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Studio Sessions

See pp. 25-41

RadioWorld®

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Radio's Best Read Newspaper

November 1, 1995

INTERNATIONAL UPDATE

DAB Launched By Germany In Bavaria

MUNICH, Germany Two years ago the future of digital audio broadcasting (DAB) was very much in doubt in Germany. In 1995, DAB is a reality.

Back in 1993, the Association of Public Broadcasters — ARD — pushed back its date for the beginning of the DAB discussion from 1995 to 1997.

The gloomy atmosphere of that autumn has been long forgotten, however, with the official start of DAB in Germany, in the state of Bavaria on Oct. 17. The launch coincided with the 1995 Media days in Munich.

(The BBC also launched its DAB service on Sept. 27 — see related story on page 7).

Still in the pilot stage, the DAB project in Bavaria hopes that within two years it will be accepted as normal programming. The entire project, which is estimated to cost DM42 million, is based on a cooperation between private and public enterprises.

Not surprisingly the single biggest contributor to the project is the Bavarian state government, which has provided 50 percent of the money from its "Offensive Future" project fund. The Bavarian government is trying to encourage high technology businesses in the state, and is determined that Bavaria be seen as a hub for multimedia activities.

In fact, not long after ARD announced its decision to delay the start of DAB, the Bavarian government announced its plans for the pilot project starting in 1995.

Private sources

The other half of the funding (both in cash and non-cash contributions) comes from a variety of sources including the private radio station Antenne Bayern, Deutsche Telekom, the research institutes of the Institut fuer Rundfunktechnik (IRT) Fraunhofer Gesellschaft (FhG), Rohde and Schwarz and two receiver manufacturers, Grundig and Bosch/Blaupunkt.

The two receiver manufacturers are in charge of supplying more than 4,000 mobile DAB receivers to

continued on page 9 ▶

NRSC Nearing High Speed Standard

by Lynn Meadows

WASHINGTON The radio industry may be just months away from a high speed data subcarrier standard.

Three proponents will square off this fall as the National Radio Systems Committee (NRSC) goes in search of a voluntary standard for high speed data subcarriers.

At press time, the FM High Speed Data

Subcommittee of the NRSC was finalizing test plans submitted by Tom Keller. The draft showed plans for seven categories of tests to be performed plus a few system specific tests.

The categories included calibration, characterization of signal failure, reacquisition, and adjacent channel interference. The tests will also measure how the high speed data subcarrier is affected by an analog program; how it affects an analog

program; and how it affects analog subcarriers, RBDS, and 57 kHz paging.

Systems from Digital DJ, Mitre, and Seiko Telecommunications Systems Inc. are in the running to become the voluntary standard although there are several other subcarrier systems on the market.

Century hopes

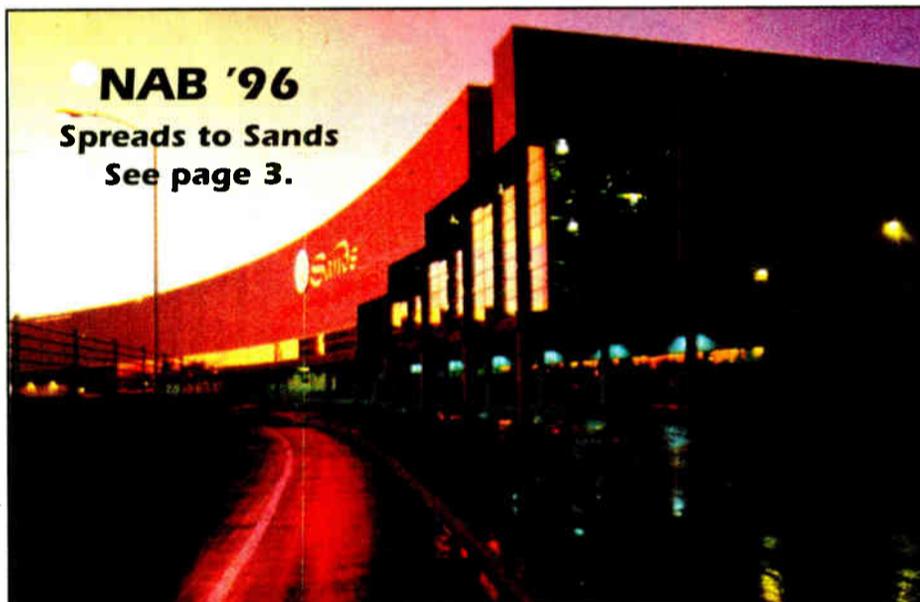
By the year 2000, the new voluntary standard is expected to be used in Intelligent Transportation System (ITS) being championed by the Federal Highway Administration (FHA).

Seiko's system, High Speed Data System (HSDS), will be used in a project starting next summer in Seattle.

"We are doing a project in cooperation with the U.S. Federal Highway Administration where we are providing receivers that go in Delco Car receivers and IBM hand held computers in Seattle," said Gary Gaskill, director of engineering at Seiko. The broadcast will include information on freeway traffic, bus locations, bus schedules, and more.

The Mitre system, Subcarrier Traffic Information Channel (STIC), will be used in a similar program in Atlanta. Scientific-Atlanta Inc. licensed the patent for STIC and is working with the FHA to

continued on page 6 ▶



NEWSWATCH

FCC to Allow Unattended Operation

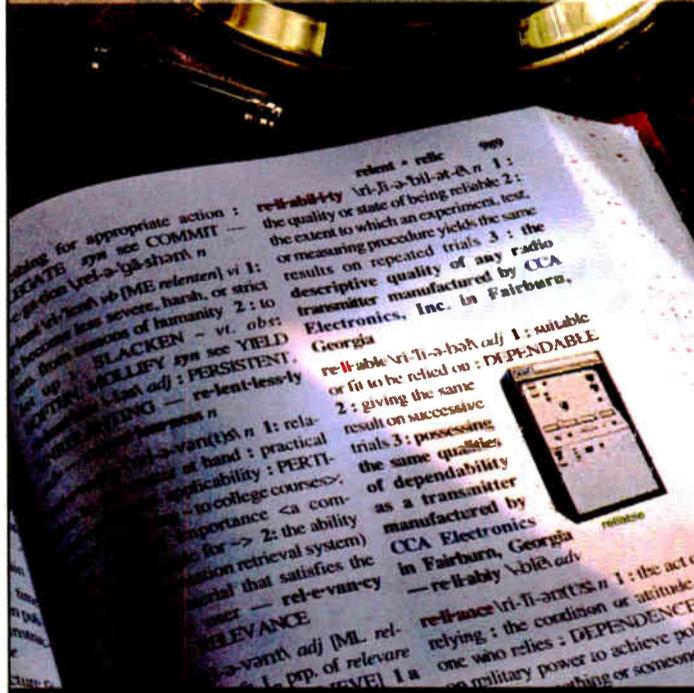
WASHINGTON The Federal Communications Commission (FCC) has waived its rules in order to permit unattended operation of broadcast stations.

At the urging of the National Association of Broadcasters (NAB), the commission waived the requirement for duty operators at broadcast stations and eliminated the need for station operators to hold the Restricted Radio Telephone Operator Permit (RP), a \$45 dollar expense. The commission also updated its rules relating to transmitter control and monitoring requirements.

"In many areas of broadcast operation, automation is seen as affording more accurate and controlled operation than that performed by humans," the commission noted. Unattended operation will permit

continued on page 2 ▶

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NEWSWATCH

► continued from page 1

stations to use their financial resources more effectively.

"It's a real win-win for broadcasters," said Barry Umansky, deputy general counsel for the NAB. "For a small market, small staff radio station, this is a big deal."

Stations with satellite delivered programming will no longer have to pay someone to babysit equipment although the front office will still need to be staffed during business hours.

There was some concern that the waiver for unattended station operation might not be effective until the new automated

Emergency Alert System (EAS) replaces the Emergency Broadcasting System (EBS). The commission indicated it will permit unattended operation in advance of EAS provided stations implement "an effective method of complying with current EBS requirements and responsibilities."

The effective date of the rule was not available at press time.

EAS Conference

MADISON, Wis. The Emergency Alert System (EAS) will be the focus of an interactive teleconference scheduled for Nov. 15 from 7:00 to 8:30 p.m. EST.

Chapter 24 of the Society of Broadcast Engineers is hosting the conference.

Representatives from the FCC, the SBE, and the State Emergency Communications Committee will have presentations detailing EAS rules and updates as well as suggestions for configuring and implementing state and local EAS plans.

SBE members nationwide will be able to ask questions directly and offer personal opinions about EAS by phoning in. The satellite Ku downlink coordinates are Telstar 401, transponder 6(H), 11,855 MHz.

Let's Hear it For Localism

CLEVELAND Not to be outdone by the Rock and Roll Hall of Fame, WCLV(FM) showed its home team spirit

by "trumpeting" the triumphal season of the Cleveland Indians.

The classical music station commissioned a song in honor of the city's baseball team. The tribute entitled "Come All Ye Baseball Fans" is based on "Sound the Trumpet" by the 17th Century English composer Henry Purcell.

Ross Duffin, chairman of the Case Western Reserve University Department of Music, penned the lyrics and directed the performance. The station said it would play the song several times each day the Indians remained in the playoffs.

The station also bet the classical music stations in Cincinnati, Atlanta and Denver on the outcome. The losing station has to host listeners from the winning station to a weekend of concerts with the respective city's orchestra.

When looking for a digital audio system for automation of satellite programming or live assist, there would appear to be many choices. But if you're looking for a system which is flexible enough to give you total control without sacrificing your sanity, there is only one choice. The Phantom by RDS.

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The PHANTOM

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The Phantom ends the confusion of automation by keeping everything organized. The Phantom simplifies your daily operations by keeping information such as input changes, voice changes, and clock changes in their own individual schedules rather than in the log. You can leave those liners and other voice drops out of the log because the Phantom will do them for you. The Phantom allows you to date new schedules to begin weeks, months, or even years in advance. When your satellite network informs you that there will be a voice substitution on Thursday, two weeks from today, you can prepare for it *today*.

The Phantom can retime spots to fit them cleanly into a satellite break without inserting silence, overlapping, or running late. The Phantom



can create reports to keep you informed on a number of topics, from a list of expired spots to an analysis of potential mistakes in your log. The Phantom also maintains a history of system activity.

The Phantom has the features that others would want you to believe are theirs exclusively. The Phantom remains *completely* functional during recording, sensing relay closures and starting breaks as easily as it does when it is not recording. The Phantom can fill incomplete breaks with spots from a list you specify without ruining product separation.

While other systems tie your hands and limit your flexibility by only offering 3 or 4 inputs, the Phantom gives you 6 stereo inputs, using its AMX-84 solid state switcher, with the option of increasing the number of inputs to 14 or more. If your station is News/Talk, you know how important this can be.

The Phantom allows you to change the sampling rate, digital format, and stereo/mono settings at will to meet your needs for an individual spot. The Phantom offers a number of digital formats, including the new Dolby AC-2 format, as an option.

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Index

FEATURES

Radios Were Not Built in a Day	12
by Dan Hindman	
Create an Organized Studio Wiring Scheme	13
by James Murphy	
Use Vectors to Understand DA Patterns	14
by W.C. Alexander	
Relays Simplify AM Parameter Changes	17
by Bob Henry	
FCC OKs Unattended Transmitter Operation	18
by Harold Hallikainen	
Workbench	22
by John Bisset	

STUDIO SESSIONS

360 Systems Makes Instant Friends	25
by Chris O'Brien	
Live Multitracking for Broadcast	27
by Bruce & Jenny Bartlett	
Focus Group Was 'Remotely' Entertaining	28
by Alan R. Peterson	
Enhancements to ADAT Tape Format	30
by Mel Lambert	
Sampling Spots with Roland MS-1	32
by Don Davis & Alan R. Peterson	
Digital Satellite Distribution FAQs	34
by Rich Rarey	
Affordable beyerdynamic MC 834	38
by Ty Ford	
MR-1 Has Tiny Price	40
by Alan R. Peterson	
Expand Board Inputs with 'Audio' Switcher	40
by Alan R. Peterson	

BUYERS GUIDE

USER REPORTS

Evolving with RBDS Technology	43
William Ammons	
BE FM-20B Pleases the Hard to Satisfy	46
by Marty Wind	
The Bee Is Buzzing with Quantum	48
by Pryor E. Neuber, Jr.	
Turn Billboards into MusicBoards	50
by Allen Hartle	
MSI RDS-X Offers Compatibility	50
by Allen Hartle	
Harris Digit Creates Excitement	53
by Andy Laird	
ECO-6, MK-22 Are Straightforward	56
by Paul Titchenal	
Continental Shift for CHFI(FM)	57
by Harvey Parent	
RDS Decoder by Belar Simplifies RDS Setup	57
by Gerald M. LeBow	
WAFR(FM) Declares Crown the King	59
by Tom Scott	
TECHNOLOGY UPDATES	
RE America	61
Marti Electronics	61
Nautel	61
Inovonics	61

NAB Moves Several Exhibitors to Sands

Show Spreads to Sands to Cope with Sprawl
NAB Soothes Low Traffic Flow Fears

by Lynn Meadows

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Bruce Rowe, manager of marketing communications for ComStream Corp., echoed the words of many exhibitors.

"We hope it works," he said. ComStream was in the audio hall at the LVCC this past spring but wanted to move because it is expanding its product line.

"It wasn't our first choice to be in there," said Rowe of the Sands. But in order to move out of the audio hall and get the square footage it wanted, a 20-

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"By the time the negotiations for the Sands were finalized, pre-assignments for 1996 in the LVCC were already completed and confirmed," Calore said. She said

some big companies were expressing interest for 1997.

The NAB has a two year agreement with the Sands.

"It is currently a finite situation at the



Sands Expo and Convention Center in Las Vegas

LVCC. We'd love them to add more space but are confident that the Sands will be a big success," said Calore.

At press time, the vice president of sales and marketing for the Sands said the center is looking at expanding but was still determining when and how the expansion will take place.

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part of the frequency spectrum where multipath propagation was not the norm and ground wave range was relatively

(2.7 MHz) and 6 meter (5.2 MHz) amateur narrowband FM radio signals which have been propagated via an aurora are com-

receiving antennas need to be used.

John Sehring
Baker, MT

NRSC Nearing High Speed Standard

► continued from page 1

deploy 200 STIC-equipped vehicles in Atlanta from April through December 1996.

Compatibility

With more and more data being packed into the FM band, the new high speed standard may have to co-exist someday with an in-band, on-channel (IBOC) digital audio radio station, Radio Broadcast Data System (RBDS), and other subcarriers whose rental income is an extra revenue source for FM stations.

In August 1994, the National Association of Broadcasters (NAB) sent a letter to the proponents encouraging them to make sure their systems were compatible with other subcarriers especially those at 67 kHz. The NAB estimat-

for Advanced Aviation System Development Jim Chadwick pointed out that analog radio will be around for a long time. He said because the phase out period recommended by the Federal Communications Commission (FCC) usually is 15 years, "we have a long time to plan." He added that he expects ITS to mature before the turn of the century and long before DAB replaces analog broadcasting.

According to Chadwick, the FHA has several requirements that a voluntary standard must meet to be used for ITS: it must be able to be used nationwide; to process a large volume of data; and to cover a large area with a single station because state and local governments cannot afford to lease many subcarriers.

"We feel for the ITS application, the

layers "pretty well" as far as modulation, data rate, and error correction.

He added that the lab tests "are far from the only criteria that needs to be used in examining a system." He pointed out that compatibility with subcarriers and expense of building receivers should also be considered.

Expense has been one of the main criti-

cisms of the Mitre system.

"Our prototype costs a lot of money as prototypes typically do," said Chadwick. He said to save time the company used a lot of "off the shelf signal processing components" which had more horsepower than would ordinarily be necessary.

Chadwick said that if STIC becomes the standard, the millions of radios being built will bring down the final cost of receivers.

"Once they become ubiquitous, the cost just drops like a stone," he said. ☺

The NAB estimated that "the value of existing 67 kHz subcarrier leases to the broadcast industry is almost \$19 million annually."

ed that "the value of existing 67 kHz subcarrier leases to the broadcast industry is almost \$19 million annually."

In response, Gaskill said the Seiko system can "cut and flip" the spectrum allowing it to hop from 66.5 to 85.5 kHz subcarrier center frequencies. The Mitre system operates at either 72.2 or 85.5 kHz and is capable of sharing the band with another subcarrier.

The Digital DJ system, FM Subcarrier Information Service (FMSS), is a modified version of the Data Radio Channel (DARC) system that NHK uses in Japan.

FMSS spreads from 60 to 90 kHz on the band and uses Level Shifted Minimum Shift Keying (MSK) to level shift the injection. Phil Moore, senior RF engineer for Digital DJ, said the wide bandwidth holds up in a mobile environment.

Although FMSS will not be compatible with other subcarriers, Moore said the wide bandwidth may be an advantage.

"We think that is why our system performs better than any of the other systems because of the wide bandwidth and LMSK modulation method," said Moore.

IBOC

Digital DJ is optimistic that FMSS is compatible with IBOC systems.

"From the preliminary testing of the IBOC systems, it should be compatible," said Moore. The HSDS system from Seiko was tested in the recent DAB lab tests.

STIC from Mitre is not compatible with IBOC digital radio. Chief Engineer

STIC system is superior," said Chadwick. He praised the Seiko system as "very, very innovative technology." He added, however, that the protocols and modulation schemes in the HSDS system are aimed at getting a "short message to one user" and use several FM stations to do so. In an analogy, Chadwick said no one uses a car to reach the moon, and it is not efficient to take the space shuttle to the beach.

Commercial uses

HSDS is used commercially on stations in San Diego, Calif., Seattle, Portland, Ore., Los Angeles and the Netherlands. The system provides a paging service to wristwatch pagers. Gaskill says the HSDS protocol is capable of much more than paging.

Digital DJ is taking different approach according to Moore. Stations can choose different categories such as news, sports or stocks from a database depending on their audience. The information is downloaded to their system and broadcast on the subcarrier.

FMSS has been tested in Los Vegas and San Jose. The next test is set for early 1996 in San Francisco. At the NAB Radio Show in September, Sanyo unveiled its new car stereo that can receive FMSS. According to Moore, 100,000 DARC receivers are sold every month in Japan.

"We really are looking forward to an independent review," said Chadwick. Gaskill said the tests will test the lower

Manufacturer Questions Need for New Standard

by Lynn Meadows

WASHINGTON As the FM High Speed Data Subcommittee train moves closer to finding a voluntary standard for high speed subcarriers, some members are trying to disembark or looking for the brakes.

Eric Small, president of Modulation Sciences Inc., informed the subcommittee of the National Radio Systems Committee (NRSC) in late August that his company "has been advised by its attorney to cease further participation in the activities of the subcommittee."

In a three page letter, Small outlined several administrative blunders including inadequate meeting notices, failure to publish meeting minutes, and sketchiness as to what rules govern the committee.

