BE Radio

MAY 1994

COVER STORY

Radio wrap-up: NAB '94

Chief engineer Kevin McNamara covers the hottest radio topics on the show floor and conference sessions at NAB '94. Whether you were there or not, you'll want to read this overview of what went on in Las Vegas at the world's largest broadcasting event.

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1994 NAB Radio Pick Hits

The votes are in for NAB '94's top 10 new radio products, as cast by our panel of expert judges. Find out what they thought merited attention from among the many products introduced at this year's show of shows.

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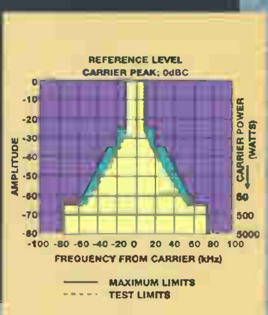

Complying with the new NRSC-2 regulations

It's coming down to the wire for verifying NRSC-2 performance. Consultant Chip Morgan explains what AM stations need to know. This may be your last chance to find out about compliance testing before the June 30, 1994 deadline.

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EDITORIAL

An early spring

NAB (like spring) came early this year. And for some broadcasters the challenges seem to be multiplying like dandelions. Broadcasting faces major changes in the years ahead, and the road is likely to be bumpy.

The discussion of these so-called converging (or is it *colliding*?) technologies always mentions voice, data and video, leaving the purveyors of *audio* (such as radio stations) wondering if they will be left as little more than road kill on the information superhighway. Actually, the news is much better than that.

Although radio faces some upheaval from conversion to DAB, and perhaps some new competition from DBS radio operators, the environment looks nowhere near as volatile as it is likely to be for television. By comparison, the future for radio appears downright exhilarating, with only incremental technical conversion needed and just a few more possible players to contend with. This is a far cry from the potential nightmare threatening TV broadcasters, where high-dollar HDTV conversion bears down from one side, and hordes of new wired competitors approach from the other.

While radio broadcasters will have to stay on their toes as they face some still uncertain issues, the future for wireless audio (and data) delivery looks bright. The spring air carries a pleasant scent of silicon out here on the information byway.

P.S.: Hearty thanks to all those who have responded to *BE Radio*. We welcome your further comments on the *BE* FAXback line at 913-967-1905 or via Internet/e-mail at 4757418@mcimail.com.

Skip Pizzi, technical editor

NEWS

EIA/NRSC call for DAB listening test volunteers

Listeners are needed for subjective testing of proposed DAB formats under evaluation by the EIA and NRSC. Tests will be conducted in sessions of two or three consecutive days at the Communications Research Centre (CRC) in Ottawa, Ontario, Canada, beginning in June 1994 and continuing throughout the year. Volunteers who are capable of or accustomed to judging the quality of audio signals will evaluate recordings of audio material that has been passed through DAB systems under varied impairment conditions. The tests will be held in the CRC's audio quality assessment lab, a world-renowned facility that is well-equipped for such evaluations. Call Ralph Justus, EIA at 202-457-8716 for further information.

Cable radio moves to DBS

DirecTv, the recently inaugurated DBS television service of Hughes Communications, will offer a 30-channel digital audio service provided by Digital Cable Radio (DCR). DCR, a joint holding of General Instrument's Jerrold Division, several cable MSOs and two major record labels, have offered commercial-free, multichannel subscription digital audio service since 1990 via selected cable systems only. The new DBS audio service, called *Music Choice*, is scheduled to begin service this summer. It will be receivable on the same standard set-top receiver used by DirecTv for its eventual 150 TV channels (unlike digital cable audio services, which require a dedicated tuner/decoder separate from the set-top TV box). Audio channel choices will be displayed via a menu on the associated TV's screen.

The DBS service is only receivable using fixed, 18-inch dishes that are sold to the consumer with the set-top decoder for approximately $700. No mobile reception will be possible. DirecTv's monthly home service packages are priced at $21.95 and $29.95, with the audio services initially included only in the higher-priced package. Once DirecTv completes its space segment with a second satellite (scheduled for fall 1994 launch), Music Choice will be included in both service levels. A second DBS provider, USSB, also plans to offer a similar service.

NAB holds radio renewal seminars

Starting this month, the NAB will conduct 1-day, regional seminars intended to prepare radio broadcasters for the 1995-98 round of license renewals. The seminars will primarily deal with needs of small and medium markets, but representatives of major market stations are also welcome. Speakers will include NAB attorneys and EEO specialists plus outside experts. NAB member stations are offered one free seat, with a second at $35 and a third at $50. The fee for non-member stations is $300. Pre-registration is required. Call Christina Griffin, NAB Radio, for more information at 202-775-3511.

1994 NAB Radio Pick Hits

BE's Radio Pick Hits judges had a lot of new products catch their attention this year. Greater flexibility and improved cost-effectiveness were the order of the day. After much deliberation, the judges came up with these products as the top 10 new items for radio at NAB '94.

Gentner: TS612 DCT multiline telephone system

Talk radio stations will appreciate the thoughtful design of this flexible telephone system. Six (expandable to 12) incoming lines are routed through two internal digital telephone hybrids and controlled by a user-friendly, versatile control surface that includes a handset and keypad. Each mainframe can support up to three control surfaces. The system uses Gentner's new Direct Connect Technology (DCT) approach, allowing it to be interfaced directly to incoming phone lines or to analog extensions from a facility's existing PBX. RS-232/422 control is also provided, allowing the system to be placed under direct control of a PC or audio management/storage system. A VIP mode allows one or two lines to be protected from accidental disconnection. Internal mix-minus, caller-conferencing and external device control (recorders, delay devices, etc.) are also provided.

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Belar: FMSA-1 digital stereo monitor

Following in the footsteps of the Belar Wizard (a 1991 Pick Hits winner), this 1-rack unit device provides comprehensive stereo FM monitoring. It also provides an AES/EBU digital audio output via an XLR connector on its rear panel (along with left and right analog outputs, also on XLR). One alphanumeric LED display accesses all menus and settings while two other numeric displays indicate values for left and right channels. When used with the Wizard and its PC software version 2.0, the FMSA-1 can be remotely accessed and controlled via PC and modem. It also can be interfaced with automated test equipment for automatic proofs-of-performance. The digital output allows separation measurements of up to 80dB.

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Moseley: Starlink 9000 digital transmission system

A uniquely flexible design characterizes this all-digital, open-architecture, modular transmission system. It can provide high-quality, point-to-point audio transmission (via wired or wireless paths), facility remote control, and FM stereo/subcarrier/RBDS generation. Mainframes are available in 1-, 2- or 3-rack unit sizes, which house three, eight or 16 modules respectively. Transmit and receive modules are frequency-agile between 200MHz and 2GHz. Digital audio transmission is supported in 16-bit linear, ADPCM and ISO/MPEG Layer II modes. Other modules include a robust and efficient channel coder, an intelligent 4-port multiplexer (combines voice, image, fax and data up to 2.048Mb/s), a DSP-based FM stereo generator (with AES/EBU input, built-in sample-rate converter and RBDS encoder), a dual FM subcarrier generator for audio or data applications (22kHz to 185kHz in 100Hz steps), a series of digital line drivers/framers, a voice/low-rate (256kb/s) data multiplexer, and an intelligent 8-channel remote-control/status/telemetry/RS-232 module.

Circle (71) on Reply Card

QEI: Quick-Link digital remote link

This interesting system combines QEI's earlier CAT-LINK digital STL technology with spread-spectrum techniques for use as a digital RPU or backup STL/TSL in the unlicensed 902-928MHz band. Unlike previous systems using this band, no data reduction is required in this system. Instead, linear digital audio of 15kHz stereo quality is transmitted in real time, in one direction only, with minimal processing delay. Direct-sequence spread-spectrum coding is used, providing a robust signal with high resistance to interference and multipath. Ten different channel codes (spreading sequences) are available, selectable from a thumbwheel on the transmitter's front panel. An optional EPROM change can provide up to 60 different channel codes. Two auxiliary communication contacts are provided to allow the remote site to control hardware or tallies at the station.

Circle (72) on Reply Card

Akai: DP88 digital signal patchbay

Akai has provided a perfect way for the small production studio to work its way into digital interconnection without sacrificing flexibility. It provides eight AES/EBU and two optical (Toslink) I/O sets plus programmable switching. Any input can be bridged to as many outputs as desired. Up to 128 patch configurations can be stored, write-protected, recalled, copied and edited.

Circle (73) on Reply Card

[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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NAB BROADCAST engineering 1994 HIT PICK

Audio Technica: AT4050/CM5 studio microphone

Here's another cost-effective professional audio product from A-T — a large diaphragm, switchable-pattern microphone, ideal for studio announcing or music recording. Three patterns are provided — omni, cardioid and figure-8 — along with an external shockmount. It operates on 48V phantom power

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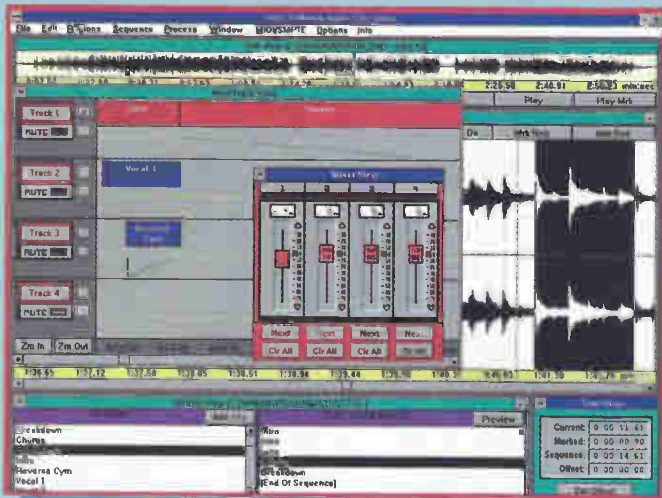


Innovative Quality Software: SAW digital audio editing/mixing system

Especially valuable to the smaller operation, this is a third-party application for a number of PC and Windows digital audio cards. It adds waveform editing and four stereo tracks of mixing and audio processing to the most popular low-cost editing systems. A great value.

