. Appearance is the single most important factor in forming a professional image.

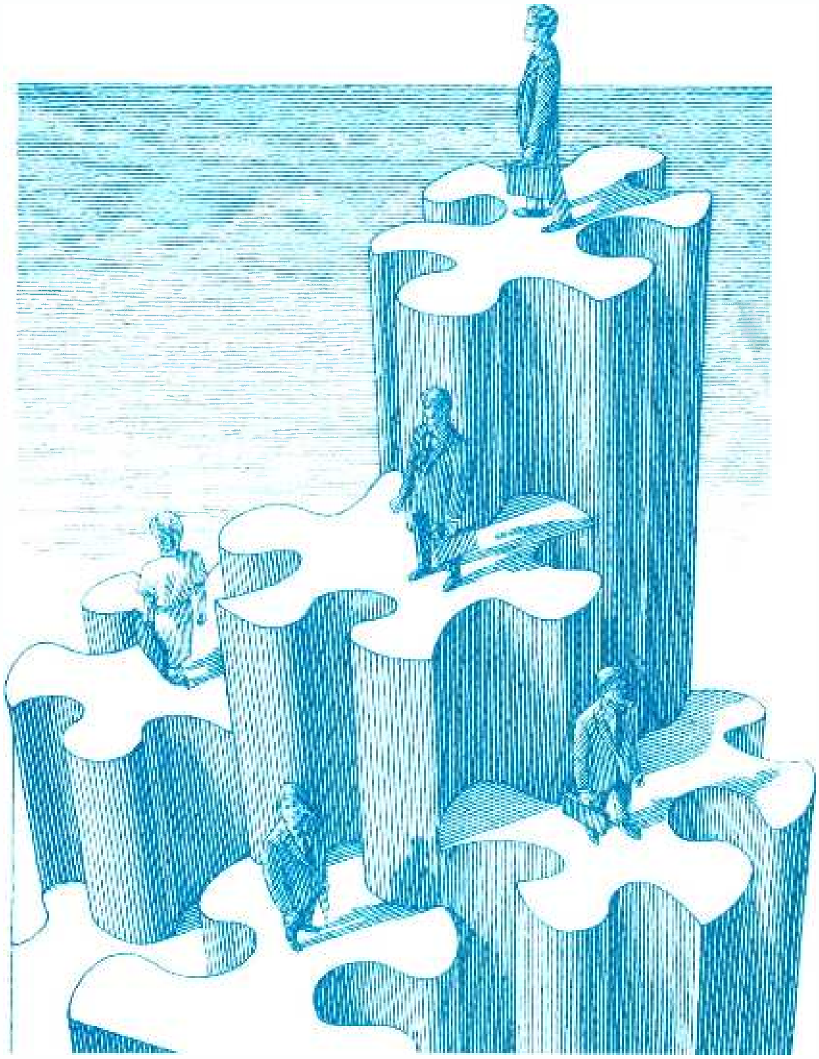
When you meet new people, their first impression of you is formed in 10 seconds and is based entirely on your appearance. More than 80% of your perceived competence will be based on your appearance.

If the station's owner arrived unannounced, would you be properly dressed to go to lunch? Or, would you look like you just staggered in from a 2-week camping trip?

I've relayed this message for years, and someone always gripes about getting dirty repairing equipment. Well, pardon me, but that excuse doesn't (if you'll forgive the expression) wash.

Remember the last time you saw the IBM or Xerox copier technician? He was

Continued on page 58



Continued from page 49
must be able to build a station with blocks of technology to form a high-performance and efficient broadcast system. Without these skills, you can't succeed. Because it's easy to contract for services if you can't do the work, the manager will simply find someone who can.

As technology changes, those who manage it must also change. As a broadcast engineer, you must, of course, be able to troubleshoot and repair the equipment. But just as important, you must be able to see how to effectively use new technology to improve your station's product — and bottom line.

Today, technical competence means more than just repair. You must be able to troubleshoot systems as opposed to components. Much of the equipment in TV stations is not repaired at the component level. It takes a different type of skill to locate and replace subsystems than it does to replace board-level components.

Competence also means being able to understand the entire station's technical operation. Interfacing a traffic computer with a library system is a typical situation. You must be able to coordinate such work, even if you'll never have to repair either computer.

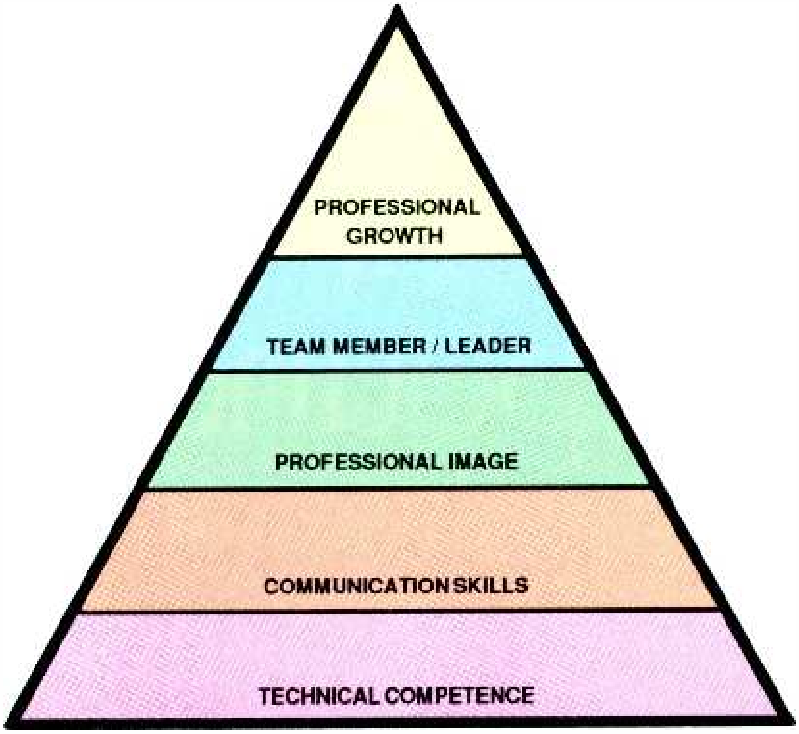


Figure 1. *The engineering skills pyramid shows how each of the skills builds upon the others. Successful engineers today must have all five basic types of skills.*

Level II: Communication

You must be able to communicate effectively, which includes writing and speaking. Engineers, unfortunately, are often perceived as loners, wanting to be left alone with their electronic boxes. Many engineers do have poor communication skills, but it doesn't have to be that way. Here are some suggestions on how you can improve your own communications within the station.

The written word

Start by sending your boss a monthly report on engineering activities. Describe what you've done, what it costs, and the improvements that resulted. At first, this may seem hard. You may feel uneasy bragging about your work. If you don't brag about your successes and efforts, who will? Never pass up the opportunity to tell others about how you improved the station's operation.

Large stations often distribute newsletters or weekly memos to the staff. If your station doesn't do this, consider starting a newsletter. Even a brief memo can help inform everyone about a common problem or solution. With a little work, a newsletter or memo can become a 2-way communication tool.

When many engineers sit down to type a memo, look out. The result is typically a 2- or 3-page diatribe on what rules have been broken lately, what new features have been installed, and why some piece of equipment isn't fixed. If that's not bad enough, the memos are often written in a condescending tone, treating the audience as though they had an IQ of 12.

Instead of talking down to your readers, keep your memos short and upbeat. Look for the positive in whatever changes have been made. When possible, mention someone else positively in the memo. This is even more important if the publication is seen as an official newsletter. People like to see their name in print if the report is good.

A newsletter or regular memo is an effective way to update the entire staff on station activities. Sometimes, engineers think they're the only ones doing new things in a station, but that's unlikely.

The accounting department may have a new payroll procedure, which affects employees' checks. The traffic department may have implemented new procedures that affect when equipment can be taken down for maintenance. The station may have been sold. The more communication that exists, the less likely anyone is to find themselves in trouble because they were not informed.

You don't have to do all of the work. I was able to recruit a secretary and promotions manager to help at my station. The result was a biweekly memo that didn't take a great deal of time.

There is another reason to give it a try. At one station, after publishing a newsletter for only six months, I was able to justify a complete desktop publishing system. Just think what you could do with such equipment — all purchased because you tried to improve the station's image and performance.

Teach the boss

Communication must also be verbal. The most critical communication is with your boss. Set up regular meetings and be sure your boss understands the basics of how the station operates. You don't have to be overly specific, but it's to your advantage to keep your boss informed on the station's operation.

There is another advantage to having your manager understand the basics — it's easier to justify capital replacements. Unfortunately, managers are sometimes considered simpletons when it comes to equipment. That is not a fair characterization, but there will always be some managers who don't know or care about the hardware. However, they're in the minority.

It's important for your manager to know the ages of the transmitter or the on-air console. How can you hope to justify replacement if the person who signs the check doesn't know that the 20-year-old transmitter is on its last leg? Waiting until you can't get parts is not the way to justify replacement.

Most managers are pretty smart when it comes to the basics about equipment.

improve your
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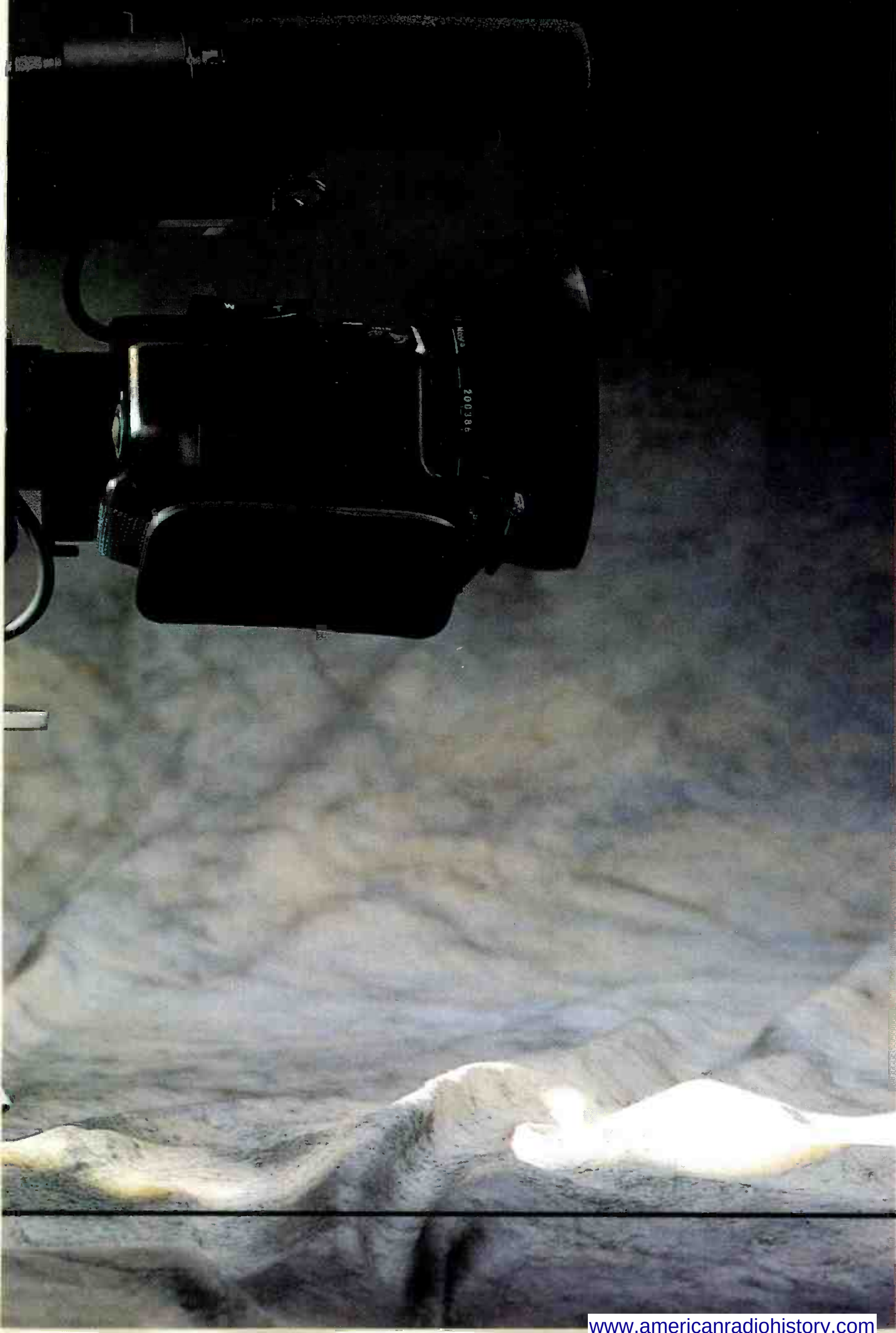
few pounds.



When we set out to produce the best image acquisition tool for field production, we knew the competition would be heavy. Which is exactly why the Sony BVW-400 comes out on top.

No other imaging device puts such extraordinary performance into such a compact, lightweight camcorder.

The BVW-400 Betacam SP® camcorder is engineered with Sony's most advanced CCD sensor technology–the Hole Accumulated Diode (HAD) 768 FIT chip. So you can shoot video with 700 lines of resolution. With virtually no vertical smear.

At the same time, the BVW-400 weighs only 15 lbs. It's just 15 inches long. And its low profile offers an unobstructed peripheral view.

There's also an optional adapter for simultaneous Betacam SP® recording on an external VTR.

All this performance in such an easy-to-handle package will give you a degree of creative flexibility that you've never had before.

Of course, when you consider Sony is the originator of one-piece technology, a camcorder this good should come as no surprise.

For more information about the BVW-400, call 1-800-635-SONY.

After all, while a camcorder should be designed to weigh as little as possible, its performance should never be taken lightly.

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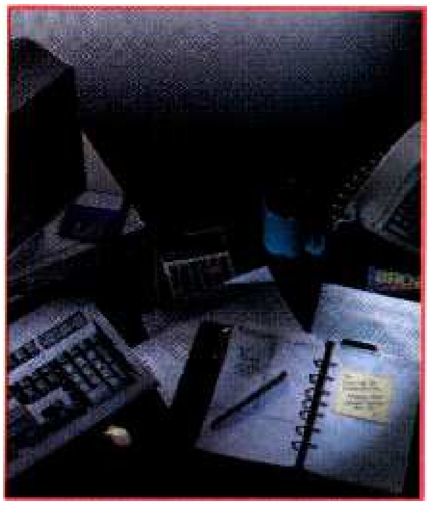
BROADCAST PRODUCTS

The broadcast engineer and changing technology

Engineers need new skills to survive in the shark-infested waters of broadcast engineering in the '90s.

By Brad Dick, editor



You heard the rumor about the station being sold, but nothing prepared you for the sale being approved so quickly. "There won't be much in the way of staff changes," your boss says. There's some hope, you think to yourself. However, from what you've heard about the new owners, it could be a rocky time, especially for the program director — and you. The new owners want to change formats and they have a reputation for bringing in their own team to run new properties. You begin to wonder whether you've been sold out in the buyout.

Although engineers don't typically change jobs as often as other broadcast professionals, such transitions are becoming more common. When your station is sold, and at the current pace it's likely to happen, what will you do? What if the new owner wants to bring in a new staff? Will you fit in? Or, will you be encouraged to move on?

Needed skills

It used to be that engineers could stay at a station as long as they wanted to. It was the manager, program and news directors and announcers that changed. After all, only the engineers knew how everything worked and no one in his right mind would risk upsetting that critical area.

However, gone are the days when engineers could remain constructively employed simply by repairing a station's equipment. If that's all you're doing today, watch out. You are a prime target for replacement. If you want to succeed in today's business, you have to play a much larger role than did your counterpart 20 years ago.

Before 1960, an engineer could survive by just keeping equipment fixed and running. If you were lucky, you'd get to install a new console or maybe even a transmitter.

For those engineers who started in broadcasting in the 1940s, changing such equipment was a major project, something done only once or twice in a career. Today's engineers replace equipment much more often because the technology (and competition) demands it.

Stations require more and different engineering expertise than ever before because of technological and marketplace changes. If you don't have these skills, your future's about as bright as a 12V lamp connected to a 6V battery.

Skill pyramid

If you look at your fellow engineers, one thing will become clear. Today's successful engineers, although technically competent, also possess a high degree of skill in other areas. Those skills are summarized in the engineering skill pyramid. (See Figure 1.) The pyramid symbolizes the importance of each skill level building upon another.

The basis for all engineering success is *technical competence*. The next level is the *ability to communicate* effectively. The third level of the pyramid is *image*. This relates to how others perceive you and your skills. The fourth level pertains to being a *team member and leader*. How effective are you in being a member of the station's management team? The fifth level concerns *professional growth*. This is the most dynamic area and one that often means the difference in climbing the corporate ladder and having that ladder fall on your head. Let's look closer at each of the levels and how they build on one another to create the successful engineer.

Level I: Technical competence

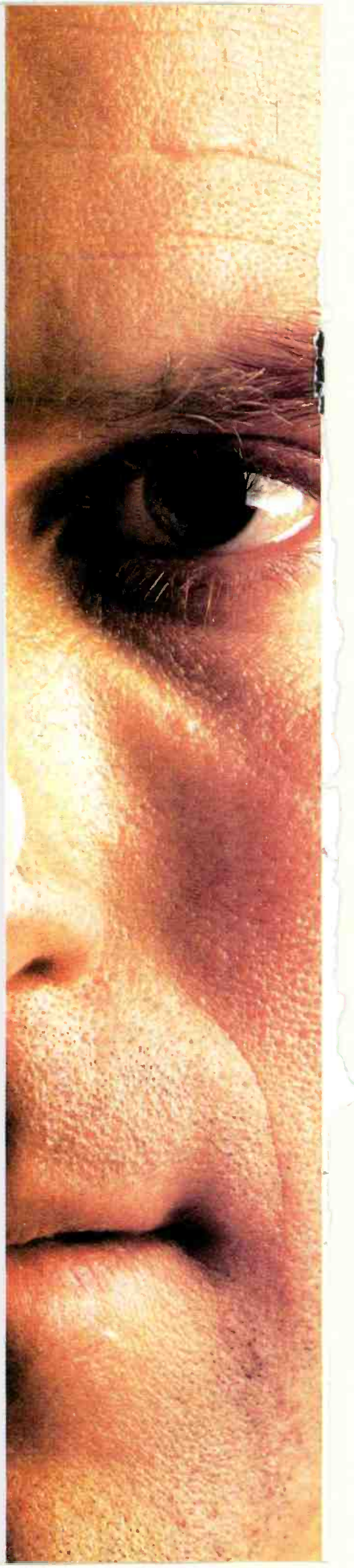
You must be technically competent. You must have the skills to install, repair and purchase the station's equipment. You

Continued on page 52


SONY
Digital
A New
Perspective

The all-digital system: the next step

The concepts embodied in digital technology will redefine broadcast and post-production operations in the 1990s. Digital technology represents much more than simply the entrance of a new recording format. It establishes an entirely new way of designing and building a system. All-digital implementation is the next step for broadcasters and post-production operators.