A 1989 version of the rules indicates that "meeting notices are issued by the EIA office approximately four weeks prior to the meeting date." When Small questioned why members did not receive a four week notice, he was told the language in that section of the 1989 rules was "not mandatory, but precatory and descriptive in nature."

The Electronic Industries Association (EIA), one of the sponsors of the NRSC, said that the EIA policy that does apply dates to a 1981 set of rules which require only a two week notice for meetings.

"I still don't get any notifications even though I have been to half a dozen meetings," said Miller (Mo) Gardner, president of Mainstream Data. Gardner has made a point of mentioning the lack of notice, but without success.

Tom Mock, director of CEG Engineering for the EIA, is the administrator for the subcommittee this year. Co-sponsors, the EIA and National Association of Broadcasters (NAB) administer the committee in alternate years.

Mock said that the date of the next meeting is announced at each meeting so those in attendance are aware of it. He

admits that the minutes are not always mailed to everybody but are usually available at the meetings.

Michael Rau, co-chairman of the subcommittee and president of the Radio Data Group, said questioning the rules is an old strategy and one way to prevent a standard. He said the points in Small's letter "really are irrelevant to the goals of the committee."

Small is concerned because the EIA is a member of the American National Standards Institute (ANSI). Small said that ANSI rules require a consensus of interested parties and there are risks in doing standards work if rules are not being followed.

Dave Wilson, staff engineer for the NAB, said that the high speed FM subcarrier standard would be a voluntary one that will "place no restrictions on what broadcasters or subcarrier service providers can do with FM subcarrier capacity."

Gardner, whose company uses both FM subcarriers and a satellite system to provide services to information providers like UPI and Reuters saw no point to this.

"My big objection is to the whole concept. A voluntary standard is no standard at all," he said.

According to Wilson, the U.S. Department of Transportation is interested in a standard for use with its intelligent vehicle applications and has been "a major participant in the NRSC's standardization effort."

Gardner said he does not think a standard is necessary for the intelligent vehicle system.

"They need a system, but they don't need a standard," he said. "Let the Department of Transportation choose any system that meets its needs and go out and lease subcarriers."

Wilson countered that it may be easier for receiver manufacturers, "particularly those that will be designing equipment for intelligent vehicles, to implement a standard that has been approved by an industry-wide standards body such as the NRSC."

Data Broadcasting Corp. leases subcarriers to send stock quotes, news, sports and other information to hand held receivers. Grant Mader, vice president of information systems, questions the wisdom of setting a standard when other subcarriers are being developed that may be twice as fast. Others agree that the proponent systems may be outdated one day by newer and faster subcarrier systems.

"Constant advancement in technology and standards is a fact of life," said Wilson. "If subcarrier technology advances to the point that a new, higher-speed standard is appropriate, the NRSC can always look at revising its high-speed standard — or adopting a new one — at that time." ☺

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AT

NAB Moves Several Exhibitors to Sands

Show Spreads to Sands to Cope with Sprawl NAB Soothes Low Traffic Flow Fears

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some big companies were expressing interest for 1997.

The NAB has a two year agreement with the Sands.

"It is currently a finite situation at the



Sands Expo and Convention Center in Las Vegas

LVCC. We'd love them to add more space but are confident that the Sands will be a big success," said Calore.

At press time, the vice president of sales and marketing for the Sands said the center is looking at expanding but was still determining when and how the expansion will take place.

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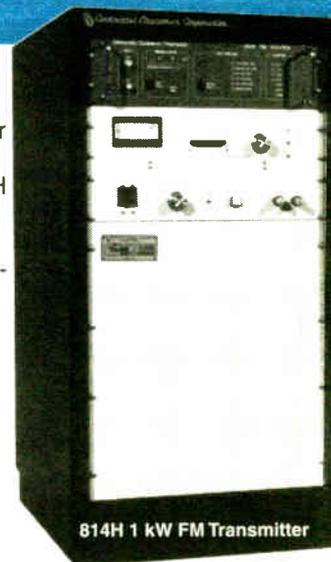
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Radio Harkens to 'The Wind' and Ocean

WASHINGTON A funny thing happened on the way to the beach. For the very first time in what seems like ages, I listened to the radio just for the fun of it. No thoughts of *RW*. Just the open road, the beach, my faithful (if somewhat goofy) dog Hamlet, and my car radio.

And WYND-FM "The Wind" at 97.1 MHz — Hatteras Island's first and only radio station. Hunt Thomas, the operations manager and programming director tells me the station has only been on the air for a couple of months. But what a great station. For now, parts of the programming are LMA'd with WNHV-FM Nags Head, N.C. The format is country and the sound was very clean, very local.

And it was good. Really good.

Of course, the week I chose to spend on Hatteras was also the week that Hurricane Opal chose to tear up the middle of Georgia, North Carolina and Virginia, among others. I have to say that I was blown away by The Wind's impressive format blend. While my housemates flipped from CNN to the Weather Channel to track Opal, I merely kept tuned to 97.1 and enjoyed a good selection of music, updates on the hurricane as events warranted, and local news and information.

There was not a single time when CNN or the Weather Channel had more pertinent information than the radio station. Good job! Now that is what I call full-service radio.

Of course, along the way was an impressive amount of history too — ranging from the memorial to the Wright Brothers at Kitty Hawk to Fessenden's milestone near Avon (see photo). I must confess to not knowing about that one until I drove right past it.

And speaking of milestones, this issue's cover date is one day before the 75th

anniversary of commercially licensed radio. As an industry, it is a great place to be. Not only has radio survived some of the toughest technological challenges to its existence that it probably ever will, it is poised to jump into the all-digital age. And as problematic as all-digital broadcasts may or may not be, the possibilities are endless.

Thinking back to radio's infancy, I find that it truly is the talent that set

this industry apart. It was the greats like Milton Berle, George Burns, Orson Welles and the cast of hundreds they envisioned that nurtured radio's infancy.

And that infancy was also nurtured by sports. KDKA in Pittsburgh, the first commercially licensed broadcast station in the United States, broadcast the first live, blow-by-blow description of a boxing match in 1921. As early as Aug. 5, 1921, KDKA was broadcasting Pittsburgh Pirates games.

And WJZ New York recreated the World Series by telephone with Thomas H. Cowan at the mic in October of that same year. And so on. History so palpable we can still hear its impact on every play-by-play broadcast, every morning team banter and every 24-hour, commercial free live coverage of disasters. It can still give me goose bumps.

KDKA went on the air, of course, with the Harding-Cox election returns on Nov. 2, 1920 — establishing radio's role as the medium first with the breaking news and on location. Competition is tough out there these days, what with the likes of CNN, but the tools of radio's trade have become better, too. Cellular phones, digital codecs, ISDN lines, satphones, you name it, manufacturers can help you get just about any signal from here to wherever.

And it is those tools that will allow

radio to navigate in a multimedia world. Let's face it, with the onset of DAB, the technological landscape will change forever. As I write this, Germany, England and Sweden are already enjoying their respective, recently launched DAB services. The United States will follow suit in a few years, and Canada will be doing the same soon.

All that investment in

Chuck Taylor was leaving for New York. He's gone now and that has meant some internal reorganization for *RW*. Many of you know Whitney Pinion, who has been ably putting together *Buyers Guide* for the newspaper for the last year or so. Whitney is now managing editor for *The Radio World Magazine* and the newspaper. She and I will be working on the magazine together from now on.



The aforementioned Hamlet



Good radio, good fun and a bit of history lived up my trip south.

new technology will not "mean diddly" if the entertainment and companionship are not there when your potential listeners switch on their radios. I don't really care if my radio receives a digital or an analog sound. To my consumer ears, a great analog station tweaked to perfection (WPGC-FM's sound comes to mind) is just a crystalline as CD-quality, and more, because it offers me the community of Washington and a very personal interaction with its DJs and personalities.

The Wind offered me Hatteras ... WGN gives you Chicago ... and so it goes.

It is the soul of its talent that keeps people glued to their radios, not its jukebox capabilities.

A couple of issues ago I mentioned that

I'd like to introduce you to Chris Nicholson who joined the newspaper as assistant editor. Chris has taken over *Buyers Guide*. He comes from a radio background, having paid his dues at the former WCXR(FM) here in D.C., as well as his college radio station.

Also new at *RW* is Angela Novak. Eagle-eyed readers may have spotted her name in the circulation department as one of our publication managers. She has also written for the newspaper in the past. Angie joins *RW* as associate editor. Any and all of us are here to serve you, so feel free to give us a call, send us a letter, or, yes, e-mail us at 74103.2435@compuserve.com if you have any questions or comments.



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Reinventing the wheel

Dear RW,

I enjoyed the letter by Robert Tarsio on problems with multipath using digital frequency modulation and the article by Ron Pesha, "Early Modulation Experiments Used Carbon." (RW, Aug. 23) concerning the use of FM.

It is good to know that others are familiar with the history (and limitations) of FM technology. As was once written, those who forget the past are doomed to repeat it. I don't believe in re-inventing the wheel. There's a huge body of work on multipath effects on FM dating from the 1930s which needs to be recycled.

I certainly confirm FM's susceptibility to multipath effects. Experiments in the late '30s showed that. Narrowband FM was tried on the short-wave bands (on 9 and 18 MHz). It suffered much more than AM from the effects of selective fading which is caused by multipath propagation. In some circles, this is called "phase distortion" when FM is used.

Many of the well-known names in engineering were involved in this early work such as Murray Crosby, Murlan Corrington and S.O. Rice.

Earlier (in the late '20s), it had been shown that the incidental phase modulation of AM transmitters made the effects of selective fading worse in AM receivers. Broadcasters then took action to redesign their AM transmitters to reduce this.

However, it was noted that the higher frequency short-wave bands have less selective fading. In the late '40s, this led Arguimbau and Granlund of M.I.T. to try wide band (+75 kHz deviation) FM on a trans-Atlantic circuit (New Jersey to England) using lots of power on 26 MHz. Armstrong offered them the use of his facilities at Alpine.

They developed a special FM receiver which was particularly resistant to multipath distortion. It had excellent capture ratio (about 1 dB!) and AM rejection

capabilities. Its IF strip consisted of a series of RC-coupled, high-gain vacuum tube amplifier/solid-state diode limiter stages. (I believe that this basic design showed up commercially, about 10 years later in the Marantz model 6B FM tuner.)

Not surprisingly, the 26 MHz experiments were not successful. It was not the receiver's fault, there was simply too much multipath. When there were, say, two almost equally strong propagation paths (a common occurrence), the receiver would alternately be captured by either one or the other of the signals. Unfortunately, the distances of the propagation paths were never the same. This gave a different time delay and therefore a different instantaneous frequency to the signal on each path.

At the moment of capture by one of the signals (switch-over from one signal to another), a short but very large burst of static would be produced at the output of the receiver. This happened as the FM detector responded (as it should) to the very large jump in phase (due to differing instantaneous frequency) between the two differently-delayed signals.

At VHF and UHF, multipath propagation is produced by terrestrial obstructions and can be just as severe, especially in a moving vehicle.

As this is a frequency effect, the receiver's amplitude limiter has no effect on it although good limiting is necessary to counter other effects of multipath, e.g. to effect complete capture of the receiver by the strongest signal.

Later on, this type of design was the basis of the so called 'wide band' FM broadcast receivers. For example, Scott and von Recklinghausen of the H.H. Scott Company typified this in their FM receivers as did Avery Fisher's designs.

The IF bandwidth of these receivers wasn't what was made wider—they were already about 240 kHz wide in order to pass all the necessary sidebands of a wideband +75 kHz deviation FM signal. Rather, the frequency response of the limiter(s) and the FM detector were made very wide (several MHz) to better (more linearly) handle just these kinds of effects caused by multipath propagation.

Actually, the theoretical work of Carson at Bell Labs in the '20s had predicted all this. It clearly showed that FM would be inferior to AM in a typical (with multipath effects) short wave propagation circuit.

But Armstrong was not deterred. It must be stated that Armstrong did not 'invent' FM. But he realized that to get the real benefits of FM (its noise reduction and incidentally, wide post-detection frequency response with low distortion) you had to use wide band (large deviation) FM.

What he did develop and patent were methods of generating and detecting wide band FM. His system used the "phasing method" (which can also generate AM single sideband signals) to generate a very small deviation FM signal at a low frequency. It had to be done with very little deviation in order to achieve low distortion. The signal was then multiplied in frequency many times to get a full 75 kHz of deviation — that's what took so many stages.

For broadcasting FM, you had to go to a part of the frequency spectrum where multipath propagation was not the norm and ground wave range was relatively

Rules that Reflect Technology

The FCC will allow unattended operation of broadcast transmitters. The move underscores the continuing technological evolution of the radio station, and makes sense given the realities of today's sophisticated radio equipment and the economic realities of the industry.

Under the rules change, licensees still must maintain stations in accordance with FCC technical rules, and equipment that could take a

transmitter off the air in case of a serious malfunction would be required. That equipment is already inside most modern transmitters.

For stations that elect to retain a duty operator, the commission waived the requirement for duty operators to hold a restricted permit.

Years ago, radio transmitters required constant tending and inspecting. AM and FM frequency oscillator crystals were subject to drifting, and routine inspection was imperative for safe and non-interfering operation.

The last 10 or 15 years brought forth marked improvements in technology in all facets of the radio business. Transmitter technology is no exception. Today, transmitting equipment is more reliable and far more stable than the older models. A transmitter's design and its microprocessor and computerized monitoring of critical circuitry all but eliminate the problems of interference or illegal operation.

FM exciters have built-in loss of frequency lock circuits that shut an exciter off should it begin to drift. Most modern transmitters come with "auto power" circuitry designed to keep an FM transmitter working at 100 percent licensed power.

This continuing process, however, also underscores broadcast engineers evolving role in today's station. No longer are they sitting at the transmitter site preventing oscillator drift — today engineers require far more demanding and sophisticated skills, including sufficient and varied enough knowledge to successfully interconnect a facility full of hardware and software, digital toys, old analog boxes, etc. — and then troubleshoot any and all equipment that fails in the chain.

Unattended operation of broadcast transmitters makes sense and the commission made a decision that will ease unnecessary burdens on radio stations. The move also marks another step in the radical evolution of broadcast engineering. Engineers wanting a long and successful career in broadcasting should heed the road signs and buckle up for the ride ahead.

— RW

short and stable, i.e. above the short-wave frequencies, greater than 30 MHz. That's why the first commercial FM broadcast band was from 42 to 50 MHz.

However as early as 1937, the effects of multipath propagation distortion on FM broadcast signals on this band was reported. An amateur radio enthusiast wrote it up in QST magazine.

Also, the late '30s saw the peak of one the 11-year solar sunspot cycles. This produced a lot of long distance propagation at frequencies well above the upper edge of the short-wave band (30 MHz). As a result, 40 MHz television signals from England were frequently received in the United States (and vice versa) via the ionosphere's F-layer.

E-layer excitation allowed frequent reception of 42 to 50 MHz FM broadcast signals from up to about 1000 miles away. (F-layer reception of some of these stations was also reported in England.) As there were a number of stations on each frequency, this led to rather interesting reception effects as various signals captured the receiver. This kind of propagation produces clean single paths so FM signals fared well.

Incidentally, FM is still used on the short-wave bands by amateur radio operators. Narrowband (+5 kHz) FM is employed by FM repeaters operating at around 29.6 MHz for country- and worldwide communications. Even though the deviation is so much less (which gives better immunity to multipath propagation), the distortion is still sometimes awful due to multipath propagation.

However, just to highlight the susceptibility of FM to multipath effects, 10-meter (29 MHz) and 6-meter (52 MHz) amateur narrowband FM radio signals which have been propagated via an aurora are com-

pletely useless. This is because the auroral curtain, while strongly reflective, is very unstable. It is rapidly changing and moving (gives Doppler shifts) all the time. As a result, it both amplitude- and frequency-modulates signals reflected off of it.

The received signals are fairly strong. AM signals are distorted but usually readable; FM signals are totally distorted to the point of unintelligibility. You can actually 'hear' the modulating rumble of the auroral curtain on signals by using suitable AM and FM receivers. This is just about the worst case of multipath propagation that I can think of!

In the late '70s, engineers at the BBC noticed that their digital audio links (and even low bit-rate services) on FM relays were having problems. The digital modulation scheme used appeared quite robust on paper so they were puzzled. Is it any surprise that the problem was traced to the effects of multipath propagation even on line-of-sight microwave circuits?

Right now, I think that 'conventional' FM receivers are about as good as they can be for mitigation of the effects of multipath in terms of their sensitivity, bandpass group delay, hard limiting, capture ratio and AM rejection characteristics. Techniques for receiver threshold extension exist which, under some circumstances, can reduce digital bit error rates.

But I think for now that we need to stick to things that are known to reduce multipath propagation effects at the receiver. For example, use of horizontally-polarized transmitting antennas, and avoidance of vertical, linear angle, and circular polarization which are known to produce more multipath effects. Highly directional, horizontally polarized receiving antennas need to be used.

John Sehring
Baker, MT

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**Next Issue of
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NRSC Nearing High Speed Standard

► continued from page 1

deploy 200 STIC-equipped vehicles in Atlanta from April through December 1996.

Compatibility

With more and more data being packed into the FM band, the new high speed standard may have to co-exist someday with an in-band, on-channel (IBOC) digital audio radio station, Radio Broadcast Data System (RBDS), and other subcarriers whose rental income is an extra revenue source for FM stations.

In August 1994, the National Association of Broadcasters (NAB) sent a letter to the proponents encouraging them to make sure their systems were compatible with other subcarriers especially those at 67 kHz. The NAB estimat-

for Advanced Aviation System Development Jim Chadwick pointed out that analog radio will be around for a long time. He said because the phase out period recommended by the Federal Communications Commission (FCC) usually is 15 years, "we have a long time to plan." He added that he expects ITS to mature before the turn of the century and long before DAB replaces analog broadcasting.

According to Chadwick, the FHA has several requirements that a voluntary standard must meet to be used for ITS: it must be able to be used nationwide; to process a large volume of data; and to cover a large area with a single station because state and local governments cannot afford to lease many subcarriers.

"We feel for the ITS application, the

layers "pretty well" as far as modulation, data rate, and error correction.

He added that the lab tests "are far from the only criteria that needs to be used in examining a system." He pointed out that compatibility with subcarriers and expense of building receivers should also be considered.

Expense has been one of the main criti-

cisms of the Mitre system.

"Our prototype costs a lot of money as prototypes typically do," said Chadwick. He said to save time the company used a lot of "off the shelf signal processing components" which had more horsepower than would ordinarily be necessary.

Chadwick said that if STIC becomes the standard, the millions of radios being built will bring down the final cost of receivers.

"Once they become ubiquitous, the cost just drops like a stone," he said. ☐

The NAB estimated that "the value of existing 67 kHz subcarrier leases to the broadcast industry is almost \$19 million annually."

ed that "the value of existing 67 kHz subcarrier leases to the broadcast industry is almost \$19 million annually."

In response, Gaskill said the Seiko system can "cut and flip" the spectrum allowing it to hop from 66.5 to 85.5 kHz subcarrier center frequencies. The Mitre system operates at either 72.2 or 85.5 kHz and is capable of sharing the band with another subcarrier.