Circle (75) on Reply Card

Henry Engineering: StereoSwitch

This handy 3x1 balanced stereo switcher provides great flexibility in its control input and tally output options. Therefore, it is ideal for interfacing with automation systems and other machine controllers. Default selection allows choice of which input is selected upon power-up.

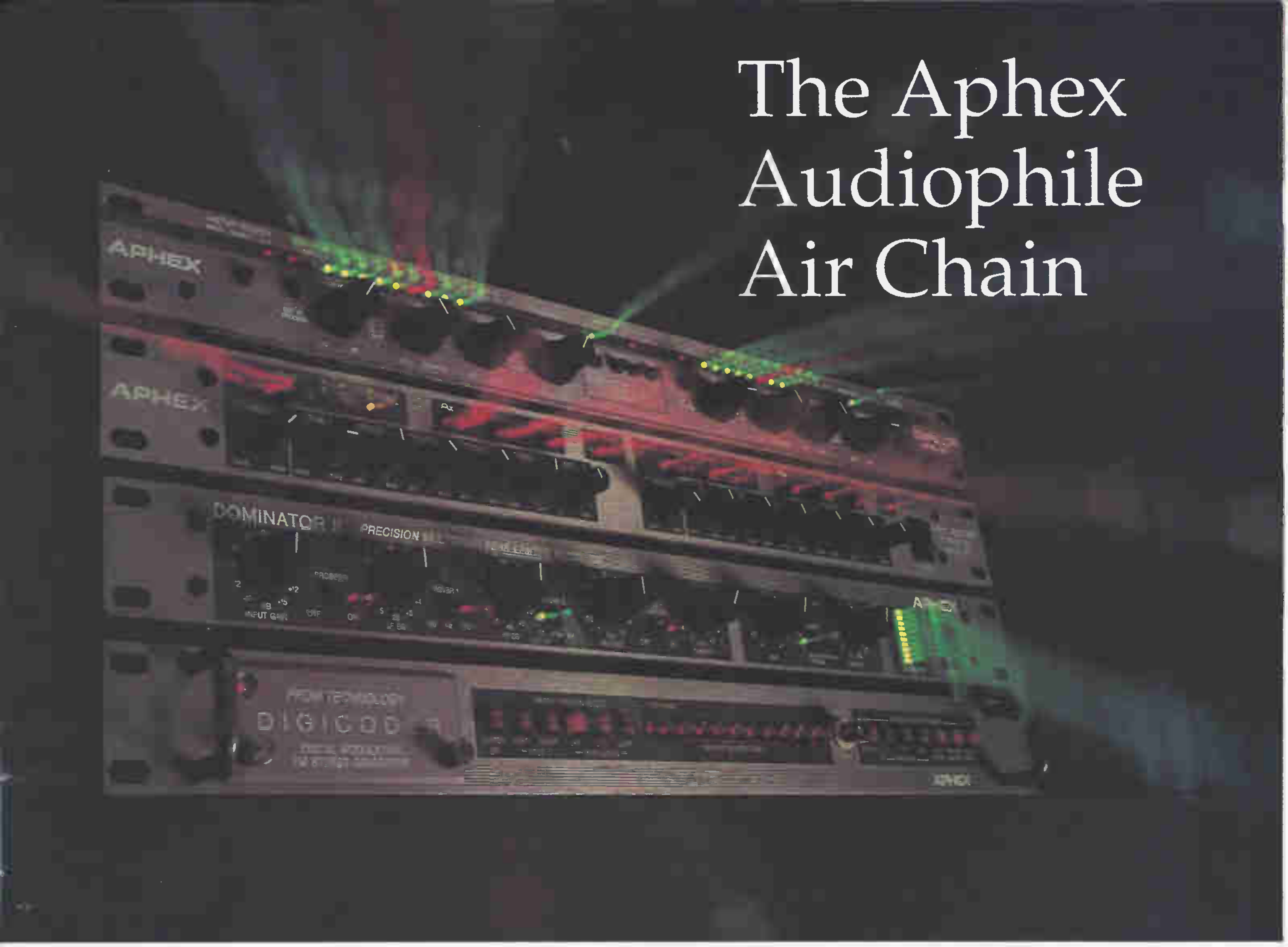
Circle (76) on Reply Card

Wheatstone: A-6000 On-air console

Ease of installation and operation characterize this high-end broadcast board. In addition to flexible and quality program audio paths, the A-6000 incorporates comprehensive tally, phone interface and IFB capabilities. The console is automation-friendly, especially for live-assist applications. Solid RF protection and common-mode performance are standard, and excellent documentation is provided.

Circle (77) on Reply Card

The Aphex Audiophile Air Chain



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"A surprise bonus has been the apparent increase of coverage in fringe areas — we are getting very positive responses from listeners in Sacramento, 100 miles away," - Tim Pozar, CE, KKSF- FM, San Francisco.

"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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NAB Broadcast engineering 1994 PICK HIT

Panasonic: SV-4100 DAT recorder

New features on this deck will be welcomed by radio users. A 3-second RAM buffer provides instant start and precision cuing, while five preset memory locations and wired remote control make on-air operations more flexible. External sync capability ensures glitch-free transfers regardless of source parameters.

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RADIO JUDGES:

John Battison, P.E., consultant
John H. Battison and Associates, Loudonville, OH

Rick Edwards, vice president
Guy Gannett Publishing/Gannett Tower, Ft. Lauderdale, FL

Kirk Harnack, president
Harnack Engineering, Memphis, TN

Andy Laird, vice president, engineering
Heritage Media Radio Group, Santa Clarita, CA

Stuart Rosenthal, technical director
Alaska Public Radio Network, Anchorage, AK

Richard Rudman, engineering manager
KFWB, Los Angeles

Christopher H. Scherer, chief engineer
WZAK-FM/WZJM-FM/WJMO-AM, Cleveland

Milford Smith, vice president, radio engineering
Greater Media, East Brunswick, NJ

Michael Starling, director of engineering and operations
National Public Radio, Washington, DC

For rules, see *Broadcast Engineering*, May 1994, p. 108.

NAB94

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BE Radio

Radio wrap-up: A look at NAB '94

By Kevin McNamara

***The Bottom Line:** The NAB show came early this year, early enough for broadcasters to celebrate the coming of spring in Las Vegas. This was only fitting, as the industry searched for ways of rebirth and reinvention. It was also an NAB without daylight-saving time, but with plenty of other ways to save time — and money — using new technologies.* $

The NAB show always presents a reference point for station personnel to gauge themselves and their facility against the rest of the industry. It's also a great place to assess new possibilities. And this year, there were plenty of those.

For example, the cost of disk storage is well below a dollar a megabyte, RAM costs less than $20 a megabyte and a reasonably well-equipped computer costs less than $1,500. In many cases, radio facilities can now implement digital technologies for less than the cost of analog equivalents.

The 1994 NAB Convention established this and many other pivotal concepts that will affect the direction radio takes for the next few years. Here are some key points:

Digital facility integration

To no one's surprise, the Radio Engineering sessions were dominated by discussions of various digital technologies. However, there were some important differences in tone from past years. Integration of multiple digital systems within a facility has become a real issue. It's clear that multipair cables, patch panels and large consoles gradually will be replaced by a single twisted-pair or fiber-optic cable and computers.

On the show floor, one systems-integrator demonstrated that a full air chain between microphones and transmitter could be kept in the digital domain using available equipment. Many others displayed digital audio production workstations or on-air audio management/automation systems. In some cases, these systems were stand-alone, but many were connected by some form of local area network (LAN). Most also had the ability to integrate with some of the more popular music rotation and traffic systems. This concept is becoming known as *desktop radio*, *radio-LAN* (R-LAN) or the *digital pipeline*. Whatever you choose to call it, the model is based on an entire radio station or stations using single or multiple LANs, each with one or more file servers distributing all of the information needed to operate the facility. This includes audio, control, billing, traffic, music, word-processing, messaging and more. The technology to implement this concept exists and is already used to varying degrees at some radio stations.

Some important new concepts were frequently discussed on the exhibit floor. Interdevice compatibility is no longer limited to issues of impedance, levels and connectors. Now the questions sound like: "Can my source data be interfaced with my existing topology in order for it to reach a destination address in a format that can be read by another digital device?" If a radio station were to assemble a digital facility with products from a variety of today's manufacturers, the answer to that question often might be "no." This is not because the hardware can't be connected via LAN, but because the data format in which the sound files are saved is not generally compatible and/or different data reduction schemes are used.

One potential solution to this problem involves the application of a standardized file format, such as the Open Media Framework (OMF) Interchange. It was developed to address the problem of incompatibility between different digital audio and video formats operating on dissimilar computer platforms. For obvious reasons, this was a popular subject of discussion among engineers at this year's NAB.

Data reduction: What a difference a year makes

A less hysterical and more sensible approach to data reduction was in evidence at NAB '94 compared to NAB '93, and for good reason. First, it's another area of incompatibility, and several different systems have already become established and popular. As noted on the show floor, sometimes these algorithms are applied in component form (such as on an STL or telco line), so the user can choose when and which to apply. In other cases, the algorithm is built into the device or system (such as a digital disk recorder). Therefore, when designing a digital facility, it's important to pay attention to the different algorithms used in each device. A few new products provide ways to keep a data-reduced signal in that form as it is stored or passed through. Alternatively, you can keep audio data in linear (uncompressed) form as much as possible. This will require more disk space, but 1GB drives were on display for about the price of two or three rebuilt cart machine motors.

