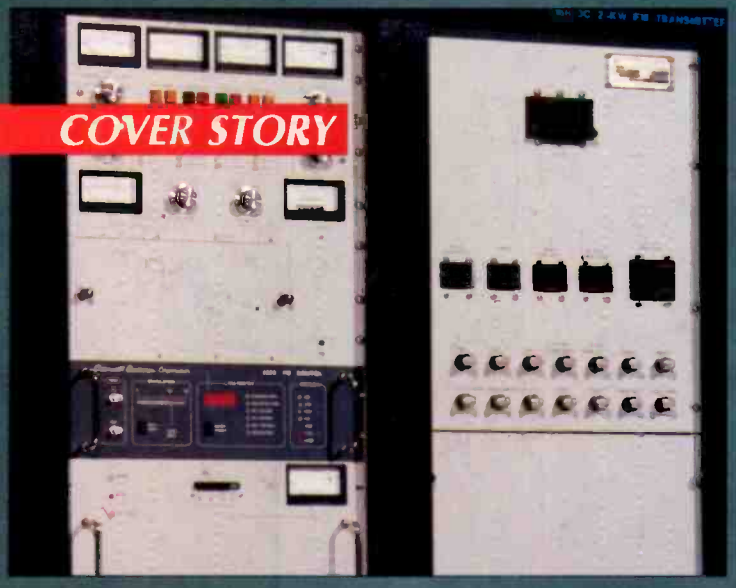
BE Radio™

July 1994

COVER STORY



Buying a radio transmitter

Updating the RF link to your listeners is an important step. Quality and reliability are equally critical in the competitive marketplace faced by most stations. Contract engineer Kirk Harnack has seen his share of radio transmitters. He presents a thorough overview of what every broadcaster should know when shopping for new RF hardware.

2

FM audio processing

Maintaining modulation within legal limits and defining a station's sound — these are the two functions of air-chain audio processing at every FM radio station. Chief engineer Chris Durso describes how today's systems can perform both tasks well.

10

A new home for MJI Broadcasting

The special facility requirements of a radio production house are difficult to provide even in the tamest of environments, but problems increase exponentially at a downtown New York City location. Award-winning studio designer John Storyk describes how one busy Big Apple operation handled this challenge.

24

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Circle (1) on Reply Card

EDITORIAL

Resurrection of a bad idea

According to an article in the January, 1994 issue of the *National Association of Radio and Television Engineers* newsletter, FM stations are wasting 100,000MW-hours of power each year. The article by Dr. Stephen Blank, a professor at the New York Institute of Technology, also claims that FM stations represent "potential public health hazards." Disregarding his dubious conclusions, his solution is even more ridiculous. He proposes that every FM station stop transmitting with circular polarization and use only vertical polarization (VP). Sounds simple enough doesn't it?

He doesn't mention that each station might have to spend perhaps $100,000 to erect a temporary antenna for the work period, remove the old antenna and then install a new antenna. Or, that the transmitter might also have to be modified so it could run at half power. If the transmitter can't be modified, the station would just have to buy another one (add another $20,000 to $40,000).

Blank claims most stations would recover the cost of conversion to vertical polarization within one year just from lower power costs. Wrong. He has clearly failed to consider the multitude of economic factors that would come into play if FM stations were required to make these changes.

If the mere economics of this proposal weren't bad enough for FM stations, the resulting degradation in coverage ought to be enough to kill the whole idea. In 1993, the FCC dismissed a petition for rulemaking by the Ozark Broadcasting Corporation proposing that the commission allow, but not require, VP only for commercial FM stations (RM-7566). One of the grounds for dismissal was, "As a general matter vertically polarized signals (in the FM band) do not propagate as far as horizontally polarized signals." Also, as any broadcast engineer that's worked with FM antennas can tell you, the vertical component of the transmitted signal can be drastically affected by the tower. Typically this pattern distortion is hidden by the horizontally polarized signal. If you give up the horizontal component, you lose this protection.

Finally, Blank's claim that CP FM antennas "generate a significant risk of radiation hazard to populated areas" is suspicious at best and tabloid sensationalistic writing at worst. The commission already requires all FM stations to provide an engineering exhibit showing compliance with the ANSI C95.1 standard governing human exposure to non-ionizing electromagnetic fields. Blank claims a 20dB RFR superiority for vertically polarized signals. Although VPOL antennas do tend to have a null straight down, modern half-lambda CP antennas also have an HPOL null straight down. Any so-called improvement would be on the order of 3dB, not 20dB as he claims.

When Blank presented his proposal at the 1990 NAB, he was practically laughed off the stage. The basic audience reaction was that he didn't know what he was talking about. I couldn't agree more. His idea was a bad one in 1990 and it's no better today.

Brad Dick

Brad Dick, editor

NEWS

Survey shows consumer demand for RBDS is high

A recently concluded study of consumer preferences indicates that Radio Broadcast Data System (RBDS) services will be welcomed by many radio users. The national survey, conducted for the Electronic Industries Association (EIA), polled 1,000 Americans on their awareness and interest in RBDS.

While 80% of the respondents were not aware of RBDS, more than 25% said they would listen to the radio more if it offered RBDS features, and 35% felt that RBDS would increase their enjoyment of radio listening. More than 70% of those surveyed were willing to pay up to 10% more for a radio with RBDS features.

Among the most popular RBDS functions were traffic and emergency news displays, with more than 60% of respondents showing interest in these features, and 20% reporting that they would purchase an RBDS radio for the emergency alerting feature alone. Also highly rated were the system's entertainment and convenience features. More than 60% of those polled were interested in program-associated data (such as song-title/artist displays), "smart-radio" features (such as search-tuning by format) and built-in paging/messaging. (See "Radio in Transition: New RBDS Services," p. 14.)

Younger consumers (18-26) showed 20% higher interest in RBDS than overall averages, indicating that RBDS may be more highly valued by future audiences. For example, more than 85% of this age group expressed interest in the song-title/artist display feature.

RBDS was introduced in the United States in 1993. The EIA reports that RBDS radios are now available from at least seven major manufacturers, with more than 130 FM stations currently providing RBDS service.

Buying a radio transmitter

By Kirk Harnack

The Bottom Line: *No matter what other equipment a radio station has assembled in its facilities, its broadcast signal is delivered to listeners solely through the efforts of the station's transmitter. It is the single most important device at the station, and the quality of its operation can make or break a station's fortunes. Therefore, choosing the right new transmitter is no small responsibility.* ——— $

When purchasing a new transmitter, the buyer faces myriad possibilities. It's essential that the transmitter purchaser be informed and prepared to decide which transmitter is best for the application.

Whether shopping for an AM or an FM transmitter, many of the same questions need to be answered in the decision-making process: New or used? Solid-state or tube amplifier? Which manufacturer is best? Which transmitter design will last the longest? What about long-term maintenance? Which transmitter features are important? What qualities should a transmitter have that may not appear on the spec sheets?

The answers must be determined in the course of buying a transmitter.

Solid-state transmitters are less demanding in their cooling airflow needs.

Deciding on a new or used transmitter

An important first step is the decision on whether to buy new or used. One reason many purchasers are interested in used transmitters is the belief that a used unit will cost less. The asking price for a used transmitter will always be lower than its new counterpart. Yet all the attendant expenses of buying a used transmitter must be considered before costs can be compared.

Purchasing a new transmitter alleviates many worries and potential problems. It also should evoke a certain amount of support from the manufacturer for quick, under-warranty parts and service. Immediately after a sale, the manufacturer is interested in making sure the transmitter is trouble-free and on the air and that the client is completely satisfied with the purchase.

A new transmitter will be more valuable because the manufacturer's latest design improvements will be incorporated into it. Many manufacturers work continuously to improve their transmitters' operation and reliability. Buying a new model can assure that bugs and potential problems have been eliminated.

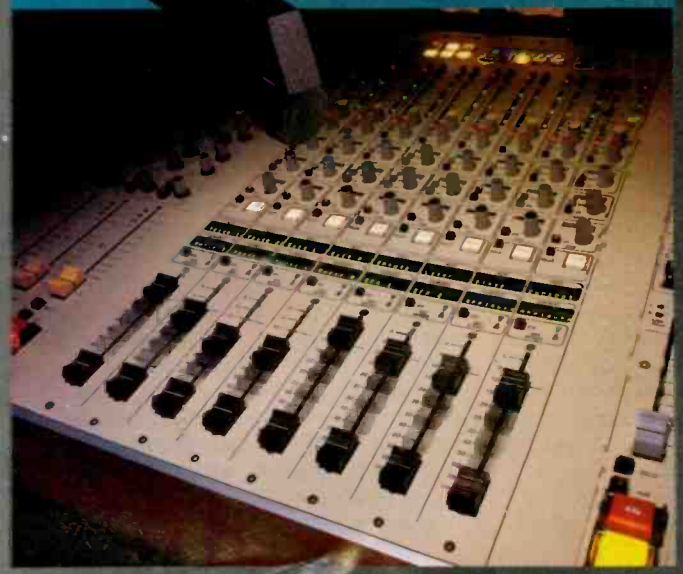
Special considerations for used transmitters

When buying a new transmitter, a customer can be assured that the product contains all new parts and that it worked recently. Acquiring a used transmitter requires the customer to forego assurances on those counts. In addition, a used transmitter often must be tuned to a new operating frequency. This process can range from moderately easy to nearly impossible.

The new transmitter market is stable enough that most models offered by manufacturers are available within a few weeks. On the other hand, buying a used transmitter involves luck and good timing. The transmitter that was on the market yesterday may be on its way to someone else today.

A buyer in the used market should rely on the advice of engineers who have direct experience with the particular makes and models of transmitters under consideration. Such advice can be the most valuable information a

Kirk Harnack is president of Harnack Engineering, a contract engineering firm in Memphis, TN. Respond via the *BE Radio* FAXback line at 913-967-1905.



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DESIGNS THAT MAKE THE DIFFERENCE

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used transmitter buyer can get. The buyer must be ready to act when a transmitter is found, examined, and determined to be worth its price.

Solid-state or tube

Solid-state (fully transistorized) transmitters are competitively priced with tube-type transmitters for AM and FM service at lower- and medium-power levels. Design improvements over the past 15 years are resulting in solid-state transmitters that live up to the technology.

AM solid-state transmitters offer significant benefits over tube-type transmitters in most applications. For instance, power consumption of solid-state AM transmitters is less than comparable tube-type transmitters. In many cases, the electricity cost-savings can pay to replace older tube transmitters. Also, audio performance of solid-state AM transmitters is more consistent overall than tube designs.