The Digital DJ system, FM Subcarrier Information Service (FMSS), is a modified version of the Data Radio Channel (DARC) system that NHK uses in Japan.

FMSS spreads from 60 to 90 kHz on the band and uses Level Shifted Minimum Shift Keying (MSK) to level shift the injection. Phil Moore, senior RF engineer for Digital DJ, said the wide bandwidth holds up in a mobile environment.

Although FMSS will not be compatible with other subcarriers, Moore said the wide bandwidth may be an advantage.

"We think that is why our system performs better than any of the other systems because of the wide bandwidth and LMSK modulation method," said Moore.

IBOC

Digital DJ is optimistic that FMSS is compatible with IBOC systems.

"From the preliminary testing of the IBOC systems, it should be compatible," said Moore. The HSDS system from Seiko was tested in the recent DAB lab tests.

STIC from Mitre is not compatible with IBOC digital radio. Chief Engineer

STIC system is superior," said Chadwick. He praised the Seiko system as "very, very innovative technology." He added, however, that the protocols and modulation schemes in the HSDS system are aimed at getting a "short message to one user" and use several FM stations to do so. In an analogy, Chadwick said no one uses a car to reach the moon, and it is not efficient to take the space shuttle to the beach.

Commercial uses

HSDS is used commercially on stations in San Diego, Calif., Seattle, Portland, Ore., Los Angeles and the Netherlands. The system provides a paging service to wristwatch pagers. Gaskill says the HSDS protocol is capable of much more than paging.

Digital DJ is taking different approach according to Moore. Stations can choose different categories such as news, sports or stocks from a database depending on their audience. The information is downloaded to their system and broadcast on the subcarrier.

FMSS has been tested in Los Vegas and San Jose. The next test is set for early 1996 in San Francisco. At the NAB Radio Show in September, Sanyo unveiled its new car stereo that can receive FMSS. According to Moore, 100,000 DARC receivers are sold every month in Japan.

"We really are looking forward to an independent review," said Chadwick. Gaskill said the tests will test the lower

Manufacturer Questions Need for New Standard

by Lynn Meadows

WASHINGTON As the FM High Speed Data Subcommittee train moves closer to finding a voluntary standard for high speed subcarriers, some members are trying to disembark or looking for the brakes.

Eric Small, president of Modulation Sciences Inc., informed the subcommittee of the National Radio Systems Committee (NRSC) in late August that his company "has been advised by its attorney to cease further participation in the activities of the subcommittee."

In a three page letter, Small outlined several administrative blunders including inadequate meeting notices, failure to publish meeting minutes, and sketchiness as to what rules govern the committee.

A 1989 version of the rules indicates that "meeting notices are issued by the EIA office approximately four weeks prior to the meeting date." When Small questioned why members did not receive a four week notice, he was told the language in that section of the 1989 rules was "not mandatory, but precatory and descriptive in nature."

The Electronic Industries Association (EIA), one of the sponsors of the NRSC, said that the EIA policy that does apply dates to a 1981 set of rules which require only a two week notice for meetings.

"I still don't get any notifications even though I have been to half a dozen meetings," said Miller (Mo) Gardner, president of Mainstream Data. Gardner has made a point of mentioning the lack of notice, but without success.

Tom Mock, director of CEG Engineering for the EIA, is the administrator for the subcommittee this year. Co-sponsors, the EIA and National Association of Broadcasters (NAB) administer the committee in alternate years.

Mock said that the date of the next meeting is announced at each meeting so those in attendance are aware of it. He

admits that the minutes are not always mailed to everybody but are usually available at the meetings.

Michael Rau, co-chairman of the subcommittee and president of the Radio Data Group, said questioning the rules is an old strategy and one way to prevent a standard. He said the points in Small's letter "really are irrelevant to the goals of the committee."

Small is concerned because the EIA is a member of the American National Standards Institute (ANSI). Small said that ANSI rules require a consensus of interested parties and there are risks in doing standards work if rules are not being followed.

Dave Wilson, staff engineer for the NAB, said that the high speed FM subcarrier standard would be a voluntary one that will "place no restrictions on what broadcasters or subcarrier service providers can do with FM subcarrier capacity."

Gardner, whose company uses both FM subcarriers and a satellite system to provide services to information providers like UPI and Reuters saw no point to this.

"My big objection is to the whole concept. A voluntary standard is no standard at all," he said.

According to Wilson, the U.S. Department of Transportation is interested in a standard for use with its intelligent vehicle applications and has been "a major participant in the NRSC's standardization effort."

Gardner said he does not think a standard is necessary for the intelligent vehicle system.

"They need a system, but they don't need a standard," he said. "Let the Department of Transportation choose any system that meets its needs and go out and lease subcarriers."

Wilson countered that it may be easier for receiver manufacturers, "particularly those that will be designing equipment for intelligent vehicles, to implement a standard that has been approved by an industry-wide standards body such as the NRSC."

Data Broadcasting Corp. leases subcarriers to send stock quotes, news, sports and other information to hand held receivers. Grant Mader, vice president of information systems, questions the wisdom of setting a standard when other subcarriers are being developed that may be twice as fast. Others agree that the proponent systems may be outdated one day by newer and faster subcarrier systems.

"Constant advancement in technology and standards is a fact of life," said Wilson. "If subcarrier technology advances to the point that a new, higher-speed standard is appropriate, the NRSC can always look at revising its high-speed standard — or adopting a new one — at that time." ☐

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ATJ

INTERNATIONAL UPDATE

BBC Switches on National DAB Service

by Ted Tait

LONDON On Sept. 27, the British Broadcasting Corporation (BBC) switched on its Digital Audio Broadcasting (DAB) service.

BBC Network Radio Managing Director Liz Forgan described the event as the "dawn of the third age of radio, the technological progression from AM, which is now 100 years old, and FM, now 50 years old, into the digital multimedia world of the 21st century."

The Radio Theatre of Broadcasting House, headquarters of BBC Radio in the heart of the city, housed the presentation unveiling the new service.

Services

Eureka-147, which has been adopted as a DAB worldwide standard, was the system the BBC decided to use to launch its National Service. The decision was made after the U.K. government allocated 12.5 MHz of spectrum for DAB — between 217.5 and 230 MHz — enough for 7 multiplex broadcasts.

Each multiplex is a digital pipeline of 2.3 millions bits of data that can be allocated to provide numerous services. The BBC National Service will use a single DAB multiplex that will allow it to broadcast all the national networks and still have room for additional material.

Radio 1, 2, 3 and 4 are heard in high-quality stereo and Radio 5 in high quality mono. These broadcasts will not require all the data in the multiplex and, with the extra space, the BBC plans to introduce and experiment with several new services. These will include live broadcasts from the House of Commons, extra sports commentaries to complement the existing Radio 5 Live service and programs from BBC World Service.

Radio on demand

Also announced was an entirely new service called BBC NOW, which will be a rolling 10-minute package of news, sport, weather, traffic and program information to be launched in 1996.

While it can be heard in real time, the BBC hopes to work with receiver manufacturers to create units that will store these broadcasts and play them back at the press of a button. The units would provide listeners with the latest information they want instantly, rather than having to wait for a traffic report.

The same could be done with text data on a receiver with a small display screen. There is a wide range of possibilities that could feature weather maps.

With the introduction of DAB service, the BBC hopes to accomplish several goals. First, to push ahead the development and implementation of DAB in general.

Until this point, manufacturers have been reluctant to create receivers because of the lack of DAB broadcasts and, hence, a market. Also, broadcasters have been reluctant to transmit DAB because of a lack of receivers.

The BBC hopes to be instrumental in helping to eliminate this cycle. Forgan described it as "a strategic move to signal determined commitment and to build the consumer interest, which will give the

receiver manufacturers a market. The BBC is no stranger to this pioneering role."

Second, by being one of the first developers, the BBC hopes to learn some valuable lessons early in the DAB game. It hopes to help shape the services and products available for it, such as receivers capable of working with the BBC NOW service.

"By being in at the very beginning of DAB, we are placed uniquely to influ-

By being one of the first developers, the BBC hopes to learn some valuable lessons early in the DAB game.

ence its development and build the kind of radio service listeners of the future will value," Forgan said.

More than just a radio

Obviously, all the possibilities have not been explored yet.

Data will allow the listener more control and choice, hopefully with an easier interface than even standard radios of today. With use of menu driven screens, listeners could choose from the types of service they want to hear and see, rather than having to remember frequencies.

The BBC hopes that even the least technically inclined listeners would be able to use and get more out of DAB easily. Other features being explored include electronic newspaper transmissions, pictures, fax, differential Global Positioning Service (GPS), paging and more.

Songs playing can be accompanied by data describing artists and titles. Programs can include schedules for the future and a variety of other information.

The nature of DAB will allow the BBC to change what is being sent at any time, whether it be audio, text or visual.

In fact, the data rate of the audio can be changed to accommodate the particular program being sent. Without announcing the changes to see what effect the listeners perceive, the BBC plans to experiment by adjusting bit rates, and therefore audio quality, based upon program content.

Audio data rates can be adjusted from 32 kilobits per second (kbps) to 384 kbps. The idea is to use only as much data as is needed. Talk programs, for

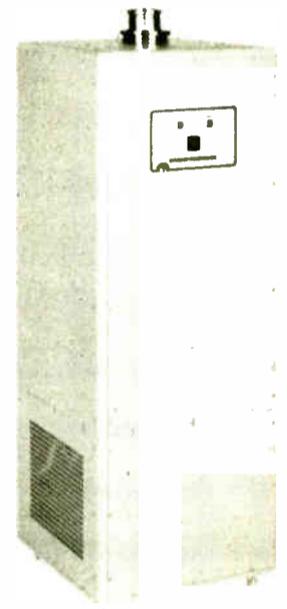
example, would be allocated less data than music, and therefore, free up space for other programs and information during that time. Efficient use is the goal.

At the moment there are five DAB transmitters in the area surrounding London, providing coverage for about 20 percent of the U.K. population. By March 1998, 27 transmitters will reach about 60 percent of the population. The BBC is working directly with GEC Marconi Communications Ltd. in the development of the transmitters and other DAB equipment.

The BBC always has had a strong commitment to radio, and it hopes that the advance into DAB will allow radio to "retain its place as a vibrant, creative, informative and flexible medium in the new communications age." 

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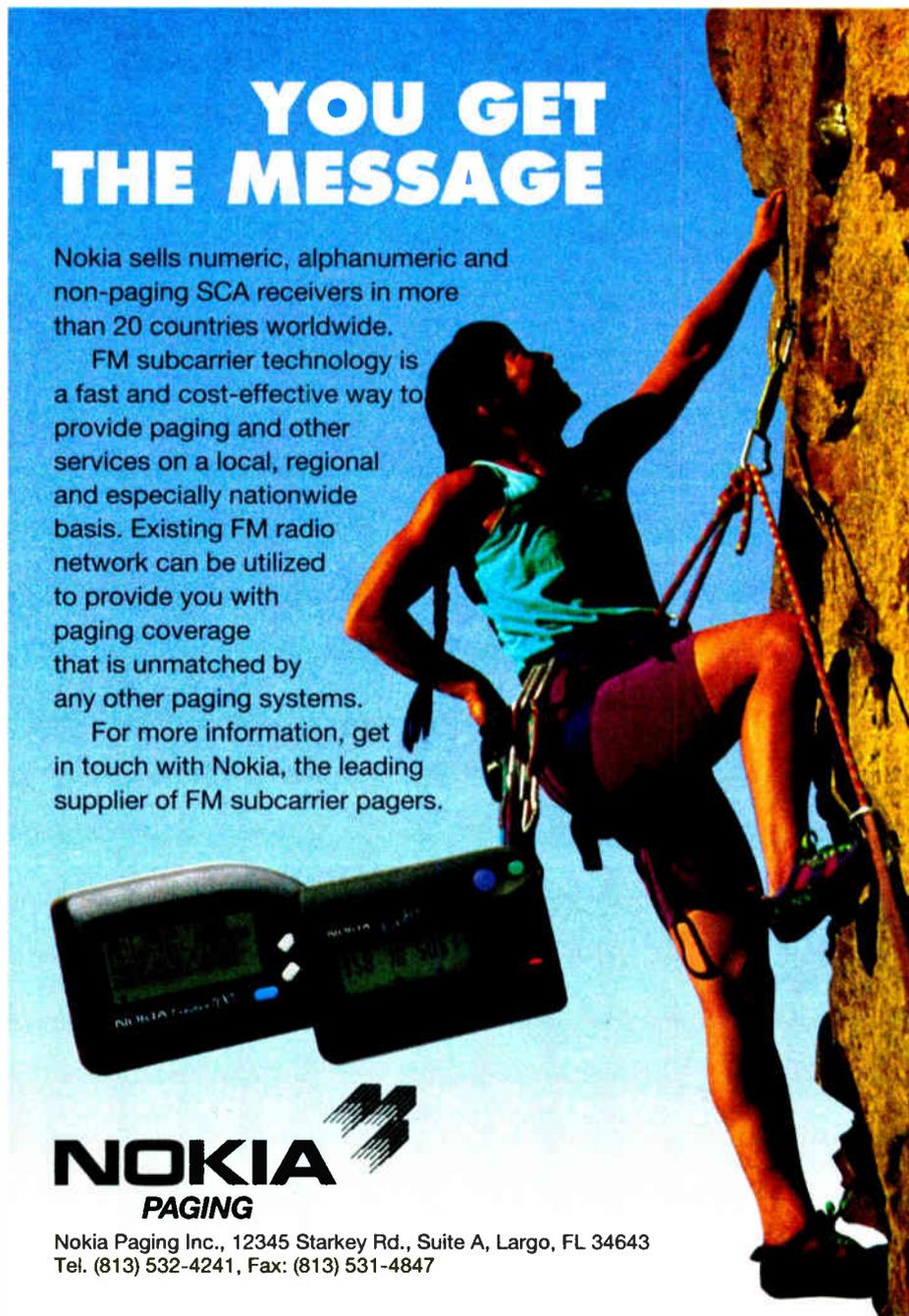
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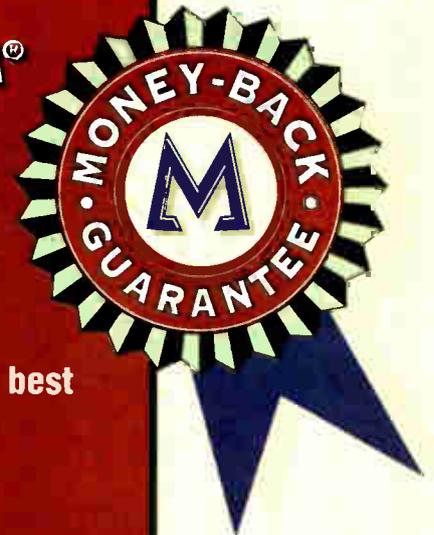
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Germany Launches DAB in Bavaria

► continued from page 1

selected people in the state. According to Helwin Lesch, president, Bayerische Medien Technik GmbH, the company responsible for coordinating this project, there are not 4,000 receivers available to start with, but he expected that problem to be solved within a relatively short period of time.

It was announced some time ago that Grundig would be supplying receivers for the project. Its new DAB receiver, the DCR1000DAB, is designed for mobile use. It was recently announced that Bosch/Blaupunkt would also have receivers available for the DAB project, which include a small screen for viewing the data transmission services.

The first of the receivers were given out to dignitaries, politicians and researchers. The cost of the receivers, which would normally be quite high, is being underwritten by the project.

Behind the scenes

While many of the people participating in the tests will be enjoying the services of DAB, a wide variety of studies will be going on behind the scenes, including: investigating the willingness of the public

to accept the technology and the programming, as well as comprehensive technical measurements to make sure that Eureka-147 system is performing as well as expected.

Unique cooperation

What also makes the Bavarian project somewhat unique is the cooperation between the public and private stations. Programs covering the entire test area include five programs from the public station, Bayerischer Rundfunk, and Antenne Bayern, the largest private station in Bavaria, that is broadcasting its regular program and an additional new one for DAB.

For the program-related data programs for the entire area, there are eight groups sending out programming. They include Bayerischer Rundfunk, Antenne Bayern, RT.1, More and More Communications and Fraunhofer Gesellschaft.

The pilot project is also transmitting separate regional programming into both Munich and Nurnberg, and beginning in the spring of 1996, separate regional programming will also be available for Ingolstadt.

The stations providing regional programming for Munich are all private,

including Radio Energy, Aravelle, Charivari, and VIVA 2. Arabelle and Charivari are also distributing program-related data services. The list of stations for Nurnberg includes three programs from Funkhaus Nurnberg, Radio Energy, and Radio Fantasy.

The competition for program distribution for the entire area was quite fierce. Thirty-one different stations and groups applied for the three transmission channels being offered, in the end two of the three went to "the Antenne" as Antenne Bayern is known.

Antenne Bayern is using the opportunity to rock Bavaria in a whole new way. The second frequency it was awarded is being used for the start of an Album Oriented Rock (AOR) station. The president of Antenne Bayern, Karl Heinz Hoerhammer believes that the AOR format will not only attract younger listeners but will show off the technical superiority of the DAB system.

Meanwhile, Bmt's Lesch said that from the start Bavaria was committed to making this a joint effort between the public and private stations and he is quite pleased of the level of cooperation to date. He, along with the other groups involved are convinced that sharing the airwaves is the only way DAB will be a public success in Bavaria. ☺

AES Dazzles with Wide Display of Innovations

by Alan R. Peterson

NEW YORK "Audio in an Interactive World" was held here Oct. 6 through 9 at the Jacob K. Javitz Convention Center. The event set an attendance record of more than 18,000 participants and over 350 exhibitors.

Broadcasters present at the 1995 Audio Engineering Society convention saw the differences remaining between audio products and techniques for radio, music production, video posting and multimedia continue to blur. The digital infiltration continues into all fields, offering power and speed to users.

However, modern-day analog technology

well. Both Roland and Fairlight presented compelling demonstrations of their products' capabilities in this field.

A notable entry in the DAW marketplace came from Fostex, as it debuted its new DMT-8 system: a portable recorder/editor which physically resembles a portable tape multitrack recorder.

Software-driven DAWs for MAC and PC platforms have gone beyond mouse control. Vestax is currently prototyping a MIDI-based fader board to be offered with their HDR line of hard disk recorders.

Where the crowds were

Exceptional interest was generated by Yamaha's new 02R digital console. Audio

Syracuse SBE Draws

by Alan R. Peterson

SYRACUSE, N.Y. There is a reason the Central New York chapter of the Society of Broadcast Engineers regional convention has such widespread recognition: They put on a very elaborate show.

So much so, the event drew engineers from hundreds of miles away, including Northern Pennsylvania, Massachusetts and Canada. Unofficial attendance figures from convention chairman John W. Soergel placed the number at more than 430 guests and 200 vendor personnel.

The annual conference and convention for SBE chapter 22 was held Sept. 29 at the Sheraton Inn in Liverpool, N.Y., a suburb of Syracuse. Fittingly enough, the Sheraton is located on Electronics Parkway here.