Next, consider that the original purpose of the perceptual coding schemes of data reduction was not for saving

McNamara is engineering manager at WGAY-FM/WRC-AM, Washington, DC. Respond via the *BE* FAXback line at 913-967-1905.

storage space, but for reducing transmission bandwidth. At this year's show, that bandwidth efficiency was emphasized not just for RF applications, but also within the LAN context. For example, ethernet networks and file servers can operate at transfer rates of up to 10Mb/s, and although that seems plenty fast, it still imposes a limit on how many files can be accessed and transferred on a network simultaneously. Unlike office LANs, where peak usage periods just slow the system down a bit, such collisions in real-time (and on-the-air) audio datastreams cannot be tolerated. Each uncompressed, high-quality stereo audio datastream requires approximately 1.5Mb/s (and LAN overhead adds more data to each stream), so even a fast LAN can bog down with more than a few users. Just as data reduction can increase digital audio storage by a factor of 5 or 6:1, so too can it increase LAN capacity by the same amount. This trend was evident at NAB, with several audio management systems advocating storage of audio files in data-reduced form.

New subcarrier services

The market for FM subcarriers seems to be undergoing a renaissance. Leading the way is the Radio Broadcast Data System (RBDS), which seems to be gaining support in the United States with broadcasters and (somewhat more slowly) among receiver manufacturers. RBDS, you'll recall, is a subcarrier centered on 57kHz, which broadcasts data at a rate of 1.2kb/s. The RBDS datastream is broken up into 13 groups, most of which have a defined application for broadcasting items, such as format types, call letters, radio text (perhaps traffic, news or weather), paging, navigation and location. One group also has been reserved for possible emergency alerting use.

Although the last couple of NAB conventions had a lot of RBDS encoding hardware on display, this year the interest in professional decoders for RBDS monitoring started to grow. Several companies displayed such hardware, and more said they would have something soon.

This is surely an indication that RBDS is moving from a technology to a product line. Similarly, this year's NAB also saw some new RBDS services discussed. Examples include artist/song title text displays or other value-added advertising features. Many of the disk-based audio management systems at the show had a feature that can automatically provide such data to an RBDS encoder. Another interesting application puts that radio text data on an RBDS-equipped, active billboard on which the station has an ad. Passers-by can view the station's ad and read the song that's currently on the air.

Receivers designed to decode the RBDS signal are currently sold for home and portable use, but the automotive market appears to be the dominant area of interest for this technology. General Motors has begun to offer RBDS-equipped radios as an option in some models. They feature 2-line digital displays used for reading text messages, and they can also automatically search the FM band for radio stations broadcasting a particular format (determined by the format code sent by the station in its RBDS datastream).

Integration of multiple digital systems within a facility has become a real issue.

The RBDS protocol also includes some so-called transparent data groups designed for the insertion of non-program-related services. These could be originated by a station, or more likely could be leased to outside service providers, just as entire subcarriers are leased today. A number of companies have begun to offer such services on a national basis, and they are currently signing up stations on whose RBDS datastreams they will plug into. These include Axcess USA, a national alphanumeric paging company, and Differential Corrections, Inc. (DCI), a service that offers terrestrially originated, enhanced positioning data for GPS satellite receivers. (See "Radio in Transition," December 1993).

Several other non-RBDS subcarrier services also made an appearance at NAB '94. Seiko Telecommunication Systems of Beaverton, OR, discussed its High-Speed Data System (HSDS), which operates at a subcarrier frequency of 66.5kHz. Seiko claims that HSDS will not interfere with existing RBDS equipment. The primary application for HSDS is to provide information, such as paging and messaging, to pocket and wrist-watch pagers with frequency-agile receiver/decoders.

Meanwhile, Digital DJ of San Jose, CA, presented its application of NHK's Level-controlled Minimum Shift Keying (LMSK) FM subcarrier system called *Data Radio Channel* (DARC). This system operates at 76kHz and is capable of 16kb/s transmission with mobile reception. Magnavox announced an affiliation with Cue Paging to add a differential GPS service called *Acc-Q-Point* to the RBDS-compatible 57kHz service. There were also discussions of other Intelligent Vehicle/Highway System (IVHS) applications for FM subcarriers that are about to be experimentally deployed by private and government developers. Some of these proposed data services will require access to multiple stations in a given market to maintain reliable services.

These new services will not be the same type of subcarrier business you've been used to in the past. Stay on top of this one — your subcarrier spectrum may become home to a bidding war soon.

ISDN and DAB

Several informative presentations on new digital telecom services were presented at NAB '94. Of particular interest to radio broadcasters is the Integrated Services Digital Network (ISDN), primarily useful for remote backhaul.

Installation and service costs for ISDN have dropped sharply in recent months, and it is expected to become widely available in most major telco jurisdictions within the next two years. In some parts of the country, the current monthly cost for the ISDN's Basic Rate Interface (BRI) is less than one-third that of Switched-56 service. ISDN BRI offers two bearer or B-channels for program data (up to 64kb/s each) plus one data or D channel operating at 16kb/s for dialing and communications functions. Each of the B channels can be designated as voice or data, and can be routed independently. The B channels can also be tied together via inverse multiplexing to accommodate higher data rates (up to 128kb/s).

Although many telephone companies offer ISDN as a service, they appear to have little experience with the broadcast-specific application of the technology. NAB presenters agreed that ISDN users should observe the following:

1. Thoroughly understand how to set up your terminal equipment.
2. Try to establish a contact at your local telco who understands your application and will provide the necessary support.
3. Give yourself enough time to set up and test the link prior to air time.

Another difference in mood was shown by DAB proponents at NAB '94. They, too, are moving from concept to reality (perhaps) as system testing begins at the NASA Lewis Research Center in Cleveland. (See "Re: Radio," p. 24.)

In summary, radio appears to be moving to the next level with digital technology. Within this context, radio engineers and managers will need to be armed continuously with the latest information if they are to stay competitive and maximize their station's growth potential. Rest assured that *BE* and *BE Radio* will help you stay on top of these issues.

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Complying with the new NRSC-2 regulations

Chip Morgan

***The Bottom Line:** All AM stations must be in compliance with FCC Rule 73.44 by June 30, 1994. It requires measurements of a station's output spectrum to verify that the RF mask specified in NRSC-2 is satisfied. Appropriate test equipment is required, and measurements must be repeated annually. This new rule will cost an AM station anywhere from $250 a year in consultants' fees to $11,000 or more for its own new test equipment.* $

Are you ready for the new FCC rules that take effect June 30, 1994? After that date, if you're responsible for the technical operations at an AM station, you can't just *say* you're in compliance with NRSC-2 — you have to *prove* it.

You have several options for testing and proving compliance with FCC rules regarding AM bandwidth. You can purchase or rent special test equipment or you can hire a contractor or consultant to make periodic measurements.

If your station installed equipment making it comply with the AM Pre-emphasis/De-emphasis and Broadcast Transmissions Bandwidth Specifications (NRSC-1) prior to June 30, 1990 or if it complied from commencement of its operations, you haven't had to worry about FCC Rule 73.44 concerning emission limitations. (See "Re: Radio," *Broadcast Engineering*, April 1994.) By June 30, 1994, however, you need to be in compliance with the NRSC-2 standards essentially at all times.

How this came to pass

The National Radio Systems Committee (NRSC) is a joint committee composed of interested parties including representatives of AM broadcast stations, AM receiver manufacturers and broadcast equipment manufacturers. In 1987, the NRSC formally adopted voluntary performance standards for AM broadcast stations in an effort to reduce second-adjacent channel AM interference.

Morgan is owner of Chip Morgan Broadcast Engineering, Sacramento, CA, providing design, construction and maintenance of broadcast facilities worldwide. Respond via the *BE* FAXback line at 913-967-1905.

First came a standard called NRSC-1, which was a modified 75μs transmission and reception pre-emphasis/de-emphasis, and a 10kHz AM audio bandwidth. NRSC-1 used a 10kHz "brick wall" low-pass filter to eliminate most adjacent-channel interference. The filter was generally installed in a station's audio processor or as an add-on component between the audio processing and the input of the transmitter. This standard was designed to bandlimit AM stations to a nominal 20kHz occupied RF bandwidth, corresponding to twice the 10kHz audio bandwidth introduced to the transmitter audio input.