How digital systems make things easier

Reliability. Today's digital products pack an incredible amount of electronic circuitry into one chip. The result is much smaller size, lower power consumption, less heat generation and fewer individual components. For these reasons, digital technology is inherently more reliable, which means less downtime and less maintenance, resulting in greater on-line availability.

Consistency.
As reliable as digital circuits are, they are also consistent. Digital signal processing is very straightforward; there are fewer things to go wrong and fewer set-up adjustments to be made. Digital signals are predictable, and therefore performance is consistently good, from the start, and over the long haul.

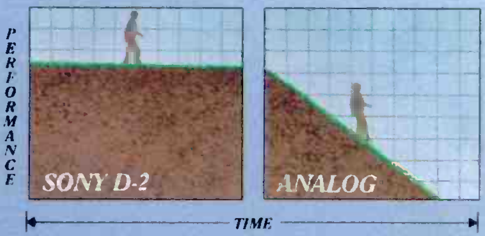
Flexibility.
By eliminating the constraints of analog signal processing (signal-to-noise degradation, chroma-to-luminance delay, etc.), each piece of digital equipment becomes far more useful. Producers need not be constrained by how many generations down the final product might be.

Efficiency.
High reliability, consistency and flexibility of digital equipment all add up to this: the all-digital system is "on-line" when you need it. Downtime and set-up time are minimized, and many analog considerations are eliminated. There are fewer constraints placed on the efficient use of your facility. The system does not control you, you control it!

Not long ago, these facts would have been fiction. Then Sony introduced D-2 composite video.

D-2 takes the amazing possibilities of digital technology and makes them a practical reality.

In fact, revolutionary is the only way to describe it. D-2's digital world is a place where performance is consistently extraordinary. Where every tape copy is as good as the original. Where audio is as important as video. And where machines operate without the need for constant adjustments.



D-2 maintains consistently high performance.

In the digital world, a D-2 VTR does its job just about perfectly. So you can too.

To everyone with their video it's time to

And it's all a matter of fact.

D-2's picture quality is exceptional from the start, and it stays that way consistently. Here's why:


D-2 effectively eliminates dropouts.

D-2's unique error correction and concealment system means you'll never have to worry about dropouts.

D-2's digital transparency is another clear advantage.

And copies of D-2 tapes aren't dubs.

They're "clones." Digital replications indistinguishable from the original.

As for audio, D-2 VTR's have broadcast sound quality previously unheard of.

who's satisfied tape recorders, face the facts.

D-2 combines digital audio with digital video.

Four independently editable channels of CD quality digital sound. In stereo that never needs a phase adjustment.

Fact is, no other composite VTR performs as well as D-2. In both video and audio. You might think such a high performance machine would be hard to work with. But in fact, D-2 is quite easy to use.

For example, D-2 shows you pictures-

ANALOG *D-2/DVR-18*

D-2 offers pictures in-shuttle 2x faster.

in-shuttle faster and in color. So you can work more quickly and efficiently. And one person can comfortably operate up to eight D-2 VTRs. Which makes it a lot easier to do a lot more.

Given all this intelligence, you'll have to agree. Sony D-2 sets a new standard in recording technology. After all, you can't argue with the facts.

D-2 lets one person easily operate up to eight VTRs.

For more information call (800) 635-SONY.

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BROADCAST PRODUCTS

Aspects of the all-digital system

What do we mean by the phrase "the all-digital system"? First, we're talking about the ability to generate audio and video directly in the digital domain, in such equipment as state-of-the-art graphics systems and audio synthesizers. Next, we're talking about the ability to record, store and retrieve those digital signals, and the ability to process the digital information (as in digital multi-effects systems, still-store boxes, production switchers, etc.). Finally, we're talking about the ability to interconnect the myriad types of equipment without reverting to the analog domain. Once we're in the digital domain, let's stay there.

Digital signal generation

Most video and audio signals originate in analog form. But, because of the transparency of digital signal processing, the sooner the signal is converted into digital form, the better. Today's most advanced cameras utilize digital signal processing right in the camera head. Soon cameras will produce direct digital output. Digital audio consoles for mixing and processing prior to digital recording are already common. Most computer graphics systems generate images in digital form, and the quality of these images is limited only by present analog-world considerations. It won't really matter to the all-digital system whether the origination image is live-action or computer-generated. The fact is, the signal representing audio or video, at its earliest, will be in the digital domain.

Digital recording is better than analog recording

Digital recording is a reality with the D-1 (component) and D-2 (composite) tape formats.

Digital recorders are more cost-effective than comparable analog machines because they are inherently more reliable, more consistent and more efficient. Being cassette-based and requiring fewer machine set-up routines, digital VTRs allow more freedom for the tape operator. With four audio channels, digital VTRs can provide new, cost-effective avenues for audio production, sweetening and programming. Tape life is greatly increased, too. The number of usable passes is far higher than with any analog tape format.

The quality of digital recording is much higher than its analog counterpart's. Digital recordings have a higher video signal-to-noise ratio, and moire is eliminated. Audio performance is at the level of compact discs. And the multi-generation aspects of digital are unparalleled (over 20 generations without any noticeable degradation).

Digital recorders offer some unique features. Perhaps the most significant feature, never possible in analog, is error correction, the ability to produce absolutely accurate playback of the recorded material, even when tape wear or damage would normally render an inaccurate playback. Error correction, along with the consistently high signal-to-noise ratio of digital processing, produces "clones."

Another feature of a digital VTR is its signal-monitoring capability. Each VTR can act as its own tape evaluator, giving the operator a consistent and reliable means of tracking the performance of each tape in the system. Future developments in sophisticated digital diagnostics will allow engineers, even from a remote location, to evaluate the ongoing, on-line performance of each VTR.

A unique feature of the D-2 (composite) digital recording format is the ability to perform audio and video pre-read edits, where the tape machine is used as a playback source and a recorder simultaneously! This unusual aspect of the D-2 format is just beginning to be appreciated.

Digital signal processing is better than analog signal processing

Digital processing has been around for years. All of today's character generators, graphics systems and multi-effects generators are entirely digital in their signal creation and manipulation. Time base correctors have incorporated a lot of digital processing; and digital control circuits have been used in production switchers, routing switchers, editing systems, transmitters, etc.

Digital signal processing enjoys the common digital advantages: more reliability, more consistency and more efficiency. All that's needed to bring out the full potential of much of today's processing equipment is the elimination of the analog interface. But digital processing offers a lot more.

Color correction in the component digital domain (D-1) has proved to be the most precise and effective means of control and manipulation of color parameters. Digital routing switchers offer efficiencies never before possible in the analog realm. One example: video (with vertical interval time code) and audio can be handled as one combined signal, requiring just one crosspoint in the switcher. Another efficiency is the ability of a routing switcher to handle both D-1 component and D-2 composite signals, eliminating the need for separate routing switchers.

Digital component and composite production switchers allow all of the features of today's analog switchers, without the aggravation of instability and constant adjustment. Powerful new video effects processing and picture manipulation are possible in these switchers. Image manipulation is an integral part of the production switcher; complex layering and multi-effects are accessed by the switcher control panel and/or edit system.

Encoding and decoding of composite and component signals will be accomplished in the digital domain much more precisely and accurately. Digital DAs and delay lines, digital audio mixing and digital distribution systems are now in place to complete the all-digital studio.

Digital interconnection is better than analog signal interconnection

Direct connection among digital boxes will eliminate the need for multiple analog-to-digital and digital-to-analog converters. Each such conversion in our present analog-oriented equipment introduces distortion and artifacts.

In the all-digital system, signal distribution and transmission will be in serial form. This means that digital video and four channels of digital audio will be all combined on one coax cable. Serial transmission allows the data to be sent over long distances without the usual problems encountered in analog (noise and interference, high-frequency roll-off, etc.).

Signal quality and consistency will be maintained throughout the all-digital system. Separate video and audio patching systems will be consolidated into a single digital patch. Routing switchers, with multiple levels of video and audio, can be reduced to one digital level.

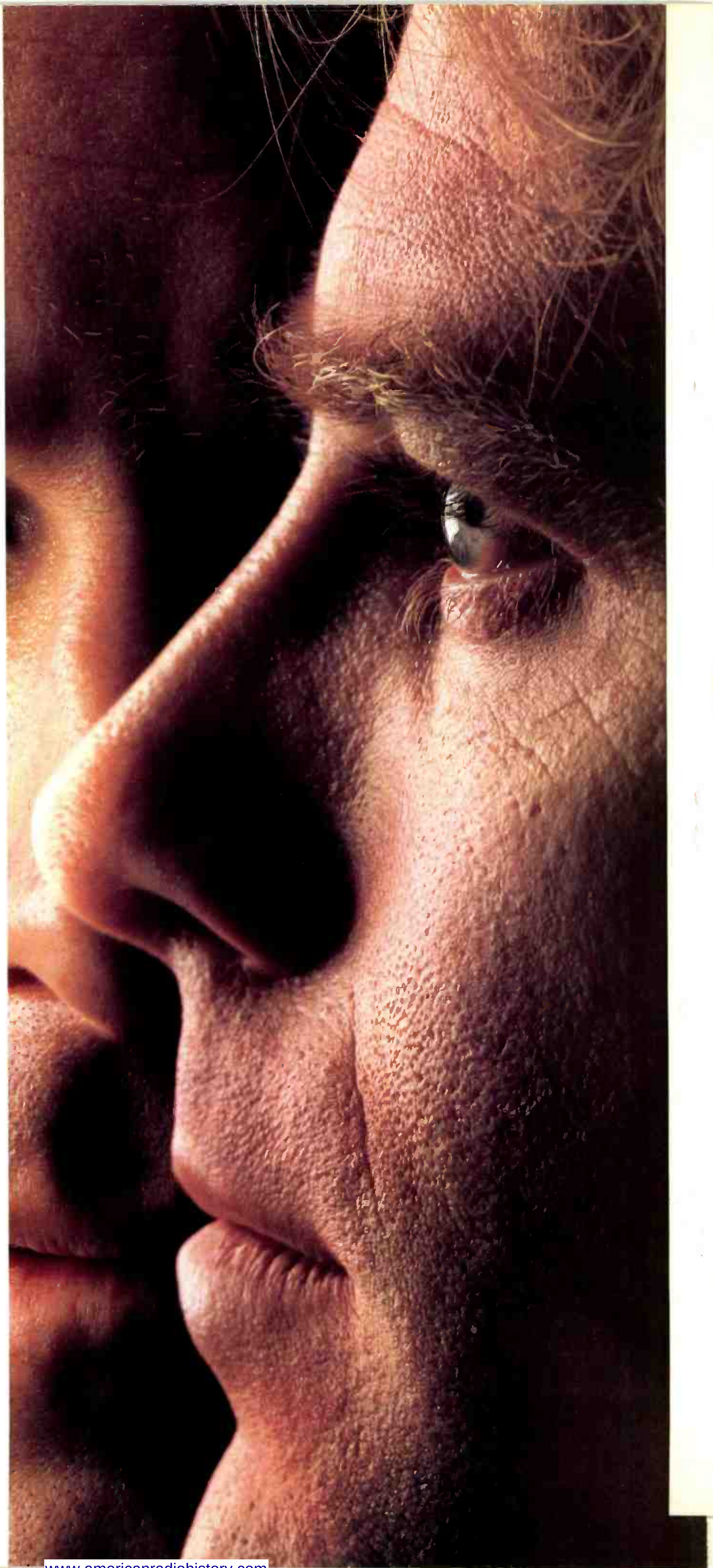
And once we're all-digital, video and audio level adjustments will be eliminated from most equipment. All signals will remain at unity throughout the system. Just one more advantage of an all-digital system.

There is little question that digital technology offers major improvements over much of our analog-designed equipment. But what started out as improvements in individual devices now extends to the overall system. The digital system provides a transparent pathway from camera to transmitter. This pathway is more reliable and efficient, and requires less set-up time, less parameter monitoring and less maintenance. The digital system has lower operating costs and a longer life, both of which contribute to a greater return-on-investment.

The creative environment

Just as the digital system provides a transparent pathway from camera to transmitter, so too does it provide a transparent pathway from talent or event to viewer. Equipment or technology ceases to be a barrier to getting the project done. This enhances the ability of creative talent to communicate effectively and efficiently with the viewer. The digital system permits creativity that is limited not by what machines can or cannot do, but by what the creative people can imagine.

We stated at the beginning that digital technology will redefine broadcast and post-production operations in the 1990s. Most of the pieces of the all-digital system are here. There will be new developments and refinements, but clearly, the '90s will be the digital decade.



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Broadcast Products

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eras also stand up very well to the heavy use and travel demanded by Brighton.

The same ruggedness is found in their editing equipment: the Sony VO-9800 VTRs, RM-450 edit controller and various Sony monitors. A tremendous amount of editing is done, since Brighton shoots over 150 homes every week. And the editing equipment is up to the task. Says Loveless, "The Sony equipment has stood up fantastically to all the editing we do. And the finished shows look great."

Brighton purchased most of its gear last March. "You better believe that Sony equipment is easy to learn and use," Loveless says. In less than a month, the first *Showcase of Homes* was on the air. What's more, prospective sellers appreciate the process. "People enjoy having a video crew in their house," he says. "They feel like they're in show business."

But in this business, sales are the only applause that count. "The show definitely produces results," Loveless says. The president of the country's second largest Century 21 office agrees. Al Little, president of Century 21 Val Realty points out, "Brighton's videos help garner a lot of business. Telling prospective sellers their homes can be advertised as a TV video is the kicker that brings them into our office." People looking to buy homes also respond favorably to *Showcase of Homes*. Says Little, "The videos touch their emotions much more than a newspaper listing. Those videos are a really useful tool."

So it isn't surprising when Loveless states, "Century 21 couldn't be happier. We have more demand from them than we can handle." As a result, plans are in the works to purchase another Sony editing bay. "We owe it all to you guys," Loveless concludes. "Sony reliability and service are great. The salesmen really stand behind their products."

In Southern California, it looks like Sony has really found a home.

TRAIL-BLAZING VIDEO

Portland, OR—When it comes to putting on a terrific performance for the fans, it's tough to beat the Portland Trail Blazers. Everyone who comes to the 12,884 seat Memorial Coliseum sees a tremendous display both on and above the hardwood. With Sony's help, the 1989-90 NBA Western Conference Champions provide a value-added bonus to fans attending games.

Last year, the Trail Blazers purchased a range of Sony professional video equipment including BVU type VTR's and a BVE-9000 editor. Then, the team's Blazer Broadcasting division set up a state-of-the art production facility. The system's centerpiece, the Seafirst BankVision scoreboard, includes four mammoth Sony JTS-16 JumboTron® color video screens. Says chief engineer Joe Bashlow, "Fans always remember the Sony screens. The resolution is superior, and the light output offers brilliant video rendition under all arena lighting conditions. Throughout the entire season, fans volunteered rave reviews." Three dedicated DXC-M7 three-CCD cameras positioned in the arena input live video to the production suite. The set-up allows fans to see a show that dwarfs even the big men on the court below.

The huge screens display key player matchups fans might overlook, as well as low and tight live game coverage. Fans also enjoy movie or sports clips called up on the Blazer Broadcasting's Sony optical video disk system. The clips tie into the action on the court. The cameras and optical disk, in effect, provide three extra sets of eyes to view the game. Says Bashlow, "We try to groom what's on-screen to the arena situation. The fans really love it."

Video is well-suited to Blazer Broadcasting's needs. Bashlow notes, "The DXC-M7 cameras are terrific at picking up action, giving us a great-looking image to work with. They're especially good at handling the bright court lights." Even when the NBA's giants barrel out of bounds and into his cameramen, Bashlow reports, "I can count on the camera, and hopefully the operator to survive."

Just like the Trail Blazers, Sony's winning more fans everyday.

Disney's NEWEST STARS

Lake Buena Vista, FL—Imagine if you could sit right next to Johnny Carson's desk and be interviewed by the "King of the Talk Shows." Or picture yourself acting on a hit TV show like "The Golden Girls." At the Walt Disney World Resort, such appearances happen routinely for otherwise average citizens. With Sony's help, "Superstar Television" at the Disney-MGM Studios Theme Park makes the dream of television stardom come true for hundreds of people every day.

Visitors to "Superstar Television" enter an auditorium that is set up like a TV studio and is fully equipped with Sony professional video equipment, from DXC-M7 cameras and PVM series monitors to VPH-1042Q projectors and U-Matic SP® VTRs. On stage are re-creations of various television programs' sets from contemporary and classic television broadcasts. Twenty-two times a day, seven days a week, members of the studio audience are brought on stage and taped with the Sony equipment, then matted into recordings of actual shows. Says Keith Kolbo, "Superstar Television's" Stage Supervisor, "In the 25 minute presentation, we create trailers and promos for a whole range of popular television shows. Visitors get to 'star' with present-day personalities, as well as the notable television figures of the past."