FM broadcasters have a more difficult choice when comparing solid-state and tube technologies. In the higher power levels, tube amplifiers are much less expensive than solid-state units. This is because of the difference in the amplifiers' design requirements. A 10kW solid-state FM transmitter requires twice as many parts as a similar 5kW model. However, 10kW tube-type transmitters require only larger tubes, power supplies and hardware than their 5kW versions. Their parts count remains exactly the same.

This scale-factor issue gives rise to another advantage of tube transmitters. A 10kW, 20kW or 30kW FM transmitter from any given manufacturer is nearly identical in design, parts count, and reliability to that manufacturer's 1kW, 2.5kW, or 5kW models. On the other hand, solid-state transmitters increase in complexity linearly with increasing power level.

Reliability

A broadcast transmitter must be reliable. Given a choice between a great-sounding transmitter that's frequently off-the-air and a mediocre-sounding unit that never fails, the latter will always be more desirable.

When reviewing different transmitters, ask current users about their respective transmitter's reliability. When checking a transmitter model's references, ask about the installation. Keep in mind that a transmitter's reported reliability is certainly affected by the quality of its installation. Manufacturers can easily duplicate the same transmitter design repeatedly, but different installations will subject similar transmitters to widely varied operating conditions. Hence, surveying a number of users of identical transmitters is critical to obtaining a true impression of a particular model's reliability.

A small footprint can be advantageous in many installations.

Longevity of manufacturer

Many of the day-to-day and occasional purchases we make are from long-standing manufacturers. Names such as General Motors, Kroger and IBM are such a part of everyday life that we can take manufacturer longevity for granted. This is often not the case with broadcast equipment and other specialized product manufacturers.

Ten years after purchasing a new transmitter, it will likely still be in use and will require maintenance and parts. Yet a decade from now, will mechanical parts be available? Will technical assistance and advice be available? Will components made by other vendors exclusively for this transmitter manufacturer be available anywhere at any price?

Often, when proper replacement parts become unavailable, a repair engineer is forced to use makeshift parts, disable certain transmitter circuits, or otherwise modify the transmitter. Frequently, these modifications result in operation without proper protection circuits or contrary to the unit's original type acceptance. At this point the transmitter's useful life is nearing a quick end.

If continued support is important to the purchaser, buying from a long-standing, reputable manufacturer should be of significant importance.

Service and support

When a transmitter is off-the-air, knowledgeable telephone support can be vital to quick problem resolution. Some transmitter manufacturers offer 24-hour phone support while others may be difficult to reach even during business hours.

Checking with other users of a company's equipment is a good way to judge support. Calling a manufacturer's technical support line and asking questions can reveal a company's attitude toward technical assistance.

Ease of maintenance

During the 1970s, a U.S. auto maker sold thousands of cars that were difficult to service in one respect: To replace one spark plug, the entire engine had to be removed. Consequently, few of those spark plugs were ever replaced.

Transmitter designs can suffer similar problems. Some designs require shutdown of the transmitter in order to change the air filters. Another design results in going off-air for a few seconds before and after adjusting the automatic power control setting or the filament voltage. These design quirks are not described in the manufacturer's spec sheet. To discover these problems sooner, rather than later, seek the opinions of qualified and trusted engineers regarding particular transmitter models.

In recent years, several transmitter manufacturers have given attention to ease-of-maintenance issues. One improvement has been solid-state Intermediate Power Amplifiers (IPAs) with convenient patching systems to route around a failed module or system. This factor may also come into play if a future in-band DAB system requires any modification of existing transmitters.

When choosing a transmitter look for roadblocks to convenient and safe servicing. Look at the overall component layout. For example, what if a blower motor fails? How difficult would it be to remove and replace?

Okay, say you meet the right girl, take her home to meet your family, get down on your knee in front of everyone and plead with her to elope and spend an eternity together frought with romance, passion, and lifelong commitment, and suddenly she says: "I can't. It'll violate my parole."

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Check the overall fit and finish of the metalwork. A fair amount of time can be wasted fighting with access doors that don't fit properly, or with fasteners that aren't correct for the task or are poorly installed.

Availability of parts

Some transmitter purchasers want the latest technological designs and capabilities. These designs are often achieved using uncommon, esoteric components. Such components may not be available in several years if they do not sell in sufficient quantities to justify their continued manufacture.

For other transmitter purchasers, a simple, proven design using more commonly available parts is appropriate. The more advanced designs will always offer more bells and whistles, many of which are important and significant. Nevertheless, simpler designs, while devoid of certain convenience and performance features, are more likely to be supplied with replacement parts in years to come.

Traditional tube designs from well-established manufacturers offer long-term reliability.

Physical size considerations

In some cases, an important criterion in transmitter selection is physical size and configuration. If a particularly small footprint is required, some manufacturers offer transmitters that are rack-mountable in power levels up to 2kW for FM and up to 1kW for AM.

Broadcasters who rent rooftop or penthouse space for transmitter placement often pay by the square foot. For these installations, choosing a transmitter based largely on footprint size may be prudent.

Required airflow considerations

All too often, proper clean airflow is improperly addressed or ignored altogether in transmitter installations. Proper consideration of cooling airflow is important to a transmitter's longevity. For this reason it's wise to examine the transmitter's airflow requirements.

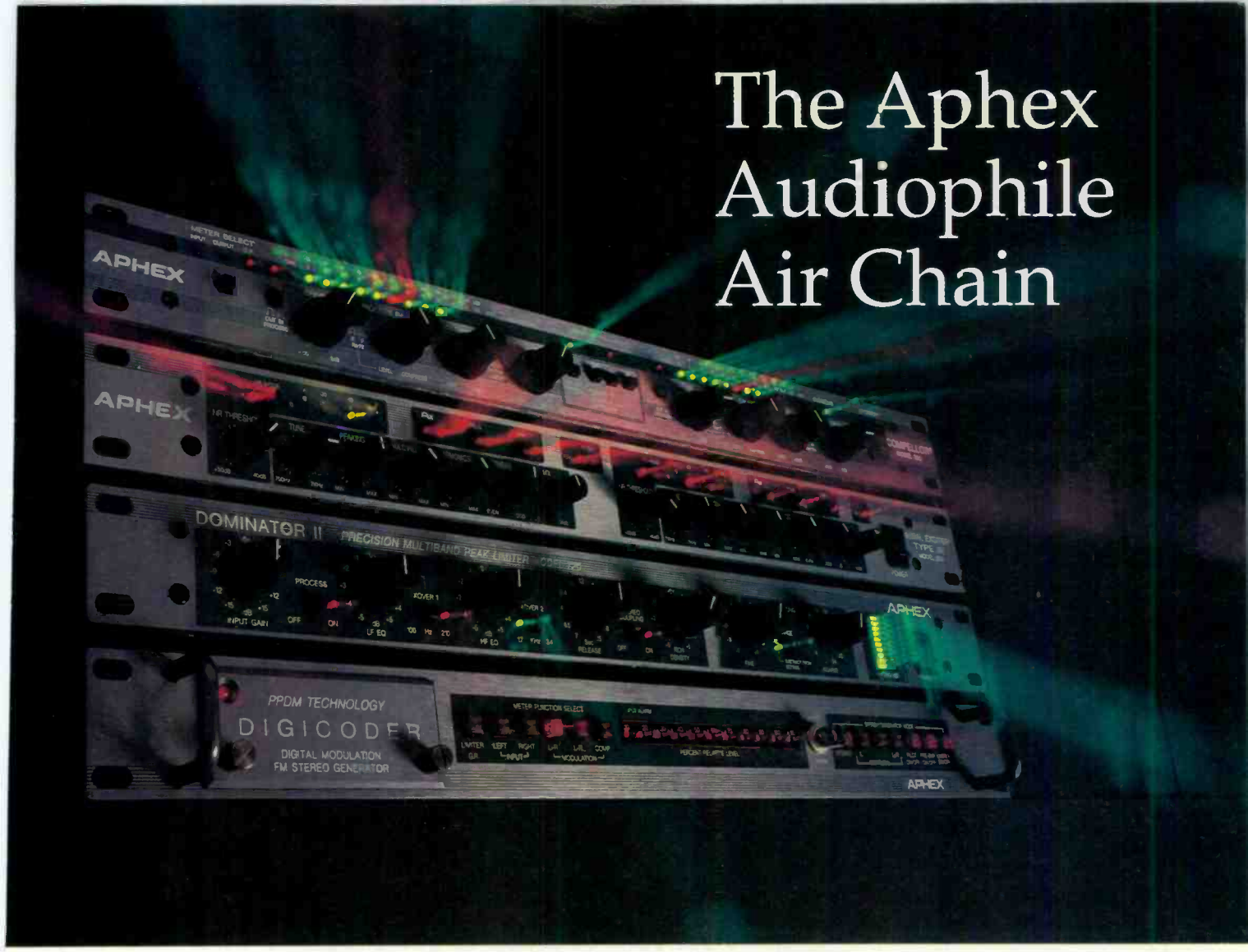
For lower-powered AM and FM transmitters, solid-state units tend to require less cooling air than tube-type models. At least one solid-state AM transmitter model on the market doesn't use any internal blower up to the 2.5kW level.

When comparing transmitter spec sheets, be sure to note the airflow requirements listed by the manufacturer. Be certain that the transmitter's intended environment can be made suitable for that unit's requirements.

Also check the design and ratings of the components in the transmitter's internal airflow system. Some manufacturers allow more "headroom" than others for inefficient or restricted airflow. If a particular model's components are employed at their maximum ratings, any restriction or inefficiency could cause overheating. In cases of marginal design by the manufacturer, ease of accessibility is important for cleaning squirrel cage blowers and fans.

Deliverability to site

A transmitter site that is particularly remote could have a bearing on which transmitter model is chosen. Most transmitters can be made lighter by removing heavy components such as high-voltage transformer(s) and choke(s). Some transmitter designs do not lend themselves well to easy transport, however. These include designs where several cabinets are connected together in such a way that disconnecting them is impractical.



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"Immediate improvements in fringe signal quality were noted. These improvements included a reduction in multipath and picket-fencing," - Gary Greth, CE, KLON, Long Beach, CA.

"We have gotten a few responses from listeners in the fringes of our coverage area saying our signal is much stronger. They are reporting the actual carrier level has increased and they can hear us where they could not get a clear signal before," - Herb Squire, CE, WQXR, NYC.