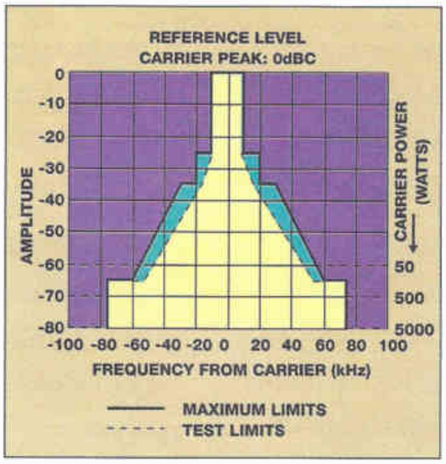


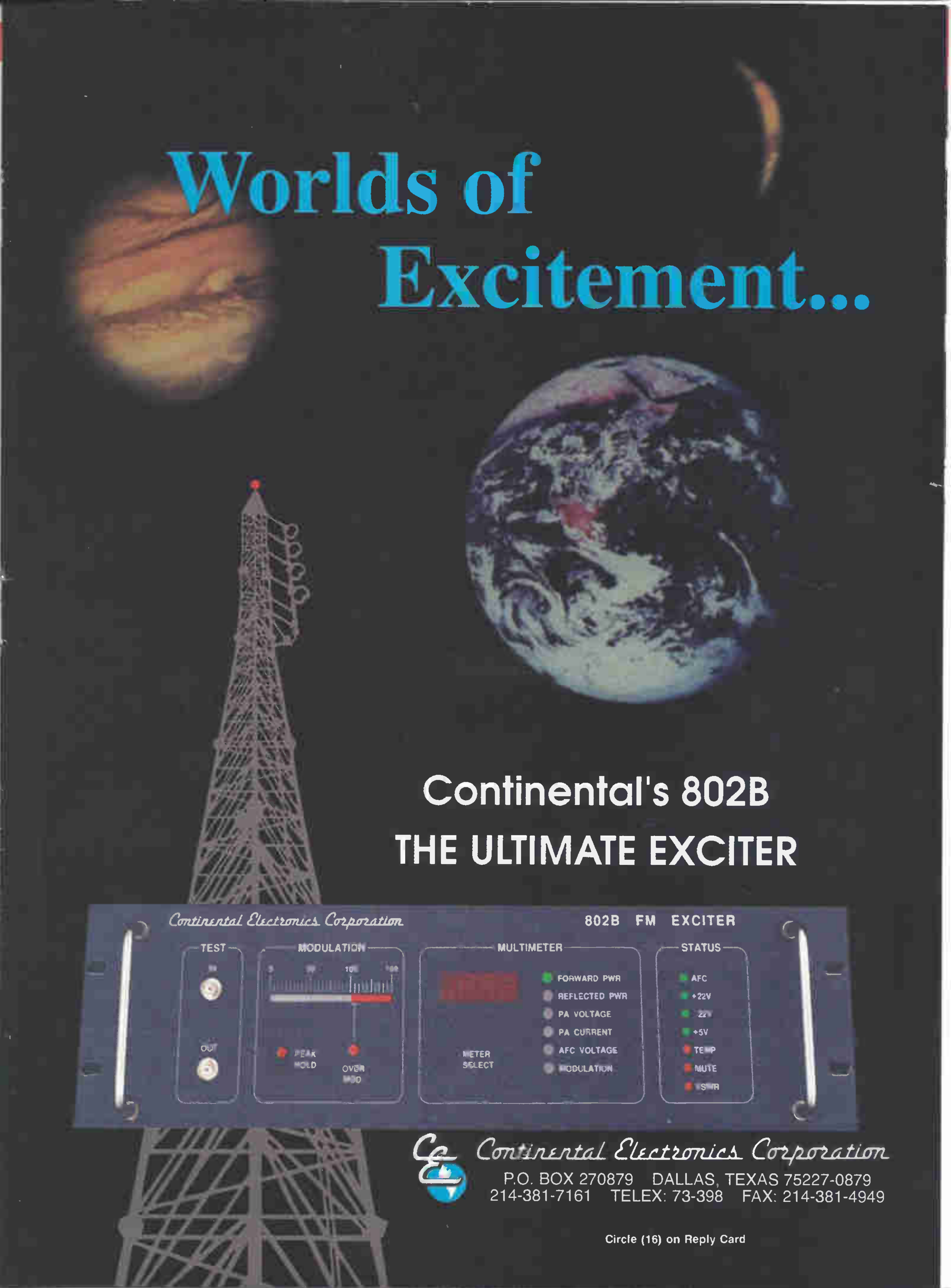
***Figure 1.** The NRSC-2 emission standard's RF mask. Note differences in last step for different stations' licensed power levels.*

Although this identified a solution to the problem of standardizing audio transmission, it wasn't a complete method to ensure minimization of adjacent-channel interference, because NRSC-1 didn't have a specific bandwidth limitation at various distances from the carrier. In 1988, the NRSC-2 standard was introduced, using a format similar to the FM occupied-bandwidth rules. The amount of energy at specific distances from the carrier was limited, keeping the occupied bandwidth within the 20kHz channel. This provided a way to specify the operation of an AM station with minimized interference. In 1989, the FCC added the NRSC recommendations to the rules in 73.44 to control the entire RF transmission of AM stations. NRSC-2 was called the AM *RF Mask*.

Causes of adjacent-channel interference

As a natural process of amplitude modulation, audio frequencies (including harmonics) in program material are impressed on the carrier wave and transmitted through the RF system. In addition, unnatural harmonics caused by non-linearity in the audio equipment (starting with the microphone and including processing gear, the transmitter and the antenna) are added to the broadcast signal. If this harmonic content becomes significant enough (due to overmodulation or serious equipment non-linearities, for example), interference can result. The pre-emphasis employed in AM broadcasting (intended to reduce received high-frequency noise in the de-emphasis-equipped receiver) only exacerbates this problem in the RF domain. The high-frequency interference signal is often referred to as *splatter*.

By strictly limiting the bandwidth of all AM stations to 10kHz, splatter is re-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duced and reception quality is improved. The NRSC standard is designed to limit the transmitted bandwidth of AM stations so that there is little overlap between adjacent stations.

How to measure this

The regulations don't specify what equipment to use, only that disputes over measurement accuracy must be resolved in favor of measurements obtained by using a calibrated spectrum analyzer.

The regulations don't specify how often to make measurements other than annually with not more than 14 months between measurements. This is similar to other FCC regulations in which it's left up to the licensee to determine the actual frequency and methods of measurement.

Nevertheless, 73.44 (d) does specify that measurements "...are to be made at ground level approximately 1km from the center of the antenna system. When a directional antenna is used, the carrier frequency reference field strength to be used in order of preference shall be: 1) the measured non-directional field strength; 2) the rms field strength determined from the measured directional radiation pattern; 3) the calculated expected field strength that would be radiated by a non-directional antenna at the station authorized power.

Measurements for spurious and harmonic emissions must be made to show compliance with the transmission system requirements of 73.44 for AM stations. Measurements must be made under all conditions of modulation expected to be encountered by the station, whether transmitting monophonic or stereophonic programs.

The NRSC standard says that "measurements of AM station spectrum occupancy shall be conducted using ordinary program material. All audio processing used in the AM station shall be in normal operating modes. The audio signal to the AM transmitter shall conform to the NRSC audio standard adopted Jan. 10, 1987." (NRSC-1).

Be prepared with answers

When a station's licensee gets a memo from its broadcast attorneys mentioning the new rule, station management/engineering will probably be asked how the station intends to comply.

Questions to consider are: How stable is our audio equipment? How reliable is our transmitter? How accurate is our test equipment? How much liability are we willing to accept? While answering these questions, consider also the cost to either make the measurements yourself or hire someone to do it.

If your operation is such that you aren't comfortable unless you know that the station is reasonably in compliance at all times, you really only have one choice — you need continuous monitoring of the signal with a dedicated monitor. A spectrum analyzer isn't practical for this because you'd need a trained operator to observe it continuously. What will work for this purpose is a *splatter monitor*. It can be set up in your transmitter rack to monitor the transmitter's output, and alarm thresholds can be set to inform your operator on duty or engineering personnel of a potential violation condition.

Keep in mind, however, that a splatter monitor is typically installed at the transmitter site and not at the specified measurement point of 1km away. For this purpose, the splatter monitor can be used in the field with an optional active whip antenna. Therefore, even with continuous splatter monitoring, official measurements should probably be made by the book on a regular annual basis.

Given the realities of small markets — and lower-budget AM radio stations in

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By the way, communications monitors, communications receivers and field-strength meters are not usable for these measurements. They can measure some carrier harmonics and mixes, but they just don't have enough dynamic range or selectivity to resolve the emissions so close to the main carrier.

Other options

A station also can hire a contractor or consultant to make the measurements. Be sure the engineer has the appropriate equipment and that he fully documents the procedures used and results measured. An outside engineer will usually have the required splatter monitor or spectrum analyzer.

It would be wise to group several measurements together when using an outside engineer. If the engineer has a spectrum analyzer, you could obtain measurements for carrier harmonics, NRSC compliance and carrier frequency all on the same hire. If the engineer has other standard AM test gear, measurements, such as common point impedance, monitor point signal strengths, modulation level and audio proof measurements could be made coincidentally.

What happens on June 30?

The exact language of the rule says that AM stations must be in compliance as of June 30. Attorneys may have differing opinions about this, but the strictest interpretation of the rules is that you should make the measurements *before* June 30 and you should be in compliance at all times *after* June 30.

FCC staff remarks have confirmed that the measurements must be completed by June 30, 1994, and that the commission intends to issue a Public Notice to this effect, time permitting.

As is usual with a deadline like this, many stations may wait until the last minute to order test equipment or to schedule measurements. Although no FCC inspection data is available as of this writing, it can be assumed that NRSC-2 compliance will be checked in the ongoing AM station inspections over the next few years.

Cost of compliance

A station could spend $3,500 or more for a splatter monitor, $11,000 or more for a spectrum analyzer or make annual payments to a contractor, which will likely run from $250 to $500 plus expenses. If you are in a market with no local qualified engineer, costs could increase to a one-day rate for the engineer plus expenses.

Each station's situation will determine which option makes the most sense. Some expenditure is inevitable, but noncompliance could result in far more onerous results.

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Digital cart machines

By Laura Tyson and Skip Pizzi, technical editor

New technology in familiar form is the preferred route to the future for many radio stations.

Selecting the digital audio storage system for your station can be an onerous task. The first decision usually involves the hard disk vs. removable media question. This is often settled by the system's users at the radio station who must consider whether they want to replace their cart machines with computers or with better cart machines. The answer will vary with the needs of each station and its staff.

Initial screening of available products is cumbersome because manufacturers' specification sheets don't follow any standard format. This makes it tough to tell what a product really offers. One countermeasure to this problem involves putting your exact requirements in writing, faxing it to manufacturers, and letting them respond. If you've never used a digital audio storage system before, however, it may be difficult to know what to ask for. You may want to orient yourself by talking to other users first. Ask manufacturers of digital storage products for user lists, and talk to other stations who are already using these systems.

Eventually, physical examination of the product will be essential for determining how the system actually operates. Many manufacturers will allow you to use their products on a trial basis. When installing these systems, keep in mind the first several weeks of operation might be a bit bumpy. Allow time for your staff to learn and become familiar with the equipment. You'll know you're on the right track if you soon find yourself wondering, "How did I ever function without this?"

Tyson is northeastern regional sales manager for pro audio at Roland Corporation U.S., based in Blairstown, NJ. Respond via the *BE* FAXback line at 913-967-1905.

The Denon DN-990R is an example of new digital cart machine recorders using the MiniDisc format.

Goals for digital cart systems

Although each station may have its own concept of the perfect digital storage system, here are a few elements to consider:

- *On-air user friendliness:* Digital cart machine systems using removable media generally have shorter learning curves than computer-based audio management systems. (See "Radio in Transition," *Broadcast Engineering*, April 1994.) For this reason, these more cart-like systems may be preferred by stations that use live on-air talent. Many digital cart machines now offer serial control/status interface to external controllers, and some include software for elegant PC-based GUI and control by automation systems. Another recent advance hybridizes hard disk storage with cart machine-style hardware interfaces. (See Table 1.)