Highlights of the regional convention included technical papers, a tour of a remote production van and a visit from Dave Viglione of the Buffalo, N.Y., FCC office.

Exhibitors took up two large rooms in the complex with nearly 80 booths occupied by manufacturers, distributors and services. Among the more notable names, Sony Electronics, who possessed one entire wall of exhibitor space; Northeast Broadcast Labs, showing off digital equipment from Roland and Arrakis; and Nynex, with a compelling audio-video ISDN demonstration.

Syracuse-based companies were on display as well, including Wheatstone (broadcast and production consoles) and Benchmark (analog and digital mic preamps and distribution systems).

Technical papers were primarily video-oriented but included topics of interest to radio engineers. Among them, a talk on the Tektronix Time Domain Reflectometer and a workshop

on compression techniques presented by Sony.

Of particular interest was the appearance of Viglione from the Buffalo FCC office, who quipped, "This is my first farewell appearance," a reference to the phasing out of the Buffalo Field Office.

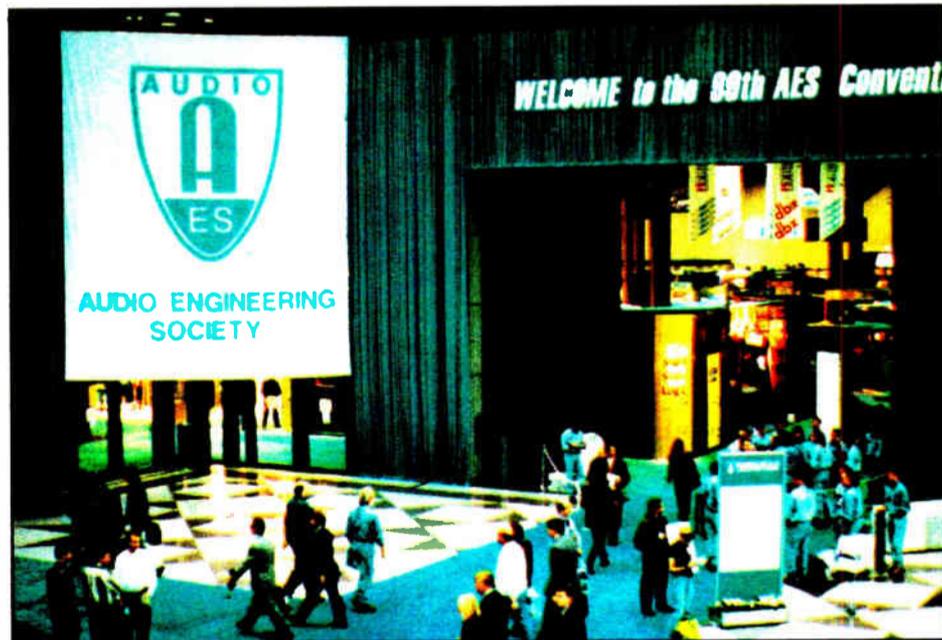
Viglione's topics included updates on the implementation of the new EAS system, the deadlines for stations to be in compliance and the wait for equipment to be type-accepted by the commission for EAS operation.

Viglione turned to the issue of tower ownership and how changes are being made in the applications process, as applied to modifying and registering towers. According to Viglione, these changes can eliminate as many as 10 to 20 forms now filed by tower owners and occupants.

Changes are also under way in the tower violations process. In the past, all occupants on a tower received notice of one or more violations. Now the owner of the structure will be the only one cited.

While generally known by most engineers but hardly ever said, Viglione told the roomful of SBE members and guests the FCC will no longer conduct random inspections of radio stations, but will perform inspections on receipt of a complaint. When asked by one station owner who will be responsible for "policing" their stations, Viglione called for a conscientious, voluntary effort on behalf of SBE engineers to do so.

The Central New York chapter 22 has been recognized by the SBE several times in the past for the quality of their regional conventions. Both local and out-of-state attendance at the 1995 conference proved this to be an accurate assessment. ☺



Attendees Entering Exhibition Hall at Jacob Javitz Center

continues to flourish as well with an abundance of new tube equipment, processing technology and a series of analog workshops.

Although new technology carried the show, the keynote speech had a passionate theme. Producer Phil Ramone stressed a need to "reach somebody emotionally" with audio; an objective easily missed in a tidal wave of technology.

DAW of a new day

Digital audio workstations (DAWs) at the AES show came with a flurry of new features. Now a single system can be appropriate for both radio and music production with only a software alteration. Systems with optional video or timecode sync can perform post-production for television as

professionals from broadcast, music production and video attended continuing demonstration workshops on the mixer.

Alesis and Panasonic debuted enhanced versions of the Alesis ADAT modular digital multitrack recorder. The basic design was released in 1991 and uses standard VHS videocassettes to record eight tracks of high quality-digital audio (look for details on both machines in *Studio Sessions* in this issue of *RW*).

Fairlight and Sonic Solutions conducted ongoing demonstrations of audio-for-video systems. Spectral's radio production suite drew broadcasters and radio production directors.

Laptop workstations were also in big demand, as evidenced by Roland's DM-

continued on page 11 ►

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World Radio History

Innovations Dazzle at AES

► continued from page 9

800 system, the SADiE portable and the afore-mentioned Fostex DMT-8.

Recordable media

CD recorders are no longer hefty components requiring several rack units of space. Recorders and duplicators are now small enough to occupy a drive space in a PC. Hardware from Yamaha, K&S Jukeboxes, Digital Audio Labs, IPC Technologies and others were shown by Revelation Products Corporation. Desktop production and simultaneous duplication of 20 CD-Rs or CD-ROMs per pass is possible with this new technology.

Of particular interest was the inclusion of Omega removable disk drives in E-mu and Roland products. The Omega JAZ consists of two hard disk-type platters in a hefty composite case. When inserted into an Omega drive, a rigid steel band is pushed aside to offer the read-write heads access to the disk surfaces.

In their basic device configuration, the JAZ can store 1 GB of sample memory or audio data. It will be interesting to see if any other companies adopt the Omega device as a new default standard for high-capacity removable audio media.

Magnetic tape is not down for the count just yet. Exhibitors proudly displayed analog and digital tape-based recorders, including Tascam's portable multitracks. Digital units from Alesis, Fostex, Nagra, Otari, Sony and Studer rounded out the exhibitors of tape-based recorders.

The latest incarnation of Otari's classic 5050 two-track analog reel recorder was shown at their booth, along with the comment "We still make and sell a lot of these machines."

Technology

New DSP developments from Motorola have yielded the 56009 Digital Signal Processor.

While not yet available, the 56009 is derived from Motorola's Symphony family of processors, with enhanced features such as large on-chip memory (without retrieving external code), an 80 MHz internal clock and the capability to process a variety of digital audio compression functions. Present applications requiring this much processing power include Dolby AC-3, MPEG Layer II and Digital Theater Systems.

The 56009 joins the 56004 processor, which is used extensively in digital EQ, automotive sound systems and audio/video receivers.

Analog Devices, Inc. conducted live demonstrations of their award-winning analog and digital signal processing circuitry. These devices have found their way into consumer and professional audio applications and broadcast equipment.

Compression and transmission

Products and methods of audio data compression and transmission were of great interest to broadcasters.

Audio Processing Technology displayed the DRT-128 Digital Reporter Terminal, designed for outside broadcast of news and sports events and delivery of high-quality audio over ISDN lines. For PC audio, the ACE100 Range expansion card and X-Console software combine to form a newsroom audio editor capable of recording and replaying compressed and uncompressed audio.

Dolby Laboratories featured the DolbyFAX system. This uses ISDN lines to transmit high-quality digital audio for professional recording, film and video applications.

Comrex Corporation drew interest with the DX200 digital codec, capable of CD-quality real-time audio. Comrex products are available for G.722, apt-X and MPEG Layer II algorithms and suitable for a number of applications and budgets.

CCS Musicam demonstrated their program delivery service for transmission and storage of Musicam-encoded broadcast material. The system allows for transmission, storage and auditioning of audio and a "cart wall" environment for archiving.

Seminars and speeches

The keynote address was delivered Friday afternoon Oct. 6 by eight-time Grammy winner Phil Ramone. The message delivered was simple and direct: "Reach someone emotionally ... find the emotional tie between musicality and technology."

With the importance of audio-for-video and enhanced technologies such as three-dimensional sound, Ramone's message to go for the emotion of the audience — not just a technically-perfect sound — was an important one.

Broadcast interest was high for a talk given by John McCarthy and John Stewart of the Canadian Broadcasting Corporation: "Producing Radio Drama Using Networked Digital Audio Workstations".

Slides of the new state of the art facility drew reactions from the audience, including shots of a fully-equipped kitchen/bathroom for ambient effects, multitrack music rooms and a hallway with trapdoors revealing various surfaces to enhance real footsteps effects.

A surprise was waiting for participants in the "New Solution to the Unbalanced-to-Balanced Interconnect Problem," hosted by Rob Silfvast of Euphonix Inc.

The patented method uses only a single resistor in a key location to achieve the noise-rejection capabilities of a balanced audio circuit. Comparisons to this method were drawn to direct boxes and transformers, but the data proved the single-resistor method to be sound.

"Audio Compression for Network Transmission" drew an audience interested in sending audio over the Internet, and a two-part session on "Low Bit-Rate Audio" gave members a greater understanding of data compression methods and advantages.

Engineers interested in studio design and equipment had their choice of sessions on "Acoustic Diffusion", "Aurilization and Room Acoustics" and "Perception and Subjective Evaluation".

"The ISDN Studio" workshop was presented Sunday, Oct. 8, with demonstrations, discussions and slides of various ways studios can use the power of ISDN. While concentrating mostly on studio/artist integration, information at this workshop was of great value to broadcasters looking to enhance their station's versatility with remote ISDN broadcast capability.

□ □ □

Look for a review of new products exhibited at the AES Convention in the Nov. 15 RW.

Country King Of the Radio

by Lynn Meadows

NEW YORK "Everybody's gone country," sings Alan Jackson at the end of his popular single and that applies to radio too.

Country remains the leading radio format according to the Katz Radio Group's report, National Format Averages for spring 1995. The report tracked programming performance over the past 10 years.

The report indicated that '70s, oldies, urban AC and alternative rock formats also experienced gains. News/talk stations were still doing well — thanks to the O.J. Simpson trial.

While the number of country stations increased, the Katz Radio Group indicated that the format had fractionalized into two groups with one targeted to younger, rock-based listeners and another aimed at older, soft/gold oriented listeners.

There was a large increase in the number of stations with an alternative/modern rock format. Katz concluded that the format had risen above "niche" status to be a strong player in many markets.

Gold-formatted stations were also doing well despite the increase in '70s-based programming formats. According to the Katz Radio Group, this was extra proof that "70s oldies and gold stations appeal to two different groups of listeners."

The report showed that urban AC also attracted new stations but not at the expense of urban contemporary formats. The Katz summary said that "the average market now has more stations appealing to the black audience and more crossover listening is taking place."

The Katz Radio Group analyzed 4,065 radio stations in 161 Arbitron markets to produce the figures for the study on format classification.

Liability Rule Opens Coffers

WASHINGTON Monetary relief may be in your future if your station uses an underground storage tank (UST) to store petroleum for your generator.

The EPA issued a Lender Liability Rule in September that will make it easier for owners of USTs to get the capital necessary to upgrade their tanks.

By Dec. 22, 1998, all USTs must be protected against corrosion and have spill and overflow prevention devices. That means tanks installed before Dec. 22, 1988, have to be replaced or upgraded.

In the past, some lenders were hesitant to make loans to owners if the property used as collateral contained a UST. Lenders worried that they would be burdened with the environmental responsibilities if they had to foreclose on such a property.

"Until now, EPA believes that concerns over environmental liability have made a significant number of lenders reluctant to make loans to otherwise credit-worthy owners and operators of USTs," the rule read.

The EPA's new rule takes effect Dec. 6. A lender will be exempt from compliance with UST requirements on three conditions: it holds an ownership interest on the property as collateral; it does not engage in petroleum production, refining and marketing; and it does not participate in the management or operation of the UST.

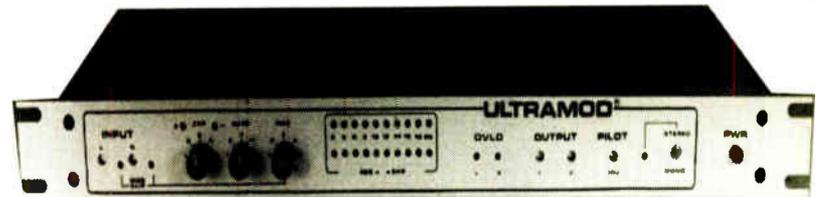
Unless another operator at the site can be held responsible for UST regulatory compliance, however, the lender will be responsible for emptying and closing the UST within 60 days after a foreclosure.

By making lenders feel more at ease about their responsibilities, the new Lender Liability Rule should open up the coffers for stations needing capital to make UST improvements.

— Lynn Meadows

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ROOTS OF RADIO

Radios Were Not Built in a Day

by Dan Hindman

BUFFALO, N.Y. On the anniversary of radio, let me try to explain the difficulties I had to overcome as a small boy just to bring "music" into our home.

In the 1930s, radio was having a good start and I was about 10 years old. I remember going to someone else's house to see and listen to a radio. It was the first time I ever had a chance to put on a set of earphones and listen to someone talking or playing music. The owner mentioned how much better his radio was than the old crystal set he had.

No money

Because I did not have any money, a crystal set looked pretty good to me. The only way to get a set was to make one. I went to the library to get some information but old magazines provided most of the detail.

First, I had to make the crystal — a small piece of lead with imperfections on the top to create a rectifying action.

I had a little area in the basement next to the coal bin where I built things too dirty to build upstairs. I put some lead BBs (air gun pellets) in an old iron spoon and inserted the spoon into the flames of our hot water heater. When the lead melted to a liquid, I poured it into a metal bottle cap with the diameter of a dime.

Then, before the lead had a chance to

cool, I dropped a little yellow sulfur on top. The sulfur smoked and turned black and when it cooled, it formed the basic crystal which is the heart of the crystal set.

Of course, a year later it was possible to buy a crystal ready made using a piece of galena (lead oxide) in place of the burned sulfur.

Some of our wealthier neighbors had battery radios. On the floor behind their radios was a line of batteries that was connected to the radio. Every night when they turned the radio off, they would connect all the batteries to a battery charger so the next night they could listen to the radio again. At that time, everyone would sit around the radio with earphones on their heads to listen.

Earphones were not too hard to come by because the new radios came with loud speakers. Needless to say people preferred to listen without earphones which left a few earphones around that a 10 year old boy could have for cutting a few lawns.

Heavy sounds

The earphones were heavy weights consisting of two coils of very fine wire. The coils were wound on a soft iron form shaped like a spool of thread.

Lying across but not quite touching the two spools was an iron diaphragm. The electrical signal passed through the coil vibrating the diaphragm at the same speed as the signal passing through the

coils. Up until a few years ago, your telephone receiver was basically the same old earphone.

Getting back to the crystal set, one of the problems was finding enough wire to wind what was then called the tuning coil. I also had to find enough wire to suspend an aerial (antenna) high and 200

The tube was cool so I removed it. I could remove seven of the tubes and the radio worked just as well.

feet long. I managed to get enough wire for our antenna and turning coil by taking apart electric motors, transformers, and anything else with wire.

The basic construction of a crystal set consists of a long high antenna connected to one end of the tuning coil. The other end of the coil was connected to ground. The local radio station transmitted its signal that was collected by the antenna. The signal would pass through the coil to ground. If the coil was wound to favor the local radio station with the correct number of turns, a stronger signal would be available to travel to the crystal.

Cat's whiskers

To get the processed signal out of the crystal and sent to the earphone, I had to find the best spot or location on the crystal. To accomplish this, I used a "cat's whisker." A cat's whisker consists of a piece of spring wire, fastened close to the crystal but not touching and capable of being bent and loosely positioned on the crystal.

With everything wired correctly, I would put on the earphones and adjust the cat's whisker until I heard a station. If anyone walked by while I was listening, it would vibrate the cat's whisker and I would have to reposition it to get the station back.

A crystal set was a great idea if you lived in a town with just one radio station. If there were more than one station in town, you would hear the strongest station the loudest with the other stations in the background. Sometimes the other stations were just as loud depending on their power and location.

Your choices were to adjust the turns on the tuning coil or wait until the other stations went off the air and only one remained.

I had two major problems building my

first crystal set: my father and my mother.

I did all my crystal making in the basement and my father thought I would burn the house down. I guess I would feel the same way if I saw my 10-year-old son run across the basement with a red hot spoon full of melted lead, pour it into a bottle cap sitting on a wooden box, and throw yellow sulfur into the lead. This filled our basement with smoke and left a pungent odor that lasted several weeks.

Unbelievable

My mother could not believe that music could come from the air without batteries or being connected to the house current. Sometimes a strong station would come on the air and she could hear it if the earphones were just laying on the table.

Sometimes, I picked up out-of-town stations late at night by waiting for the local stations to go off the air. My mother would come into my room just to make sure I was not connected to any form of power that could cause problems.

Radios were improving by then. Instead of batteries, they operated on regular house current. People would buy a radio based on how many tubes it had — just like buying a car and people bragging about the number of cylinders. Everyone

continued on page 22 ►

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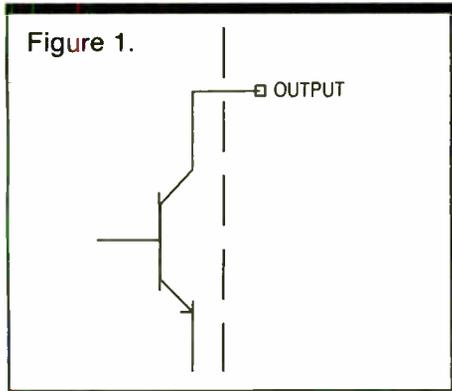
BOTTOMLINE BROADCASTER

Create an Organized Studio Wiring Scheme

by James Murphy

MORGANTOWN, W.Va. It seems that every time I install a new piece of audio equipment, I end up connecting at least as many, if not more, control circuits.

I remember back in the old days (pt-toeey), the only wire you needed when installing consoles, tape recorders or phone equipment was just shielded audio cable. Nowadays we have tallies, open collectors, input data and dry closures;



not to mention RS-232 and even parallel connections. More often than not these newfangled turbo-gizmos required multi-conductor cables just to accommodate the control circuits.

By the time you add a few of these magic boxes into your scheme — if you do not have some kind of system — it will look as though some giant bird has been making trips to the scrap wire heap and is building a nest in your equipment racks.

Before we go any further into systems, we might explain the different types of inputs and outputs to help you understand the importance of having an organized method of handling them.

Outputs

Most outputs in modern equipment are called open collector, or just OC for short.

Figure 1 shows the internal schematic of this type of output. The first thing to remember about this output is that you cannot check its operation with an ohmmeter. In fact, the meter should read infinity with the equipment off because you are reading across two PN back-to-back junctions.