The Aphex Audiophile Air Chain allows maximum loudness and modulation while maintaining the natural dynamic feel of the program. Quick and easy to set up, it maintains the same high quality regardless of the type of programming or who is controlling the board.

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Also examine beforehand the difficulties that could result from attempting to squeeze a large transmitter through all access doors and into its final position at the site.

Getting the best price possible

When the choice is down to a few competing brands, it's time for serious bids from the manufacturers' representatives. Bidding practices seem to vary widely from one manufacturer to another. A few will bid their list price and allow no further negotiation: "The product stands on its own and here's the price" is their approach — the Saturn dealer school of transmitter sales. Other manufacturers will bid below the equipment's list price and usually keep a little more negotiating room available in case it's needed.

Try to keep price comparisons in the "apples-to-apples" domain. Standard equipment and features vary quite a bit from one manufacturer to another so a true price comparison may not be entirely possible nor desirable.

Proper ventilation is important to any transmitter's longevity.

Manufacturers' representatives are often in a position to include other transmitter installation accessories in their bids at discounted prices. Items such as transmission line, line hardware, connectors and the like are sometimes sold near cost when included with a transmitter purchase.

When negotiating price, remember that a personal relationship with the manufacturer's representative can be vital in obtaining a good transmitter value. Remember also that such good value may not necessarily be the lowest bid on the table, but will involve buying what is proper to do the job at hand.

Summary

Buying a transmitter involves at least as many choices as buying a car. When considering the degrees of quality and reliability available, remember that every song, newscast, talk show, PSA and commercial that will be aired for years to come will depend upon the transmitter and its related systems.

The transmitter is a station's vital link to the public. Its purchase decision should be treated accordingly.

➡ For more information on radio transmitters, circle (65) on Reply Card. See also "Transmitters," pp. 68-69 of the *BE* Buyers Guide.

September

Audio management

A look at how digital technology is changing the face of audio in radio. From digital cart machine replacement to integrated storage, production and on-air systems, radio stations have a wide variety of options available for audio management.

Radio consoles

Don't buy that new radio console until you've read this article.

Control room monitoring

Radio control room monitoring systems are important to maintaining a top-quality on-air sound. The author looks at ways you can improve your system.

SUGGESTIONS

Use the ***BE Radio*** FAXback line to suggest articles you would like to see on any radio technology.
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BE Radio

FM audio processing

By Christopher M. Durso

The Bottom Line: *Audio processing is an essential part of any radio station's air chain, and it can significantly affect the perception of the station in its market. The ever-growing number of products on the market make it difficult for a station to stay ahead of the pack. Knowing what tools are out there and how they work are the first steps toward successful processing at your station.* $

Today's FM audio processing is at once both science and art. It serves a specific function with respect to modulation limits set by the FCC (which can be precisely measured), while simultaneously creating a *feel* or *sound* for the radio station (that may be difficult to quantify). Therefore, a station's audio processing serves two masters — the chief engineer and the program director.

As the digital age has matured, the choices available to meet both objectives have expanded.

The Orban Digital Optimod 8200 is a digital audio processor that includes a stereo generator and offers optional AES/EBU I/O and sampling rate conversion.

Audio processing 101

To accomplish these twin tasks, processing systems perform at least two important functions: limiting and compression. Limiting audio results in a maximum level (or voltage) that will be applied to the exciter baseband input. This level will result in modulation that will not exceed the maximum allowable amount. While the amount of limiting and its attack/release times can vary, the process usually creates some unavoidable distortion artifacts. The greater the amount of limiting, the more noticeable this distortion can become.

Limiting, therefore, trades off between loudness and listener fatigue. Technologies deployed in late-generation processors have made it much easier to achieve high levels of average modulation (thereby increasing perceived loudness) without introducing objectionable amounts of distortion, however.

Ultimately, signals of excessive level that find their way past the limiter unmolested must be controlled by a clipper circuit. The clipper is potentially the most destructive of all audio circuits in a processor.

The Aphex Systems line includes a number of separate analog audio processing devices. Shown here (from top) are the Compellor, Aural Exciter Type III, Dominator II and Digicoder (a digital/analog hybrid stereo generator).

Meanwhile, an audio processor's compression (or *leveling*) section essentially reduces the dynamic range of the audio signal by constricting the average level by some set amount. The amount of compression applied is expressed as a ratio of the modified transfer function. A compression ratio of 4:1 means that the input voltage must change by four units of measure in order for the output voltage to change by one unit of measure. This reduction in dynamic range is usually desirable when reaching a largely mobile audience, especially in an environment where multipath is troublesome. Given the high ambient noise levels found in automobiles, compression serves to keep the signal audible over a wide range of listening environments and signal reception conditions. Some radio formats can tolerate a reduction in dynamic range more transparently than others, however.

In addition to handling the discrete left and right channel audio signals, most broadcast audio processors (those that include a stereo generator) add a highly stable, phase-accurate stereo pilot signal at 19kHz. The stereo composite baseband assembled by such processors includes the main channel audio (L+R) signal (processed and bandpass-limited to 15kHz), the stereo pilot at 19kHz and the stereo difference (L-R) subcarrier at 38kHz (twice the pilot frequency). Some engineers also opt to process the L-R signal separately in order to achieve a widened stereo image. This technique is not required to maintain modulation compliance, but may help define the audio signature of the station.

Durso is chief engineer at KPBS-FM, San Diego. Respond via the *BE Radio* FAXback line at 913-967-1905.

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To obtain an extra edge of loudness as well as provide greater overmodulation protection on highly processed signals, the technique of *composite processing* has gained popularity. The composite processor is the last element in the audio chain prior to the exciter baseband input and, when properly adjusted, can deliver a few more dB of increased loudness. Careful attention must be paid to avoid clipping the stereo pilot, which could result in *pilot modulation*, a violation of FCC rules. To avoid this, the stereo pilot is inserted after the composite processor.

Finally, many FM stations introduce additional signals in the baseband subcarrier region above 53kHz. Any station using subcarriers must minimize spurious energy present in this subcarrier region of the composite signal. In the absence of adequate filtering in the audio processing chain, adjustments made to the main channel signal can have a profound negative effect on subcarrier services.

The Audio Signature from Circuit Research Labs is a digitally controlled analog audio processor with setup memory and remote-control capability.

A station's audio processing serves two masters — the chief engineer and the program director.

Processor types

FM audio processors generally fall into three categories: *analog*, *analog/digital hybrid* and *digital*. In addition, processors are usually further divided into *multiband* or *split-band* types.

The multiband (usually a 2-band) processor generally divides the audio signal between the low frequency and mid/upper frequency bands. This allows the processor to treat the energy levels in these bands separately and helps to reduce the pumping that results from the low-frequency band (the spectral area that is generally predominant in music and speech) driving the overall gain of the system. To avoid excessive alteration of the audio signal's dynamics, an adjustment is usually provided that determines how much the low-frequency band acts as the overall gain-reduction control. This approach can preserve much of the original dynamics of the program material.

A more competitive approach splits the audio spectrum up into a larger number of bands (typically four or more) that are each processed and controlled independently. Characteristics of each band (such as attack and release times) can be adjusted to change the density of the program or to emphasize a particular part of the spectrum. In many cases, a split-band limiting section is followed by a separate split-band compression section. Often, a wideband (i.e., single-band) automatic gain control (AGC) section precedes the split-band processing sections. This type of processor enables programmers to fine-tune the sound of a station more precisely and process more aggressively.

Analog processors use conventional technologies to perform the functions of audio filtering, compression, limiting and pilot/stereo subcarrier generation. This is not to suggest that such products lack sophistication. To the contrary, modern analog audio processors contain extensive state-of-the-art electronics and can produce excellent sonic results.

The Unity 2000i from Cutting Edge Technologies is a single-box, multifunction hybrid processor that comes with remote PC control software.

Digital/analog hybrid processors typically use digital circuits for control while audio signals remain in the analog domain. Digital control can provide greater consistency and allows easy storage of multiple parameter settings that can be recalled to change the action of the processor almost instantaneously. This type of flexibility is useful to stations that change programming with dayparts, or that simply want different amounts of processing for different times of the day (e.g., more compression during drive-time). Settings might also be changed to conform to the needs of on-air talent. Another popular hybrid processor technique is the digital generation of the 19kHz pilot and 38kHz stereo subcarrier signals. This method results in superior phase and frequency stability performance, which is critical for maintenance of optimum stereo separation.

Digital audio processors convert audio signals to digital form, and then apply digital signal processing (DSP). DSP is controlled by software and gives the user control over numerous parameters of the processor. Control over so many aspects of the audio processor can actually be problematic at times. Engineers and programmers must resist the temptation to make adjustments that may result in a progression of errors. Many parameters must be adjusted proportionally and the setting of one adjustment may quickly destroy the relationships that make up the sound of a particular processing configuration. Digital audio processors will yield excellent results when properly adjusted, especially when operated through a digital air chain all the way to the exciter.

In most cases, digital processors also derive filtering, pilot and subcarrier generation digitally. Because digital audio processors can so carefully control the content of the composite signal, stations transmitting subcarriers in the upper baseband region should notice an improvement in crosstalk performance.

These digital processors are essentially computers attached to DSP hardware under software control. Therefore, processor overhead also makes it easy to include powerful scheduling features that can accommodate daypart programming. Digital processors also may include digital inputs and outputs that conform to the AES/EBU standard. It is possible today to take the stereo analog signal from the broadcast console (or other final studio source) and convert it to AES/EBU (if it is not already) for transmission through a digital STL. At the transmitter site, the digital signal is returned to AES/EBU form and fed to the digital processor. The most recent development in this area now allows an AES/EBU output from the digital processor to be fed to a digital FM exciter input. In this case, the stereo generator is part of the exciter, which feeds the digital baseband signal it creates to a numerically controlled oscillator (NCO) for deviation of the FM carrier.

Late-generation processors can achieve high levels of average modulation without objectionable distortion.