The response of the people in the audience is tremendous. They see family and friends appear on the Sony screens throughout the auditorium, crystal-clear and larger-than-life. And the participants greatly enjoy the "Superstar Television" show. After participating in the high-quality production, and having their 25 minutes of fame, they can return home and tell everyone how Disney and Sony made them stars. ■

SONY

BUSINESS AND PROFESSIONAL GROUP

The planning package consists of a 1-page engineering budget form. (See Figure 1.) Worksheets for deriving each line item on the budget are shown in Figures 2-5. The budget plan is divided into three parts: *studio operations and maintenance*, *transmitter operations and maintenance* and *capital expenditures*. Under the *studio* and *transmitter* sections, expenses are broken down into three subheads: *operation* (for consumable items and minor repairs), *projects* and *scheduled maintenance*. Under the latter two headings, each project or scheduled replacement is listed, dated and priced separately.

This method breaks the budget into discrete parts. It forces a systematic data-collection process, along with careful planning, scheduling and organizing. Consider

Consider budgeting a yearly financial proof of performance.

it a yearly financial proof of performance to determine needs, list problems, and become aware of the economic dimensions of the technical operation and its maintenance. The worksheets provide an annual self-evaluation of the facility, and can become part of the technical maintenance record for the station.

Begin with a step-by-step budget construction process, and end with enough documentation and data to justify line item entries for a year's worth of engineering.

Studio operation

The budget summary shown in Figure 1 begins with studio operations. On the first line, *consumable items* are addressed, such as open-reel and cassette tape; tape cartridges; batteries for news gathering or account executive spot demo tape record-

19______ ENGINEERING BUDGET ESTIMATE/PROJECTION FOR __WXXX__

BY ______________________________ DATE ____________________

+++++++++++++++++++++++++ Studio +++++++++++++++++++++++++++++++++

OPERATION:

Consumable Items (tape, cas., carts, bat., & misc.) .... + __________

Maintenance/repair (tape rec., mixers, etc. & misc.) .... + __________

PROJECTS: (equipment/system reconfiguration/modification)

1. .... + __________
2. .... + __________
3. .... + __________

SCHEDULED MAINTENANCE: (repair/replacement/renovation)

1. .... + __________
2. .... + __________
3. .... + __________

TOTAL FOR STUDIO OPERATION & MAINTENANCE .... = __________ +

+++++++++++++++++++++++++ Transmitter ++++++++++++++++++++++++++++

OPERATION:

Consumable Items (tubes, air filt, gas, & misc.) .... + __________

Maintenance/repair (xmtr, ant, tower, & misc equip) .... + __________

PROJECTS: (equipment/system reconfiguration/modification)

1. .... + __________
2. .... + __________
3. .... + __________

SCHEDULED MAINTENANCE: (twr lights & paint, other repair/renovation)

1. .... + __________
2. .... + __________
3. .... + __________

TOTAL FOR TRANSMITTER MAINTENANCE & OPERATION .... = __________ +

CAPITAL EXPENDITURES FOR TECHNICAL IMPROVEMENTS ....__________ +

19_____ ENGINEERING BUDGET FOR STUDIO AND TRANSMITTER ....__________ =

Figure 1. *A sample 1-page engineering budget form.*

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ers; tape recorder, LP and CD cleaning supplies; tape editing supplies; replacement light bulbs; and other small, miscellaneous items used in the production process.

Make a list of these items, with a record of vendor and cost. Use the data to project usage based on the station's programming and marketing goals. Start with last year's figures, if they exist, and add a growth factor (according to the station's plans) and an inflation factor (according to the economy).

The next line deals with *studio equipment maintenance and repair*. In the course of producing a station's air signal, equipment wears, and eventually wears out. For example, head life on cart and tape machines can operate for 500-600 hours. Each year, a typical station produces more than 6,000 hours of audio material. Depending on which equipment is used to produce the audio, and how many of these devices are available, you can expect to replace heads and pinchrollers anywhere from twice a year to once every two or three years. Phono styli, tape cartridges, mixer pots and console switches also wear, depending on use or format requirements, and equipment durability.

Start from a maintenance record, if possible, or figure it from usage projections to determine the frequency of replacement and the amount to cover the normal wearable parts on all studio devices. In many of these cases, the initial cost of these parts will depend upon the frequency of replacement required. Examine this to determine if any "penny-wise, pound-foolish" choices are being made. Tape cartridges are a good example, because the

19_____ ___________ OPERATION DETAIL WORKSHEET FOR ___________

BY ____________________ DATE ______________

CONSUMABLE ITEMS ——— USAGE RATE / COST PER UNIT ——— COST ——

1. ....

2. ....

3. ....

4. ....

CONSUMABLE ITEM TOTAL .... ________

ITEM ——— MAINTENANCE / REPAIR ——— COST ——

1. ....

2. ....

3. ....

4. ....

5. ....

TOTAL FOR MAINTENANCE / REPAIR .... ________

Figure 2. *Worksheet suggestions for consumable items and repairs.*

cheaper cart often wears more quickly than its higher-priced competitor. Over the replacement cycle (although this may stretch beyond a single fiscal year), the one set of premium cartridges will cost less than the two or three sets of the bargain-basement brand required during the same period. Also, higher audio quality may be delivered during that period if you used premium cartridges. You will also get a higher protection of the investment if you use better software on the expensive hardware. Consider someone who buys a Ferrari and puts only the cheapest gas in it. This will not allow the capital investment to perform to its highest potential.

Next is *projects*. For this line item, figure the projects for the upcoming fiscal year. These include projects to solve problems in programming or production, and maybe even in sales. They could involve reconfiguring a studio's equipment, building a custom system, or making technical modifications to current equipment. Projects are the reflective part of the budgeting process — a sort of station wish list — and are generated from the needs expressed by other staff members. "Wish we had a dubbing studio," or "a place to play demo spots to clients, in person or on the phone" are a couple of examples. Projects are the small things that make a station worth more in little ways. They make a station's production or sales systems a little more efficient.

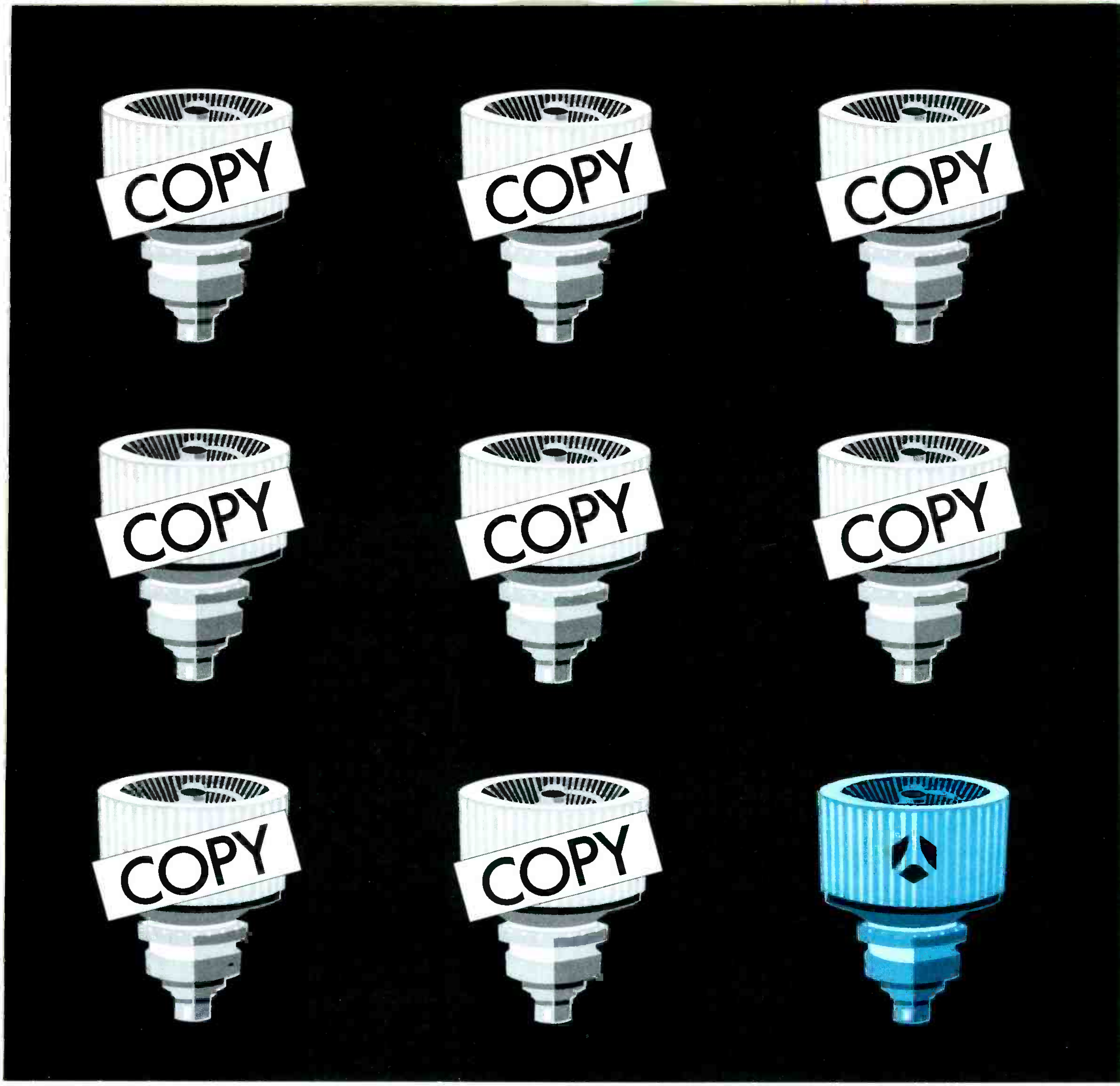
Just because something is replaced doesn't mean it will never need to be again.

Start by making and keeping a list of project items. Work from the list to determine the need, value and cost to implement the project. Rank them by priority; many things are nice to have, but not absolutely necessary or cost-effective. Above all, assess project needs from an operational standpoint.

The last line item in the studio section is *scheduled maintenance*. In every studio a number of timely things have to be done, and that reflects upon the whole station. When wear or obsolescence dictate it, studios should be painted and refurbished. The environment should be maintained to promote equipment efficiency and station productivity, which primarily involves the heating, lighting and ventilation systems. The structural aspects of the studio affect the efficiency and productivity of the station. Maintenance should be scheduled on a timely basis, at best, or on an as-needed basis, at worst.

The "bridge-painting" model may be helpful here, in which a person paints a bridge from one end to the other, finishing just in time to begin repainting again at the other end. In the application at hand, the entire contents of a facility will eventually require replacement, in a never-ending process of identifying what is the most needy at the moment. Having this progression of retooling predetermined over a period of years is the goal. Just because something is repaired, upgraded or replaced doesn't mean it will never need to be again.

A list of scheduled maintenance items is a good way to keep track of their timeliness (and their cost-at-last-replacement). Start the worksheet by using the list as a guide. Some maintenance may be weather- or problem-dependent, and may result from operational difficulties or oth-



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er unexpected emergencies. A good planning process helps avoid exigency, and saves money — crisis engineering is the most expensive kind of engineering a station can have. Determine the costs and priorities for each, considering the time variable for each item. Extrapolate where necessary from existing maintenance records as to the expected lifespan for critical or heavily used items.

Transmitter operation

Once again, begin with *consumable items*. These are the things necessary to maintain the operation and performance of the transmitter. In the course of operation, transmitter equipment also wears. Transmitters use tubes, air filters, and occasionally, go through some of their other parts. Tubes can last from one to two years or more, with air filters lasting typically less than that. Other maintenance depends on the age of the transmission system and the whims of nature.

Start with a list of the items, including best vendor and cost. Use maintenance records' data to project usage, based on efficiently maintaining the transmitter.

On the next line is transmitter equipment *maintenance and repair*. The maintenance needs of the transmitter site equipment differ from that of the studio. Transmitter sites tend to be isolated places, subject to vandalism, lightning and weather extremes. The items listed on this line should be limited to the normal maintenance variety, however. These are usually items found during inspections (of transmitter, transmission lines, antenna and tower) that have failed from use or age. Issues of safety or improved reliability may also fit here, if they are not of a capital nature, and simple enough not to require project status. Cost projections in this area are complicated; they differ from the more predictable consumables, because the needs are subject to great variation from year to year.

Start from a maintenance or trouble record, if possible. Determine what problems have occurred, and project what will or might occur in the future. Look for problems to solve. The overall maintenance

Continued on page 74

19______ ________________ PROJECTS DETAIL WORKSHEET FOR ________________

BY ____________________________________ DATE ________________________

——————— PROJECT ——————— COST ——

1. ....

2. ....

3. ....

4. ....

TOTAL FOR PROJECTS .... __________

Figure 3. *Worksheet suggestions for projects and scheduled maintenance.*


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STUDIOS

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SONY
PROFESSIONAL VIDEOTAPE

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goal is economic efficiency without loss of performance in this final part of the product "assembly line."

In the transmitter *projects* line, consider that projects for the transmitter site/system differ from studio ones. They tend to be reactive rather than proactive, and oriented toward improving operational efficiency, or fixing problems. Minor updates because of new technology, may also be included, such as more automatic systems to make the plant self-regulating, better remote control or safety improvements. Complexity for the sake of complexity should be avoided, along with unwarranted glitz and twinkling lights.

Start the worksheet with a list of project items, perhaps the result of operational difficulties. Work from the list to determine the need, value and cost to implement the project. Rank them by priority.

For the *scheduled maintenance* line, consider that a transmitter site requires a number of timely things to be done. These items reflect the station's position and image in the community and industry. Every five or six years, towers need repainting. Every year and a half or so, tower lights need replacing. Every summer and fall there's brush and grass to cut and mow.

There's also timely maintenance to preserve the buildings' weatherproofing. Verify that roofs don't leak and that buildings are in an environmentally safe (for equipment and people) condition. Include periodic antenna adjustment and tests to keep a measure on performance. To ensure that the overall condition of the transmitter plant doesn't deteriorate, best results will occur if these items are scheduled on a timely basis rather than on an as-needed basis.

A list of scheduled maintenance items helps keep track of their timeliness and most recent costs. Start the worksheet by using the list as a guide.

Technical improvements and capital expenditures

This is the last worksheet, and perhaps the most important. Based on the technical analysis of the budgeting process, operational and technical needs can be determined. All equipment will eventually require replacement because of use, tech-

Continued on page 78

19______ ________________ **SCHEDULED MAINTENANCE WORKSHEET FOR** ________________

BY ____________________________________ **DATE** ____________________

———— MAINTENANCE ITEM ———————— COST ——

1. ....

2. ....

3. ....

4. ....

TOTAL FOR SCHEDULED MAINTENANCE ....__________

Figure 4. *Worksheet suggestion for capital expenditures.*

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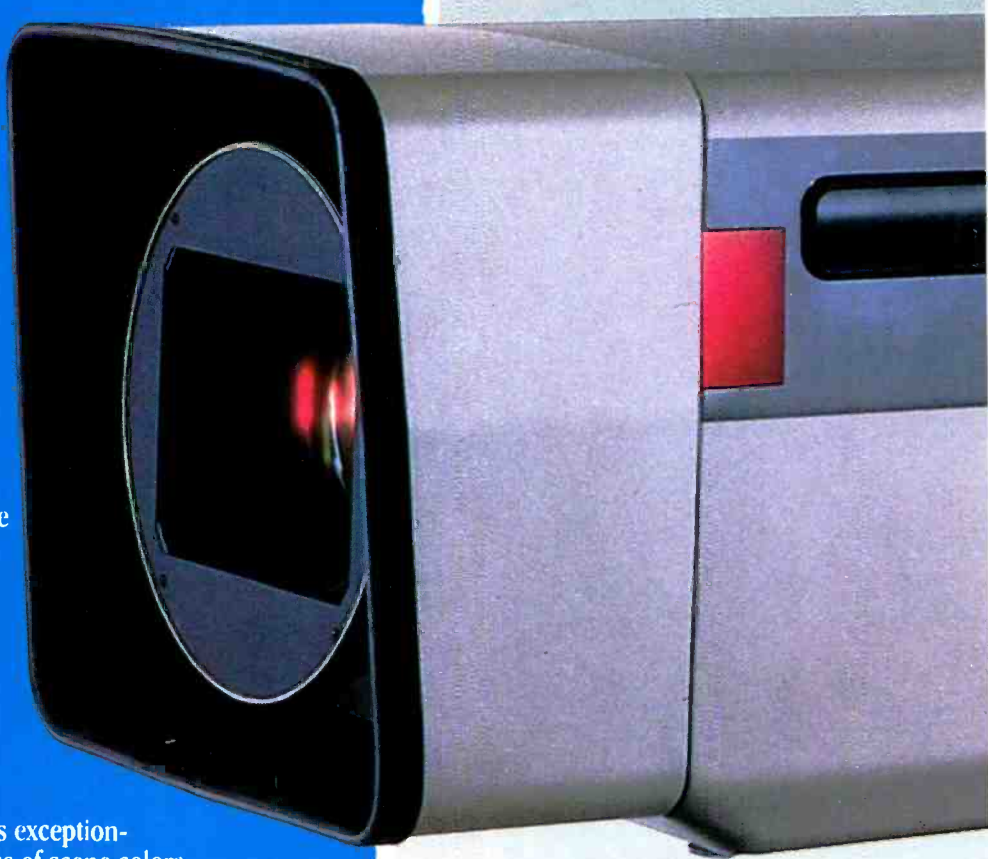

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The HK-355 Studio Chip Camera offers many exceptional features:

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Continued from page 74

nological improvements, or a change in the facility's operational needs. The replacement or addition of new equipment is a *capital expense*, subject to technical considerations and production and financial ones.

Create a technical improvement list. Make a list of reasons for each item, detailing why it is needed and what benefits its acquisition will provide. Make a list of reasons against each as well, noting any reasons why it shouldn't be purchased (for example, what other items could be bought with this money), and, of course, include its total cost, including taxes and delivery charges. Justify the requested capital expenses using these facts, and rank them according to pertinent priorities.

Finally, enter the data from the worksheets on the engineering budget form and submit it for consideration and integration into the station budgeting process. Budgets are not the cut and dried things that the numbers would imply. The final engineering budget must fit within management goals and the economic realities of operating a competitive business. For engineering to have any direct input and control over how station resources are expended in the technical area, this documentation is essential.