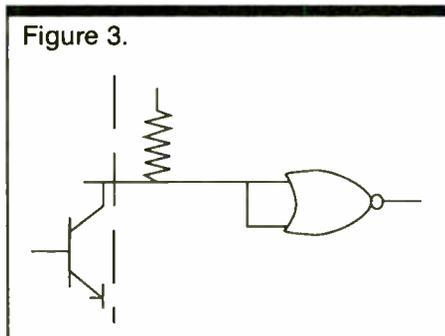
To determine if this output is working properly, you essentially need to wire it up. This circuit requires a load and supply in order to operate. If you cannot do that, you will need to construct a test circuit similar to that shown in Figure 2. With these few components, you can determine whether an OC circuit is turning on or not.

If you build this, limit the circuit to approximately 20 milliamperes (mA) to keep from burning out the equipment's output transistors. Most of them will handle more, but check your service manual before you exceed 20 mA. If you use a 9 V battery, use a 470 ohm resistor. Adjust this resistor value if you use a higher supply.

Understand the output transistors will have this voltage across them when they

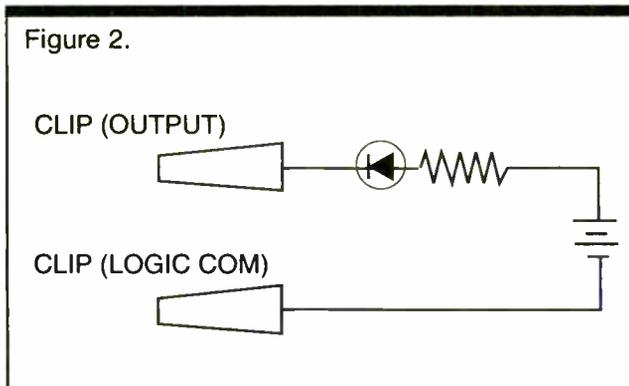
are off, so keep your external voltage supply low.

All that having been said, now you can determine if the output is working properly. Connect the clip to an output and the other end to a logic common, then set



the equipment to activate the respective output. The LED will light when the output becomes active or "turns on."

This type of output should only be used to drive a lamp or relay. If you try to interface this output into digital logic using a pull-up resistor or similar scheme as shown in Figure 3, remember that the collector does not sink completely to ground. In fact, the voltage level drops to only about 1.2 V. This is not considered a valid logic-Low condition and might cause erratic logic behavior.



In our example the output of the NOR gate would not go high at turn-on.

The best way to interface with this type

of output is with a reed relay properly protected by a diode and used with a voltage of 5 to 12 V. Use the dry contacts of this relay to perform logic or to control external functions. Used with a pull-up resistor, the relay contacts will provide proper logic levels to downstream gates, albeit at a slower transition.

Inputs

Figure 4 shows a typical transistor input. This type requires a logic-High condition, or voltage transition, which will provide the base current necessary for turn-on.

This circuit is rare, mainly due to the narrow input requirements. Placing too much voltage at the input can easily destroy the BE junction while insufficient bias can cause erratic or sometimes bizarre behavior of the equipment. As a cure, most manufacturers have gone to opto-isolator circuitry to make input requirements more (geek term) "user friendly."

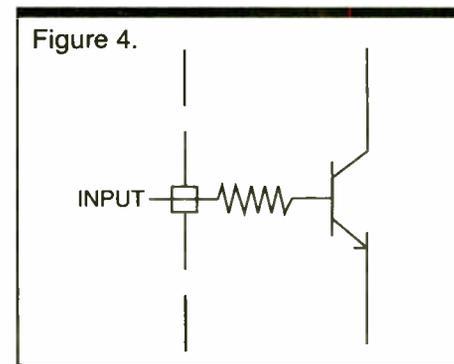
Figure 5 shows the topology of an opto-isolator circuit in a chip. The transistor will perform the necessary input change in logic when the diode is "lighted." This can be done by placing a negative voltage at the cathode or a positive voltage at the anode, whichever protocol the equipment uses.

The idea here is: If the diode is forward-biased to any reasonable level, the transistor will do its job.

As I said, when you begin connecting these inputs and outputs to various distribution amplifiers, switchers, routers and consoles, wiring can become a mess. A little thought and preparation can avert this wiring jungle, and can

make troubleshooting much easier when the time comes.

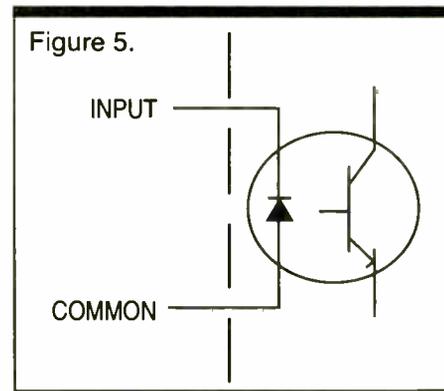
In Figure 6, we use a terminal block that should be mounted in an accessible, well-lit place. It doesn't matter what type



of termination you use as long as it is adequate for present and future connections.

Incidentally, it is wise to terminate all connections to the equipment. Don't fall into the trap of thinking that you are going to use only those inputs required at the outset. Eventually you will use them all. Trust me.

The wiring scheme is simple. Connect the positive side of the (external) power supply



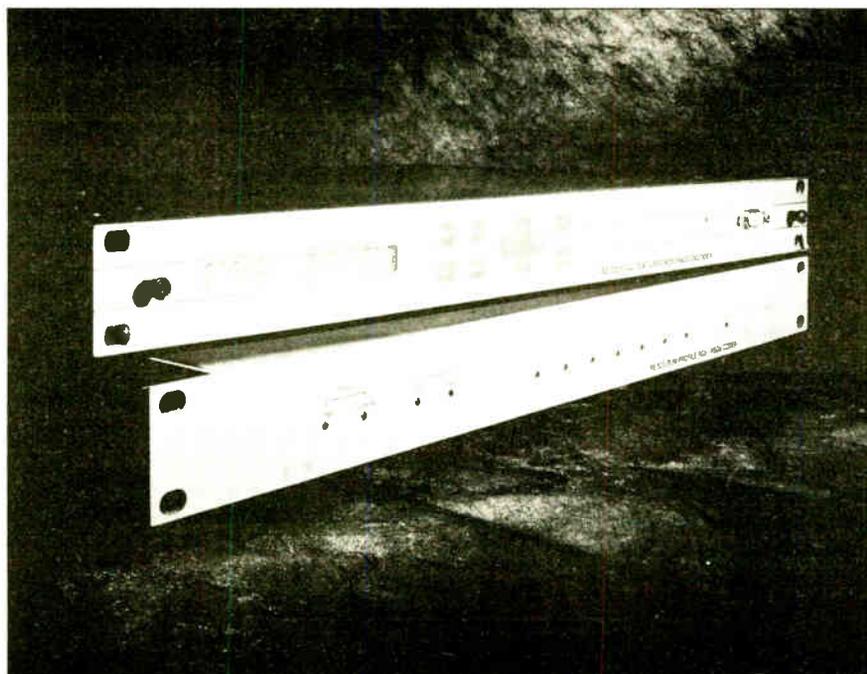
to the top termination. This should be protected. Next, jumper down the block every other termination, and mark these as "Pull-up 1," "Pull-up 2," and so on. Connect the negative side of the power supply to the bottom terminal, then on to the equipment's logic common.

More connections

Next, connect each output from the equipment to the even terminations down the block. Mark them "Out 1," *et al.*, to

continued on page 14 ►

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FEEDLINE

Use Vectors to Understand DA Patterns

by W.C. Alexander

DALLAS How do all those towers make the station directional? I have had station owners, managers, program directors and listeners ask me that question countless times over the years.

One way is to use a bunch of techno-jargon. Remember what they taught you in college? Either dazzle 'em with brilliance or baffle 'em with ... well, you know.

Another option is to get out a pen and paper and sketch out a simple vector diagram of a two-tower, zero-null array. This is most likely what your college instructor used to introduce you to the principles of directional antenna operation, and it works!

Beyond the curiosity of nontechnical people who are exposed to or otherwise involved in some way with a directional antenna (DA), I have gotten a lot of blank stares from station engineers, too. These people are supposed to know exactly how all this stuff works, right? Well, maybe not.

I have found that most engineers who have not had a good deal of experience with DA design and tune-up often have only a surface knowledge of DA theory. A lot of station engineers that have been charged with the maintenance and well-being of one or more complex directional antenna systems fall into this category. They understand the basics and know the significance of antenna monitor indications and base current values, but when something goes wrong, they do not have a clear idea of which way to go.

An understanding of complex numbers, some basic directional antenna theory and skills in the use of vector addition can point these folks in the right direction.

The vector formula

As a first step to understanding the use of vectors, we need to take a glassy-eyed look at the DA vector formula in its entirety. This will give the mathematicians who are reading this something to do while laying the foundation for some (much) simpler

calculations later for the rest of us. The equation to express vectors for a directional array is the same equation that can be used to calculate the pattern shape for a directional array of *n* towers.

This equation is:

$$E = \sum_{k=1}^n E_k f_k(\Theta) \angle \beta_k$$

Where:
E = total effective field strength vector at unit distance (P) for the antenna array with respect to the voltage vector reference axis.

k = *k*th tower in the directional antenna array.

n = total number of towers in the array.

E_k = magnitude of the field strength at unit distance in the horizontal plane produced by the *k*th tower acting alone.

f_k(Θ) = vertical radiation characteristic of the *k*th tower.

Θ = elevation angle of the observation point (P) being measured up from the horizon in degrees.

$$\beta_k = S_k \cos(\Phi_k - \Phi) + W_k$$

(Phase relation of the field strength at the observation point P for the *k*th tower taken with respect to the voltage vector reference axis. *S_kcos(Φ_k - Φ)* is the space phasing portion of *β_k* due to the location of the *k*th tower and *W_k* is the phasing portion of *β_k*.)

Where:
S_k = electrical length of spacing of the *k*th tower in the horizontal plane from the space reference point.

Φ_k = true horizontal azimuth orientation of the *k*th tower with respect to the space reference axis.

Φ = true horizontal azimuth angle of the direction to the reference point (P) measured clockwise from true north.

W_k = time phasing portion of *β_k* due to the electrical phase angle of the voltage (or current) in the *k*th tower taken with respect

to the voltage vector reference axis.

Got all that? Yeah, me too.

This equation, when applied to a directional array, will yield a complex number that represents the field strength and phase of the signal arriving at a particular observation point from each element in the array. I will not try to explain the use of the formula in its entirety but rather will use part of it to plot vectors.

An easier way

To see the vectors for a particular azimuth, all we really need to know are the theoretical parameters and the following formula:

$$\beta_k = \Theta_k + [S_k \cos(\Phi - \Phi_k)]$$

Where:

β_k = phase relation of the field from tower *k* on the specified azimuth.

Θ_k = phase of tower *k* with respect to the reference tower.

S_k = electrical length spacing of tower *k* from the reference tower.

Φ = true horizontal azimuth angle for which the vector is being calculated.

Φ_k = true horizontal azimuth orientation of tower *k* from the reference tower.

If you look closely, you will see that this is actually the rotational portion of the other formula. At first glance, it looks a

lot easier, but what are all those variables? Look at a typical set of directional antenna theoretical parameters and see if things start to make sense. Look at Table 1.

TABLE 1.

Tower	Field	Phase	Spacing	Orientation
1	1.000	0	0	0
2	1.000	90	90	0

Does this look familiar? It should. These are the theoretical parameters of a typical two-tower directional array. Every DA has a set that includes the same parameters. The values listed under the "Field" heading are ratios. All other values are in electrical degrees. The reference tower is tower 1. Plug these parameters into the vector formula and see what happens.

Θ_k: This is the phase of the tower with respect to the reference tower. In this case, the phase of the reference tower with respect to itself is zero, and the phase of tower 2 with respect to the reference tower is 90 degrees.

S_k: This is the spacing of the tower, in electrical degrees, from the reference tower. In this case, the spacing of the reference tower with respect to itself is zero, and the spacing of tower 2 with respect to the reference tower is 90 degrees.

Φ_k: This is the orientation of the tower, in electrical degrees, from the reference tower. continued on page 16 ►

Organized Wiring Scheme

► continued from page 13

match the pull-ups directly above them.

Voilà. You now have an organized, systematic wiring scheme requiring only a single-pair cable to energize a relay or a lamp. This will prevent the nightmarish scenario of running a single wire to a relay and a single conductor back to a supply; a situation that will — at some point in the future — send the most learned colleague to the nearest aspirin bottle or pub mumbling your name peppered with expletives.

Inputs can be handled the same way. If a negative supply is needed, simply terminate the negative and fan it up the block, then connect the positive to the block's first terminal and on to the equipment. The inputs are then terminated between the voltage terminals and labeled as "Input 1," "Return 2," and so on.

Again this permits a paired cable to be

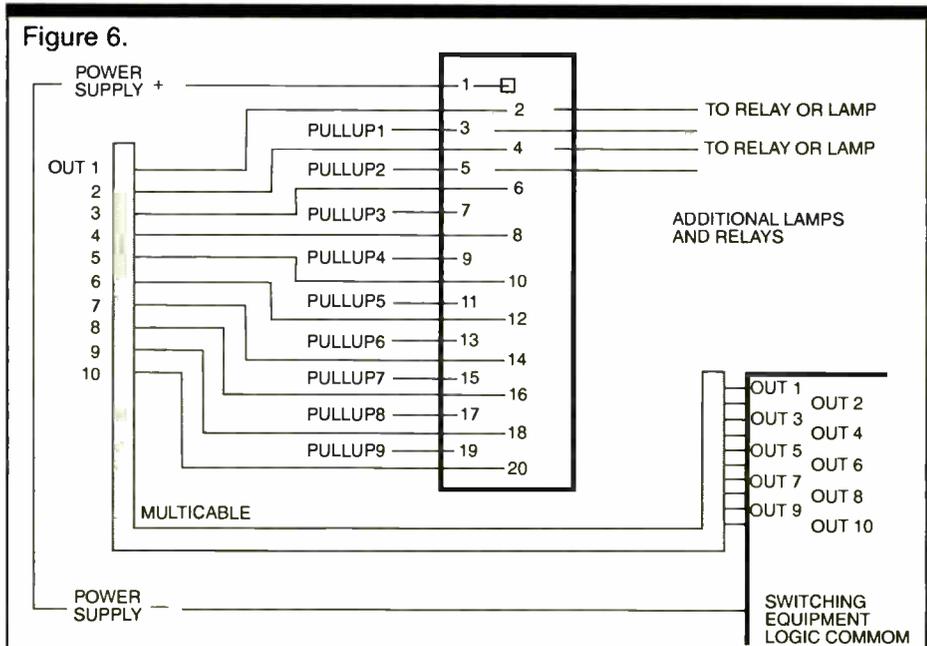
run to a set of switch contacts or relay contacts. Closure activates the opto-coupler, and the rest is, well, magic.

Some equipment will permit you to connect to its internal supply, but usually the manufacturer requires you to supply your own pull-up. This is wise thinking as it prevents external short circuits from spiking or sinking a bus that could damage computer and memory components.

Although it will take a bit more time at the outset, you will be rewarded many times over when you need to troubleshoot or add new functions. If you don't have the parts in your junk box for this one, you had better look for a new junk box.

□ □ □

Jim Murphy is director of engineering for the West Virginia Radio Corporation. He can be reached via e-mail at jmurphywv@aol.com or by telephone at 304-296-0029.



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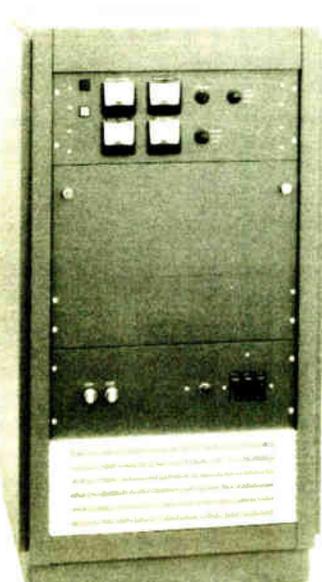
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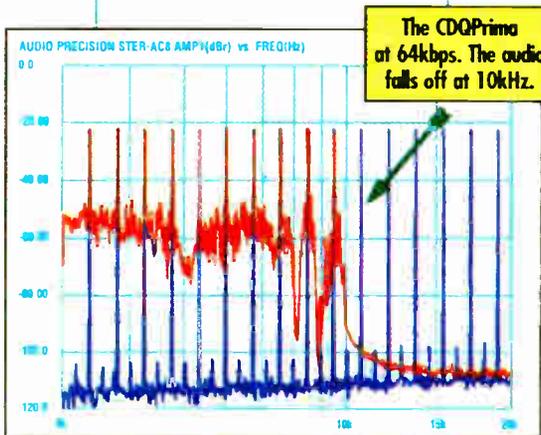
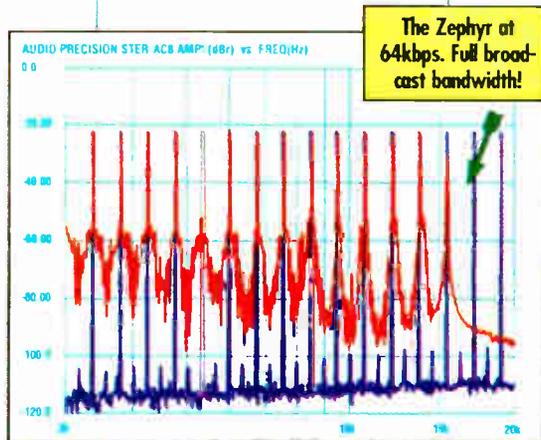


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Understanding Patterns

► continued from page 14

tower. In this case, the orientation of the reference tower with respect to itself is zero, and the orientation of tower 2 with respect to the reference tower is 0 degrees, or true north.

Φ : This is the azimuth from the center of the array to the observation point. Another way to express this is as the azimuth on which we wish to compute the vectors.

Start with $\Phi = 0^\circ$ true. When we plug in all the parameters for tower 1 (the reference tower), we come up with a value of 0 degrees. This is the same as the phase of tower 1, and this will always be true of the reference tower.

If the phase of the reference tower had

been other than 0 degrees, the formula would have yielded whatever the phase of the reference tower was. In other words, it is not necessary to run the reference tower through the formula — only the other towers in the array. Just know the field and phase of the reference tower. The complex number representing the vector for tower 1 at an azimuth of 0 degrees true, then, is $1.000\angle 0^\circ$.

The second tower

Now run the parameters for tower 2 through the formula. When I did this, I came up with a phase of 180 degrees, so the vector for tower 2 at an azimuth of 0 degrees true is $1.000\angle 180^\circ$.

With these numbers in hand, plot them on a piece of paper. You will need nothing more than a ruler and protractor. Starting near the center of the page, make a dot to represent the starting point. Using the protractor and ruler, draw a line 1.0 inch long at an angle of 0 degrees, or straight up on the page. This represents the vector of tower 1.