Control of hybrid or digital processors may also be possible from a remote location, typically via PC and modem, using control/communication software

Continued on page 22

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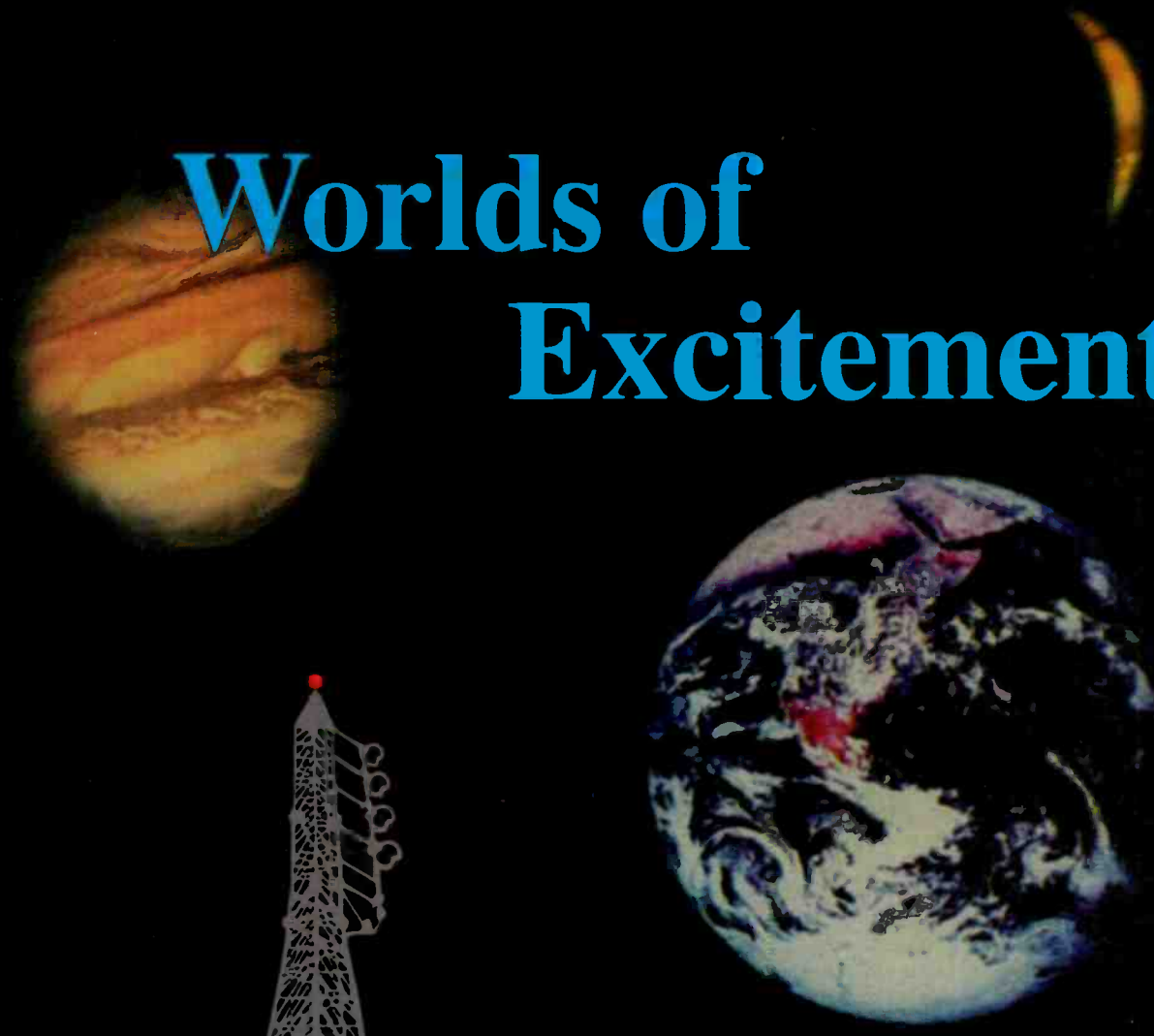

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New RBDS services

By Skip Pizzi, technical editor

As RBDS begins its deployment, a number of new service providers and platforms have emerged.

The Radio Broadcast Data System (RBDS) has been a long time coming in the United States, but as it begins in earnest, several new service providers have begun to market their offerings to RBDS-equipped broadcasters. These providers operate as third parties using a portion of an FM radio station's RBDS subcarrier datastream to reach customers within the station's coverage area. The customers typically are outfitted with proprietary receiving hardware by the service providers. In these respects, the approach is quite similar to traditional data subcarrier leasing.

Where things differ with RBDS is in the multiplicity of services that can share a single subcarrier. First, you'll recall that the primary function of RBDS is providing *program associated data (PAD)* to radio listeners. (See "Rx for New Radio Profits," March 1992.) As a secondary function, auxiliary or *transparent* (i.e., inaudible/invisible to the radio listener) services such as those discussed in this article can be added. They serve users other than the radio station's normal listeners and bring additional revenue to the station from service providers.

An interesting synergy evolves from this relationship. Because a station's only real cost of implementing RBDS comes at the initiation of the service (i.e., coder and monitor purchase and installation), station management is naturally interested in seeing some early return on the investment. (See "Radio in Transition: Implementing RBDS," June 1994.) Yet the promotional and sales-enhancement value of RBDS's PAD services is limited in the short term by a lack of RBDS-capable receivers in the hands of radio listeners. Significant penetration of this hardware will not be attained among general radio audiences for several years. On the other hand, third party or "industrial" RBDS applications can have a more immediate impact because the receivers are quickly placed in the hands of customers identified by service providers. Marketing of these services also is handled by service providers—the broadcaster serves only as a delivery conduit and can begin to reap financial benefits soon after implementation in many cases.

Broadcasters should be cautious in their acceptance of these services.

Caveats

Some industry observers advise broadcasters to be cautious in their acceptance of these services, however. The RBDS subcarrier's relatively low 1.2kb/s data rate can only accommodate a limited amount of this transparent data before it begins to slow the operation of both PAD and transparent RBDS functions. Signing long-term leases for substantial transparent data use of an RBDS subcarrier may seem like a good idea today when so much of the RBDS datastream seems like excess capacity. Yet, if and when RBDS PAD services become popular in the future, a station may regret the speed or capacity penalty paid by burdensome transparent data carriage. As with any subcarrier leasing, broadcasters must be fully aware of their spectral assets' value — both in current and projected terms.

Also note that some of the services below also may require an increase in injection level of the RBDS subcarrier from its nominal 2.6% to 5% or higher. This may affect the received quality of main-channel audio or other subcarrier services.

New services and systems

Among the first RBDS transparent services to be established was paging. So far, only one company, Axcess USA, has implemented RBDS paging on a large scale. The company sells franchises to stations or third parties to operate local paging systems. Axcess provides alphanumeric RBDS pagers to subscribers. There is no national paging interconnection feature as yet with the service.

Sage Alerting has pioneered the use of RBDS for a similar addressable messaging service, but this one emphasizes emergency or other alerting features, again on the local level only. Sage also has proposed an RBDS-based system to the FCC as a candidate for updating the Emergency Broadcast System (EBS).

Industry insiders report that the market for RBDS paging/alerting may open up soon as more companies begin to offer services and receiver hardware.

The market for Differential Global Positioning System (DGPS) services is also growing. These services increase the accuracy of satellite-delivered GPS

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data to non-military users from a few hundred meters precision down to a few meters or less. DGPS has been available for some time via other delivery methods (satellite or microwave) but at high cost. Delivery of DGPS correction data via RBDS broadcast can greatly reduce the cost of such service, making it attractive to many new users. Differential Corrections, Inc. (DCI) provides DGPS service as an RBDS application to properly equipped or adapted GPS receivers using the so-called RTCM-104 standard. (See "Radio in Transition: On the Horizon," December 1993.)

A similar DGPS service called ACCQPOINT is provided by Magnavox, in conjunction with Cue Paging. It is not technically an RBDS application, but instead is offered as part of Cue Paging's 57kHz service. This established national paging network can co-exist on the 57kHz subcarrier with RBDS service, although some slowdown in response time of both services may occur.

An interesting development that might find an RBDS application is Milestone Technologies' SATX system, a one-way binary file transfer protocol with the robustness required for wireless delivery. This could increase the utility of RBDS's TDC (transparent data channel) or other functions. So far, RBDS data has been limited to short text messages or ASCII files. A one-way, wireless, binary file transfer function could allow serious computer data downloads; such a protocol is critical to any future information superhighway "off ramp" or real datacasting application for broadcasters. Although true wireless computing requires a 2-way, point-to-point link, there may be marketable uses for one-way, point-to-multipoint data-file downloading, such as database updating or navigational/mapping services.

A specific commercial application for RBDS data is the *MusicBoard* system from Specialized Communications. This service downloads the name of the currently airing song title and artist to an active billboard display promoting the station. The billboard features a large lighted display (similar to a time/temperature or news headline banner) set inside a huge, stylized car radio faceplate with the legend "Now Playing on WXXX:" During commercial breaks, the display runs generic promotional text.

A company called Terrapin has developed a different kind of locating receiver that does not use GPS but instead tracks the 19kHz pilot frequencies of several FM stations in a given market, and triangulates a location based on received phase deviations. The system, called Position Information Navigation System (PINS) can obtain reasonable positional accuracy, but is limited by the frequency drift inherent in FM pilot signals. Correction data to compensate for this drift can be transmitted to PINS receivers in a given market via the RBDS subcarrier of one FM station in the market. With this correction data, positional accuracy down to 10m can be achieved. Other RBDS data also can be received by a PINS receiver, allowing it to combine location and text information on a single display.

Unlike GPS, PINS can be used in urban canyons and even indoors. Each receiver is addressable, and a PINS module can be built into a portable phone to provide Mobile 911 (M-911) service. Under this proposed system, a portable phone can automatically report its position to emergency services when 911 is dialed. Terrapin also foresees wireless computing and IVHS applications such as location adaptive databases (smart yellow pages), plus a number of interesting 2-way services when combined with a mobile telephone (such as automatic vehicle location, traffic condition reporting or paging with message-received acknowledgments).

Terrapin's approach is really a platform for RBDS rather than a service. Along the same lines, Modulation Sciences has developed a line of general-purpose RBDS receivers that can output the full RDS or RBDS data set. The receivers, called the *RDS-X* series, are fully addressable, or they can be made "pseudo-addressable" by only responding to RBDS signals accompanied by an identifying beacon (similar to the use of tone-squelch in 2-way radio systems). The receivers can also provide FM audio output and diversity reception. They are targeted at the industrial marketplace, and their availability may encourage other new service providers to enter the marketplace using these receivers as their customer platforms and configuring them as needed.

Nevertheless, at least some of the proposed services and systems described in this article may achieve success, and with it bring some early returns to FM broadcasters who have implemented RBDS.