- *Cost of hardware:* Implementing a new format requires purchase of equipment for the on-air studio as well as production and news areas. Depending on the system and the station's needs, the exact number of machines for on-air playback will vary. For example, some machines can be programmed to play multiple cuts from the same *carrier* (i.e., "cart") without any audible break,

Model SM-1 AM Splatter Monitor

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The Model SM-1 Splatter Monitor provides AM broadcast engineers with a means of accurately and easily measuring off-channel emissions to ensure compliance with the FCC (NRSC-2) emissions standard. Manufactured in response to the recommendations of the National Radio Systems Committee (NRSC) for AM improvement, the instrument provides many of the features of an expensive spectrum analyzer at a significantly reduced price. The Splatter Monitor measures the level of splatter or any other spurious emissions which fall between 11 kHz and 100 kHz away from both sides of the carrier

The Splatter Monitor provides both fixed and portable operation. While normally installed in an equipment rack and fed with the transmitter or common point RF sample, it also operates in the field from a twelve volt DC source. An optional active antenna then provides the RF sample. This portability is very useful for investigating interference complaints.

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whereas other systems require recue time between cuts on the same carrier. The latter will require more playback machines in the on-air control room. Some stations may also desire the ability to overlap or mix audio elements from separate digital carts, necessitating multiple machines, just as in analog operations.

• *Cost of media:* Naturally, media costs vary among formats, which currently include MiniDisc, Bernoulli, 3.5-inch magneto-optical (MO) and 3.5-inch floppy disk of several densities. Raw cost-per-minute of storage is less than analog cart in practically all cases, but other issues contribute. For example, some systems require data reduction, some offer it optionally, and some don't use it at all. Some systems also allow choice of sampling frequencies and mono/stereo selection to enhance storage capacities. Furthermore, some systems are more flexible and convenient in their accommodation of rerecording/inserts in multicut-per-carrier applications. (See "Audio Format Cost Analysis," *BE Radio*, March 1994.)

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Radio Systems				x		58
Sonifex	x					59
Sony		x				60
Studer Digitec/Numisys					x	61
360 Systems				x	x	62

Table 1. *Major players in the cart machine replacement marketplace and their storage formats. These include cart-like systems using removable media, plus hybrid hard disk systems using dedicated control surfaces that simulate cart machine operation.*

• *Backup:* Removable media systems retain an important advantage over PC-based audio management systems in any worst-case scenario. If a hard disk system crashes, the station can potentially be taken off the air, and recovery may be difficult and time-consuming (not to mention expensive, if backups are not available). Crashes in a removable-media system are usually limited to a single carrier, which should be relatively simple to replace from either original (archived) recordings or a backup carrier kept on file.

360 Systems Digicart/II uses Bernoulli or optional internal hard-disk for storage. A number of dedicated control panels (shown) or PC control interfaces are available.

• *Random access:* The elimination of recue time provided by disk-based systems can add up to literally weeks of time saved per year. It also lets an operator preview the audio material up to the last second before air. Random access further permits editing of audio on the final carrier, an impossibility with analog cart. In most cases, this editing is non-destructive, allowing you to undo any edit and try it again.

Decisions, decisions

It's obvious that a lot of choices exist for broadcasters who want to maintain the traditional user-interface of the cart machine, while stepping up to digital quality and cost-effectiveness. (Table 1 provides a complete list.) Each system presents its own strengths.

When comparison shopping, remember to evaluate the medium *and* the operating system of any cart replacement device. In practice, the latter will probably have more impact on performance. It may help to think of these systems as tiny computers, for which a preoccupation solely with the disk drive would provide inadequate assessment.

Along those lines, designers may consider the storage devices within these systems as internal components, such that they may be swapped out for (or augmented by) different drives and controllers, while remaining within the confines of the original system. Several manufacturers have already taken this route, producing systems that offer several disk-drive options in modular form.

This trend is likely to continue, given recent industry announcements. For example, this summer Sony will make available its raw MiniDisc drive as an OEM product (previously, the entire MD audio system with its inherent data reduction and associated control was all that other manufacturers could obtain). IBM has also announced imminent availability of a higher-density, 3.5-inch MO disk and drive with 230MB capacity (compared to the current 128MB). Meanwhile, Seagate recently unveiled a small hard disk system with 9GB capacity.

Digital cart machines are increasing their connectivity, matching more of the properties of PC-based systems.

Stand-alone digital cart machines are also increasing their connectivity, matching more of the properties of PC-based systems. Consider this element carefully when shopping.

Digital cart machines can allow a smooth transition path for many stations into the digital age. With such attractive new technologies and costs, the sun may finally be setting on the analog cart machine.

Editor's note: The September 1994 issue of *BE Radio* will examine PC-based cart-replacement systems.

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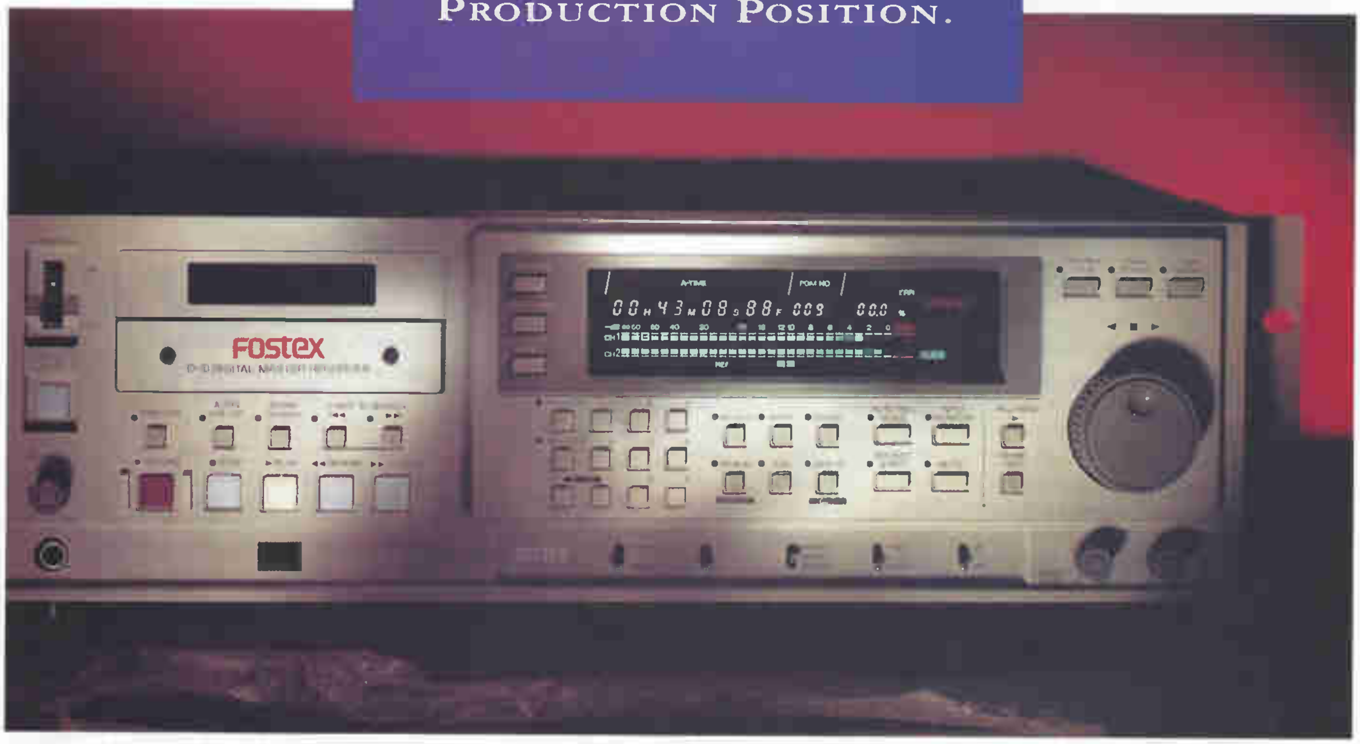

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such as fader start, event out, transport commands, etc. In addition, two optional slots are available for future upgrades.

For fast, high quality compilation or re-sequencing of program material, for precise assembly editing, and as a source machine, the Fostex D-10 is the ideal candidate.

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A hard look at DAB ancillary data

By Skip Pizzi, technical editor

"Where's the bits?"

For some time, the radio industry has anticipated DAB, not just for improved reception characteristics and CD-quality audio, but for the new business that it could generate with its ancillary data capabilities. This interest has been fueled by the coincidental mad rush to the information highway, in the hope that DAB ancillary data could provide broadcasters with a possible new revenue stream.

Unfortunately, the truth is somewhat unkind to those who expect great things from DAB ancillary data. The bits just aren't there — at least not with the way systems are currently configured. In-band FM systems under evaluation claim to provide auxiliary data rates ranging from a mere 8kb/s to 64kb/s.

Compared to what?

To set a benchmark for how much ancillary data is required, consider the FM subcarrier services that exist today. The traditional 67kHz and 92kHz subcarriers can each provide mid-fi mono audio, or up to 19kb/s of data. Using state-of-the-art data-reduction techniques, equivalent quality audio services would require at least 24kb/s. The 57kHz subcarrier for RBDS or paging adds another 1kb/s to 2kb/s.

Adding these up, it will require approximately 40kb/s or 50kb/s of DAB data to match the ancillary services an FM broadcaster can provide today. This is more than most DAB formats can provide, and even the best (at 64kb/s) doesn't offer much growth potential.

This might not be a problem if analog FM and in-band DAB services coexist in a simulcast mode indefinitely, but if eventual replacement of FM services with in-band DAB is assumed, some existing ancillary services could not be supported. (Note that this point is moot for AM broadcasters — any ancillary data service, even the 2kb/s proposed by the only AM IBOC format, is an improvement.)