The continuous plant evaluation and performance review of technical hardware that this process entails is an extremely valid *engineering* process. Such objective research pays dividends in the audio quality of the station, as well as the labor efficiency of maintenance personnel. It may also pave the way toward better working relations between the facility's corporate management and its engineering department. By "speaking the language" and becoming more a part of the team, the broadcast engineer will be capable of influencing and getting involved in the station's success.

19______ TECHNICAL IMPROVEMENTS WORKSHEET FOR ______________
+++ CAPITAL EXPENDITURES +++

BY ______________________________ DATE ____________________

———————— TECHNICAL IMPROVEMENT ————————— COST ——
— REASONS FOR & AGAINST —— BENEFITS PLUS & MINUS —

1. ....
....
....
.... ______________ +

2. ....
....
....
.... ______________ +

3. ....
....
....
.... ______________ +

4. ....
....
....
.... ______________ +

TOTAL FOR CAPITAL EXPENDITURES FOR TECHNICAL IMPROVEMENTS.. ______________ =

Figure 5. *Justify your request for technical improvements with fiscal as well as technical reasons.*

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And since each cut has its own ID, cue lists can be created and stored within DigiCart to speed production. It's even possible to cue up a second spot while the first one is playing on the same machine!

C O M P A R E

FEATURE	ANALOG	DIGICART
Random Access	No	**Yes**
Cue Title Display	No	**Yes**
Time Remain Display	No	**Yes**
Instant Cueing	No	**Yes**
Adjustments	10–20	**None**
HF Loss With Wear	Yes	**None**
Stereo Phase Error	Poor	**<1°**
Wow & Flutter, %	.1–.3	**Zero**
Start Time, Sec.	.1–.3	**Zero**
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Distortion	1.5%	**.005%**
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Panasonic Broadcast Systems' answer is the new, lower-cost, high quality 1/2-inch videotape recording system, a family of recorders priced like 3/4-inch, but with performance and quality more like one-inch. With cassettes nearly 50% smaller than 3/4-inch (providing up to 50% more recording time), Panasonic's new MII not only provides much more flexibility in the field; it takes up far less archival real estate. Plus, the new MII's broad compatibility ends the dilemma of meeting rising quality requirements within today's lean budgets.

AU-410 Dockable Recorder mates with camcorder cameras of all the major brands.

AU-520 Portable Field Recorder with 90 minute cassette record capability.

Panasonic's new series of MII recorders capitalizes on Matsushita's vast experience as the world's largest manufacturer of video recorders, combining advanced VLSI technologies with the very latest materials. The result is a series of recorders that work smarter, fit better and cost less than any comparable system.

FIELD ACQUISITION SYSTEMS

If you're thinking 3/4-inch systems for the field, think again. You can compare 3/4-inch to the new MII for price, but you can't compare the quality, features or performance. And, you simply can't get a 3/4-inch camera/recorder.

The new AU-410 Dockable Recorder can mate to virtually any video camera designed for camcorder operation. Now, your favorite camera can make pictures with quality that rivals that of one-inch VTRs. The AU-520 Field Recorder provides *all* the high-end production features required in the real world, and, unlike 3/4-inch, offers full 90-minute videocassette record capability in the field.

NIC HAS SWERS.

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Don't let the low prices of these studio production VTRs fool you. All use full bandwidth video and an advanced analog component CTCM video signal

AU-62 Studio Player, the ultimate in low-cost, high performance utility players.

system for video excellence, generation after generation. Each recorder has digital time base correction built-in and advanced VLSI techniques have cut the total PC board area by 40 percent, power consumption by 40 percent, and system weight by 20 percent.

Want the machine to wake-up in a specific mode for certain applications? A non-volatile memory and on-screen menus allow you to program each machine's operating personality to suit yours: shuttle knob speed, machine status and time code displays, machine address, ballistics emulation (C, Beta, MII, SMPTE time code* or CTL, pause-to-standby characteristics, etc.) or revert to the factory default settings with one touch.

To ensure reliability, all new MII machines feature self-cleaning heads, a drum motor confidence check during edits, a modular power supply, plus a Super Dropout Compensation* (SDOC) system, which corrects for up to one field.

For systems compatibility with almost any mix of VTRs in use today, each of the new production VTRs includes a 9-pin RS-422A serial/parallel interface, plus a 50-pin parallel input via an optional interface board.

AU-65 Studio VTR, the perfect editing platform for sourcing from MII or other formats.

Each new MII VTR is completely conversant with today's edit controllers. The new MIIs

AG-7750 S-VHS Recorder with Y/C 3.58 component I/O, time code, RS-422A and digital TBC assures maximum quality dubbing to and from MII.

are plug-compatible with 3/4-inch VTR machines. Acquire in S-VHS or distribute in S-VHS at the highest quality levels using the system's Y/C in/out for dubbing to or from S-VHS.

AU-63 Studio Player with AT™ Auto Tracking for superior slow-motion, is the perfect companion for an AU-65-based suite.

The AU-62 Studio Player is the ideal utility machine for high quality, low-cost video playback. The AU-65 Studio VTR is the perfect editing platform with 1-event assemble and insert editing for video and audio.

Variable memory editing makes the AU-65 incomparable for slow-motion inserts. The AU-63 Studio Player with AT™ Auto-Tracking is the perfect companion for an AU-65-based suite or for any other application where the best in variable speed performance is important.

The openness of Panasonic's new MII is a standing invitation to every producer to step up to the world of full bandwidth video. Now, the question becomes, "Can you afford to pay more for less?" That's a question only you can answer.

*OPTION

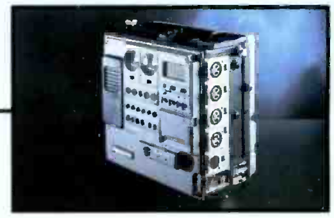
MII SYSTEMS COMPATIBILITY

Field Acquisition

ANY CAMERA
Accepts NTSC composite, Y/C component, or RGB component video camera outputs.

AU-520

DOCKABLE CAMERA
The AU-410 docks with the full range of professional video cameras from Ikegami, Sony, BTS, Ampex, Hitachi, JVC, etc., as well as Panasonic's AK-400, AK-450, and the new AQ-20 digital processing video camera.



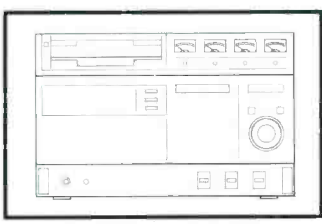
AU-410

Source VTRs

AU-62

AU-63

S-VHS



Any VTR using RS-422.

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Edit/Record VTR

AU-65

AU-665

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data or the audio output.

A early provider of data network service was Bonneville Telecommunications, formerly known as Radio Data Systems, based in Salt Lake City. Bonneville began to broadcast data under an experimental FCC authorization in 1971. Indesys, of Sunnyvale, CA, offers FM radio subcarrier receiver hardware and a network operating at 19.2kbit/second. Multicomm Telecommunications based in Arlington, VA, (a subsidiary of Amway, former owners of the Mutual Broadcasting System), began development of an FM radio subcarrier network in 1982. By 1986, Multicomm was operating subcarriers in more than 80 markets because of limited acceptance and conversion to C-band and Ku-band satellite links. However, that number was reduced to about 15 markets by 1988.

• *Traffic information*: Not yet common in this country, the Radio Data System (RDS), sponsored by the European Broadcasting Union (EBU) in Geneva, Switzerland, can turn on or temporarily retune a car's FM radio when a traffic report comes in, as well as send station-related program and identification data to receivers equipped with alphanumeric displays. FM stations in all western European countries, where RDS-equipped car radios are available, are transmitting RDS on a 57kHz subcarrier. American broadcasters viewing the RDS display at the 1990 NAB convention indicated greatest interest in the "Radiotext" and "program type search" features. These receiver functions could display a station's call letters, slogan, frequency or call-in number, and could direct listeners to an alternate frequency, such as a translator. According to RDS marketers, Delco Electronics (General Motors) and Philco (Ford Motor Company) are developing RDS-equipped radios for future automobiles. The system is also being explored as a possible replacement or enhancement for the EBS system.

FM radio subcarriers will also be a part of a broadcast traffic service test in Los Angeles. The multimillion dollar project called "Pathfinder" is a joint venture of Caltrans (the California State Transportation Agency), the Federal Highway Administration and General Motors. Cars equipped with navigation systems and electronic map displays will receive and display data from the L.A. Traffic Operations Center via FM subcarrier. The subcarrier data will display traffic jams on maps in the test vehicles, which began this summer.

• Telemetry: For years, radio stations have used their subcarrier capability to send transmitter readings back to the station's control point. Although this transmitter-studio link avoids phone line costs, it is not usable if the FM transmitter is off the air. Also, an FM subcarrier transmitter telemetry channel occupies a portion of the same spectrum that may be used by potential revenue-producing subcarrier services.

As Figure 1 shows, business music applications lead the use of FM station subcarriers for the country as a whole, although the combination of stock and commodities information, paging and other data services totals to a higher figure. In the top 30 markets, audio services are currently overshadowed by the data-related services.

Among all forms of data broadcasting, that is, wireless point-to-point and point-to-multipoint delivery of data information around the country, two methodologies currently predominate: FM subcarrier systems and VSAT terminals. Figure 2 shows that the installed base of data broadcasting transmission installations or "drops," is led by FM subcarriers on various stations across the country and by Equatorial Communications, a digital VSAT network. Together, they account for 85,200 out of 114,000 drops in the United States, a 75% market share. Though diminishing (they represented 86% in 1987), FM subcarrier's market share will carry through 1992 and probably beyond. This graph also shows the projected increase in market share expected in the use of alphanumeric pagers for additional data transmission besides simple paging (stock quotes and sales data). These services are typically transmitted on standard VHF business frequencies in the 160MHz and 400MHz bands.

FM subcarrier technology

The wide channel bandwidth authorized for FM broadcasting makes it feasible to multiplex several channels of information together with the monophonic main channel. (See Figure 3a.)

Stereophonic sound is, of course, the most common form of multiplexing on FM stations. It uses an amplitude-modulated suppressed-carrier subchannel at 38kHz, and a 19kHz subcarrier pilot. The modulation of the stereophonic subchannel is equal to the instantaneous difference of the left and right audio signals (L-R), which are usually low-pass-filtered to 15kHz; therefore, bandwidth of the stereo subchannel is 38kHz $\pm$15kHz, or 23kHz to 53kHz.

The stereo pilot must modulate the main carrier between 8% and 10%, thus the L+R main channel and the L-R subchannel together may modulate the FM carrier by up to 90% (as depicted by the modulation envelope diagram of Figure 4). Because the L-R subcarrier is double-sideband AM, the envelope is shown with a maximum modulation of 45% for lower sidebands and 45% for the upper sidebands.

Before 1982, the FCC rules permitted a modulation spectrum, or baseband, of 75kHz for FM stereophonic transmission. Although standard stereo requires only 53kHz of baseband, the additional spectrum between 53kHz and 75kHz was authorized for subcarrier use. In its Report and Order on the subject in 1982, the FCC authorized the use of FM baseband up to 99kHz, primarily to provide spectrum for proposed quadraphonic transmission, but also opened it up for additional SCA usage. Multichannel audio never became popular with FM broadcasters, possibly because the quadraphonic systems have signal-to-noise ratios (S/N) several decibels poorer than stereophonic reception (which in turn is already up to 23dB noisier than mono FM), and because discrete quad transmission required a subcarrier that occupied the pre-1982 portion of the baseband available for revenue-producing SCA subcarrier services. What evolved was the current state of affairs, in which two (or more, with narrowband data services) revenue-producing SCAs are possible along with stereo FM. (See Figure 3c.)

Also in the FCC's revision of the FM baseband in 1982, the allowable modula-

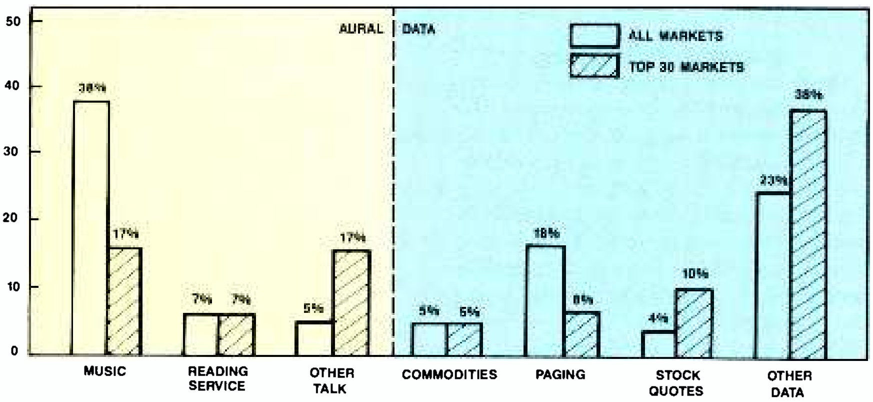

Figure 1. FM subcarrier usage by type of service (estimated). (Source: Waters Information Services, Binghamton, NY.)

tion of the FM carrier was increased when subcarriers were added. Before 1982, the modulation back-off required when subcarriers were added was one-for-one — 1% reduction of the main channel and stereophonic subchannel for each percent of subcarrier modulation or injection. After it was demonstrated that under typical program conditions, one-half-for-one modulation back-off occupied approximately the same bandwidth as stereo alone, and, therefore, produced no significant increase in adjacent or alternate channel interference, the FCC adopted this change as well. Broadcasters are now required to back off the main modulation only ½ percent for each percent of subcarrier injection, up to a total of 110% peak baseband modulation, as shown. Other combinations of subcarrier injection up to 20% with main-plus-stereo modulation are apparent.

20% subcarrier injection (maximum permitted with stereo)
80% main + stereo subcarrier modulation (10% back-off)
10% stereo pilot

110% total modulation

A back-off of 10% in main-plus-stereo modulation amounts to approximately 1dB, which is not a noticeable difference to most listeners. Therefore, broadcasters had one fewer negatives to consider when adding subcarrier services.

Note that all 20% of the available injection may be concentrated in one subcarrier, provided the center frequency is below 75kHz. When only SCA-type subcarriers are transmitted with a monophonic main service, total subcarrier injection up to 30% is permitted. (See Figure 3d.)

The FCC's rule changes also allowed new forms of subcarrier modulation to be employed, in addition to the standard FM subcarriers previously allowed. For example, double- and single-sideband AM were permitted, as well as frequency- and phase-shift modulation, which opened the lucrative field of high-speed data transmission.

Subcarrier frequencies

There are innumerable ways to divide the composite baseband spectrum. The most frequently used spectrum centers on 67kHz, which long ago became a de facto standard for FM subcarriers. This location in the baseband allowed sufficient frequency separation from the stereophonic subchannel, which extends to approximately 53kHz. The 67kHz frequency was also separated — but less so — from 76kHz, which was present in earlier stereo decoders as a second harmonic of the reinserted 38kHz L-R subcarrier, and the source of significant beat notes or "birdies." (Modern integrated circuit stereo decoders typically use a 38kHz square wave, which is almost devoid of the beat-generating second harmonic.)

Based on the need to provide sufficient separation from existing 67kHz subcarriers, and maintain clearance below the FCC's 99kHz baseband modulation limit, a second de facto standard developed at 92kHz. This frequency actually has a little more modulation bandwidth available than does the 67kHz carrier, a function that compensates partially for the slight rise in its noise floor with baseband frequency, typical of all FM systems. The

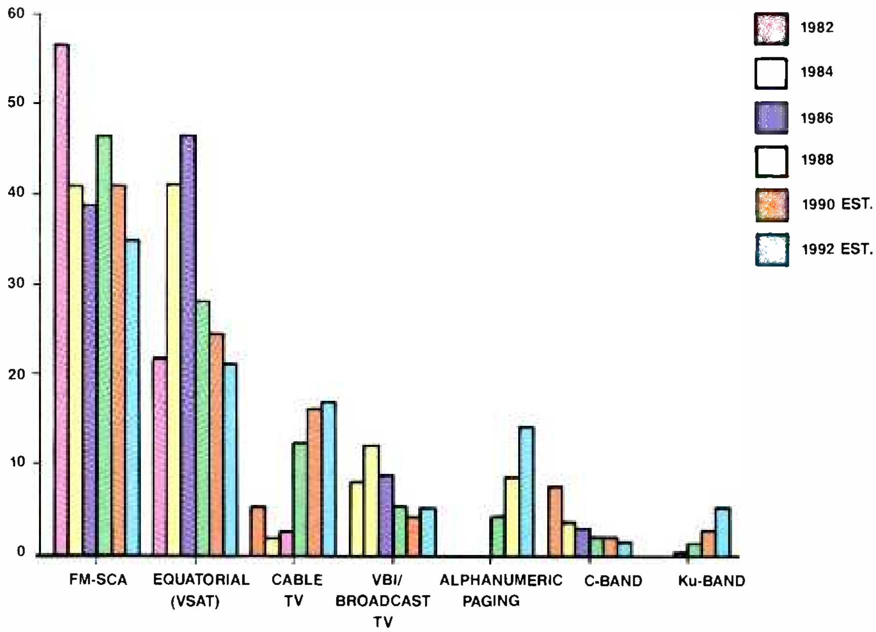

Figure 2. Market shares of U.S. data broadcast methods. (Source: Waters Information Services, Binghamton, NY.)