➡ For more information on RBDS services, circle the following on Reply Card:

ACCQPOINT	(74)
Axcess USA	(75)
Coupon Radio	(76)
Differential Corrections	(77)
Milestone Technologies	(78)
Modulation Sciences	(79)
Sage Alerting	(80)
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Circle (20) on Reply Card

Lower-cost directional antenna systems

By Grant W. Bingeman

Hot guy wires can make AM DAs more cost-effective.

There is a new technology available for AM directional antenna design that can dramatically reduce land and capital equipment costs. Instead of using two towers, for example, many applications could simply use one tower and a hot guy wire. Theoretically, for a new station, this technique would require roughly half the land and half the number of towers compared to conventional design. It might also be used when modification of an existing pattern was required. By tuning existing guy wire(s) or adding a simple slant wire, a station might be saved from having to relocate its antenna site, as is often required for such modifications.

This hot guy wire technology has been proven outside of the United States, but the FCC has yet to accept it. The commission requires certain traditional formulas to be used to calculate radiated fields. Although exceptions have been allowed in the past, additional measurements are usually required to prove that what the antenna designer has predicted is true if the standard formulas appear to be violated.

Studies indicate that better skywave radiation predictions could be obtained using such *moment-method* antenna design than with the existing FCC formulas. The moment-method is considered superior because it makes fewer assumptions and simplifications of the current distribution on the radiating elements in a directional array. This implies that less actual interference can be expected at night from directional antennas designed with the moment-method.

There is now some regulatory activity on this front. A Notice of Inquiry has been issued under MM Docket No. 93-177 under which the FCC may eventually accept moment-method antenna designs in place of the old sinusoidal current distribution designs. Meanwhile, consultant Clarence Beverage has studied hot guy wire antenna designs for implementation at WXCT, Hamden, CT. As a result, a Proposal for Rule Making recently has been filed specifying the technical characteristics of the active slant wire antenna.

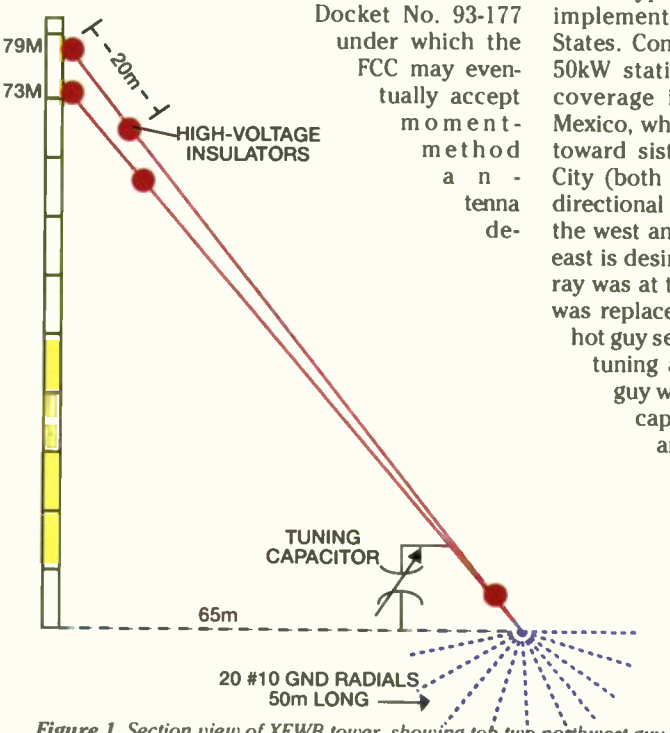

Figure 1. *Section view of XEWB tower, showing top two northwest guy wires used as directional reflectors.*

South of the border

This type of antenna has already been implemented outside of the United States. Consider the case of XEWB, a 50kW station that desires maximum coverage in and around Veracruz, Mexico, while reducing signal strength toward sister station XEW in Mexico City (both at 900kHz). To this end, a directional pattern with a minimum to the west and a maximum to the southeast is desired. The original 2-tower array was at the end of its useful life and was replaced by a single tower with a hot guy section. This was achieved by tuning a portion of the northwest guy wire as a reflector. A variable capacitor was used near the guy anchor to adjust the electrical length of the guy wire. (See Figure 1.)

XEWB is located northwest of Veracruz on sandy soil close to the ocean. Comparison of the (hot guy) directional to the non-directional measured field intensities shows a reduction in gain toward the west of 4dB to 5dB, depending on exact

Bingeman is senior engineer at Continental Electronics, Dallas, TX. Respond via the *BE Radio* FAXback line at 913-967-1905.

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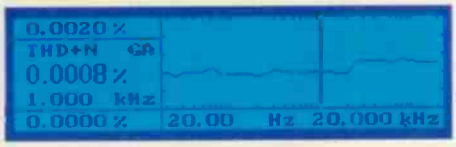

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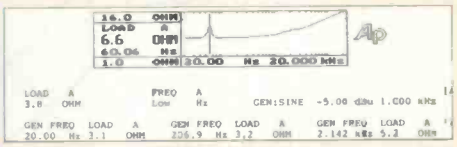

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bearing, and a maximum increase of 3.5dB toward Boca del Rio, southeast of Veracruz. (See Figure 2.)

Thus, the creation of a 2-element directional array out of a single tower by exciting a guy wire as a parasitic element is a viable and economical means of doubling radiated power in a particular direction, and providing protection on one or two other bearings. Of course, if the guy wire was fully driven (via transmission line, power divider and phasing networks), so that independent current phase and ratio control were provided, additional pattern control would be available if needed.

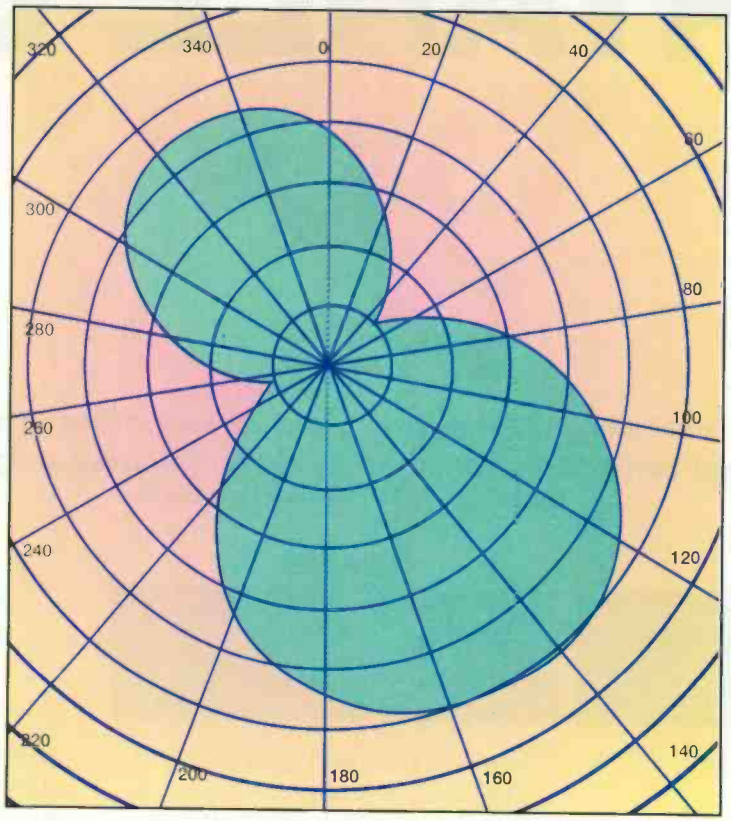

Figure 2. Predicted pattern for XEWB after installation of hot guy wire system. Subsequent tuning adjustments reduced rear lobe.

Installation

Some of the following details of the modification from a 2-tower to a 1-tower/hot guy configuration emphasize current and voltage concerns because of the high power of XEWB. These would be moot in the case of a significantly lower-power station (5kW or less).

Conversion of the quarter-wave tower to directional operation entailed adding jumpers across some of the existing guy insulators, replacing the remaining guy insulators with larger sizes having a higher voltage rating, laying 20 ground radials each 50 meters long around the guy anchor, adding a tuning capacitor between the nexus of these new radials and the bottom of the hot guy wire, and adjusting the tower impedance matcher for the reduced base resistance and increased base reactance.

The choice of what appears to be too small a number of ground radials bears some explanation. The minimum number of ground radials can be determined by knowing the RF current rating of the size of wire used for the radials. For example, if the wire can handle 1A without undue temperature rise, and you have 20 amperes at the bottom of the guy wire, then you know that you need at least 20 radials.

The second consideration is a compromise between efficiency and cost. An effective empirical approach to this question is to measure the self-base impedance of the active guy wire while radials are added to the circuit (the tower is detuned in the usual manner). When the self resistance no longer drops significantly with increasing radials, you have a good compromise. Keep in mind that the existing radials from the tower can assist. Thus a "standard" ground system of 120 long radials and another 120 short radials would clearly be overkill in this particular hot guy wire situation.

For 50kW XEWB, it was decided that the guy current was better shared between two guy-wires, so the top two northwest guy wires were excited simultaneously. They were simply jumpered together near the anchor and received the same insulator modifications. (See Figure 2.) It is important to note that the voltage gradient at the top of the hot guy wire can be quite high, and requires careful corona treatment. The insulator needs to be a high-voltage type with corona rings for all but the lowest power stations. Experiments at XEWB determined that a closely spaced string of large (8-inch long) egg insulators is adequate for no more than 10kW with modulation for the given tuning. Other patterns and guy wire configurations may limit this to 5kW.

Theoretical antenna analysis indicates that a *reflector* configuration is pref-

Continued on page 22

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RE: Radio continued from page 20

erable to a *director* arrangement, based on current/voltage stresses and bandwidth. Nevertheless, if a director is required, it can easily be produced by adjusting the guy wire tuning reactance, or using a shorter portion of the guy as the active element.

Application notes

A weatherproof tuning box and a fence need to be erected around the hot guy wire anchor, because considerable voltage may be developed across the guy wire's bottom insulator. It is a good idea to provide an RF ammeter in series with the tuning reactance, and sampling for the antenna monitor.

In general, in order to avoid uncommonly high voltages and currents, and possible bandwidth problems, it is good practice to keep the guy wire base current below the level of the tower base current. At XEWB, guy wire current was about 80% of tower current. More gain can be obtained with higher currents, but the cost of increased insulation, bigger components or bandwidth treatments may not be justified for a few tenths of a dB higher gain.