Now, move the protractor to the end of this line (the north end) and draw the vector for tower 2. This line, 1.0 inches long at an angle of 180 degrees (or straight down), will lie back over and completely cover the tower 1 vector, with the end falling back at the starting point. The resultant vector is the distance and angle between the starting point and the end of the tower 2 vector. Since these points coincide, the resultant vector is $0\angle 0^\circ$.

This vector diagram for an azimuth of 0

degrees true shows graphically how at that azimuth the signals from the two towers completely cancel one another.

New heading

Now try the same thing at an azimuth of 180 degrees true. Remember that the vector for the reference tower is always the same; in this case $1.000\angle 0^\circ$. Plugging parameters of tower 2 and a 180 degree azimuth into our formula, a vector of $1.000\angle 0^\circ$ comes up. Draw the two vectors on paper, and it is easily seen that the vector from tower 2 completely adds to the vector from tower 1, yielding a resultant vector of $2.000\angle 0^\circ$.

Now try something in between. Plug in an azimuth of 90 degrees true and tower 2's parameters, and you should come up with a tower 2 vector for 90 degrees true of $1.000\angle 90^\circ$. Draw tower 1's vector of 1.0 inch at an angle of 0 degrees, then draw tower 2's 1-inch, 90 degree vector onto the end of that. If you measure the resultant vector, you will find it is 1.414 inches in length at an angle of 45 degrees.

You can see from this graphical representation that the signals from towers 1 and 2 partially add to produce a field that is greater than the field of either one, but less than the sum of the two combined. If you run the same problem for an azimuth of 270 degrees true, you will come up with the same vector.

Go ahead and try this at other in-between azimuths. When you get closer to 0 degrees, you get more cancellation of the two signals; when you get closer to 180 degrees, you get more addition.

What if you have more than two towers? Simple. Calculate the vector for each tower and draw it onto the end of the preceding vector. The resultant vector will still be from the starting point to the end of the last vector. When dealing with more than two towers, label the vectors as you draw them. It is easy to lose track if you forget to label them.

Now the vectors

Now that we have all these vectors, we have at our disposal a method of graphically depicting what is happening on any given azimuth with an array. This is particularly helpful when setting up an array or working to correct a problem.

By plotting the vectors on a given radial, you can see how different towers interact to create the resultant field on that radial. Many monitor points are on null radials, where complete or near-complete cancellation occurs. By plotting the vectors, you can visualize how towers pair-up on the radial.

In more complex arrays, pairs of towers often cancel other pairs of towers. Using vectors, you can get a mind picture of the best way to go about array adjustment.

What happens when you cannot achieve a null on a given radial? Often, this is caused by reradiation, which introduces an unknown or error vector into the equation. This is beyond the scope of this discussion, but I mention it because it is a common occurrence. More often than not, however, the effects of reradiation are very localized and do not affect an entire radial.

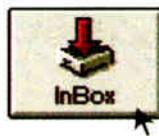
By bettering your own understanding of directional antenna theory, not only will you improve your own stock-in-trade, but maybe you will not get so many blank stares when you explain the mystery of the directional array to the general manager's golfing buddies.

□□□

Chris Alexander is the director of engineering at Crawford Broadcasting in Dallas. He can be reached at 214-445-1713.



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Relays Simplify AM Parameter Changes

Simple Circuit Provides Momentary Closure Output That Can Be Used to Switch AM Transmitter Day/Night

by Bob Henry

ALBUQUERQUE, N.M. With the many AM stations I have worked at, my experience has shown well-intended DJs (operators-on-duty) frequently forget change power and/or pattern for pre-rise and post-sunset authorization. Obviously, the solution to this problem is to incorporate a timer; the On state would be for sunrise parameters and the Off state for sunset parameters. Interfacing one, though, is another problem. The quick and easy solution would be to

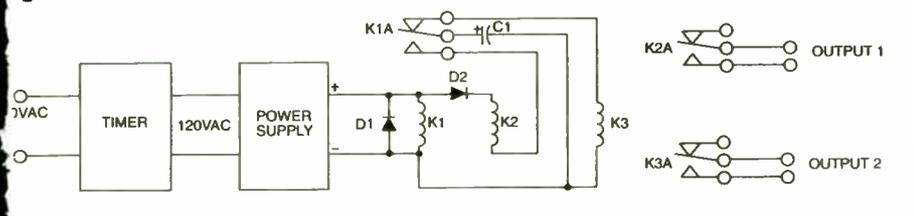
must occur as close as possible to the correct times. This is very important.

Since this is a two-state time switch, this system would probably not be useful for stations that have three or more transmitter operation parameters to change throughout a 24-hour period. However, if all that is needed is a sunrise/sunset adjustment, this circuit can prove advantageous.

Circuit description

Generally, all that is needed are momentary contact closures to make the switch, so the circuits described are designed to

Figure 1.



connect a timer and relay together. The normally open (N.O.) contacts could operate the On/Raise function of a transmitter and the normally closed (N.C.) contacts would handle the Off/Lower inputs. This is not a good idea, as it is comparable to someone holding their finger on the Up or Down button continuously after the control command had taken place.

Imagine starting your car and then leaving the key turned over to the "start" position after the engine is already running. You can see the problems this could cause.

Relays to the rescue

Here now is the solution to the problem: a simple circuit that will provide a momentary closure output that can be used to switch an AM transmitter between daytime and nighttime operating

make one or the other "output" contacts momentarily close for about one second (depending on the size of the capacitor and the relay coil resistance).

Relays provide real foolproof contact

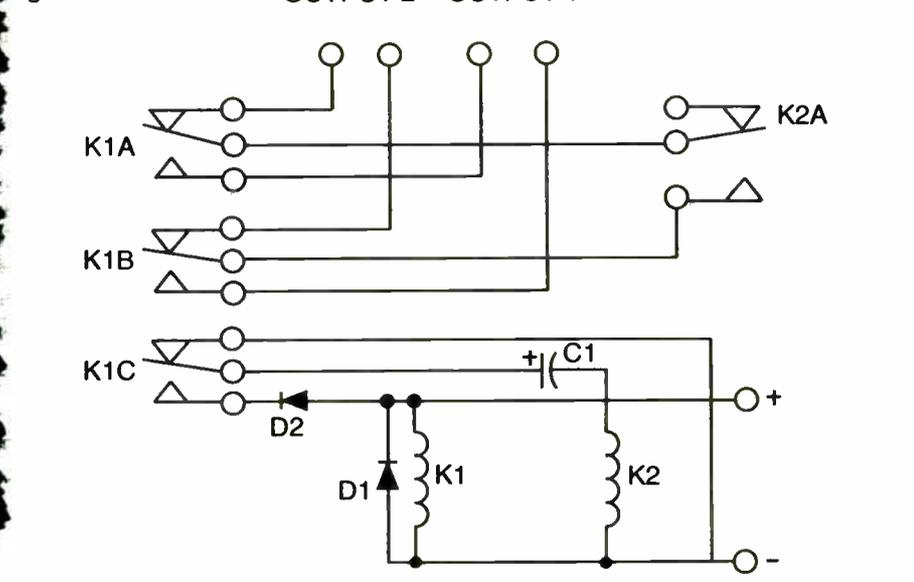
Parts List for Figure 1.

- C1: 470 mfd/25V
- D1, D2: 1N914 (or better)
- K1, K2, K3: SPDT relay, 320 ohm coil (Radio Shack 275-241)

closures and can generally be interfaced directly with an existing system. Such a circuit can be located at either the transmitter site or at the studio remote control.

All the parts can be obtained at a local Radio Shack, but because these circuits are not critical, "junk box" parts could be used with a little experimentation and electronic common sense.

Figure 2.



parameters. As long as the timer is programmed to do so, the switching will occur every day at the same time.

A couple of significant points to remember: The switching intervals of the timer need to be changed once a month to correspond with the sunrise and sunset times for the coverage area. The timer also must be fairly accurate, since switching the transmitter parameters

A Radio Shack digital timer (part number 63-891) is used for its accuracy, simple operation and battery backup in case of power outage. The power supply is a 120VAC-to-12VDC wall wart that should provide no less than 50 milliamps. I was lazy and bought one rather than build one.

In Figure 1, DC voltage is applied to relay K1's coil. When energized, the N.O. contacts close, charging capacitor

C1 through the coil of relay K2. This causes K2 to energize until C1 is charged. In both Figure 1 and Figure 2, the diodes provide isolation that prevent C1 from discharging back through the

Parts List for Figure 2.

- C1, D1, D2: same as figure 1
- K1: SPTT (triple-throw) relay, 12 V coil

relay coil of K1 when power is removed.

At this point, K1 relaxes and switches C1 across the coil of K3. K3 then becomes energized until C1 is discharged. When this happens, K3 relaxes.

K1 is energized, C1 (being discharged) is switched across Output 1 and C2 is switched to R1 where it is discharged.

When power is removed from the coil of K1, it relaxes and the discharged C2 is switched to Output 2. Now, C1 is switched to R1 where it is then discharged.

K1 can have a 120 VAC coil, which can be used with the timer described above. A 120 VAC coil prevents the need of having a power supply to operate the relay. However, a DC relay and power supply will work as well.

Figure 3A shows an example of a logic-type input similar to what is found in digital remote controls and how the circuit

Figure 3.

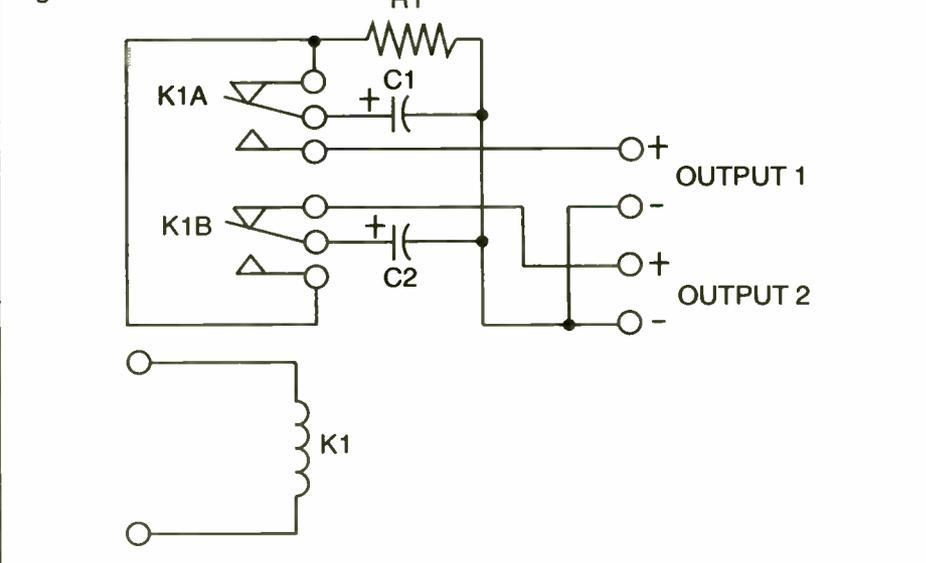


Figure 2 works in a similar way, but only two relays are used, due to the additional set of contacts shown on relay K1.

Here, C1 is both charged and discharged through the coil of K2. This means K2 will momentarily energize once power is applied and again when power is removed. The contacts of K1 simply route this momentary closure to Output 1 or Output 2.

Figure 3 shows just one DPDT relay with two capacitors and a resistor. The capacitor being switched to one of the outputs can perform a "momentary closure" from the + to the - in that the discharged cap acts as a short until it

shown in Figure 3 could be used. The value of pullup resistor R determines how long C1 and C2 take to charge. A 100

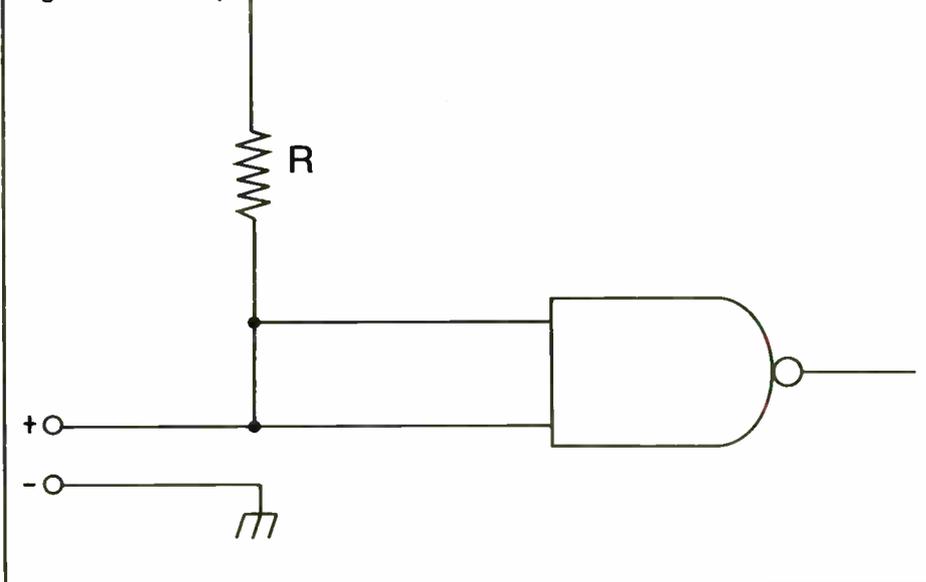
Parts List for Figure 3.

- C1, C2: 100 mfd/25V
- K1: DPDT relay (see text)
- R1: 10-100 ohm, 0.5 W

100 mfd capacitor has been chosen as a garden variety value for this purpose and should work satisfactorily.

Relays are easy to use and are still commonly available. In circuits such as these, they provide simple, cost effective and

Figure 3A.



becomes charged, at which point it looks like an open.

This is particularly useful for logic level switching requirements, such as is found in most logic-based remote controls (Figure 3A). It involves switching either C1 or C2 to one of the two outputs. When

foolproof solutions to circuit requirements that may have been thought to be done only in more complex ways.

□ □ □

Bob Henry is on the engineering staff of KRQE-TV in Albuquerque, N.M. He can be reached at 505-243-2285.

INSIGHT ON RULES

FCC OKs Unattended Transmitter Operation

by Harold Hallikainen

SAN LUIS OBISPO, Calif. On Oct. 2, the Federal Communications Commission (FCC) adopted rules that will allow unattended operation of broadcast transmitters. At this writing, the Report and Order is not yet available, but we can get an idea of the rules from an email exchange I had with FCC staff.

By the time this article is published, the full text of the Report and Order should be available on the Internet and on our fax server. I've noted that the FCC's gopher server seems to have more complete indexing of files than either the Web or ftp server, so you may want to check

there. There will be pointers to all related documents on our web server.

The Uniform Resource Locators for each of these sources are listed in table 1. Further, the EAS Memorandum Opinion and Order on the Petitions for Reconsideration is expected shortly. The integration of EAS with unattended operation promises major changes in the industry over the next couple years. I will keep you informed of the details on unattended, EAS, and other technical regulation concerns.

No ATS required

In the NPRM, the FCC asked whether stations electing to run unattended should

be required to have automatic monitoring and control equipment similar to the existing Automatic Transmission System requirements, or are transmitters stable enough to not require external automatic control equipment? The FCC decided to leave this up to the station. Further, if automatic monitoring was required, what parameters should be monitored?

The current practice, exercised by many stations, of determining transmitter output power frequently while not frequently determining the modulation level or carrier frequency does not, to me, put priority on the parameter most likely to cause interference. In nondirectional stations

without mode changes, it appears the parameter most likely to cause interference, especially in AM stations, is modulation, yet continuous monitoring of modulation was not required.

It would make little sense for the commission to require the monitoring of the number two or three likely cause of interference while not requiring monitoring of the number one cause. Therefore, it appears, the commission decided to leave the decision to the stations. They will dictate what parameters must be monitored, but will continue to require stations to comply with all limits on the station license or in the Rules. It appears the FCC will not cite a station for insufficient telemetry or control (except for the requirement outlined below).

The FCC will cite stations for operating beyond the terms of the station license in the Rules, whether the station knew of such operation or not.

In summary, no ATS required, but keep the station legal!

Three hour shutdown

Should a station discover it is operating beyond the terms of its license in a manner that could cause interference (overpower operation, overmodulation, off frequency, DA parameters outside limits), the station must correct the situation

Table 1 - Finding the Source Document

FCC Web Server	http://fcc.gov/
FCC Gopher Server	fcc.gov
FCC FTP Server	fcc.gov
H & F Web Server	http://slonet.org/~hhallik/
H&F Fax Server	805-541-0201

shut down within three hours of discovering the condition.

The NPRM originally proposed the existing three minute shutdown requirement for the ATS rules be extended to the new rules. Most commenters suggested this could cause loss of service to the public by conditions not likely to cause interference. They suggested a longer period of time to allow stations an opportunity to try to correct the condition before a shutdown.

The FCC adopted the existing existing three hour limit on operation with loss of telemetry.

Three minute shutdown

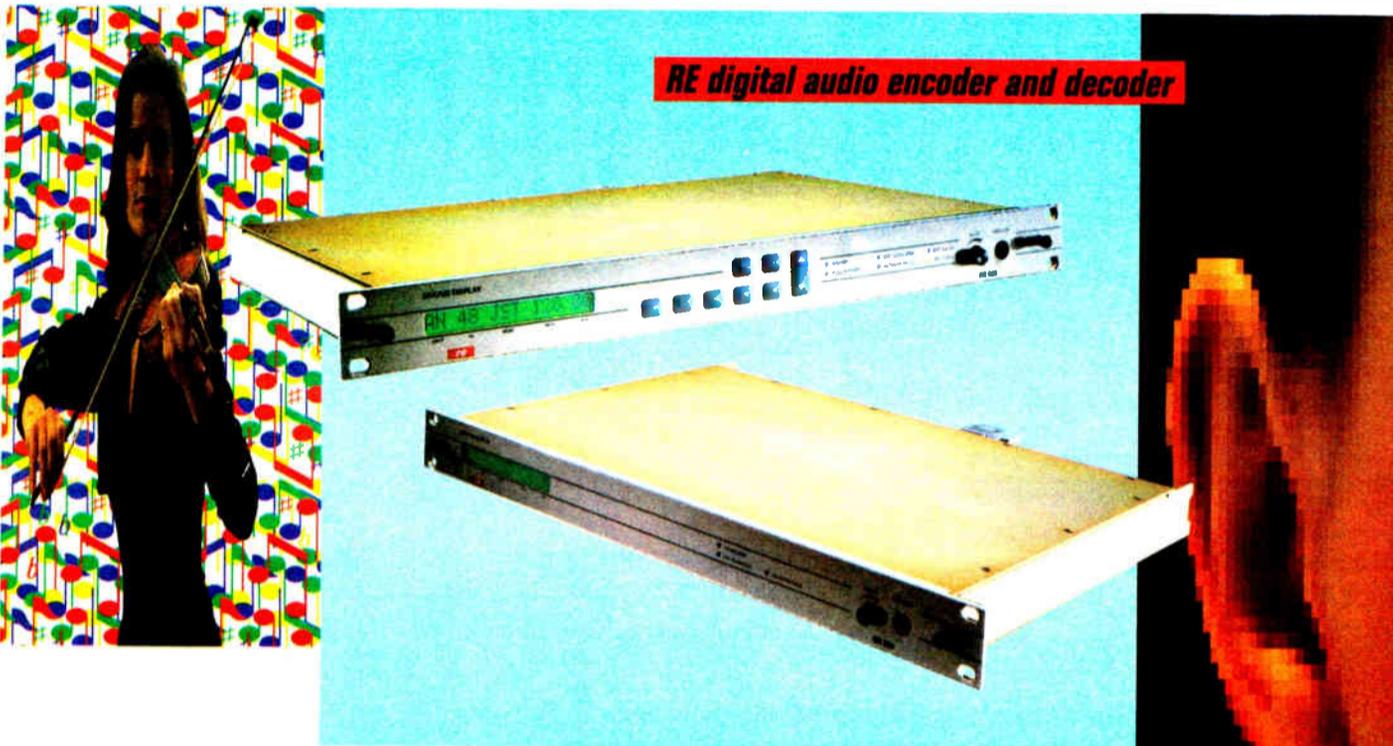
The FCC did maintain a three minute shutdown requirement for serious interference conditions where the FCC requests the station to shut down. A station must have the capability of shutting down the transmitter within three minutes receiving an FCC request.