Assumptions about Eureka 147

Eureka 147 is a configurable system. It allows the user(s) to select the source coding and channel coding rates of each program channel in a multiplexed *pod* from a finite set of options. For audio signals, the source coding determines how much data reduction will be applied. The channel coding defines how much error correction will be added to each source-coded signal (either audio or ancillary data), thereby affecting its robustness for transmission.

The bits just aren't there — at least not with the way systems are currently configured.

If a group of six broadcasters all wanted to use the highest possible settings for their audio signals (256kb/s source coding plus rate 1/2 channel coding), they could not all be accommodated on the 1.5MHz pod because the total data rate would exceed the channel's capacity. Some or all would have to use more data reduction (down to 224kb/s or lower) and/or less error correction, in order to fit in the channel. And then, they each would be limited to an ancillary data rate of only 2kb/s — intended solely for *program-associated data* (PAD) services like those of RBDS.

Of course, a Eureka 147 system can be reconfigured without the constraints of an existing, narrow channel structure. There's still no free lunch, however: To get a minimally adequate ancillary data rate (say, 64kb/s) plus CD-quality main channel audio equally for all stations in a pod, only *four* stations can be accommodated in the 1.5MHz channel. This would significantly affect any allocation schemes under the Eureka 147 format.

Course corrections

Whatever DAB format is used, broadcasters should press for sufficient ancillary data capacity to be provided. Just how much depends on many unsettled market and regulatory issues, but logic dictates that at least existing ancillary services should be duplicated, and some capacity for growth allowed.

Yet, if the rosiest visions of high profits from ancillary services are to be realized, even 64kb/s isn't going to cut it. For broadcasters to have a hope of gaining critical market share in ancillary data (including potentially lucrative addressable services), a much wider pipeline will be required. Radio broadcasters will be competing with terrestrial and satellite 2-way wireless data services, along with wideband wired services like ISDN (128kb/s to 1.5Mb/s) and ADSL (1.5Mb/s to 6Mb/s), not to mention TV broadcasters, who may be able to use more spectrum for ancillary service on their digital simulcast channels. A 1-way, narrowband datacasting service won't stand much chance of gaining a foothold (beyond offering PAD) in such a context. Even the dollars currently earned for FM subcarrier leasing may be at risk.

A thorough examination of this issue is important if broadcasters are to avoid taking two steps forward and one step backward with conversion to DAB.

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- E ❑ Contract Engineer
- F ❑ Other ____________________ (please specify)

3 Which of the following best describes your title?
(Please check only ONE box.)

A. Company Management:
- 01 ❑ Chairman of the Board
- 02 ❑ President
- 03 ❑ Owner
- 04 ❑ Partner
- 05 ❑ Director
- 06 ❑ Vice President
- 07 ❑ General Manager
- 08 ❑ Other Corporate/Financial Officials

B. Technical Management & Engineering:
- 09 ❑ Technical Director/Manager
- 10 ❑ Chief Engineer
- 11 ❑ Other Engineering or Technical Title

C. Operations & Station Management/ Production & Programming:
- 12 ❑ Vice President Operations
- 13 ❑ Operation Manager/Director
- 14 ❑ Station Manager
- 15 ❑ Production Manager
- 16 ❑ Program Manager
- 17 ❑ News Director
- 18 ❑ Other Operations Title

D. Other ____________________ (please specify)

4 Which statement best describes your role in the purchase of equipment, components and accessories?

- A ❑ **Make final decision** to buy specific makes, models, services or programs
- B ❑ **Specify** or make **recommendations** on makes, models, services or programs
- C ❑ Have no **part** in specifying or buying

5 Which of the following types of equipment will you be evaluating for purchase in the next 12 months?

1. Audio Products
- A ❑ Audio consoles
- B ❑ Audio recorders/players
- C ❑ Microphones
- D ❑ Digital audio workstations

2. RF Products
- E ❑ Transmitters/Antenna systems/towers
- F ❑ Test & measurement equipment
- G ❑ Program transmission systems, STL/fiber
- H ❑ Satellite equipment/services

3. Other Products
- I ❑ Monitors
- J ❑ ENG/EFP equipment
- K ❑ Tape/optical storage
- L ❑ Cases, consoles, cabinets, racks; wire cable
- M ❑ Automation equipment

4. ❑ None of the above

6 What is the budget for equipment you are evaluating for purchase in the next 12 months?

- 1 ❑ Less than $10,000
- 2 ❑ $10,000 - $24,999
- 3 ❑ $25,000 - $49,999
- 4 ❑ $50,000 - $99,999
- 5 ❑ $100,000 - $299,999
- 6 ❑ $300,000 - $499,999
- 7 ❑ $500,000 and up

7 If you checked A or B on question #2, what is the ADI rank of your market?

- A ❑ Top 20
- B ❑ 21 to 50
- C ❑ 51 to 100
- D ❑ Over 100

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Hot standby for digital STLs

By Kevin Tam

Switchover between digital and composite analog STLs can be tricky.

Because studio-to-transmitter links (STLs) are vital in radio station operations, greater peace of mind can be achieved by establishing backups. With the advent of 950MHz digital aural STLs, broadcasters need to rethink backup strategies. Three separate areas need to be considered: program audio, subsidiary signals and RF.

The use of *hot-standby* systems produced by STL manufacturers and various custom-made devices have been commonplace in radio operations. They can be relatively uncomplicated when the backup link is identical or similar to the primary link — for example, two composite RF links or two sets of stereo-conditioned phone lines. Handling a mixture of systems, such as a primary RF link with a phone-line backup, requires more thought, however. When digital STLs are involved, other issues must be considered, such as the incorporation of additional devices (audio codecs and modulator/demodulators) into the hot-standby scheme.

Complete backup is important because a radio station's main audio programming might be only one of several signals conveyed on the link. These additional signals (including subcarrier audio and data, additional aural program channels and remote control) complicate backup.

Another consideration involves the value of preserving investment in an older, analog composite STL for use as a new digital STL's backup.

Tam is director of marketing and sales for the Communications Products Group at Dolby Laboratories, San Francisco. Respond via *BE's* FAXback line at 913-967-1905.

Discrete or composite?

For FM broadcasting, the majority of analog aural STLs have been composite links, whereby the FM multiplex signal is generated at the studio by a stereo generator, often combined with audio processing. Some telco (T1) digital STLs also can accept a composite signal. In this aspect, backup configuration between RF composite links and T1-based composite links is not difficult. Audio processing and the stereo generator can remain at the studio.

Digital aural STLs resemble *discrete* links in the handling of audio, however, because programming is accepted as left and right channels. This may be suitable for AM stations and some FM stations that use analog discrete links. It presents a challenge, however, for the broadcaster who wants to use a *composite* analog STL as a backup for the "discrete" digital system, or who wishes to keep audio processing and stereo generator equipment at the studio. These requirements can be satisfied by deriving two different outputs at the studio: the fully processed stereo audio signals to feed the digital STL and the composite FM signal for the analog STL. (See Figure 1.)

At the transmitter site, the composite

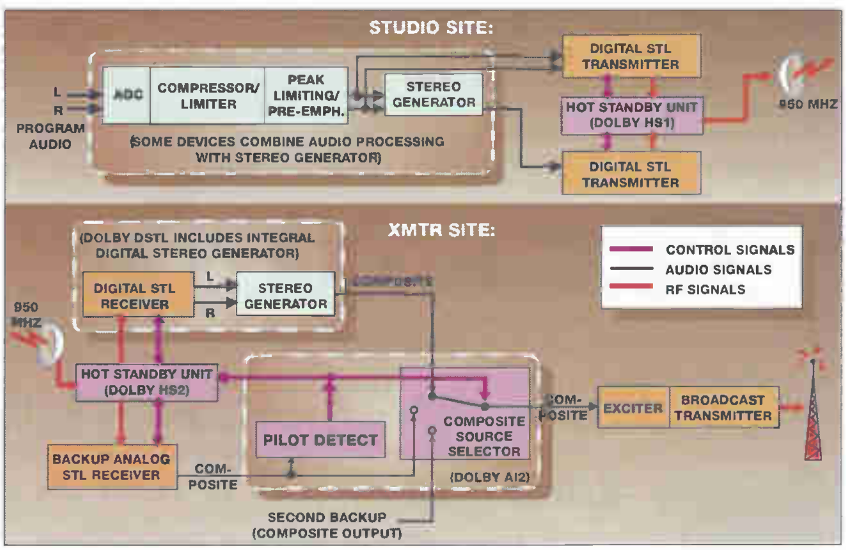


Figure 1. *Hot-standby installations using digital STLs with analog backup must cope with discrete and composite audio signals. For fully automatic operation, the receiver must also sense whether the digital or analog system is using the STL channel. A pilot-detect circuit accomplishes the latter.*

signal from the analog STL is available to feed the exciter. The digital signal, however, must be fed to its own stereo generator before being routed to the exciter. Switching of these signals must be under control of the hot-standby unit. In this arrangement, the digital STL must be capable of handling fully processed, pre-emphasized audio and include a built-in digital stereo generator.

"Digital" RF

How the hot-standby system determines that the primary link has failed, and that it should switch to the backup STL, also is a key aspect of such a system. Three possible scenarios include *transmitter* failure, *receiver* failure and *path* failure. (At the receiver, *path* and *transmitter* failures will be essentially indistinguishable.)

• *Transmitter/path failure scenario:* If the digital STL transmitter malfunctions, the hot-standby unit at the studio site switches to the analog standby STL transmitter. The radiated RF signal is now analog (composite FM). The audio portion of the digital STL receiver, at the broadcast transmitter site, mutes in the absence of valid digital audio data. The receiver hot-standby unit senses this fault condition and thereby enables the analog STL receiver. In this scenario, switchover at both sites is simple and automatic. Note, however, that if the digital STL system is not a monolithic unit, any outboard components must each communicate their fault status separately to the hot-standby system.