Using a guy wire as a radiating element in a directional array will require fewer towers and thereby shrink an antenna site's requisite dimensions. The consequent reduction in capital outlay and debt service for land allows more room for profit at the radio station.

Acknowledgment: The author wishes to thank Sr. Miguel Barrientos of Sistema Radiopolis and Sr. Aguilar and his staff at XEWB. Thanks also to the Secretaria de Comunicaciones y Transportes (Mexico's FCC) for their cooperation and foresight.

Editor's note: For further technical information see "An Economical Directional Antenna for AM Stations," *41st Annual Broadcast Engineering Conference Proceedings* (NAB 1987). ■

FM Audio Processing continued from page 12

provided by the processor manufacturer. This allows engineering and programming staffs to adjust a processor located at the transmitter site while listening in a controlled environment at the studio (or elsewhere).

Implementation issues

Installation of FM audio processors varies, depending upon a number of factors. When the studio and transmitter are colocated, the processor is generally placed in a rack adjacent to the exciter/transmitter. The cable run containing the composite signal should be kept as short as practical between the processor and exciter input. Where long runs cannot be avoided, a composite signal distribution amplifier may be required, along with use of the exciter's balanced input or an external isolation transformer (to maintain signal levels and guard against the introduction of ground loops).

Some radio formats can tolerate a reduction in dynamic range more transparently than others.

When the transmitter site is at a remote location, a studio-transmitter-link (STL) must be employed, using either an RF path or leased telephone circuit(s). Either analog or digital transmission can be implemented, and signals may be delivered to the transmitter as discrete left audio, right audio and subcarriers, or as a composite signal ready for transmission.

With analog aural STLs, a *discrete* system will yield better signal-to-noise performance at greater distances than a composite approach because less bandwidth is required. This means that audio processing equipment must be located at the transmitter site, making the comprehensive (PC/modem) remote control available in the latest generation of audio processors all the more valuable. Subcarrier equipment, including RBDS, must also be located at the transmitter under this scenario. In addition, some peak protection or *preprocessing* must be placed in front of the STL transmitter to prevent overdeviation of the STL system. Similar concerns exist with equalized telco STL circuits.

A *composite analog* RF system allows all processing equipment to be kept at the studio, which can be advantageous, assuming that the STL signal-to-noise is still acceptable. *Composite digital* transmission is possible using T1 telco circuits or 23GHz RF links. The bandwidth limits of 950MHz aural STLs will not allow composite digital signals. In fact, they can only allow transmission of *discrete* digital signals with the use of bit-rate reduction via perceptual coding techniques.

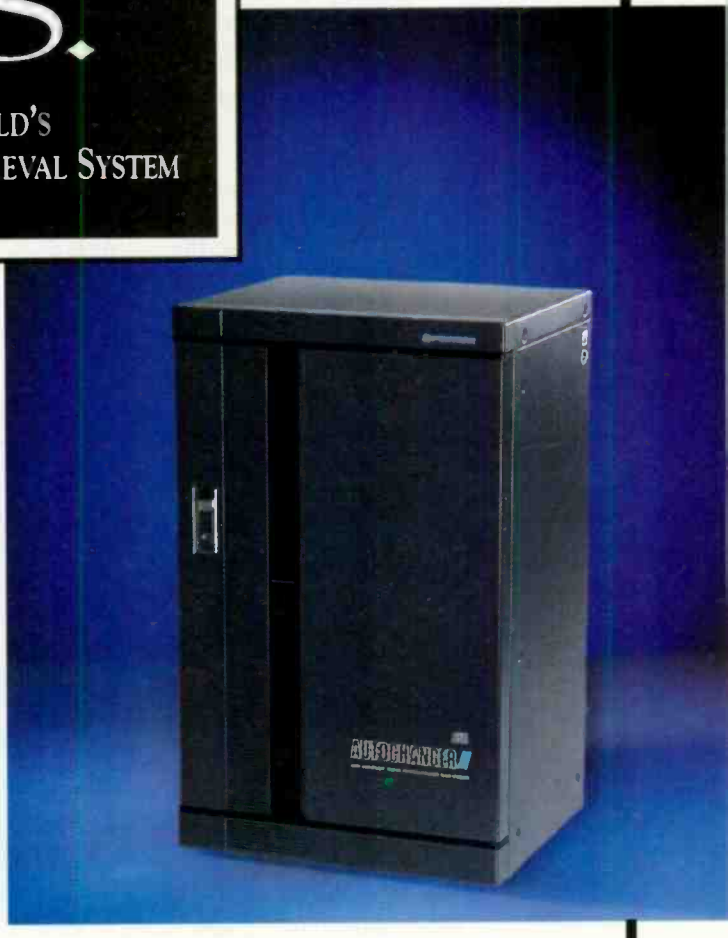
The processes of digital conversion, processing and rate reduction all generate *delay* in the audio path. Although this throughput delay is relatively low, some operators may find it annoying. Of course, it is only noticeable when the operator is announcing on-air because that is the only time when a real-time reference is available. To solve this problem, a matrix can be built that is fed by both the off-air signal and a console program output (the latter may include audio processing). The matrix is activated and steered by the console microphone logic output.

Continued on page 28

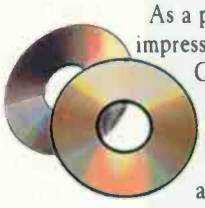
THE WORLD'S OLDEST DISC RETRIEVAL SYSTEM

VS.

THE WORLD'S NEWEST DISC RETRIEVAL SYSTEM



No matter how technologically advanced an industry may become, it's always a good idea to keep things simple. Well, what could be simpler than programming audio by hand? The Pioneer CAC-V3200 Compact Disc Autochanger.



As a professional audio user, you'll be impressed that it provides access to 300 CD's with uninterrupted playback thanks to dual CD players. And they can be connected together to program thousands of CD's. You'll also appreciate that its built-in interface makes it pre-programmable for error-free playback by almost any computer. And its fade-in and fade-out capabilities, pitch control, and analog and digital outputs make it a remarkably ingenious piece of equipment.

However, if you just want to get practical about the whole thing, you can look at it this way, too. The CD Autochanger makes audio programming so absolutely efficient and error-free that your life will be made easier and your business could become more profitable. Which makes it seem rather impractical not to find out more.

Call Pioneer and ask about the CAC-V3200 Compact Disc Autochanger. You'll find it to be a simple decision that deserves a big hand.

PIONEER
The Art of Entertainment

BE Radio

A new home for MJI Broadcasting

By John Storyk, R.A.

The Bottom Line: *A radio production/syndication house requires a hybrid facility providing efficient and high-quality output from parallel administrative and technical operations. Its geographic location affects its success, as well. But building any new audio facility today also calls for some tough decisions on design philosophy, as the industry teeters on the brink of a virtual digital production environment. Balancing these diverse elements provided the challenging context for this project.* $

In 1980, MJI Broadcasting debuted *Rock Quiz*, its first syndicated radio show. Soon thereafter, the company established itself as one of the country's leading suppliers of innovative radio programming. By 1992, MJI was the second largest radio syndicator in the United States, carrying 13 programs (including *The Grammy Awards* and *The Country & Western Awards*) fed to more than 2,000 stations with a total of 20 million listeners.

That same year, MJI moved to its new 15,000-square foot headquarters in New York City. Every media facility presents design challenges, and this one was no exception.

As usual, not enough space

Several months were spent outlining the exact program requirements for the new offices and production facilities, and simultaneously searching for a suitable new location. Like many successful companies, MJI's growth had occurred during its previous 12 years with a minimum of attention paid to physical needs. At last there was an opportunity to plan intelligently for the future. Expansion forecasts indicated that between 16,000 and 20,000 square feet would be required during the next five years to accommodate MJI's projected growth.

As is often the case, the best physical piece of real estate is not always the best financial deal. The search resulted in the selection of an approximately 15,000 square feet parcel at 1290 Avenue of the Americas, one of Manhattan's best mid-town addresses for the entertainment business (home of *Rolling Stone*, Atlantic Records and SBK Records).

Control rooms at MJI allow simple reconfiguration for integration of future technologies.

Analyzing MJI — the business

An important starting point for any design is a block diagram of the space. MJI operates in several business areas simultaneously, so diagraming its functions and programming the space was challenging.

MJI's producers create shows by reading, phoning, writing, and then ultimately recording and post-producing them in radio production studios.

The technical staff works with producers to create the shows as well as edit, record and produce all aspects of the finished programs. MJI has a number of different show formats, each with slightly different recording requirements. Four completely isolated radio production studios were installed, and the basic walls were erected for a future fifth suite (to be completed this year). Analysis of exact programming needs resulted in only two of the five suites requiring voice-over booths.

Maximizing pre-production functions enabled MJI to achieve an exceptionally high yield of shows per recording/production suite. In previous MJI facilities, pre-production has always ended up in windowless back rooms or even corridors on occasion. The new space allowed this critical staff function to be situated in a far more pleasant environment.

MJI's libraries had been scattered throughout spare corners of their earlier facilities. Over the years, interviews and programs had accumulated (at a rate of about 30 per week), along with a

Storyk is principal designer at Walters-Storyk Design Group, Highland, NY.

large record, tape and CD collection. This material is one of the operation's most valuable assets. Today, a professional librarian administrates this collection in one central room.

Traffic flow

Nothing happens in business without sales. MJI is in the barter syndication business — they "trade" completed radio programming for portions of each station's advertising time. Monitoring affiliated stations and sales of the MJI-produced radio shows essentially happens in a telemarketing environment.

It is to the company's credit that executive and administrative space occupies so small a percentage of the entire complex. MJI president Josh Feigenbaum has the classic Manhattan high-rise corner office with windows facing the celebrated Museum of Broadcasting across the street.

MJI's programs are created by producers working with pre-recorded material and numerous in-studio interviews. These efficient ("one take") interviews take place in one of three studios. Guests rarely visit MJI's "back rooms" (usually there is not enough time in their schedules). The interview rooms and the handsome conference room have become a core of the facility.

All flow in and out of MJI takes place here — guests, deliveries, and so forth. Grouped with these spaces are a small lounge, kitchen, mail room, traffic and other support rooms.