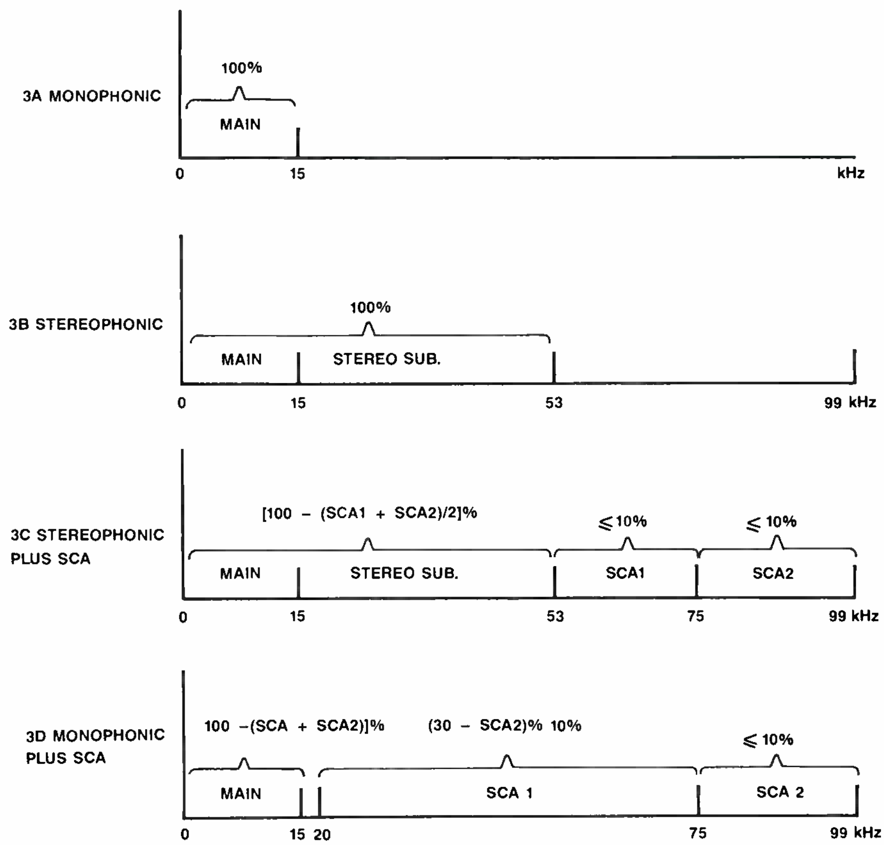

Figure 3. FM baseband spectrum and modulation limits.

TVV	ATV	KOCO	WSOC	WXIA	WCMH	WDBJ
EVV	TVNZ	WITF	WTVH	KPIX	WVIZ	WVTV
ARK	CCTV	KJTV	KGBT	KSEE	WGAL	KVVU
ELO	VOK	WISN	KRGV	KRMA	KOAT	KPHO
CBS	TTV	WCVB	KTXS	WOFL	WUTR	WHMM
DVM	RAI	WAKA	WSLS	WATL	WCET	WAVY
TOL	KBC	KSTS	WHME	WHO	WSYX	WXEX
EHT	BTQ-7	WJCL	WJZY	WGN	WCAU	WOWK
BRZ						KBDI
MOX						KWHY
AIT						WTVT
NEM						WGNX
SLA						WAVE

These stations had to pay *us* to get on this list.

ETK	STW-9	WIPB	WETK	WTVW	WNEP	WECT
LVI	BCV-8	WTVJ	KHJ	WPSD	WVIA	WMHT
ETK	KBS	KGUN	KARK	KPLC	WIS	KWTV
FCF	CSSR	KCOY	WYAH	WJZ	WSMV	KABY
FQC	BBC	WHCT	WTTV	KMOV	KCOS	WSAV
FMT	WABI	WMAZ	KFME	WFIE	KPRC	WBTV
BFT	WCCB	WBAL	KLTV	WHAS	KTRK	WFMY
ITV	WETM	WBFF	WSFA	KLFY	WWCP	WCPO
KVR	WXXI	KSPR	KPNX	WDSU	WYFF	WCIV
KVU	KEZI	WPTZ	KICU	WMAR	KBTX	KUTV
JOH	WTAE	WHYY	KSBW	WLOS	KFDM	KUSA
BUT	KSFY	KLRN	KCNC	WXII	KSAT	KXLY
IVM	WCFE	KTMD	WRC	WRGB	KVUE	KXAS
SV-7	WTTW	KODE	WXEL	WBNS	KSL	KWCH

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92kHz subcarrier is further removed from the stereophonic portion of the baseband, as well as its harmonic products that lead to intermodulation beats in receivers, and, therefore, this frequency usually has less effect on the stereo service.

Other subcarrier frequencies are possible under FCC rules, and are bound only by the protection requirements of an adjacent stereo or subcarrier service and the total injection limits. For example, the RDS system mentioned earlier, uses a narrowband (approximately 3kHz) channel centered at 57kHz for its digital signaling. Other system designs have employed an array of single-sideband subchannels across the 53kHz to 99kHz band to carry five independent channels of 5kHz audio or medium-speed data. The Receptor system discussed earlier sends almost 20kbit/second using a subcarrier frequency of 66.5kHz, which improves performance because it is harmonically related to (3.5 times) the stereo pilot.

Transmission systems

Improvements in receivers and stereo decoders, and the careful choice of modulation type and subcarrier frequencies have minimized the potential for main channel interference from subcarrier services. Of course, the performance of the transmission system also must be considered. Proper planning is essential in the establishment of any subcarrier operation. To ensure that the subcarrier service is carried with minimal degradation to itself and the stereophonic service (which is the broadcaster's "bread and butter"), plus any other subcarrier services on the baseband, the entire transmission system should be investigated.

Stereo generator: Modern stereo generator designs are more than clean enough for stereo-only service, but they must be exceptionally clean when additional subcarriers are operated. The term "clean" here refers to low spurious modulation products outside the 0-53kHz band. (See Figure 4.) This is achieved by low-pass filtering of the left and right audio before

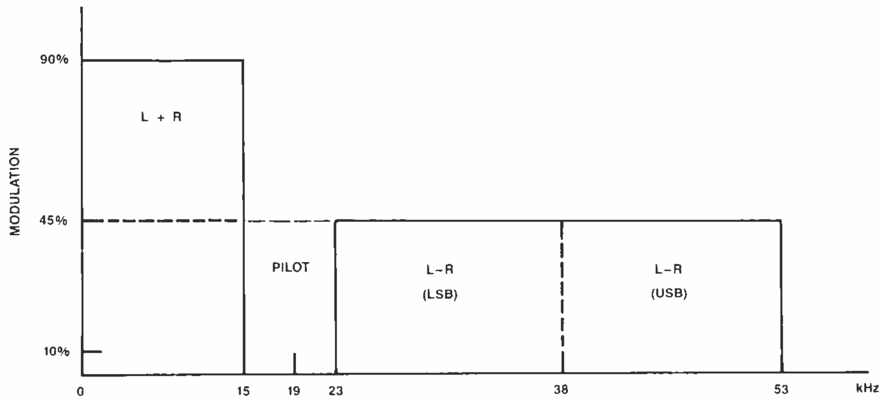

Figure 4. *FM stereo baseband modulation envelope.*

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Specifications	ABEKAS A42	ALTA Centaurus	AMPEX ESS-5	HARRIS ESP II
Bandwidth	4.2 MHz (±0.25 dB)	**5.5 MHz (-3 dB)**	5.9 MHz (±5 dB)	5.0 MHz (±0.5 dB)
Signal to Noise	52 dB	**58 dB**	?	56 dB
Storage Capacity*	200 fields 100 frames	**250 fields 125 frames**	207 fields 207 frames	200 fields 200 frames
Synchronizer	—	**Dual**	—	Dual
TBC	—	**Dual**	—	—
Production Effects	1 wipe dissolve —	**9 wipes dissolve 7 digital**	1 wipe dissolve —	3 wipes dissolve 3 digital
Warranty	1 year	**2 years**	1 year	1 year
Single Channel / Dual Channel	$19,900 / $24,900	**— / $16,900**	— / $31,500	$26,333 / $30,995

*Basic System

Based on available data as of June, 1988.

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stereo generation (which directly affects the bandwidth of stereophonic subchannels), and removal of pilot harmonics and clipping products. Such protection is intended mainly for the benefit of subcarrier services, which typically operate 20dB below full modulation (for 10% injection), and are more susceptible to spurs from the stereo subchannel. However, even low-

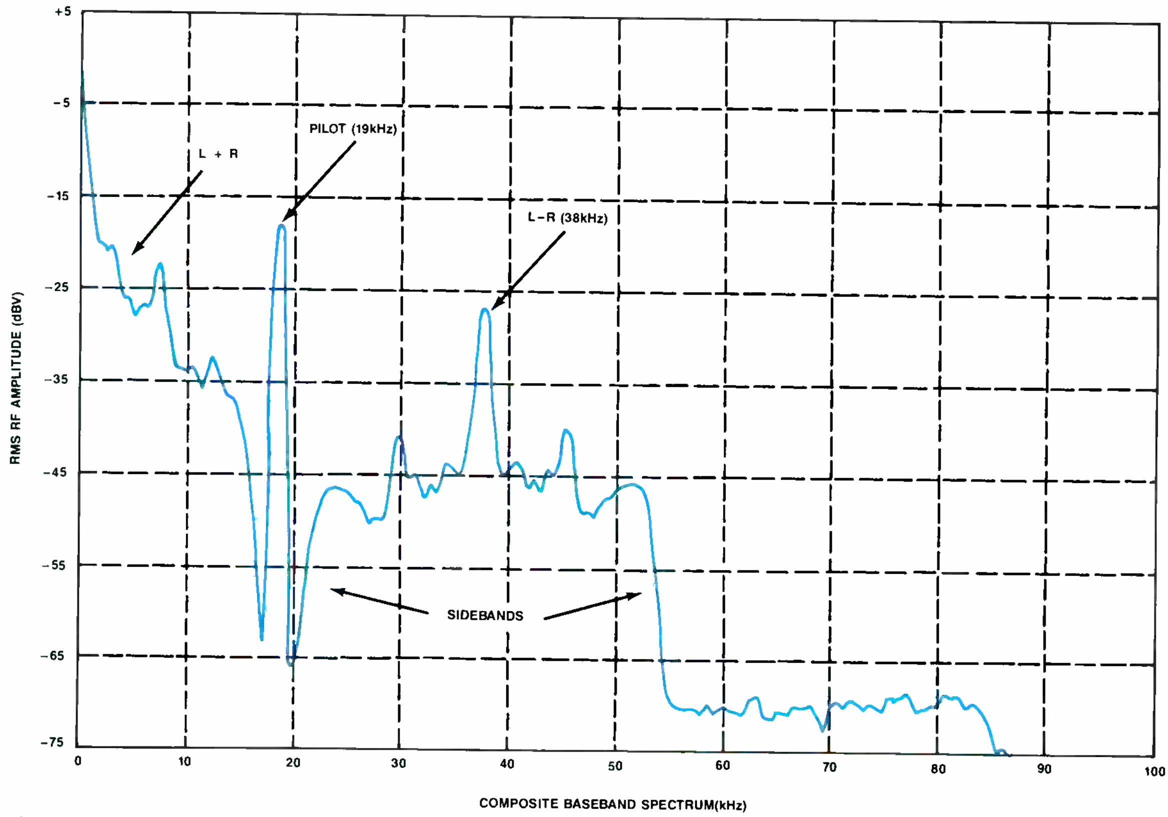

Figure 5. *An example of a clean stereo FM station's spectrum. No additional subcarriers are in use.*

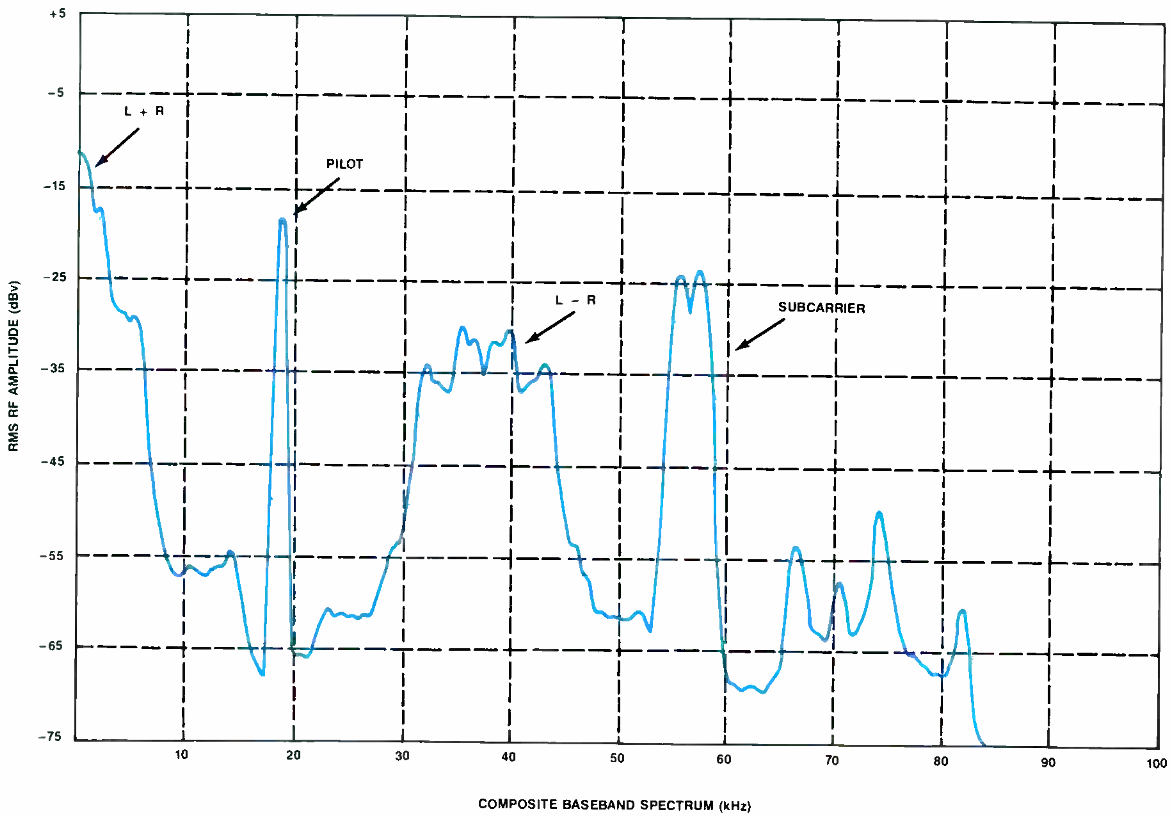

Figure 6. *Spectrum of an FM stereo signal with paging subcarrier at 57kHz. Note several -50dBV to -60dBV harmonic spurs in the upper part of the baseband, caused by interference picked up in the station's STL. If aural subcarriers were employed, these spurs would be problematic.*

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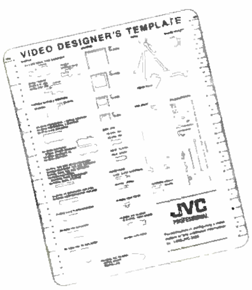

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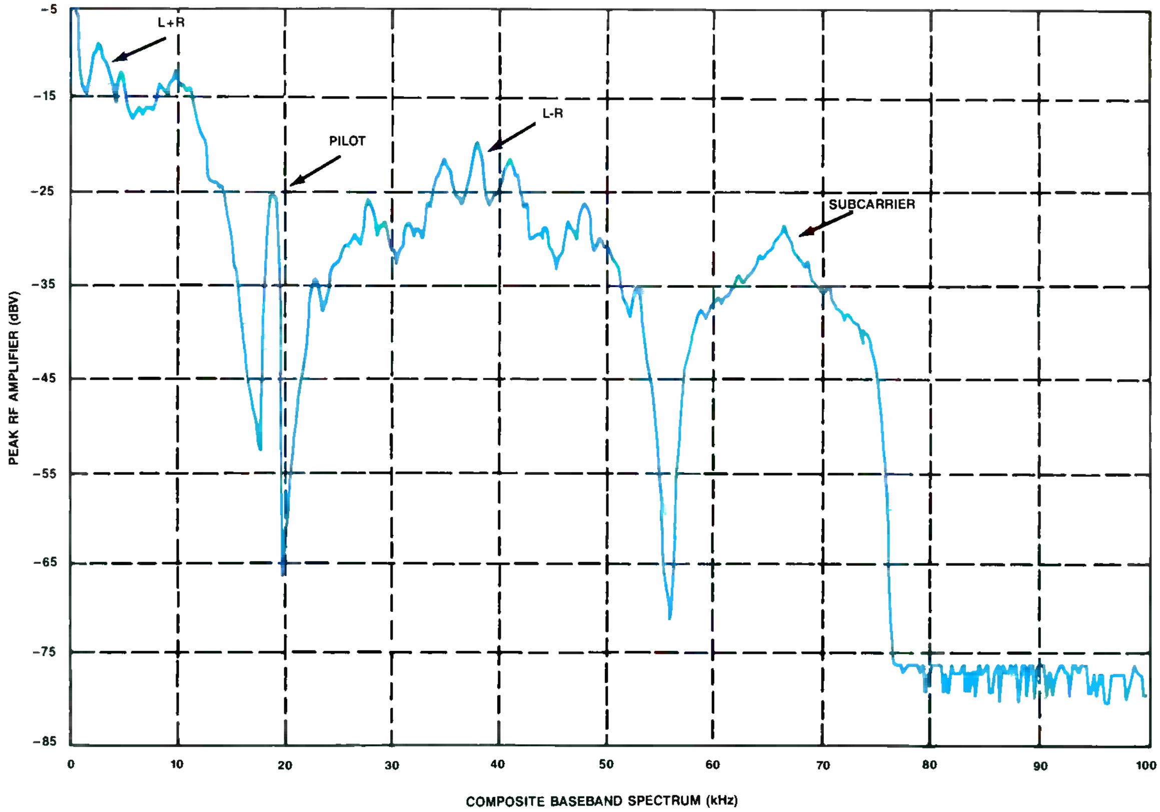

Figure 7. *Baseband spectrum from an FM stereo station with the Receptor messagewatch subcarrier at 67kHz. Note that depth of filtering between L-R and data subcarriers is >70dB.*

FIELD PRODUCTION

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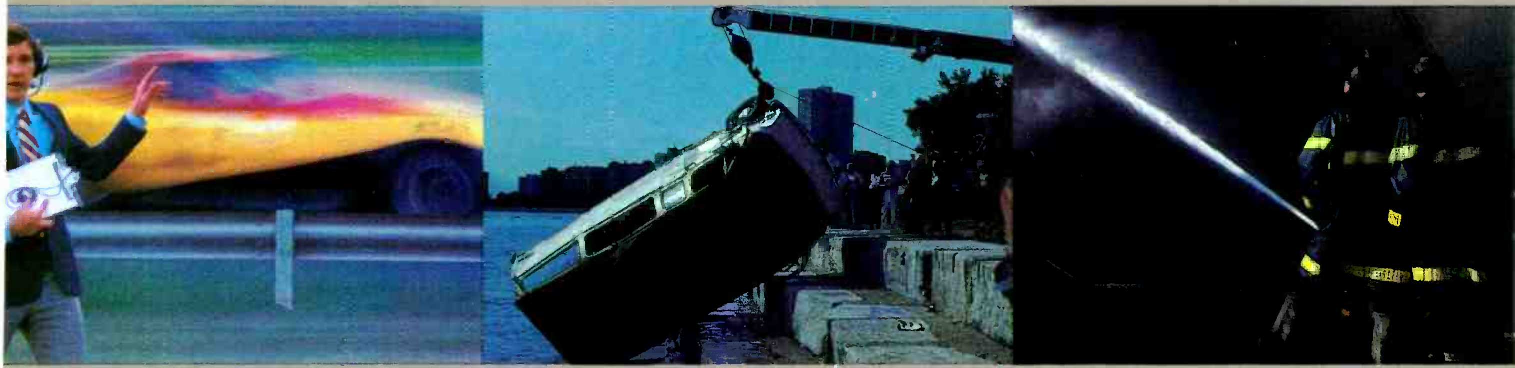

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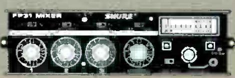

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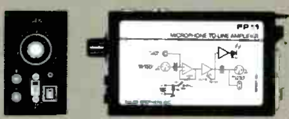

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level pilot harmonics (-60dB relative to 100% modulation) can cause audible beat notes in some stereo receivers.