The NPRM discussed an "on-call person database." They did not adopt such a database, instead relying on existing informal contacts the FCC has with stations (phone number lists, etc.).

The NPRM also discussed adopting a contact person posting requirement similar to that required on translator stations. They did not adopt this requirement on unattended broadcast stations, but did not change the requirement on translators.

It appears quite possible for there to be no on-call person (the whole staff is out of town on vacation) when the FCC wants a station shut down. They are taking the risk that this will happen infrequently. Further, of course, stations should infrequently be in

continued on next page ►



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a condition requiring an FCC requested shutdown. A review of FCC CIB activities (available on the Net) shows they often have to go out in the field to shut down transmitters in other services (especially paging transmitters, marine radios with stuck microphone keys, and Emergency Locator Transmitters), but I have not seen report of such action against a broadcast station.

Pure dial-up OK

The FCC deleted the old "fail safe" requirement, which required a continuous circuit between the control point and the transmitter, years ago. However, a clarification of the rules issued later indicated that either continuous control or some alternate means of shutting down the transmitter was

outside the remote control unit).

The commission found this requirement unnecessary. Stations may utilize dial-up circuits with no backup circuit to meet the three minute shutdown requirement discussed above. While the FCC is not specifying requirements on these control mechanisms, I would expect stations to be cited for operating outside licensed parameters if they do so, or be cited for failing to shut down on an FCC request if they are unable to do so within three minutes, perhaps during a station inspection.

Non-approved DAs OK

The NPRM asked if directional stations with non-approved sampling systems should be allowed to run unattended. My comments indicated there was little difference in interference potential between unattended stations with approved or non-approved sampling systems. AFCCE suggested unattended not be authorized for non-approved sampling systems as an inducement for those stations to upgrade their sampling systems.

The FCC decided that non-approved DAs could run unattended under the same rules as those with approved sampling systems. Note that the previously mentioned lack of a requirement for an ATS or AMC system applies to directional (and television) stations also. It is up to the station to determine what measures are required to insure compliance with the license terms.

The FCC will not judge the measures you take. It will, however, cite the station for out-of-tolerance operation.

Tower light checks

Comments on the NPRM varied from "no frequent inspection required, since there have been no aviation accidents due to lack of lighting," to a required "success

reporting" instead of "failure reporting" if automatic tower light alarms are used. The FCC decided that automatic alarms could report failures only, if desired, to the licensee, and optionally to the FAA. Further, the once-per-day tower light inspection still stands, so stations that run unattended could have an operator present for the five minutes or so required to complete the existing daily tower light observation.

Stations that elect to run unattended may continue to do manual tower light inspections. Automatic alarms will not be required.

Those stations desiring to continue using operators no longer need to utilize licensed operators (typically holding a Restricted Permit). Note that the chief operator requirements still remain, and the chief operator is required to hold an RP. No wait for EAS required.

In comments filed on this NPRM, several commenters indicated that it appeared difficult to automate the existing EBS, so unat-

tended operation may as well be held off until EAS is in place, because EAS was designed with automation in mind. NAB commented that it was possible to automate EBS, so no wait for EAS was necessary. The FCC agreed. In our discussions, Jim McNally of the FCC said, "Broadcasters will probably need to informally develop a temporary standard for an 'end of alert' tone. Probably something similar to distinguish between a national and a local alert. If some consensus can be reached on resolving those problems, automating the EBS may not be very difficult."

Waivers

It appears to me that such a consensus could make a system work, but not be compliant with the current EBS rules. As such, I'd expect stations hoping to use unattended before EAS is in place to file waiver requests. I have heard proposals to use one of the two existing EBS tones as

continued on page 21 ▶

A good log will indicate the station has a history of compliance with the technical requirements of the license.

required. Many commenters on this NPRM suggested that dial-up circuits are more reliable than dedicated circuits, so this provision was not necessary.

A continuous circuit has a "failure mode" advantage in that circuit failures put the station in a non-interfering condition (off the air). Dial-up circuit failures leave the transmitter in its existing state, possibly causing interference, especially if mode changes are missed.

In my comments, I suggested the commission get rid of the "alternate circuit" requirement. As an alternative, I suggested an hourly handshake between the control point and the transmitter site with a three hour shutdown. Those stations using DTMF telephones as the control point control unit could call the transmitter site once an hour and send a DTMF sequence to reset a timer (perhaps a low cost timer

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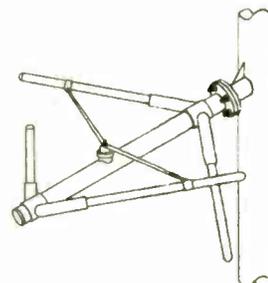
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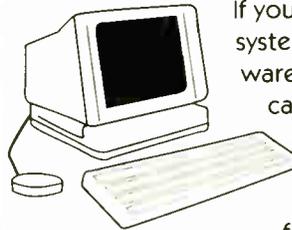
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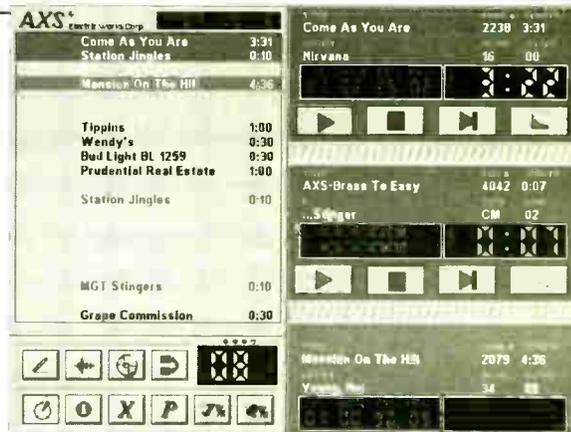
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Unattended Operation

► continued from page 19

an EOM indicator. I have also heard of a station that was granted a waiver based on a system that merely rebroadcast the EBS receiver on receiving the EBS attention signal, then "timed out" after a few minutes, returning to normal programming. I have not heard of proposals to distinguish between national, state, and local EBS activations, though if a station elects to carry all of these automatically, it appears such a distinction may not be necessary.

In seeking waivers of the existing EBS requirements, stations may want to outline how they will rebroadcast emergency information, how they will return to normal programming, whether they have a method of broadcasting the scripts from the EBS checklist, whether they will regenerate the EBS attention signal, how they will comply with EBS test logging requirements, etc.

My guess is that the FCC will go with the National Association of Broadcasters (NAB) suggestion of requiring EAS to be in place July 1, 1997 (as opposed to the current July 1, 1996). It is up to you to decide if temporary measures are worth the effort or if you wish to just be an "early adopter" of EAS.

Minimal unattended

Once a station has EAS installed or has figured out a way to handle EBS, it appears a station has considerable leeway in how it operates its transmitter. While it appears that no local on-call person is required, any such person must be able to shut the transmitter down within three minutes of an FCC request. That person legally need not be able to determine any operating parameters.

No notice to the FCC is required of how to reach that person. Indeed, everyone could be on vacation.

Stations with no tower lights or mode changes have it pretty easy, once

EBS/EAS requirements are complied with. These stations can just turn on the transmitter and leave it running, provided they can shut the station down within three minutes of an FCC request. This requirement can be easily met with a minimal dial-up control system.

Stations with tower lights and/or mode changes may choose to run with an operator during the times that the mode changes are being made and the tower lights are being checked. This could be the station manager calling the transmitter site from home. A trip to the studio or the transmitter would not be required. Stations need not install

automatic equipment to handle mode changes or tower light checks, though they certainly may.

Effective date

New rules typically are effective 30 days after they are published in the Federal Register, unless petitions for reconsideration are filed (as was done with EAS). Check your library, check the above listed net and fax sources, or check the next issue of **RW** for more details.

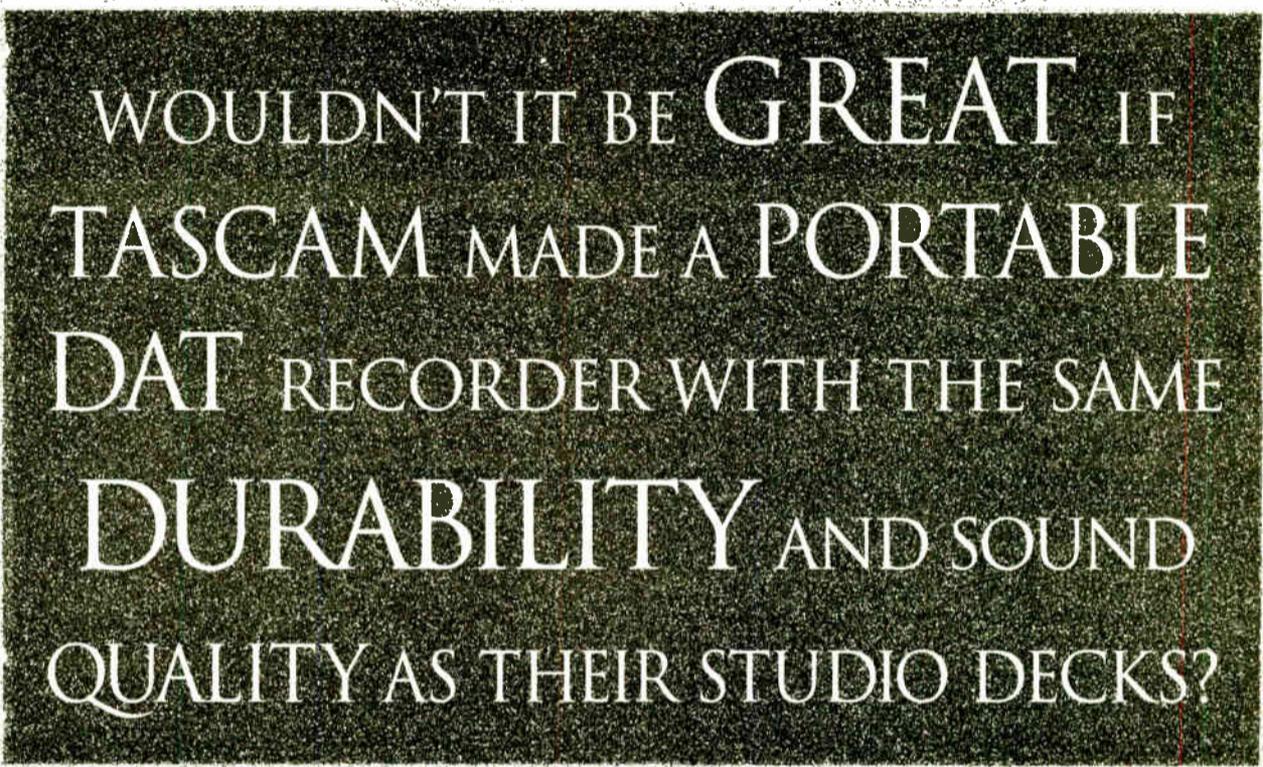
Developing an audit trail

Though the FCC will not require automatic equipment or telemetry to guarantee in-tolerance operation, it still requires in-tolerance operation. This being the case, stations may want to continue to do frequent parameter logging either through frequent transmitter site inspections, frequent

telemetry checks, or automatic logging. A good log will indicate to an FCC inspector that the station has a history of compliance with the technical requirements of the station license and the Rules. The commission has granted stations unprecedented freedom. Use it wisely.

□ □ □

Harold Hallikainen wrote this on the plane back from the Alaska Broadcasters Association meeting in Anchorage. He is president of Hallikainen & Friends, a manufacturer of transmitter control and telemetry equipment. He teaches electronics at Cuesta College and is an avid contra dancer (joining the Dancing Bears for a dance in Anchorage). Reach him at 805-541-0200 (voice), 805-541-0201 (fax) or hhallika@slonet.org (e-mail) and <http://slonet.org/~hhallika/> on the World Wide Web.



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WORKBENCH

Power Supply Heat Failure Problems

by John Bisset

SPRINGFIELD, Va. This column has long been a clearing house for tips for owners of Scientific Atlanta satellite receiving equipment. Aaron Wasilewski, director of engineering for Northwest Broadcasting in Washington state continues the compendium.

Aaron mentions the "SA Quick Fix" for power supply trouble, which was discussed in one of the inaugural *Workbench* columns. It consists of jumpering the front panel test points of the working power supply up to the test points of the bad power supply, to allow both sides to operate. (Make sure the dead supply is turned off!).

Even Scientific Atlanta will tell you such a fix should only be temporary, and that steps should be taken to replace the downed supply before more damage occurs.

At this point, you can have the supply repaired — which isn't cheap; or you can buy a new supply, which is even more expensive. Aaron writes of a simpler fix, with an added bonus. Try replacing the +15 VDC supply with a SOLA Model SLD-15-3030-15. This is a dual +15

VDC, which, when wired correctly, can give you the dual DC with the correct polarity, and with better regulation.

This particular supply will allow a draw of 3 amps, which means you could run both sections of one system with this sole supply.

The only down side is that the SOLA supply is not the same size as the LAMBDA, which means it must be externally mounted from the chassis. A simple wiring modification can make this possible. Also remember that you'll need to retain the +5 VDC supplied from the other module in the same chassis where the LAMBDA resided.

I mentioned that Aaron wrote of a big bonus. Here it is: The most prevalent cause of the LAMBDA supply failures is not the fault of the supply itself. The real killer is the heat generated from within the chassis that doesn't really have anywhere to go except the relatively small ventilating slots in the chassis housing.

Almost all of the capacitors, when exposed to this environment, will suffer extensive damage in a short period of time. Such results include poorer regulation, electrolytic caps drying out, and heat stress to other components in the

supply. Aaron found that a muffin fan, operated at 110 VAC can be installed in the same mounting area where the defunct +15 VDC supply sat.

When choosing a fan, the only restriction is that it be slim enough to fit within the confines of the power supply module slide. The 110V AC was chosen because it is present for the supply that sat in this slot.

Aaron also included some particulars regarding purchase of the supply. It can be purchased thru Newark for \$120 plus shipping and tax, or bought through any SOLA dealer. That is nearly one sixth the cost of a new LAMBDA supply.

Just as it's good insurance to have a spare LNA on the shelf, Aaron suggests picking up one of these supplies and keep it on the shelf too. The next time the power supply fails, you'll be the apple of the general manager's eye when you get the dish up and running in five minutes!

Thanks to both Aaron Wasilewski of KMWX/KFFM and Bob Maxwell at KUTI/KXDD for giving us another way to stretch a buck in this time of shrinking engineering budgets!

★ ★ ★

Criss Onan sells Broadcast Electronics' hard drive systems, and sent e-mail to our AOL address praising the review of the "Breathe Right" strips. If you snore, you've got to pick up a pack — you won't believe how much better you'll sleep!

Criss also wrote to say that BE's new

AV-AIR screen is working. It is as simple as drag and drop. Combined with BE's less expensive play/play daughter-board and the dropping prices of 9GB hard drives, the computer invasion rolls on. If you'd like more information on the BE system, you can call Criss at 716-223-3659.

★ ★ ★

Speaking of computers, we offered some tips on SCSI cabling and the use of terminators awhile back, and Robert Cham of RPCcommunications in Bristol, Vt., wrote with a few of his own. While configuring a MAC system consisting of an SE30 with a 50 MHz accelerator, an internal 520MB hard disk doubled with Stacker, a full page monochrome monitor (1 bit video makes for faster performance), and a non-postscript laser printer, everything was SCSI interfaced.

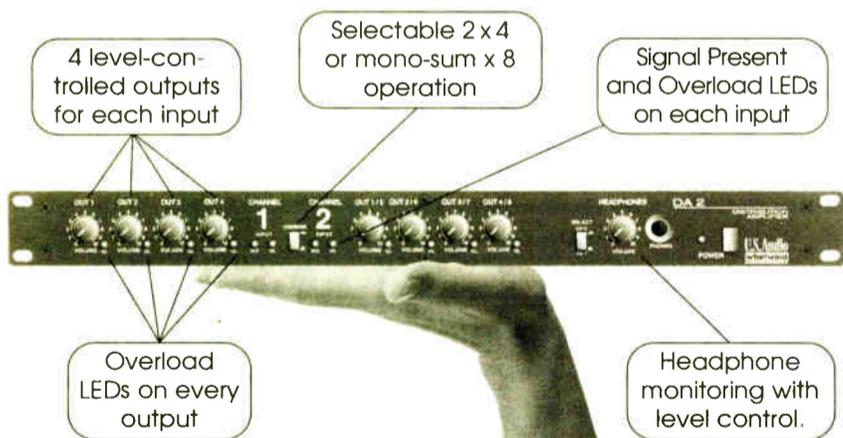
Following all the rules left the MAC looking in vain for the hard drive. What finally worked was terminating only the internal hard drive, and leaving the other end of the SCSI chain floating. Similarly, when using five or more SCSI devices (don't forget that the computer counts as one), Robert has had to terminate both ends of the chain and one device in the middle of the chain.

His basic message is "all rules are off, except possibly a terminator at the head of the chain" when following the rules doesn't work. What's nice about this cut-and-try method is that you can't harm anything by experimenting with terminator placement. If you come up with the wrong solution, the hardware just won't work. Robert's word of caution, however,

continued on page 35 ►

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Circle (51) On Reader Service Card

Building Radio Sets

► continued from page 12

thought the more tubes a radio had determined the distance you could receive stations from and controlled the volume of distant stations.

When the battery eliminators were really eliminated and radios plugged into any wall socket, my folks bought a radio. This was one of their largest purchases and they were proud of it — all 12 tubes.

In tube heaven

The radio was called a Radiola and it consisted of a table with a built in speaker. The radio was about three feet long with a hinged cover on top. The hinged cover was said to be for service but I think it was really used to show any visitors your 12 tubes.

I need not mention that this radio was also my pride and joy. I would bring my friends in to show them all the tubes.

One day, while I was showing one of my friends the radio, I opened the top cover and noticed one of the tubes was not glowing. The tube was cool to the touch so I removed it. I discovered that I could remove seven of the tubes and the radio worked just as well.