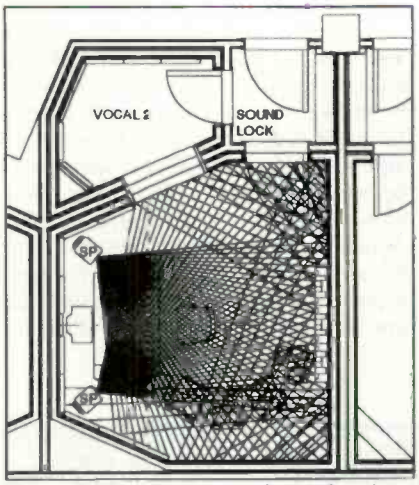


Figure 2. Plan view of control room 2, with ray trace analysis. Note that operator position is free from first- or second-order specular reflections caused by vertical room boundaries.

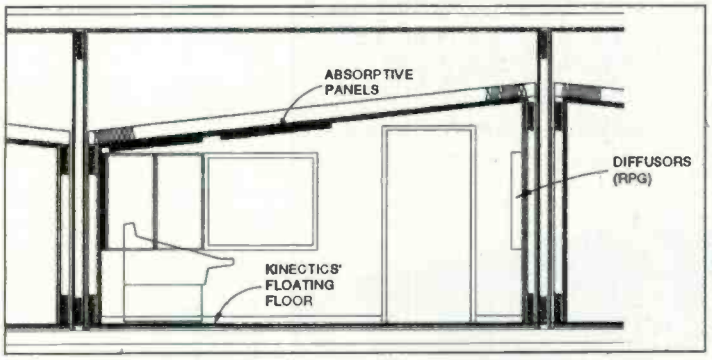


Figure 1. Section view of control room.

Design considerations

After some time, the transformation of a space flow diagram into an actual building floor plan took place. Several underlying design considerations were agreed to early in the development stage:

1. The need for efficient work spaces was predominant.

2. Technical considerations should be merged with creature comforts in studio suites and interview rooms. Work at MJI is intense at times, so a relaxed working environment provides a welcome counterpoint.

3. As much natural daylight for as many staffers as possible was desired. This was one reason for selecting this particular site. Most of the offices along internal corridors have overhead clerestory lights (interior-wall windows) to allow daylight into the non-perimeter spaces of the facility. In the pre-production area, even more interior wall glass is used making the space more open and providing a positive effect on operations. The exceptions are the studios for which MJI engineers preferred not to have daylight. Isolating radio production suites on a New York City exterior building wall is possible, but not without considerable expense.

MJI's design offers a combination of rich woods in the public areas along with more technical finishes in the production and technical areas.

Technical production rooms

MJI's radio production suites are as interesting a challenge in acoustical and architectural design as would be expected for a project of this scale. After deciding not to have natural daylight in studios and control rooms, their location in the master plan was determined

quickly based on functionality. They would be close to production and the library.

All of the control rooms are identical, both ergonomically and acoustically. For the past 10 years, MJI has produced shows by assembling mostly $^1/_4$-inch tape elements and integrating them with vinyl, or more recently, CD recordings. All rooms were configured for this equipment: up to four $^1/_4$-inch tape recorders surround a mixing console with easily accessible, built-in processing equipment racks and mid-field monitors.

All electric power for the production area comes from a 30kVA isolation transformer. Low-voltage wiring for the rooms is surface-mounted in troughs around the front and side walls. Therefore, all equipment and associated wiring can be installed and modified quickly. It was important that the production suite design accommodate anticipated digital workstation installation in the near future. The surface-trough system for low-voltage wiring ensures the efficiency of this changeover.

Two of the recording suites have isolated recording booths with Kinetics roll-out floating floors. (See Figure 1.) Used only for voice-overs, the booths are non-reverberant.

Each control room employs near/mid-field monitoring with an expansive ceiling configuration. The rear walls are diffusive. Front and near side walls use 2-inch high-density, cloth-covered fiberglass panels. Figure 2 shows the ray trace diagrams for a typical suite. Noise Criteria ratings for all recording and listening rooms are NC25 or better.

Building in New York City — always a thrill

Everyone has heard stories about construction in Manhattan. For the most part, they're true. In this case, a few other elements presented an even greater challenge:

1. Union construction crews were required in this building — one of Manhattan's most prestigious midtown locations.

2. MJI gave the builder 12 weeks to complete the entire job.

3. Relatively strict background/environmental noise and room-to-room sound isolation requirements were made for the technical spaces, particularly difficult in midtown, high-rise construction.

4. By New York City standards, the project had a tight budget, at less than $60 per square foot.

MJI was truly a fast track project. Some early site-preparation and construction work began even before completion of final design drawings. A real team effort was required to surmount the many challenges posed by the project.

Design team:

Architectural/Acoustical Design: Walters-Storyk Design Group, Highland, NY. John Storyk, Beth Walters.

Electrical/Mechanical: Robert Wolsch & Marcy Ramos, Engineers, New York, NY.

General Contractor: OD&P Construction, New York, NY.

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As for use at broadcast facilities, well, we're not total newcomers. Over 70 U.S. radio stations already have Mackie mic/line mixers in place.

Does that mean you folks aren't quite as conservative as everybody says? If so, call your favorite broadcast supply house, or dial us toll-free for complete information on Mackie's line of mixers.

If you <u>are</u> conservative, keep an eye on us, anyway. We want your business even if we have to wait five years.

1 Mention in this ad denotes documented useage only. Mention is not intended to infer endorsement by any of the television shows listed.

2 Price is slightly higher in Canada.

3-band equalization done right: ±15dB at 80Hz, ±12dB at 2.5kHz (perfect for voices), ±15dB at 12kHz. Far more useful than traditional 100Hz, 1Khz, 10Khz EQ.

Sealed rotary controls resist contamination from dust, liquids and smoke.

The Mackie Designs 6x2 **CR-1604 Mic/Line Mixer.** Suggested retail price, $1095[2]. Available at America's top broadcast supply houses.

Six recording studio-grade microphone preamps with +48VDC phantom power. Discrete circuitry with four conjugate-pair, large-emitter geometry transistors delivers –129.6dBm E.I.N., 30OK bandwidth, 0.005% THD, and incredible headroom.

Individual channel signal metering via solo function.

7 AUX Sends from 4 knobs. AUX 1 doubles as a headphone monitor cue via the MON. Sends 3 & 4 become AUXs 5 & 6 via the SHIFT button.

Two extra buses. Mute buttons route the channels' signals to an extra stereo bus called ALT 3/4. Route it to the headphones, for monitoring advance audio cues. Preview a signal that hasn't been brought up in the mix yet... then add it by unmuting the channel.

Unity Plus gain structure gives high headroom and low noise at the same time. Set the fader to center-detent Unity Gain, press channel solo to monitor the channel via the CR-1604's LED meters, adjust the input trim ONCE, and you're ready. Because there's 20dB MORE gain available on the fader, you won't need to constantly re-adjust the trim.

Maximum RF protection. Both mixers use **metal** jacks and washers plus a shunting capacitor to de-rail RF before it gets to any circuit traces.

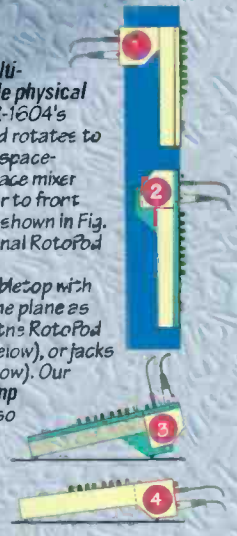
Rugged design and construction. All of our compact mixers have mil-spec, double-sided, thru-hole-plated fiberglass circuit boards (horizontally-mounted on brass stand offs for impact-resistance), double-parallel-wired faders for 2-times redundancy, and electronic protection against power surges, impedance mis-matches and static discharges.

Solid steel main chassis.

8 mono or 4 stereo **AUX Returns** with individual level and balance controls. All have 15dB additional gain above Unity to boost weak effects.

Powerful headphone amp (with volume control) drives any phones to head-banging levels even an AOR production person will appreciate.

Unique, multi-way convertible physical configuration. CR-1604's input/output pod rotates to back (creating a space-saving 7"-rack-space mixer shown in Fig 1), or to front (10 rack spaces, shown in Fig. 2) with our optional Rotofoot bracket. Use the CR-1604 on a tabletop with jacks on the same plane as the controls via the Rotofoot bracket (Fig. 3 below), or jacks to top (Fig. 4 below). Our **XLR10 Mic Preamp Expander** can also be added in any of these configurations.



Better-than-digital specs and headroom. Both the 16-ch. CR-1604 and 12-ch. MS1202 have a dynamic range of 108dB and an internal S/N ratio of –116dB. You're getting a mixer that can handle the output of digital workstations, CDs and DAT tapes without overload.

A chip off the old block. Perfect for remotes, our **MS1202 12x2 Mic/Line Mixer** has 4 of the same superb mic preamps that distinguish our larger CR-1604, plus phantom power, 2 AUX sends/ch., 2 stereo AUX returns, channel patching, 2-band EQ, 3-way 12-LED peak metering, headphone monitor amp with level control, built-in power supply. Suggested retail is just $399[2].

Circle (27) or Reply Card

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FM Audio Processing continued from page 22

When the microphone is off, the operator monitors off-air, but when the microphone is on, the operator hears a (processed) non-delayed program signal. It is desirable to include audio processing on the non-delayed feed so that the operator can make mixing judgments while listening to a sound that approximates the on-air processing.

Some final points

While a single box that does all has been assumed for the purpose of this discussion, it is by no means the only solution. Multiple complementary pieces of equipment can also be used. Particularly in analog systems, stand-alone limiters, compressors, special-effects processors and stereo generators are offered. Even with a single-box audio processor, some special-purpose outboard devices may still be useful, such as composite processors and filters or stereo-image processors.

Without careful attention to the entire air chain, even the best processors will fail to perform at their peak.

Also remember that audio processors are not the only determinant of the radio station's sound. Without careful attention to the entire air chain, even the best processors will fail to perform at their peak. Interfacing between devices is also important, and the audio response of the entire system must be as linear as possible below 10Hz to minimize overshoot. (When overshoot is present in the system, the processor must be operated more aggressively to maintain peak control, and so begins the spiral toward overprocessed sound — ultimately destroying the original intent of using audio processing in order to stand out on the dial.)