• *Receiver failure scenario:* If the primary STL receiver malfunctions, the hot-standby unit at the receive end will detect a fault and switch to the analog backup STL receiver. The digital STL transmitter is still radiating on the STL channel, however, and the analog STL receiver will demodulate the digital signal as noise. To solve this problem, a *pilot-detect* circuit can be used. Whenever the standby system selects the analog STL receiver's output, its composite signal is checked for the presence of a 19kHz FM-multiplex pilot. If it is not present, the output of the backup path is muted. Meanwhile, the standby system alerts the studio site about the digital STL receiver's failure via a telemetry return on the remote-control system or an equivalent path. This, in turn, engages the analog backup STL transmitter at the studio. Now, pilot will be detected in the composite signal at the STL's receiver, and its output can be unmuted by the standby system. (As before, any outboard devices in a non-monolithic digital STL system need to be separately tied into the standby system.)

All of the switching and pilot-detect functions just described are incorporated in an *Analog Interface Unit* (Model AI2) from Dolby Laboratories. It works in conjunction with Dolby's HS1 and HS2 hot-standby units — transmitter-end and receiver-end respectively. The system also accommodates a third signal path for an alternate backup STL system. In essence, the AI2 contains a 3-position, 4-gang switch. Up to four different signals from either primary, backup or secondary backup STL sources can be routed to the output.

Auxiliary signals/subcarriers

Dealing with subsidiary signals presents more interesting challenges. Analog composite and discrete aural STLs carry them on subcarriers. Digital aural STLs of all types accept baseband signals. In some cases, they can also carry serial digital data directly.

Non-monolithic or *hybrid* digital STLs are just that: They can accept baseband signals that have been digitized, as well as analog subcarriers. The digital portion is coded to resemble an analog multiplex signal. The analog subcarriers can be placed in their conventional locations above the "digital composite" signal. Doing so may exact a penalty on path performance, however, because these analog signals are subject to the limitations of analog transmission. Path analysis must be based on the most fragile signal to be carried — in this case, the analog subcarriers.

When switching between different types of STLs in a hot-standby system, subcarriers may need to be treated differently between primary and secondary modes, just as in the composite vs. discrete example for main program audio described earlier.

Hot-standby enhancements

Although most hot-standby units are merely convenient assemblages of RF and audio switching, the microprocessor control incorporated in the Dolby HS1/HS2 allows extension of hot-standby performance to support a station's increasingly complex operations. For example, different operational modes can be supported:

• *Primary/secondary:* When an existing analog STL serves as a backup to a digital STL, the digital system can be designated as the primary unit. Whenever the secondary analog system is selected, the system will automatically restore operation to the digital unit when it returns to a fully functional state.

• *Bi-primary:* When a switchover occurs between two systems of like capabilities, the unit most recently activated (whether manually selected or because of a switchover) is designated as the primary unit. This minimizes unnecessary switchovers and their attendant signal interruption. To prevent rapid cycling between units after a switchover has been initiated, a user-selectable *inhibit period* can also be employed. Manual override selection of system A or B also is available on the hot-standby hardware's front panel or via remote control.

As radio operations increase in complexity, backup links become more essential and more complicated. Understanding the issues of mixed signal types and RF compatibility is required for successful implementation. The use of flexible, intelligent hot-standby systems simplifies the task.

For more information on Dolby's DSTL system, circle (51) on Reply Card.

Fostex D-10 DAT recorder

By Curtis Chan

The D-10 is a good choice for a number of applications, particularly those in the production studio.

Anyone contemplating the purchase of a professional DAT machine should consider the Fostex D-10. It's a good choice for a number of applications, particularly those in the production studio. Its $3,000 suggested retail price makes it a mid-priced machine by radio station standards, and within that class it is quite cost-effective and durable. Although it does not provide off-tape monitoring, serial control or time-code operation, it fulfills most other professional audio production needs well. Fostex has just announced an optional SMPTE generator/reader and serial control upgrade for the D-10, however.

The control panel

The D-10's control layout is functional and intuitive. Transport controls are all located under the cassette tray, including those for auto cuing and search operations. The cassette tray can be closed by pressing PLAY, STOP or gently pushing the front edge of the tray. If the tray is closed with a cassette inserted, the D-10 will enter the pause mode for "instant" play. Professionals will appreciate the pre-programming of some transport buttons. For example, if the PLAY button is pressed during locate/search, the recorder will automatically go right into play mode after locating the desired point. For REWIND and FAST-FORWARD, the recorder will run at 5x play speed if either button is pressed once, then at full fast-wind speed (250x play) if the button is pressed again. This is helpful for doing short-duration fast-winds. Anyone who has used DAT in the production room will understand the value of this feature.

Chan is president of Chan and Associates, a marketing consulting company for audio, broadcast and post-production, Fullerton, CA. Respond via the *BE* FAXback line at 913-967-1905.

Performance at a glance:

- *Cost-effective studio DAT recorder*
- *Audiophile-quality sonic performance*
- *Versatile and user-friendly controls and display*
- *RAM buffer for instant-start and scrub-editing*
- *Flexible jog/shuttle transport control*
- *Comprehensive location and cue-memory functions*
- *Accommodates A-Time, R-Time and Time/Date displays*

A blank search function seeks out the next unrecorded section of a tape. The START-ID search buttons allow the recorder to park and play about one second before a START ID is reached. A 10-key numeric pad also is provided for direct input of edit/location points.

Switches along the bottom of the front panel select between local or remote control, GPI, analog or digital (electrical or optical) input selection, 44.1kHz or 48kHz sampling frequency and emphasis on/off. Note that the D-10's internal clock will phase-lock to an external clock source via the digital inputs. For instance, if the source material is coming in at 44.056kHz, the D-10 will set its playback sampling frequency to match.

The D-10 has a group of six buttons that deal with ID-numbering functions in comprehensive fashion. Four helpful mode keys select user-preference options on how several functions of the machine will operate. Other front-panel functions offer flexible location and memory control, along with a jog-wheel for precise cuing.

Display section

The D-10's display shows a variety of information. The DISP TIME key allows the display to switch between A-Time (time from head of tape), R-Time (SMPTE emulation) and Recording Date/Time (stamped from a real-time clock in the recorder). The DISP LEVEL key activates monitoring of the margin level display, showing margin of headroom for channel 1, 2 or both, and an error-rate display in percent. The margin indication shows how many dB remain before reaching the maximum permissible level. It is refreshed each time a signal higher in level than the presently displayed figure occurs.

When setting the input level, the display will indicate peak levels and hold them for approximately two seconds. In all other instances, the display changes to the memory edit mode for input or correction of edit-point numbers or dates. To the right of the numeric display are several indicators providing recorder status data.

The display is also used extensively in the machine's setup mode. The setup mode is entered by pressing the 0 and 1 keys on the keypad simultaneously. Used together with the jog/shuttle knob, this mode allows confirmation of the software version, selection of the optical remote control, setup of the reference level, selection of detection level for auto-cuing and auto-ID functions, and resetting of the user memory.

Jog/shuttle operation

One nice feature of the D-10 is its RAM scrub and jog/shuttle knob. In addition to VCR-like jog/shuttle operation, with the SEARCH/CUE key engaged, playback is possible at one-half to two times the normal jog speed and one-half to 15 times the normal shuttle speed. This function is impressive, allowing shuttle and jog into play speed forward and backward, with the ability to clearly hear the audio material throughout.

The D-10's control layout is functional and intuitive.

The RAM SCRUB function allows approximately 1MB of RAM (about five seconds of audio) to be used for cuing to an edit point with the jog/shuttle wheel. Extremely slow and precise scrubbing is possible, closely emulating an analog reel machine's operation.

Rear panel

Along with numerous connectors, the back of the D-10 provides blank panel space to accommodate the time code and serial control option board and its associated connectors. Analog audio I/O is available on XLR and RCA-phono inputs and outputs, with a balanced/unbalanced switch selecting between them. For digital I/O, the XLR-3-type AES/EBU and IEC consumer optical formats are available.

One nice feature of the D-10 is its RAM scrub and jog/shuttle knob.

For control, the D-10 provides a 5-pin GPI. The unit is also supplied with a set of 19-inch rack-mounting brackets.

Room for improvement

Although the D-10 is a successful design overall, a few minor quirks could be resolved. First, a delayed power muting function should be added to avoid the audible pop in the speakers or headphones when switching the power on and off. Second, in order to use the RAM scrub feature, the tape must have A-Time or R-Time striped on it. This isn't a problem if you use a deck with that capability when recording, but such a machine may not always be available. Third, there is no option to defeat the useful but unusual transport-control modes mentioned earlier: Pressing the fast-wind keys once engages the 5x slow mode, with a second push needed to bring the unit into the full-speed winding mode. Similarly, hitting STOP from PLAY puts the deck into the pause mode, requiring a second push to bring the deck to a full stop mode. Users seem to become accustomed to this after a few sessions with the D-10, however, and typically conclude that the approach is logical and functional. Finally, a pin-2/pin-3 hot switch on the back as well as an output attenuation switch would be convenient. Throughout the world, balanced audio polarity conventions still run both ways. Also, having a switch to attenuate the analog outputs from +4dBu down to 0dBu, -3dBu or -6dBu would be helpful for a variety of monitoring situations.

The machine also provides a high degree of sonic purity and musical transparency.

The recorder more than makes up for these few complaints with its performance. Coupled with its remarkable robustness and ruggedness, extensive control features and well-written user manual, the machine also provides a high degree of sonic purity and musical transparency, which is what it's all about in the end.

Editor's note: Field Reports are an exclusive *BE* feature for broadcasters. Each report is prepared by the staff of a broadcast station, production facility or consulting company.
These reports are performed by the industry and for the industry. Manufacturer's support is limited to providing loan equipment and to aiding the author if requested.
It is the responsibility of *Broadcast Engineering* to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by *Broadcast Engineering* magazine.

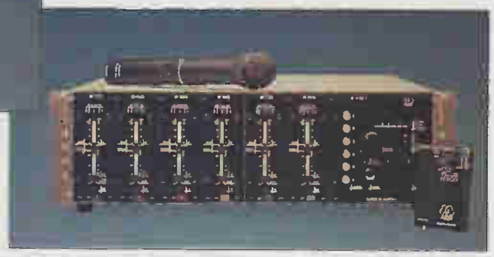
➡ For more information on the Fostex D-10, circle (50) on Reply Card.