Figure 5 is a graph drawn by a spectrum analyzer, using a high-quality demodulator connected to the transmission line sample output of an operating FM station; normal programming and audio processing were in effect during the measurement of this exemplary station. The horizontal range spans from 0Hz on the left to 100 kHz on the right, and vertically spans from 100% modulation at the top line to 80dB below this reference at the bottom. The graph shows the energy contained in a bandwidth of approximately 1kHz (954.85kHz, to be exact) across this frequency span. Peak modulation was close to 100% frequently around the time of this measurement, but the spectrum analyzer's graph shows the average (not peak) energy within relatively narrow bandwidths (compared to the width of the main and stereo subchannel). The displayed level of these channels is less than the wideband peak values displayed by station modulation monitors.

The stereo pilot is visible as the sharp spike next to the 20kHz reference line. Note that the injection is a little low (-23dB or 7.1% modulation). Also, notice that the low-pass filtering in the left and right audio and minimal use of audio clipping has effectively protected the pilot from interference products (to approximately 70dB below reference modulation). The baseband above the stereo subchannel (above 53kHz) is low in noise and spurious products, measuring approximately 75dB below reference modulation. The fall-off in noise above 85kHz is because of a low-pass filter in the composite microwave STL receiver.

Figure 6 depicts another station measured in similar fashion to the first, but this station has some problems with spurious signals in the upper baseband, at approximately 67kHz, 72kHz, 75kHz and 83kHz. It is believed that the microwave STL link of this station was receiving interference from private radio transmitters operating on a frequency near the 950MHz auxiliary band. Although adequate for stereo service, these spurious products would noticeably degrade the noise level of an audio subcarrier service, and could also degrade the reliability of a high-speed digital subcarrier. This station was also operating a paging subcarrier service at 57kHz (which was unrelated to the cause of the previous problem).

Figure 7 measures an FM broadcast station operating in stereo with the digital subcarrier for the messagewatch system mentioned earlier. This subcarrier is essentially double-sideband-suppressed carrier modulation with digital filtering. Notice the steep fall-off in energy at

Continued on page 119

"At first we considered digital too costly and exotic for our needs. In reality, it was neither."

– Bill Dowd, Operations Manager, KTUU-TV, Anchorage

We all know that perception can differ from reality. Just mention Alaska and it conjours up images like the one above. Cold and remote. But can you imagine temperatures reaching 90 degrees, a rain forest, or even a desert in the arctic?

To truly appreciate the beauty and diversity of Alaska, you need to talk to an expert. Like Bill Dowd of KTUU-TV in Anchorage. Who, as a broadcast professional, also has some surprising things to say about D-2.

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As for compatibility, the DVR-10 fits right in with our analog and Betacam® machines. Which not only increases our creative flexibility, but it gives us the consistent quality we never had with our analog equipment alone.

But there was still something else we didn't expect. That the cost of upgrading to digital was comparable to that of analog equipment. Which means we didn't have to raise our commercial production rates. So that was it. The decision was made"

*...**Bill Dowd***

It's no surprise that broadcasters everywhere are realizing the benefits of going digital. And in markets of all sizes, they're going with a Sony DVR-10.

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BROADCAST PRODUCTS

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Bringing in the feeds

By Peter Hammar

Mobile units cover the 1990 Goodwill Games.

Some call them "mobile units," "remote pickup units" or "remote production units." Others say "outside broadcasts" or "OBs" or "scanners." Whatever the name for TV trucks in the field, there were plenty of them in Seattle July 20 through Aug. 5 to cover the 1990 Goodwill Games. Approximately two dozen remote units fed a multimillion dollar broadcast center, built in a converted bus garage. These trucks sent the Goodwill Game's sights and sounds to more than 20 million U.S. households on TBS via cable. The Goodwill Games world feed, using international satellites, provided coverage to more than one billion potential viewers.

Olympian task

The Goodwill Games spanned 17 days, and 2,500 athletes from more than 50 countries competed in 186 events in 21 sports. Engineers had to connect sites in Seattle, in Tacoma to the south, at the Tri-Cities 150 miles to the east, and in Spokane, 300 miles across the state. To do so required building a backbone of leased fiber-optic and copper lines. A myriad of private fiber-optic and laser links, terrestrial microwave hops, C- and Ku-band satellite feeds and copper completed the network.

Venues included the new Weyerhaeuser Aquatic Center in Federal Way near Tacoma (swimming and diving), and the Athlete's Village and Husky Stadium at the University of Washington in downtown Seattle (track and field, athletics, wrestling and volleyball). Events were also held at the Seattle Coliseum (basketball and boxing), the Tacoma Dome (gymnastics, figure skating and ice hockey), and the Spokane Coliseum (volleyball, gymnastics and weightlifting). Other venues included Seattle's Lake Washington (rowing/sculling), and Seattle city streets (marathon running).

Coverage included cutaway shots from various vantage points atop Queen Anne Hill and the Columbia Center skyscraper, aboard the Goodyear blimp Columbia, from the roaming Voyager Caravan prowling the greater Seattle area and Puget Sound — even from an F-18 fighter jet circling the city.

Simple and reliable

A simple philosophy guided the choice of equipment: Use the cheapest method that will work well, won't break, and will maintain consistent NTSC quality. Skip Long, Goodwill Games project engineer for TBS, and Larry LaFave, TBS venue project engineer, reviewed and developed the equipment list.

The broadcast nerve center for the Goodwill Games was the International Broadcast Center or "IBC." To create the IBC, Turner converted a former Seattle municipal bus maintenance barn into a $5 million broadcast production facility. The center featured six video edit suites, three large production control rooms, and numerous radio and voice-over booths. There were two videotape centers, with more than 60 Betacam SP VCRs and type C VTRs. The center also had a graphics area, with 10 character generators, a paint system and a digital disk recorder for rotoscoping and cel animation.

Parked just outside the center were two large mobile units. Turner Broadcast rented and reconfigured them as master control rooms. One unit, the 48-foot Super Shooter 8, controlled the TBS feed. The second, Super Shooter 5, served as the "host broadcaster control room." This truck produced the international feed for countries that did not send representatives to Seattle to cover the games.

The contractors who reconfigured the two master control trucks were responsible for all maintenance. The vendor assigned an engineer-in-charge and one or two assistants to each vehicle. This turnkey approach provided great cost savings.

Mobile units on location

Most of the mobile units at the venues were working sports trucks and needed little, if any, modification for the games.

Hammar is owner of Hammar Communications, San Carlos, CA.

Three of the trucks were 35-foot, straight-body vehicles, or "bread vans." The others were 40- or 45-foot trailers. Some units covered more than one venue, moving as needed during the two weeks of the Games.

Turner leased these trucks from a variety of sources around the country. The different layouts created a small challenge for production personnel. A changing environment eliminates the "automatic reach" that puts an operator's fingers on the right controls almost without thinking. Some trucks sported the East Coast tradition of mounting the switcher on the right-hand side of the truck. Others used the West Coast left-hand style (hence the term, the "Left Coast"). One truck had the switcher sideways.

The TBS production compound in the Tacoma Dome produced ice skating events for the 1990 Goodwill Games. The rink is visible to the upper right.

Turner engineering configured two vehicles for slow-motion video. These used special 90-frame-per-second cameras married to special 90fps VTRs. These trucks traveled between venues as required.

Venue communication: Calling the shots

The communication system between the IBC and each venue included talkback, cue and interruptible feedback (IFB). A 4-wire intercom system was the primary communications hub. Additional 2-wire party-line intercoms formed smaller subsystems within the IBC.

For communication to the remote trucks, the IBC used full-duplex transmission circuits via T-1 carrier, and dry (no ring voltage) Class A copper phone lines.

Each mobile unit had a director, technical director and the other normal staff needed to make a large mobile setup work. The field directors in the mobile units received general direction from the producer and director back at the IBC. However, all individual shot calls came from the directors at each venue.

Having all shots called from the field led to the occasional feeling of helplessness

Engineers had to connect sites in Seattle, in Tacoma to the south, at the Tri-Cities 150 miles to the east, and in Spokane, 300 miles across the state.

on the part of the directors back at the IBC. Some speculated that robotics and other automation devices could do away with field directors altogether. However, the broadcast's success proved the effectiveness of local venue control. Field directors, chosen for their experience in covering certain sports, can build rapport with the crew and talent. People seem to respond better to commands and instant problem-solving from a local director than to orders barked by an unseen voice many miles away.

Cellular phones aided communications between the IBC and the field, as well as between the venue trucks and their field crews. According to one communications person at the IBC, however, cellular phones can actually create problems: instant phone communication makes it possible to replace planning with last-minute decision making.

Live or delay

Normally, all feeds from the field went back to the IBC live. Turner crews did a few tape-delayed feeds when there were more simultaneous events than there were available video links back to the center. As a backup in case of line trouble, most venues made archival recordings on 1-inch or Betacam while feeding the IBC live.

Audio and video monitoring in the field

In addition to line-out monitoring and metering, most venues also relied on the Game's closed-circuit TV (CCTV) system. The CCTV system consisted of 16 channels carrying 10 "venues of the day." Six additional channels — Canal Plus, TSS (Soviet television), TBS' world feed, and three information channels — completed the CCTV mix.

To maintain consistent audio and video levels, the broadcast center had a daily check-out procedure. When the venue crew arrived at the truck, they called the tech center to check their audio and video, and get a "buy," or OK. The truck

A simple philosophy guided the choice of equipment: Use the cheapest method that will work well, won't break, and will maintain consistent NTSC quality.

crews then contacted the "4-wire room" and checked out the intercom and related connections. The mobile unit was then handed off to the host or domestic control rooms and checked through all the way to the end point.

US West lines operated at unity gain. The daily check-out looked for losses between the mobile units and the terminal gear, and in the links between the telco office and the IBC. Equalizing distribution amplifiers compensated for any losses.

Gathering and transmitting audio at remote broadcasts can lead to many problems. Ground loops, noise (SCR, RFI and EMI), and impedance differences plague

Shadowed by a medal-bedecked Space Needle, the International Broadcast Center for the Goodwill Games was a $5 million production complex built in a former bus maintenance barn.

copper-based interconnects. At one venue, the Seattle Coliseum, Turner engineering used a 16-bit digital-audio fiber-optic system. This transported audio signals from the floor to the mobile unit approximately 1,000 feet away. The system naturally overcame the biggest problem in the field — ground loops. Also, some of the technicians back at the broadcast center did A-B comparisons. They noticed the coliseum's digital fiber-optic audio feed seemed to have a larger dynamic range than the analog, copper-based setups at the rest of the venues.

Two production trucks formed the international (left) and domestic master control rooms for the Goodwill Games. The IBC appears to the right.

Video timing

Integrating all of the video equipment was a design challenge for the Turner engineers and their contractors. The system needed to provide in-phase feeds from any tape or venue source to 10 switchers in the center and the two adjacent mobile units.

Most of the mobile units at the venues were working sports trucks and needed little, if any, modification for the games.

Remote trucks usually function as freestanding units. However, for the Games, engineers wired all of the truck equipment, VTRs, character generators and, in one instance, the still-store into the main IBC signal system. All of the signals were zero-timed as they entered the IBC's 128×128 routing switcher. The IBC's main sync generator served as the system's master clock. In this way, any of the equipment in either of the two trucks or the IBC itself could end up together in time at the production switchers.

It would have been impractical to genlock the venues to the IBC. Instead, a battery of 24 frame synchronizers, one for each venue, retimed the signals as they entered the router.

One of the outstanding accomplishments of the Goodwill Games broadcast was its use of point-of-view (POV) cameras.

At the rowing event on Lake Washington, each boat had either an active camera unit or a "dummycam" of the same weight. Three boats with 2GHz transmitters beamed their separate video and audio signals to a relay helicopter. At the helicopter, an RF intercom subswitched the signals into a frame synchronizer. The helicopter then retransmitted the switched signals to a receiver at a remote truck near the lake.

One of the outstanding accomplishments of the Goodwill Games broadcast was its use of point-of-view (POV) cameras.

The interior of the domestic master control room, a 48-foot production trailer. The monitor wall holds 72 monitors.

Another orchestration of POV was on the opening day of the Games. The roving Voyager Caravan roamed the streets of Seattle. It even boarded a ferry out on Puget Sound. The caravan double-hopped its signals, first to a relay on the Space Needle, and then via a laser transmitter to the roof of the IBC approximately 500 feet away. Another pathway for Voyager video was by 2GHz microwave to the 700-foot-high Columbia Center. Thereafter, the signal went down US West fiber links back to the IBC.

One spectacular shot involved reporter Steve Largent live in a Blue Angels F-18 flying over downtown Seattle at 250 miles per hour. The signal got home via the Columbia Center hop.

Working with telco

The bulk of video for the games was routed through fiber-optic lines provided by US West, which is the regional Bell operating company for the area. The fiber network consisted of one or more

One spectacular shot involved reporter Steve Largent live in a Blue Angels F-18 flying over downtown Seattle at 250 miles per hour.

times two multiple-channel, fiber-optic systems going from each venue back to the multiple-channel, fiber-optic systems going from each venue back to the IBC. One or more single-channel fiber lines followed the same route. Most venues were equipped with at least one fiber-optic receiver, as well as the CCTV feed to the venues from the IBC. (See Figure 1.)

In addition to fiber, US West provided dozens of dry pairs for communications and additional audio feeds. The Turner engineering staff had high praise for US West. As one engineer put it, "This is not the telco some of us have come to know and love over the years." According to another, telco personnel had spent months working beneath city streets with him, and were always anxious to respond. Even telco supervisors labored by his side until 3 a.m. one day, when last-minute arrangements for the closing ceremonies had to be completed.

High-fiber future?

Engineers at the Games agree that future events like this will require more use of fiber optics and greater interface with

The Turner engineering staff had high praise for US West. As one engineer put it, "This is not the telco some of us have come to know and love over the years."

the telcos. More pathways for dedicated video, audio and communication feeds mean more flexibility in the field and in broadcast centers. Additionally, such problems as ground loops and RFI/EMI will disappear.

Engineering the Goodwill Games was a mammoth undertaking, reminding us once again of just what our technology can do if we wish. But coverage of the Games, or any other event, is not merely a test of technology, but of people. Given how smoothly most of the coverage went, it was clear that directors and operators, engineers and vendor support staff stayed in top form throughout the entire two weeks of 18-hour days.

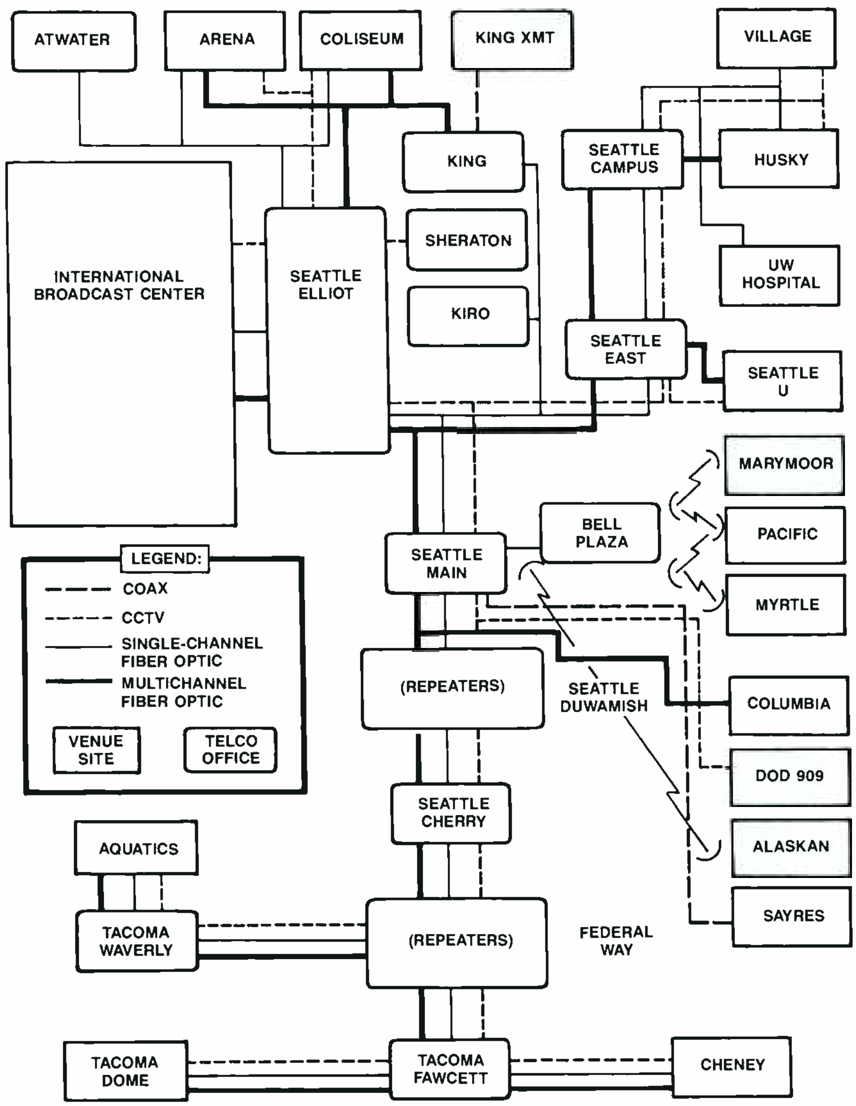

Figure 1. The US West video network for the Goodwill Games included single- and multichannel fiber-optic systems between the various venues and the IBC. A minimum of copper video cable was used.