With so many choices available today it may seem a daunting exercise to settle on the right audio processor(s) for your station, but it can be done. Remember that form follows function, so consider all the influential elements — the station's format, its transmission system, the processing features required, and, of course, the station's budget — when making your decision. The right processor choice, its proper installation and smart operation will guarantee a great sound that stays legal, keeping both the engineer and the programmer happy. ■

➡ **For more information on FM audio processors, circle the following numbers on Reply Card. See also "Dynamics Processors," p. 54 of the BE Buyers Guide.**

AEV SNC di Vaccari G.& C.	(66)
Aphex Systems	(67)
Circuit Research Labs	(68)
Cutting Edge Technologies	(69)
Gentner Communications	(70)
Inovonics	(71)
Modulation Sciences	(72)
Orban Associates/AKG Acoustics	(73)

New Products

RDS/RBDS decoder/monitor/analyzer

Modulation Sciences

• **PRD-3000:** PC-based RDS/RBDS monitor that checks and analyzes all aspects of a station's RDS transmission. Accurately measures RDS injection level and decodes and displays all RDS/RBDS data. Supplied with software that runs on any compatible PC and features advanced analyzer functions, selectable error detection, and easy operation with menus and mouse support.

Circle (150) on Reply Card

RDS/RBDS data receivers

Modulation Sciences

• **RDS-X series:** a complete RDS/RBDS data receiver that receives and outputs any and all RDS or RBDS data groups along with composite baseband and demodulated audio. The receiver can be used to feed billboards and signs in fixed and mobile applications, control lighting in remote locations, provide return telemetry, manage power line loads, and distribute emergency messages and data. Features addressability, beacon tuning, alternative frequency switching and group filter capabilities.

Circle (151) on Reply Card

Improved digital audio workstation

Digidesign

• **Software version 1.5 of the Session 8 PC:** integrates random access 8-channel direct-to-disk digital recording, multichannel digital mixing and sequencer-style digital audio editing; features strip silence, region bin auditioning with a mouse click, shuffle mode in the edit interface, backup capability, the ability to use locate points as grid and the ability to trim regions with the mouse even if handles lie outside the wave view; interfaces with popular Windows MIDI sequencers; compatible with MPU-401 standard MIDI interfaces.

Circle (152) on Reply Card

Integrated transmission system

Crown Broadcast

• **FM200:** a user-adjustable 20-200W low-power FM transmitter; provides built-in audio processing, stereo generation and reliable backup transmission capabilities; suited for network applications; user-selectable in the 87-108MHz range and offers an optional range of 65-73MHz; powered by 100/120VAC, 220/240VAC or 36-48VDC power with a built-in power regulator; available as transmitter only, transmitter with stereo generator and transmitter with stereo generator and audio processing; features laser-trimmed analog multipliers, digitally synthesized subcarriers and crystal-controlled switched capacitor filters; offers frequency stability better than +/-250Hz from 0°-50°C; automatic control circuitry provides protection.

Circle (153) on Reply Card

Digital audio workstation

Timeline

• **Studioframe DAW-80:** uses technology based on the industry standard Intel/Windows platform; offers 8-tracks of recording and editing capability, which will be expandable to a 32-track system; features icon-driven editing, which is interfaced into multimedia production and post-production.

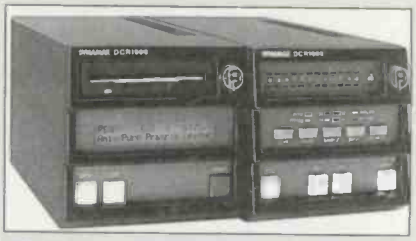
Circle (154) on Reply Card

Broadcast audio console

Otari

• **B-10:** a small audio mixer designed for broadcast and audio post-production facilities; 18-bus console uses narrower (30mm) input modules; features channel grouping up to four groups for flexible console configuration, enhanced talkback functions with a total of four talkback outputs and talkback output routing to the program bus when not in the on-air mode; the high-level input on the group module provides cascade connections with other mixing consoles; direct output from the group module allows for 8-track recording; includes eight VU meters and a correlation meter, high-reliability XLR connectors and a 2-way power supply.

Circle (155) on Reply Card



Digital cartridge machines

Fidelipac

• **Dynamax DCR1000 series:** the recorder offers selectable sampling rates, secondary and tertiary cues, start on audio and direct digital dubbing from CD via the standard AES/EBU digital inputs; a PC keyboard is included for titling and editing.

Improved version incorporates a new 25MB floppy disk drive from NEC; it is backward compatible; can play and record the 13MB and 2MB floppy disks used previously in the DCR1000 series; the disks can store more than 10 minutes of stereo audio with a 15kHz bandwidth on a single disk; disks can be recorded with up to 99 cuts per disk.

Another new version incorporates a Magneto-Optical (MO) disk drive using 3½-inch MO diskettes; the 128MB diskettes are recordable and erasable and can store more than one hour of stereo audio; will be available in the fall with an optional 230MB drive.

Circle (156) on Reply Card

Upgraded audio analyzer

Potomac Instruments

• **AA-51:** features automatic total harmonic distortion measurements, shielded active balanced inputs, a frequency counter, a 0.03% (full scale) S+N/N measurement range, a noise floor less than -92dBm, a reference set level control, 0.1% wow and flutter sensitivity, switchable high-pass and low-pass filters and headphone and scope input monitor jacks. Owners of AA-51 audio analyzers have the opportunity to upgrade the hardware on their instruments for half the cost of a new one.

Circle (157) on Reply Card

Headphones

Denon

• **AHD-950:** an over-the-ear, closed-type headphone; driver system uses 50mm vaporized diamond diaphragms driven by 6N-OFC (oxygen-free copper) voice coils that are 99.9999% pure and housed in Neodymium; the driver housings are made of a rigid yet damped plastic with high specific gravity; the 10-inch connecting cord is made of the same wire as the voice coils; offers frequency response of 2Hz to 31kHz, 30Ω impedance, sensitivity of 106dB/mW and power handling of 1,500mW.

• **AHD-750:** an over-the-ear headphone with non-resonant body housing and ultrasoft oval ear pads; has 50mm diameter diaphragms made of vaporized titanium; offers frequency response of 2Hz-30kHz, 30Ω impedance, sensitivity of 106dB/mW and power handling of 1,500mW.

• **AHD-650:** closed-type headphone with non-resonant housings and large, oval ear pads; has large 50mm diaphragms; features Neodymium magnets and high-purity, linear crystal oxygen-free copper voice coils; offers frequency response of 3Hz-29kHz, 35Ω impedance, sensitivity of 106dB/mW and power handling of 1,200mW.

Circle (158) on Reply Card

RDS tuner

Denon

• **TU-650RDS AM/FM tuner:** 8-character alphanumeric display shows call letters or ID/logos providing instant verification of transmitted codes and messages. Program Type (PTY) codes are used for search-tuning based on a user-selected type of programming. Also displays accurate clock time as broadcast by the station and features FM IF bandwidth switch for higher selectivity under crowded dial reception conditions or lower distortion when stations are more widely separated.

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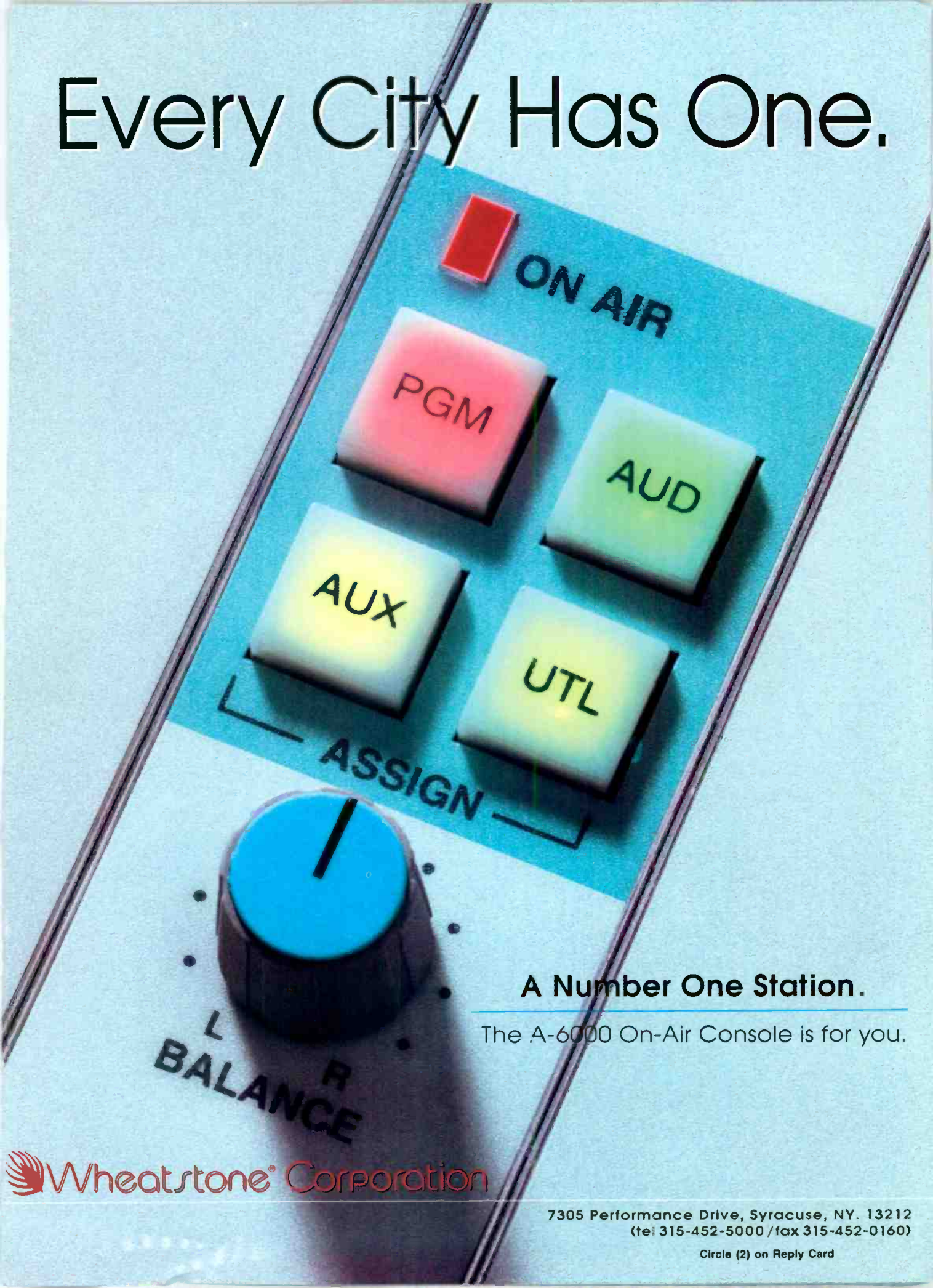

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