NEW PRODUCTS

Pacific Recorders & Engineering ADX Basic workstation

• A scaled-down, stand-alone version of the ADX Workstation, this Macintosh Quadra-based digital audio editor/processor comes with a dedicated control panel that emulates familiar tape recorder controls. Internal 1.2GB hard disk holds three track hours. Additional SCSI drives can be added. Interfaces with ADX Mixstation, a moving-fader automated 8-input mixer, or with any standard 8-input mixer for manual mixdown.

Circle (150) on Reply Card



AKG WMS100 and WMS900 wireless microphones

• The WMS100 is the first in a series of cost-effective, single-channel true-diversity VHF wireless microphone systems to be offered by AKG. Designed for stringent European communications standards, the system provides low interference with high audio quality, including dbx noise reduction for wide dynamic range. Two hand-held and one body-pack transmitter styles are available. The WMS900 is a modular, UHF, true-diversity wireless system accepting up to 12 simultaneous microphone channels within a single UHF-TV channel. Master antennas can be placed far from receivers without requiring RF amplifiers.

Circle (151) on Reply Card

AEV Exclusive FM on-air audio processor

• This 10-band processor features 10 presets and 246 user memories. Independent control of more than 40 variables allows precise adjustment of processing parameters, which can be daypart-switched by an internal, 1-week timer. AES/EBU electrical or optical I/O and a digital stereo generator are available options. An internal pink noise generator aids in set-up and spectrum analysis. Remote control via PC or other systems is also provided.

Circle (152) on Reply Card

CCS Audio Products PACE workstation

• From a company best known for making small codecs comes this full-blown, multi-computer-based news production workstation, originally developed for CBS Radio. It operates with ISO/MPEG Layer II data-reduced files and a user-friendly, icon-based operating system, using icons that reflect conventional processes like carts and tape reels. The work surface includes assignable moving faders and self-labeling LCD push-buttons. Storage, editing, mixing (including mix-minus feeds) and router control are handled in an integrated fashion by the system. Multiple PACE stations can be networked via 10 Base-T LAN. Audio files can be transferred over the LAN at speeds many times faster than real-time. The PACE display can also monitor off-air TV programs using the system's integral TV receiver.

Circle (154) on Reply Card

Harris Quest solid-state FM transmitters

• This cost-effective series of transmitters ranges from 100W through 1,000W, and uses broadband FET RF amplifiers that require no tuning or adjustment. AC and DC overload protection is included, and the output will withstand shorted or open RF loads. An integrated 10W exciter provides high-quality audio. The design emphasizes compactness and simplicity in operation and repair.

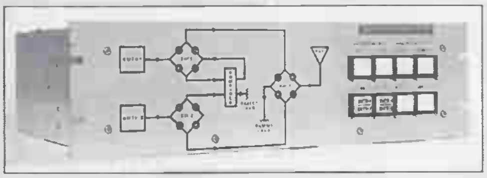
Circle (153) on Reply Card

Cutting Edge Unity AM broadcast audio processor

• This multiband audio processor designed for AM radio includes 1-button recall of presets or user-stored configurations, automatic daypart adjustments and dial-up remote control via modem. Available processing selections include broadband AGC, phase rotator, low-frequency enhancer, 4-band processor/leveler, 4-band limiter and final clipper/low-pass filter. It is fully NRSC compliant. Presets include News/Talk, Country, CHR and others, with 50 user-memory addresses available for storage and comparison of customized settings.

Circle (155) on Reply Card

Continental Electronics RF controllers



• Continental now offers a line of controllers for automatic and manual RF switching in AM or FM transmission facilities. Included are the 377D-1 Combiner Control (pictured), the 377C-1A Exciter Control and the 377D-2 Transmitter Control. They are rack-mountable and compatible with most radio transmitters, providing simple automatic switching for redundant operations.

Circle (158) on Reply Card

Circuit Research Labs SC-100 RBDS and subcarrier generator

• The RBDS subcarrier is generated using digital signal processing (DSP) by this encoder. Optionally, the unit also can generate any other FM-SCA subcarrier via DSP. Static RBDS data can be entered using the front-panel keyboard and menu displays on a large backlit LCD screen. An RS-232 modem interface allows remote PC control for dynamic data input. Static data is stored in non-volatile RAM, and an internal real-time clock is included. Expansion slots are provided for other subcarriers or future upgrades.

Circle (159) on Reply Card

Nautel NE50 digital FM exciter

• Thirty-two-bit direct digital synthesis (DDS) is used to generate the modulated FM carrier in this 50W device, providing a highly controlled output that remains stable over time. Non-linearities and EMI sensitivity are greatly reduced by this design. Simple front-panel adjustments allow frequency selection without tuning adjustments, and audio performance remains high regardless of channel used. After LO mixing, a tracking filter replaces the SAW filter used in previous DDS designs, providing improved group delay and reliability. Comprehensive control and status display is available for local or remote control.

Circle (156) on Reply Card

Arrakis Trak*Star and DigiLink enhancements

• Networking of up to six Arrakis workstations under the control of a single console is now possible with the new Gemini Command Center. A number of small, single-purpose satellite stations are also available, for applications such as fast record/playback of phoners and remote phone-in of news feeds. Cart-walls of up to 400 spots can also be accessed to a triple-play pushbutton controller. New Smart*board consoles interface directly to the Arrakis workstations.

Circle (157) on Reply Card

Otari Corporation's MiniDisc storage and playback system

• MR-10 MiniDisc recorder/player is a professional broadcast storage and playback system for fast-access audio storage and playback using the MiniDisc random access optical disc format; provides up to 74 minutes of high-quality digital audio recording time per disc; features TOC editing, selectable EOM detector, and a front panel headphone output with level control; function modes include Memory Start, Stop/Standby and Single/Repeat Play; also features audible cue mode and lighted front panel controls with enhanced MD informational readout capabilities including a min: sec: frm timer, track number indicator, title readout, level meters and a mode indicator.

Circle (160) on Reply Card

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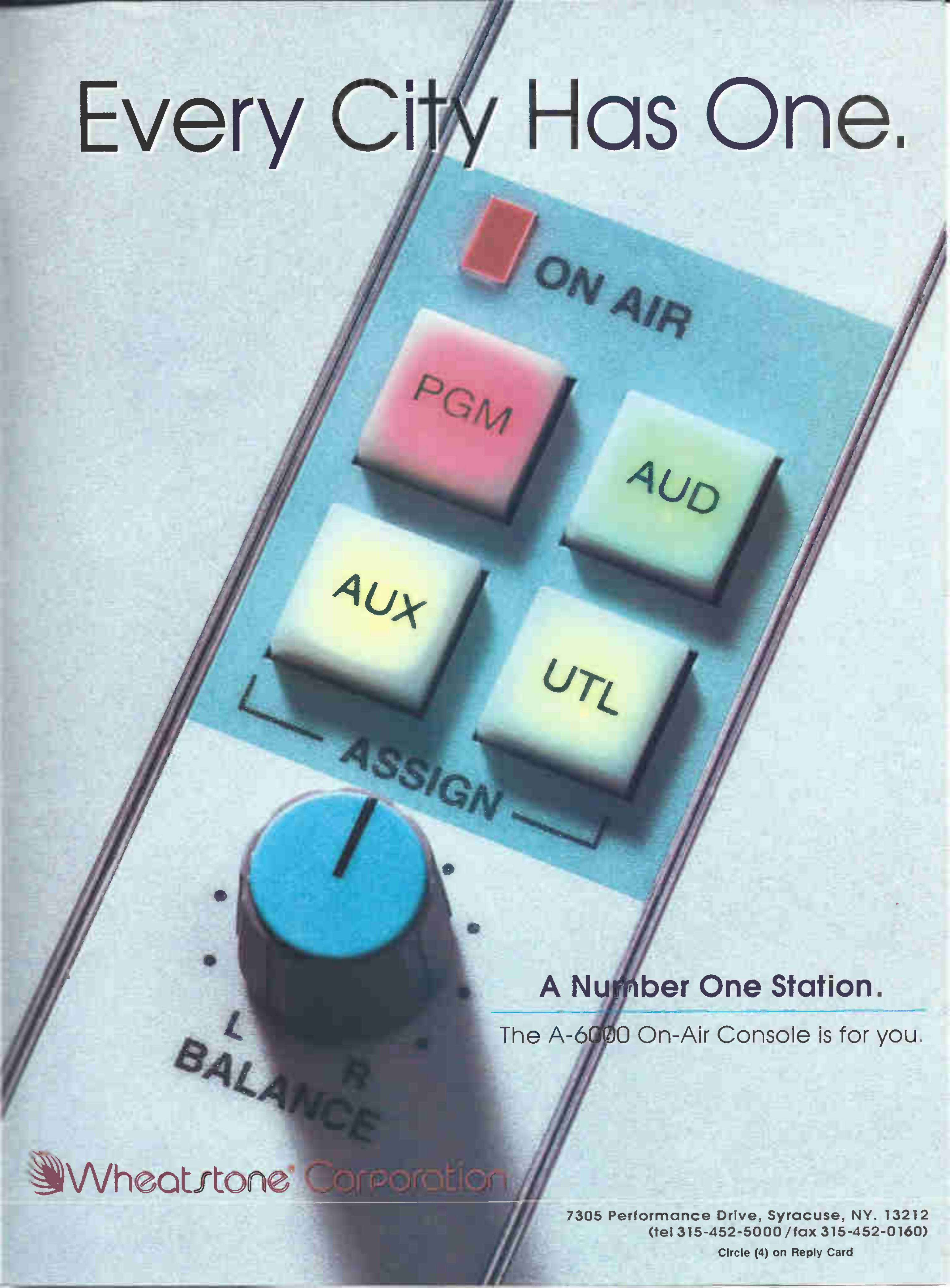
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DENON

The First Name in Digital Audio

Circle (5) on Reply Card