Continued from page 48
respondents also echoed another theme — the need for *qualified* technical people.

The industry will pay and pay well for those people who know how to implement tomorrow's technology to help their stations make money. If you're one of them, your future is bright. However, if all you want to do is push a camera or a few buttons or if you're waiting for retirement, watch out. The industry is too smart to support people who can't contribute to the station's operation.

Say what?

The most difficult part of the salary survey is reading through the many hundreds of comments from respondents. It's not because of the time involved, but because there are usually so many complaints that the process becomes discouraging. This year was no exception.

The survey showed that many engineers are tired of the long hours and low pay. Also, many believe they don't receive the recognition they deserve.

Bean counters received the typical slams as did the FCC. This was the first year that complaints about the FCC didn't rate in the top five.

Radio engineers complained about the failing AM band. (So what else is new.) This time, the Japanese received the most blame because they manufacture the receivers. Said one respondent, "They (the Japanese AM radio manufacturers) wouldn't know a good AM receiver if it bit them."

TV engineers have coined a new term for part-time help, "1099ers." The phrase refers to the use of non-staff, part-time (and, therefore, less expensive) personnel to perform duties at the TV stations. Many respondents complained about the use of the 1099ers instead of qualified and trained staff.

Several personal examples of engineers leaving the industry were evident. One said that he left after 15 years and immediately received a 25% increase in salary. He also said, "I no longer have to work weekends and holidays."

Not everyone complained about the industry, although the ratio was about 50:1. Some were excited about the new technologies coming to broadcasting — DAB and HDTV. Here are a few of the comments:

"There are plenty of opportunities for radio engineers who understand the 'big picture' (knowledge of business, programming and promotions.)"

"Strong need for maintenance personnel. Weak need for operators."

"Was in TV for six years, radio chief for 10 years. Last year I got back into TV where I could receive a better salary and my skills would be better utilized, even as just a *staff engineer*."

"Too many small market (radio) broadcasters who refuse to pay competitive salaries. I work for three stations part-time to make 75% of the median salary listed in last year's survey for the top 100 markets."

"Trend is toward more free-lance and less full-time engineering employees."

"Stations seem to be investing only as an immediate problem-solving strategy, instead of investing in the future (equipment wise). At our station, a trend to save money tends to be in low salaries, slow to rehire replacement engineers and to hire non-licensed, non-certified, non-trained people to work at entry-level positions. Audio- and videotape positions are prime examples of this. Opportunities seem to be strictly in maintenance positions, and computer knowledge is valuable."

"The Norfolk Southern Railroad Communication Technician starting salary is $30,000 per year. Our chief engineer doesn't make that after 25 years at this station."

"The equipment is so advanced it's difficult, if not impossible, to repair in the field."

"I take care of three AM-FM combinations. The trend will be to do more multistation (radio) work."

"Loss of engineering positions because of the sharing of engineers between stations."

"Opportunities exist for radio broadcast engineers, but our industry pay for starting engineers is a joke. My assistant needs a second job to survive. I think you're going to see a trend of using consultants for all RF soon. RF engineers are in great demand. So great that we can demand high money and get it!"

"Our students are having good success in production houses, equipment supplies and industrial video. Unfortunately, TV looks weak and radio looks especially bleak."

"There will always be jobs for talented, creative engineers with good people skills."

"Trends: more automation, a 4-tier employment system. A core few managerial and technical staff, some minimal wage gofers and button pushers, 1099 employees for part-time and on-call work, and outside vendors for maintenance."

"Within the last month, my station laid off seven people."

"Age discrimination is now a real problem. The only reason I stay is that I'm afraid I couldn't get another job at my age."

"It appears to me that administrations are happy with technicians who can install and remove equipment and know how to ship it back to the manufacturer for repair."

Jesse Maxenchs has been appointed Western Hemisphere regional manager for AKG Acoustics, San Leandro, CA. He is responsible for U.S. sales of Orban OPTIMOD broadcast products, for sales of all Orban and dbx products in Canada, and for Central and South American sales of products of all AKG divisions.

Richard Farquhar has been named vice president and director of sales and marketing for TSI, Louisville, KY.

Daniel G. Wright has been appointed president and CEO for Abekas Video Systems, Redwood City, CA. He is responsible for the worldwide operations of the company.

Tom O. Mikkelsen has been appointed director of operations for Cycle Sat, Forest City, IA. He is responsible for the headquarter's technical facility, technical staff and tape duplication.

Robert Corrigan, Matthew Doyle and **Martin Stein** have been appointed to positions with Ampex, Redwood City, CA. Corrigan is vice president of marketing, Ampex marketing and sales and service. He is responsible for worldwide marketing support including advertising and promotion, trade show coordination, market research and planning, customer and sales training, telemarketing, teleproductions and graphic services. Doyle is vice president of Ampex marketing and sales and service. He is responsible for worldwide customer support and field service activities. Stein is director of market strategy. He is responsible for defining mid-range to long-range product and market opportunities.

John Greene has been named district sales representative for JVC Professional Products, Elmwood Park, NJ. He is responsible for the sales of the company's product line in Virginia, eastern Pennsylvania, southern New Jersey, Washington, DC, and Maryland.

Lynn Claudy has been promoted to director of advanced engineering and technology for NAB, Washington, DC. He is responsible for managing NAB's policy development process on advanced technology. He also coordinates policies on advanced television.

Ted Pine has been promoted to director of marketing for New England Digital, Lebanon, NH. He is responsible for the development and implementation of advertising, public relations, trade show and direct-mail marketing programs. He also assists in the development of long-term business and product development programs.

Robert Zohn has been appointed director of sales and marketing for Nucomm, Hackettstown, NJ. He directs worldwide sales and distribution of the company's fixed and portable analog microwave systems.

Don Burt has been named Eastern regional sales manager for Quantel, Philadelphia. He is responsible for managing territory in 20 states, including areas in the mid-Atlantic, Washington, DC and the Southeast.

Cindy Edwards and **Keith Arnett**

have been promoted to positions with the Davis Communications Group, Four Oaks, NC. Edwards is inside sales manager for radio products. Arnett is vice president of marketing. He is responsible for the overall operations of the company.

Darrell W. Wenhardt has been named West Coast director of design and product management for A.F. Associates, Northvale, NJ.

John Carey has been promoted to vice president of sales and marketing for Otari, Foster City, CA.

Peter Lewis, Stephen Morris and **Vincent Pietrorazio** have been appointed as technical staff engineers for Neve, Bethel, CT. Lewis and Morris are responsible for field service for the company's consoles and the Mitsubishi product line. Pietrorazio specializes in the Mitsubishi product line.

Ray Baldock has been named director of product development and Northeastern regional sales manager for Odetics, Anaheim, CA. He is responsible for new product development within the company's broadcast cart product family. He also services accounts in the Northeast.

Herbert Didier has been appointed sales director for the broadcast equipment division of TFT, Santa Clara, CA. He is responsible for assisting with the company's marketing efforts, which include sales support and public relations.

Adriano J. Bedoya has been appointed international sales engineer for Canon USA, Englewood Cliffs, NJ. He is responsible for sales throughout Latin America.

James T. Stenberg has been promoted to director of engineering for Micro Communications (MCI), Manchester, NH. He is responsible for development, design and manufacturing engineering. He also represents MCI as the technical member at various industry committees and consultant activities.

Horst Stahl has been named technical director for the Angenieux Corporation of America, Miami. He is responsible for engineering and technical support of the company's products nationwide. He also acts as a liaison to the Angenieux factory in France concerning the development of products for the American market.

Mary G. Nahra has been appointed national sales manager for East Coast Video Systems, Belleville, NJ.

John J. Schwan has been appointed vice president of sales for editing machines, Washington, DC. He directs the company's national sales efforts.

E. Riley Webb Jr. has been appointed Western regional sales manager for OFTI, Dallas. He is responsible for the management of the company's manufacturers' representatives, distributors and direct salespersons west of the Mississippi.

Leonard Staskiewicz has been appointed Northeast zone manager for BTS Broadcast Television System, Salt Lake City. He is responsible for overseeing the sales direction of six regional BTS sales managers throughout the Northeast.

Digital audio recorder
By Cipher Digital

• **CDI-328:** hard-disk and magneto-optical media system in 2- or 4-track models; sampling at 48kHz, 44.1kHz and 32kHz with oversampled Delta/Sigma A/D conversion; may be referenced to external time code, video or word clock; includes remote edit control unit; random access capability to two track-hours of full-bandwidth audio in storage processor.
Circle (352) on Reply Card

Machine controller
By Audio Kinetics
• **ES.LOCK 1.11 option:** serial control for transport synchronizer for use with Studer A820/A827 multitrack audio and Panasonic and Sony video transports; for 9-pin serial port configuration; enables more accurate transport "crawl" feature, record track selection and frame jogging; same cable usuable for any compatible transport.
Circle (353) on Reply Card

Fiber-optic material
By Fotec
• **A450 series:** "gap loss" fixed attenuators for fiber-optic systems using ST, FDDI or FC connectors; based on the loss of a fixed gap between the ends of fibers; available as precision spacers for use with splice bushings or as ST-ST, ST-FDDI, FDDI-FDDI and FC-FC bulkhead splices.
Circle (350) on Reply Card

Tool case
By Techni-Tool
• **Tec-Tuff kit:** an assortment of high-quality tools in a strong, durable case; 3-tumbler combination lock; 18.5″×13.5″ case available in 6-, 8- or 10-inch depths; valance design with padded handle.
Circle (361) on Reply Card

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International-FAX 415-932-2171

Circle (72) on Reply Card

Studio timer

By Allied Broadcast Equipment

• **ST-3 timer:** ⅝-inch-high digital timer; includes stop, start and reset function buttons on the front and back; eight connections brought to rear-panel terminals offer pull-to-ground configuration for external machine control, but may be rewired for push-to-positive control; by Audio-metrics.

Circle (355) on Reply Card

Console enhancement

By AMEK Systems & Controls

• **B2520 mixer:** enhanced audio console includes eight stereo subgroups and 24 multitrack buses; expanded monitor and metering system.

Circle (399) on Reply Card

Storm tracking

By Accu-Weather

• **LPATS/Accu-Strike:** data service provides real-time lightning strike data, accurate to one half mile and three seconds of the actual occurrence; data from Atmospheric Research System is carried via the interactive database and weather graphics service for observation on many computers; available on high-resolution maps or full-color graphics; may be resolved on maps to individual counties.

Circle (358) on Reply Card

D-2 and automation features

By Ampex

• **AutoMark:** permits reproduction of audio from D-2 VTRs with clarity of still or slow speeds; enables precise editing; reduces noise encountered in picking specific locations on tape on all non-Ampex D-2 systems.

• **External device control:** uses system playlist to access eight devices, including switchers, non-digital VTR format transports.

• **AutoResolve:** software utility to scan playlist, identifying and resolving playlist conflicts; creates buffer tapes to avoid conflicts, allowing playlists to be executed as prepared.

Circle (398) on Reply Card


AMPEX 297
AMPEX 197
BCA-60
AMPEX 298
AMPEX 196
DYNAIR
AMPEX 219
AMPEX 298
BC-20M
AMPEX 198
AMPEX 319
AMPEX 187
AUTO TRANS
PATTERN

Audio dynamics control

By Aphex Systems

• **Dominator II:** 3-band peak limiting for enhanced loudness by 3dB-6dB; no interaction between bands while in 34dB range, user-adjusted peak ceiling serves as a maximum amplitude; 104dB dynamic range; Model 720 is for use where flat response is necessary; Model 723 is for applications requiring pre-emphasis curve.

Circle (364) on Reply Card

Satellite system software

By Baylin Publications

• **TVRO system analysis:** software package demonstrates how changing TVRO parameters, such as antenna diameter and LNA noise figure alter received picture quality; IBM-compatible software uses 10 parameters to predict slant distance, path loss, antenna gain, G/T, C/N, S/N and fade margin with English or metric units; calculates elevation and azimuth to assist in correct aiming of antennas for C- and Ku-band satellites scheduled for operation through 1995.

Circle (354) on Reply Card

Maintenance assistant

By B&K Precision/Maxtec International

• **Model 815:** component tester; performs capacitance and resistance tests on components; offers 26 ranges for testing of transistors, LEDs, batteries, SCRs, diodes; water and overload resistant; 3½-digit 0.8-inch LCD readout.

Circle (390) on Reply Card

Contact cleaning

By Caig Laboratories

• **WIPE applicator kit:** convenient approach for maintenance using CRAMOLIN deoxidizer solution; pocket-size container holds 50 "fabric-like" wipe applicators, each saturated with the non-flammable, ozone-safe cleaning solvent; solution cleans, lubricates and improves conductivity of contacts, including gold.

Circle (395) on Reply Card

Prompting product

By Broadcast Developments

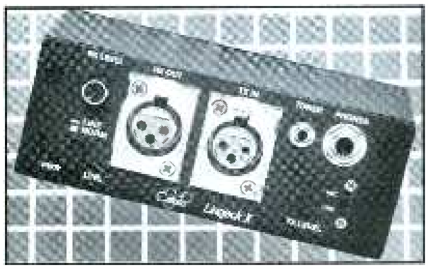
• **SROLLBOX PLUS:** IBM-compatible prompter; dual screen display of prompting output as well as run order; permits instant editing of prompting script.

• **Prompter displays:** 9-inch electroluminescent flat screen for on-camera prompting; also 4-inch portable, battery-operated prompter for hand-held camera operation.

Circle (393) on Reply Card

Broadcast-cellular link

By Cellabs



• **Linejack II:** a cellular phone interface; includes balanced XLR input, output jacks, tuner input, phono jack for headphones; mic, line-level switching; transmit and receive level adjustments; 2″×5.3″×2.8″ unit.

Circle (392) on Reply Card

Reporter-telco interface

By EELA Audio

• **S20A Reportophone:** enhanced unit combines small audio mixer with integral telephone connection; select tone or pulse dialing; internal battery power; mic, line inputs with compression and filtering provided.

Circle (372) on Reply Card

Enhanced batteries

By Frezzi Energy Systems

• **FBP-90A:** expanded capacity NiCad battery with 5Ah capacity; matched cells housed in impact-resistant case; easy disassembly for inspections; low internal resistance; field replaceable fuse and thermal protection; compatible with standard BP-90 equipment, Frezzi/PAG microcomputer-controlled charger, Sony BC-210 charger or trickle charged on BP-90 chargers.

• **NP1-ABC:** dual-channel NP1 battery analyzer and charger; analyzer uses 2A discharge and 14-hour balancing trickle charge; automatic selection of battery type being charged.

Circle (389) on Reply Card

Obstruction, tower lighting

By Crouse-Hinds Airport Lighting

• **PCF/PEC/TLF lighting system:** combination of photoelectric controller and flasher with tower and obstruction lighting controller; solid-state unit flashes any incandescent light of 1.3kW or less; PCF control flashes about 30 times per minute; initiates flashing operation when ambient illumination drops to 34fc.

Circle (371) on Reply Card

Commercial monitoring

By Russco Electronics

• **CIA-1 system:** Commercial Interrogation Assistant; connects between a radio and cassette recorder; records only voice from the program audio to monitor other stations' commercials; starts and stops the recorder automatically; typically uses a single 45-minute cassette for an 8-hour broadcast period.

Circle (357) on Reply Card

HDTV-to-PAL conversions

By Snell & Wilcox

• **ME 2010:** HDTV downconverter produces standard PAL images; advanced motion processing with 10-bit digital filtering; optimum 625-line image developed from three or four fields of digitized information; enhanced image quality compared to previous ME 2001 downconverter; development project with BBC.

Circle (365) on Reply Card

Acoustic baffles

By ASC Acoustic Sciences Corporation

• **Studio Trap:** free-standing 9-inch diameter acoustic control devices; adjustable diffusion characteristics above 440Hz; tripod-mounted units rotate to adjust reflective and absorptive surfaces; vertical adjustment also permitted; covered with fire-resistant fabric in a range of colors.

Circle (369) on Reply Card

Dynamics processor

By AKG Acoustics/dbx Division

• **Model 160XT:** audio compressor, limiter; active-balanced and single-ended outputs with 1/4" phone and XLR connectors; matched RMS detectors improve power summing when two units are strapped for stereo; select between two compression/limiting modes; VCA circuitry controls signal level; negative compression ratio available for dynamic reversal effects; separate detector input available for signals processed by external side-chain equipment.

Circle (383) on Reply Card

Video effects mixer

By Hotronic

• **AM101 digital mixer:** integrated TBC/synchronizer for digital effects between video sources without individual TBCs; compliant with VHS, S-VHS, U-matic, satellite relays; transcodes between composite and component Y-C/S-VHS; 4-input unit performs transitions between component and composite sources including strobe, wipes, cropping, tiling, mosaic and other effects; optional stereo audio mixer is available.

Circle (356) on Reply Card

TBC/synchronizer option

By Prime Image

• **RGB transcoding:** option available for HR-600+ and 7.5MHz series TBC and frame synchronizer products; this feature expands transcoding to composite, Y/C-3.58, Y/C-688, Y/R–Y/B–Y and RGB; the feature is bidirectional, permitting integration of standard video sources with computers providing an analog RGB output based on RS-170A; available with sync-on-green or sync separate.

Circle (374) on Reply Card

Video signal monitoring

By Hamlet Video International

• **HVI 203B:** enhanced composite videoscope; 3-H filter, A/B/C parade with chop mode for channel overlays on waveform and vectorscope monitor emulation; polar SC-H indication included.

• **HVI 205:** component videoscope; YRGB signal monitoring unit for studio camera control and telecine operation.

• **ARM SF1:** sound follower for video editing; "lay off" process accomplished as video editing proceeds to reduce delays; all units produce in-picture displays of signals to trim the space usually needed for test equipment in cramped engineering quarters.

Circle (366) on Reply Card

Camera setup charts

By BPI/Porta-Pattern

• **Large charts:** series of 18″×24″ camera alignment charts; mounted on 1/4-inch expanded PVC; eight different formats are available, each in a separate vinyl case.

Circle (367) on Reply Card

Expanded effects patterns

By Ross Video

• **Switcher enhancement:** boarder generator offers 1-line and 2-line DSK border shadow widths; 1-line border is particularly useful in highlighting and defining small keyed images.

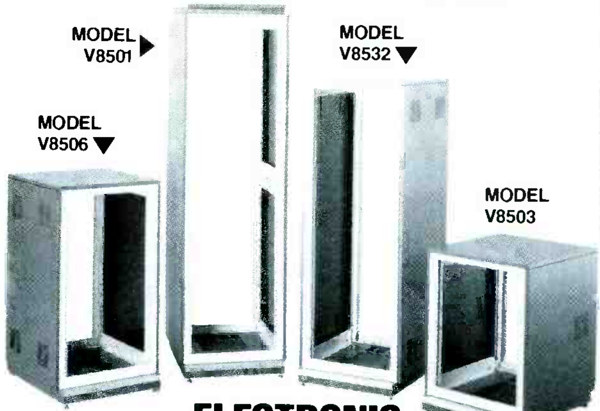
Circle (391) on Reply Card

Video effects system

By ECHOlab

• **TEMPEST:** point-and-click control with mouse through extensive menus and icons; compatible with full component, S-VHS, composite video; CCIR 4:2:2 sampling, 49-point spatial filter; 1/16-pixel resolution used for calculation of effects motion; wide range of effects; key output with hard-edge channel, optional chroma-key, 8-bit soft-edge flying key capability; integrated test patterns with all adjustment parameters stored in non-volatile memory.

Circle (363) on Reply Card



Optical transmission system

By Lester Audio Laboratories

• **DAS 2000 series:** fiber-optic distribution, splitting and routing system; modular product offers programmable Soft Patch 64x64 matrix with 192 program non-volatile memory of point-to-point or point-to-multipoint patching; 48kHz sampling, 8× oversampling with 8-bit PCM D/A and Delta Sigma A/D conversion; 98dB range with −132dB noise floor.

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FO video link

By ORA Electronics

• **Model TRX400:** replaces coaxial cable for composite video transmission; 75Ω cable attaches to BNC female connector of TX200 transmitter and RX200 receiver; optical path through standard SMA connectors and 70-100 micron fiber-optic cable; 12VDC or 18VAC-24VAC powering may be obtained from video camera or other sources; each unit measures 3″×2″×1″.

Circle (380) on Reply Card

Stereo editing unit

By Klark-Teknik Electronics

• **DN735 recorder:** solid-state "lay-off" recorder assists in editing of short passages of stereo audio; synchronized to other equipment by an external SMPTE time-code signal, the unit provides a 20-second memory, expandable to 175 seconds; use as two additional tracks for a standard VTR, permitting audio cross-fades from scene to scene; RS-422 serial port compatible with many editing controllers.

Circle (360) on Reply Card

Portable microwave

By RF Technology

• **D series:** transmitters and receivers operating in the 1.4GHz-15.6GHz spectra; portable units have 500MHz frequency agile range of 36 switch-selected channels; output is 2W from 1.4GHz-2.7GHz, 1W at 13GHz; narrow and wide IF bandwidths allow transmission of composite signals; compatible with Gold-Line RF power amplifiers; operation from AC or DC power sources.

Circle (351) on Reply Card

Equipment design facility opens

The Baranti Group has opened a new facility in Toronto. As an electronic engineering design group, Baranti specializes in the development of professional video and audio equipment, and electronics for motion picture film.

Audio Animation moves to new facility

Audio Animation, Knoxville, TN, has relocated its headquarters within the city. The address is 6632 Central Avenue Pike, Knoxville, TN, 37912; telephone 615-689-2500; fax 615-689-7815.

Audiovisual acquires Vaughn subsidiaries

Audiovisual, Omaha, NE, has obtained Video Midwest/AVC Systems, the Minneapolis-based division of Vaughn Communications Group. Operations will continue from the Minneapolis office until January 1991, and the newly acquired division will retain its name until the move to a new facility is completed.

Varian signs Continental letter of intent

Varian Associates, Palo Alto, CA, has tentatively agreed to sell its Continental Electronics unit in Dallas to Houston-based Tech-Sym Corporation for an undisclosed amount of money.

New England Digital relocates headquarters

New England Digital has relocated its headquarters to Lebanon, NH. The new facility provides 100,000 square feet of administrative, manufacturing, R&D and marketing support space.

New EEV distributor for broadcast products

EEV, Elmsford, NY, has announced that RIA Corporation, Salt Lake City, will distribute its broadcast products in the mountain region of the United States. RIA will be responsible for front-line representation of EEV's Leddicon, Vidicon and Tetrode tubes to all radio and TV stations in Colorado, Idaho, Montana, Nevada, North Dakota, South Dakota, Utah and Wyoming.

SSL expands European distribution network

Solid State Logic (SSL), Oxford, England, has announced the expansion of its European distributor network. MediaCom will distribute SSL products in Germany and Audio Sales will represent the company in Austria.

Basys acquires LaKart Limited Partnership

Basys has obtained LaKart Limited Partnership. LaKart, renamed Basys LaKart Incorporated, will retain its current address and phone number in Newton, MA.

NOB sells digital telephone hybrid

Nederlands Omroepproduktie Bedrijf (NOB), Hilversum, Netherlands, has signed a contract allowing Swiss-based Studer to manufacture and market under license the D.S.P. HYBRID/feedback canceller.

Faraday Technology Limited relocates headquarters

Faraday Technology Limited has relocated its headquarters to Croft Road Industrial Estate; Newcastle-under-Lyme, England.

Utah Scientific signs distribution channel agreement

Utah Scientific Incorporated (USI), Salt Lake City, has chosen Kentucky-based Midwest Communications to be one of its primary distribution channels. Under the agreement, Midwest will represent the USI product line.

Schmid Telecommunication signs agreements with North American representatives

Schmid Telecommunication, Zurich, Switzerland, has appointed five North American sales representatives to sell its products. Ontario-based MSC Electronics will handle sales throughout Canada. Holzberg, Professional Audio Supply and Electronic Marketing Associates will distribute Schmid products in the United States, and Glen Allen & Company will be responsible for covering territory in Puerto Rico, the Virgin Islands and the Dominican Republic.

Next month...

ANNUAL STATION MAINTENANCE REPORT

- **Maintaining Remote Radio Equipment**

As stations move into the field in increasing numbers, the need for maintenance of audio and video remote transmission equipment becomes more important. Remote radio gear requires a different view of preventive maintenance. The article examines the likely failure modes of remote hardware and describes how to repair systems when they are down.

- **Testing Techniques**

Sometimes the use of the same principle and practices used in the manufacturing process are the shortest path to returning equipment to service. This article will share some of the efficient methods used by manufacturers in aligning new equipment to optimum performance standards.

- **Developments in Magnetic Tape**

New developments in tape recording technology require better tape formulations. As improvements are made in machines, improvements are also made in the tape used on those machines. This article examines some new tape formulations and why they're better.

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"This is one system that works for both engineering and the business manager."
—Fred Baumgartner
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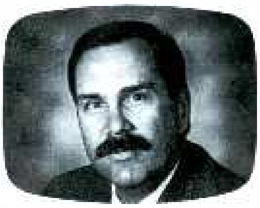
"It does everything you could ask... and then some. Plus, it does it well." —Lacy L. Worrell
WMAZ-TV

"The cooperation from Panasonic has been outstanding." —Wayne G. Tiner
WECT-TV6

"It passed the 'smoke' test."
—Rex L. McArthur
KTRV



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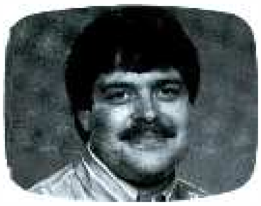

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WHO-TV

"The M.A.R.C. is great! The walkaway time sure beats having engineers load tapes. Now they can do installation and maintenance."
—Robert W. Bell
WSBT-TV

"We've been extremely happy with the M.A.R.C. at both stations—Panasonic technical support has been absolutely super!"
—Jim Wright
KPLR-TV, KRBK-TV

"Excellent quality pictures and stereo sound. Spot mortality almost non-existent."
—Hilliard Gates
WKJG-TV

"Sleep at night and enjoy your weekends." —Jack Davis
KRBK-TV

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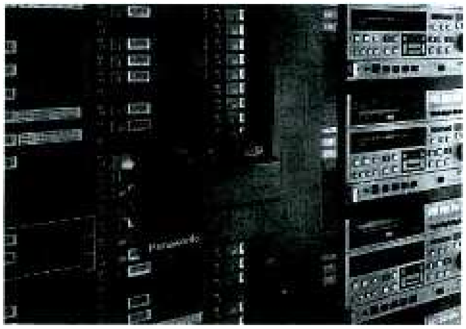

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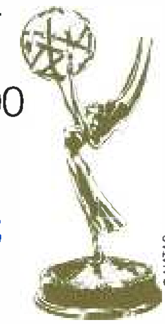

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Professional services

News
Continued from page 4

participating broadcasters, NAB wants to involve all interested parties — specifically the cable and consumer electronics industries — in the process to select a preferred system.

The standardization process will be coordinated with the ongoing work of the U.S. Advanced Television Systems Committee (ATSC).

Copies of the RFP can be obtained by contacting Lynn Claudy, NAB, Science and Technology Department, 1771 N St. NW, Washington, DC 20036-2891; 202-429-5340; fax 202-429-5343.

SMPTE working group to draft serial interface standard

The Working Group on studio video standards of the Society of Motion Picture and Television Engineers (SMPTE) is preparing a draft standard for a serial interface to carry component and 4fsc composite digital signals over coaxial cable.

The Working Group wants to conduct private system tests of the proposed standards, simulating conditions likely to be encountered in real TV environments. These tests will possibly be conducted in December. Any party wishing to offer equipment, or prototype equipment, to assist in evaluating the proposed standard should contact Peter D. Symes, chairman, WGSVS, c/o Grass Valley Group, P.O. Box 1114, Grass Valley, CA 95945; 916-478-3437; fax 916-478-3180.

SMPTE issues call for papers

A call for papers for the 25th annual TV conference of the Society of Motion Picture and Television Engineers (SMPTE) has been issued. To commemorate this Silver anniversary, the conference will be held in Detroit, site of the first SMPTE TV conference. The meeting will be held Feb. 1-2, 1991 at the Westin Hotel.

The theme for the conference is "A Television Continuum — 1967-2017."

The Audio Engineering Society (AES) will join the SMPTE at the conference.

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Contact Renée Hambleton, at (913) 888-4664, for information on frequency and pre-payment discounts. To place your classified ad send your order and materials to Broadcast Engineering, Classified Ad Mgr., P.O. Box 12901, Overland Park, KS 66212.

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ASSISTANT CHIEF ENGINEER with five years experience on UHF-TV transmitters and studio equipment, located in the beautiful Northwest, EOE. Send resume to Manager, KTBW TV-20, 1909 So. 341st Pl., Federal Way, WA 98003. FAX 206-874-7432. 09-90-2t

CHIEF ENGINEER for Top 40 FM and DA AM in Fort Wayne, Indiana. Must have extensive analytical troubleshooting and repair skills for all types of radio broadcast equipment. Position will require leadership abilities and interaction with other staff members on a daily basis. This is a first-class Radio Group operation with quality people and top notch equipment. Send resume and salary history to Director of Engineering, Federated Media, P.O. Box 2500, Elkhart, IN 46515. 09-90-2t

ASSISTANT CHIEF ENGINEER: Must have FCC general or SBE certification, 2+ years in TV broadcast, strong knowledge of high power UHF-TV Transmitters and base-band video. This is a 24 hour on-call position with a major market TV station. Send resume and salary history to: Neal Ardman, Chief Engineer, WPTT-TV, P.O. Box 2809, Pittsburgh, PA 15230, EOE. 10-90-1t

CHIEF ENGINEER: Hands on chief for cable satellite network utilizing an automated uplink facility. Must be familiar with Varian transmitter, SONY Betacam, 1-inch and ¾-inch machines. System maintenance background necessary. Experience in post-production and cable system operations desired. Must have general class FCC license. SBE certification a plus. Resumes and salary history should be sent to: Personnel Department, NuStar, 1332 Enterprise Drive, West Chester, PA 19380. No phone calls please. Equal Opportunity Employer. 10-90-1t

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CHIEF ENGINEER needed for new Christian Television station. Experience in new station installation a plus. UHF transmitter experience necessary. Prefer a minimum of 3 years experience. Send Resume to: TV, P.O. Box 18862, Shreveport, LA 71138. 10-90-1t

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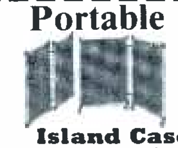

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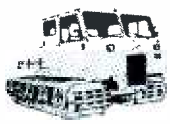

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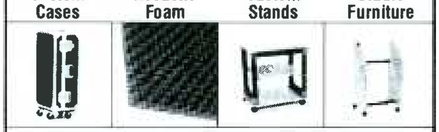

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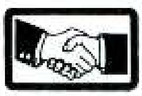

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approximately ±9kHz on either side of the subcarrier. It is a good example of how well-controlled the spectrum of a subcarrier can be. Furthermore, tests by the author have indicated that a properly coded and modulated data subcarrier has significantly lower perceptual side effects, such as whistles or beat notes in the demodulated stereo, than does a frequency-modulated audio subcarrier. Apparently, the energy from an FM digital subcarrier is spread such that it appears in the decoded stereo audio as band-limited noise (if it even shows up at all), which is easily masked by the program audio. Frequency-modulated audio subcarriers, on the other hand, occupy the center frequency much of the time. If intermodulation causes translation in frequency into the stereo audio, this is heard as discrete tones, which are not so easily masked by the programming.

• *Transmitters*: Broadcast transmission equipment requires attention when high-quality subcarrier services are going to be added. Many older multitube transmitter designs are more band-limited than the best of the current designs, but any transmitter's performance can be improved with proper tuning techniques. It has been my experience that FM transmitter tuning typically gets less attention than it deserves, especially when subcarriers are operated. Although a complete report on transmitter tuning is beyond the scope of this article, the following are some pointers for transmitter operation and tuning:

1. Take the time to experiment and adjust transmitter tuning; it may take all night, but high performance from the subcarrier and low interference into the vital stereo service is worth the effort.

2. Measure synchronous AM (the fluctuation in power level at the rate of audio deviation of the carrier, across the transmitter's passband). This is a valuable tool in estimating transmitter performance. Studies have shown that the minimum desired bandwidth for FM broadcasting is 800kHz (to the -3dB points on each side of peak). For this bandwidth, the resulting synchronous AM is calculated to be approximately -42dB relative to 100% amplitude modulation of the carrier envelope. This number may sound easy to achieve, but you should ensure that the testing is accurate.

3. You should own an accurate synchronous AM measuring device. The AM detectors supplied with most modulation monitors do not provide a sufficiently correct match to the RF sample to accurately measure synchronous AM, and no de-emphasis should be allowed between the detector and the metering. A precision diode detector for the transmission line (suitably calibrated) or AM noise measurement device should be purchased. Readings should be taken periodically to document the performance and provide comparisons after final tube changes.

4. Connect the transmitter to the normal antenna system rather than a dummy load during measurements and tuning. Resistance and reactance of the antenna will be different from the dummy load, and the optimum tuning point of the transmitter will shift with different loads.

5. You should own a calibrated, high-quality, FM demodulator (modulation monitor). System measurements are no better than the tools used, so be sure about the monitor performance. Most broadcast monitors designed in the past 10 years are excellent, but they should be rebuilt when capacitors age, and should be calibrated by the manufacturer.

6. You should own a laboratory-quality spectrum analyzer and oscilloscope camera. A spectrum analyzer covering the range from low audio through at least 100kHz is a valuable diagnostic tool. I have found no better tool for assessing the performance of an FM transmission system and its component parts than a spectrum analyzer. Its purchase cost may equal the revenue from only a few months of subcarrier leasing, but if purchasing is not possible, make arrangements to rent one as often as needed. A Polaroid-type camera (or calibrated plotter if you can afford it) is essential to document the system performance. Ideally, you should have photos on file at various points in the transmission system, such as at the outputs of the stereo generator, microwave STL receiver, subcarrier generator and FM demodulator (connected to the transmitter RF output sample), and off-air at the studio. A variety of modulation conditions should be tested, including test tones, program audio and no audio input.

Acknowledgement: Thanks go to Alan Reiter of Waters Information Services for some of the business data, to Richard Cassidy of AT&E/Receptor for the spectrograms used in this report, and to Robin Cross of WNIU-FM, DeKalb, IL, for additional application notes.

Ad index

The TV-500: Designed for One Reason . . .

April 16, 1990

Gary C. Snow, President
WHEATSTONE CORPORATION
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Syracuse, New York 13211

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Al Centrella, Audio Engineer
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Al Centrella, Audio Engineer

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