Whenever a tube went bad, we would remove one of the "extra" tubes and put it in place of the tube that failed. Years later, I found a radio exactly the same at the Henry Ford Museum in Dearborn, Mich. If I could find one

today, I would probably buy it for old times sake.

When working with the crystal sets, I learned that the earphones I used could also be used as a microphone. I separated the phones from the head band and connected two long wires between the separate phones. You could speak into one and listen out of the other. This method was better than the two tin cans and string method because you did not have to be in "line of sight."

Using the earphones as a telephone had other advantages. I placed one earphone next to my father's radio speaker compartment and ran two wires out of the back of the radio, outside the house, and up to my room.

I connected the wires to the other earphone and was able to listen to the radio downstairs while I was in bed upstairs. This worked until my mother found the wires going up the outside of the house to my room.

Of course, my mother did not appreciate this for another reason: if the radio was not on, the earphone acted as a microphone and picked up any sound or conversations in the room.

So much for falling asleep to music.

□ □ □

Dan Hindman, now retired, has been taking things apart and putting them together all his life. He is currently learning the innards of his new home computer.

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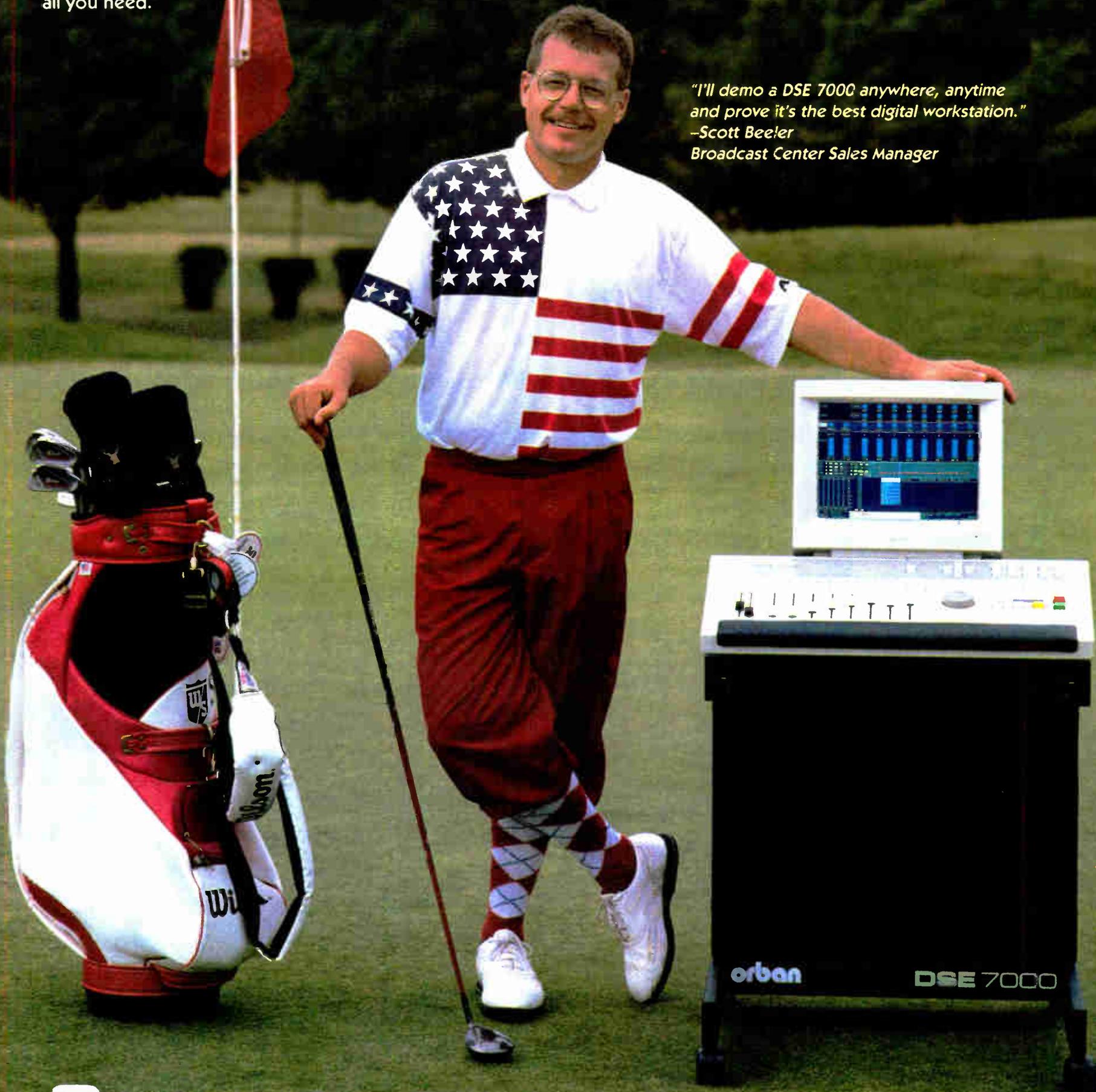
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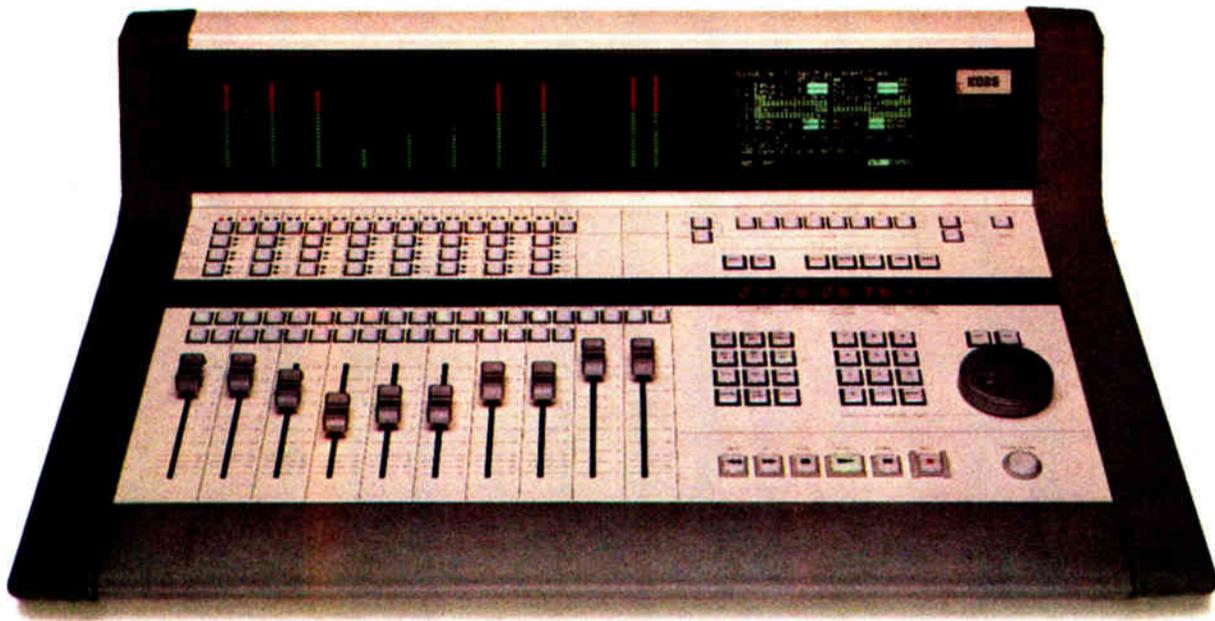
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Mel Lambert
reveals new
ADAT decks
See page 30

PRODUCT EVALUATION

360 Systems Makes Instant Friends

by Chris O'Brien

WASHINGTON I kept telling myself, "it's only a review ... it's only a review."

Upon opening the box from 360 Systems I was a little bit cautious about Instant Replay, the new fast access digital audio recorder. Sure it was sleek and attractive, with all those light-up buttons to push. Sure, it won the **RW Cool Stuff** award, but was it a real audio tool?

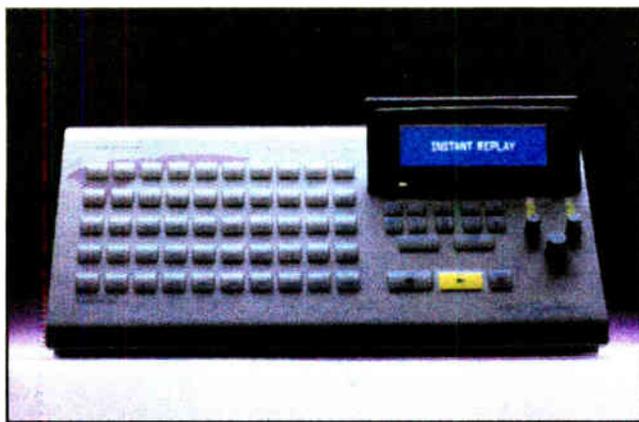
"Basically, this thing is a box with a lot of 'hot keys' and a four hour stereo hard drive," I said. Suddenly I realized that I had just said a four-hour stereo hard drive.

"Tons of glitches, I'll bet. Well, I'll just see about this Instant Replay."

Day 1: Setup

Making sure to look at the clock prior to hooking up the Instant Replay, I noted the time. It was 9:30 a.m.

Connections looked pretty simple: standard XLRs in and out. Once the XLRs were plugged in, I nervously reached for the power switch. Ah, the familiar sound of a hard drive coming up to speed. Time check, 9:33 a.m.



360 Systems' Instant Replay

"Three minutes for setup," I said to myself, "something is going to go wrong, I know." I took a deep breath and reached for the play button. The studio monitors were instantly filled with an unbelievably clear and crisp sounding stream of sound effects! Time check, 9:35 a.m.

In only five minutes time I was up and running on the new Instant Replay from 360 Systems.

Impressed at the ease of operation and setup I took a moment to browse through the manual. After all, who looks at manuals first? The language of the manual was straightforward and very minimal on the "engineerese."

On a rampage

To truly put Instant Replay through its paces, I pulled the production director aside and requested an abundance of spots requiring sound effects be assigned to the airstaff. A true test of this machine would be the announcers: always in a rush to complete their production and

easily ticked off when they have to seek out sound effects from our ancient vinyl library.

"At last, 360 Systems," I thought to myself. "I may like you, but they never will. They hate everything." I chuckled as I returned to my office.

Shortly after 11 a.m., I heard the oohs and aahs pouring out of the production studio.

"Quick," I said to the production director, "This should be good."

To my surprise the announcers had rallied around Instant Replay and were taking turns at hitting hot keys, instantly jumping from sound effect to sound effect. And I mean instantly: there was no pause what-so-ever between sound effects. What a fast machine!

The announcers had been taken by storm by Instant Replay, which meant my mission to play devil's advocate had now become even more difficult.

Day Two: a closer look

The owner of the radio station decided to take a look at Instant Replay. I was certain this seasoned veteran could point out a few minor faults.

"Wow! This is fabulous!" my boss exclaimed. "We should get this for our new studio!"

Before I could bring up the fact that I had already spent a lot of his money on brand new studios, he was busy pushing buttons and admiring the sleek design and small profile (15 x 9 x 5 inches) of Instant Replay. Yet another person hooked by 360 Systems. This

new machine was not only functional, it was hypnotic.

By the end of the second day at the Thunder 107.7 studios, Instant Replay had been in use numerous times. In every instance it proved effective and efficient. And I must admit, the test was over for me. I was now convinced that Instant Replay was indeed a legitimate audio tool.

And all humor aside, I was extremely impressed by the device.

Brass tacks

Instant Replay is offered with 3.5-inch internal hard disks which store Dolby AC-2 coded audio, and can be expanded to eight hours. The model I tested (DR-550-4) stores a total of four hours of stereo audio. Unlike tape cartridges of finite length, there is no limit to individual cut lengths stored on the drive. If you had a file that was an hour long, you could store it as a single cut with three hours of time remaining on the hard disk.

Realistically, Instant Replay should be used to store many cuts. For example, a four-hour drive allows you to archive 240 60-second commercials or 480 30-second spots.

Instant Replay is a real champ in a morning show environment. Normally with carts, it takes time to locate a desired effect and trigger it without missing "the moment." Instant Replay can have station jingles, weather and traffic sounders, sound effects and contest drops loaded for playback. When the show's direction changes, talent is ready with immediate access to suitable audio. Rapid access and instantaneous playback of effects make it a natural performer in fast-moving studios.

Perfectly portable

Instant Replay's portability has made it a favorite with Charlie Bird, a semi-retired music director for NBC. According to 360 System's Steve Gordoni, Bird selects music he requires for a project, assembles it into an Instant Replay, and is ready to carry it all to an assignment. The material is in the sequence he wants it to be, and all in clean digital audio.

Imagine bringing an entire show's worth of recorded bits, comedy songs and effects to work in one 10-pound box. All elements can be pre-staged in the desired order without tying up a production room to do it.

A very efficient hard drive is at the core of the Instant Replay and it requires regular maintenance (as does any hard drive). You can defrag the drive in about 30 minutes to an hour and upon completion a simple hard reboot is all that is required to get the unit back on line and in action.

Among the other features I like is the printer port. I am able to print out an inventory of all the sound stored on Instant Replay. This is particularly handy in the show prep and production arenas.

The absolute best feature of Instant

Replay is D-Net file transfer. Files can be exchanged between 360 Systems' product line through its D-NET network. Single cuts or contents of an entire disk can be moved digitally between machines at eight times normal speed via the AES/EBU ports.

Speaking of digital capabilities, Instant Replay comes with a built-in sample rate converter, allowing it to accept 32 or 44.1 kHz digital audio. Instant Replay con-

Product Capsule: 360 Systems' Instant Replay



Thumbs Up

- ✓ good design (appearance)
- ✓ good technical design
- ✓ great audio quality
- ✓ ease in recording effect



Thumbs Down

- ✓ no rackmount version

For more information, contact 360 Systems at 818-991-0360; or circle **Reader Service 19**.

verts incoming sample rates to 48 kHz for processing and storage. All in all quite a machine.

If I could make any suggestion to 360 Systems it would be to manufacture a rackmount version of Instant Replay. Its Digi-Cart system comes close, but this machine is tough to beat.

Instant Replay runs between \$2400 and \$2900, depending on your supplier. I suggest you shop around. Figuring the total price of a quality stereo record/play cart deck, four hours of carts, a standalone digital sample rate converter and what it costs to store and maintain it all, 360 System's Instant Replay is worthy of its **Cool Stuff** honors from **RW**.

For those of you who would like to try the Instant Replay for yourself, go get your own. I am buying this one!

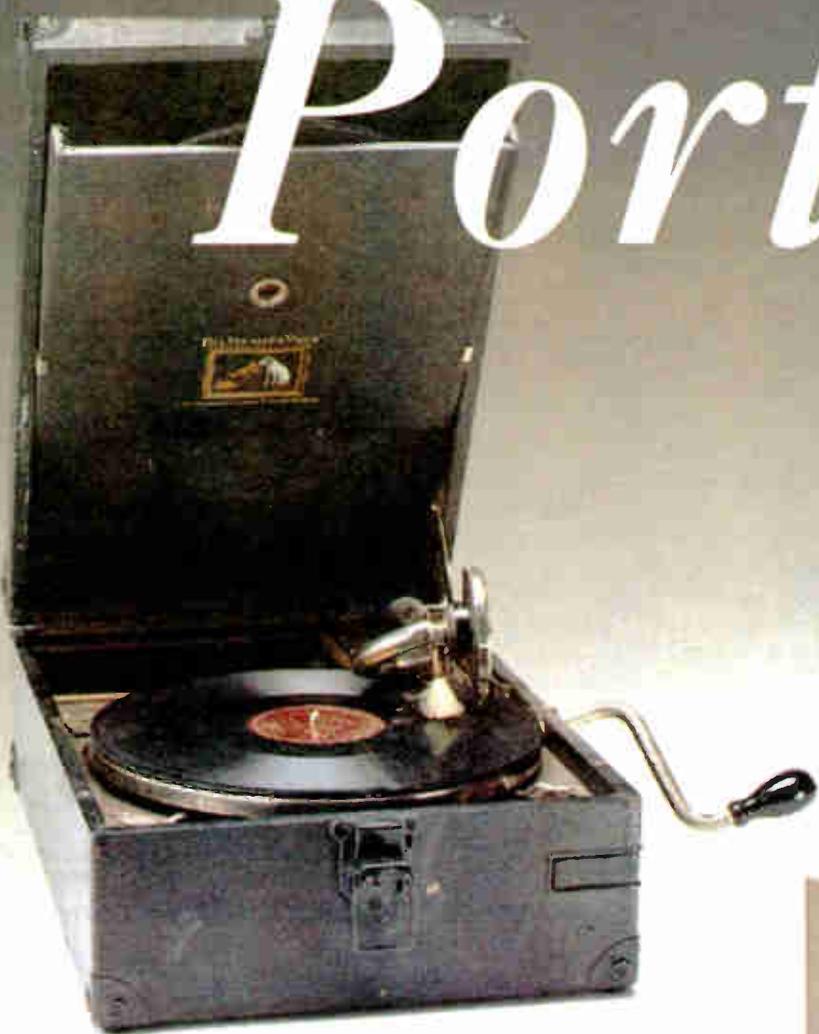
□ □ □

Chris O'Brien is program director for WRCY-FM "Thunder 107.7" in Manassas, Va. (Washington). Chris is available for questions or comments at 703-631-2577 or e-mail at chobrien@aol.com



**Small Reverb
Small Price
Big Sound
A Work
of ART
on page 40**

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World Radio History

LINE-OUT

Live Multitracking for Broadcast

by Bruce Bartlett
with Jenny Bartlett

ELKHART, Ind. It is easier than ever to do a multitrack recording of a concert for broadcast. All you may need is a small mixer, a digital eight-track recorder and cables. To illustrate this recording method, here is a story right from the trenches.

I was asked by our local public radio station, WVPE-FM, to record a blues concert. The tape was to be broadcast a

I asked the PA engineer what kind of output connectors his board had. They were +4 dBm phone jacks. My mixer inputs are -10 dBV phone jacks, so I built several 12 dB pads and put them in-line with the cables feeding my mixer. This prevented the PA mixer feeds from overloading my mixer inputs.

The night before the concert, I formatted the Hi-8 mm recording tape using a special technique which greatly reduces the risk of drop-outs:

from a DI box not connected to anything.

Finally the band arrived and set up. When the PA engineer plugged into the synth amplifier output, we heard a loud buzz again. The synth amp was defective. We ended up miking the amp's speaker.

A quick sound check followed. After the PA engineer set levels and tweaked the mix, I adjusted the recording levels going to the multitrack. Once the levels were set, I could pretty much take it easy and enjoy the concert.

We heard some buzz in the bass guitar signal. Apparently the guitar cord was picking up interference from stage lighting. Cutting EQ at 10 kHz removed most of the buzz.

During intermission I recorded audience noise (room tone) for later use. In the broadcast production of the concert,

announcers will talk over the recorded audience noise, in order to sound like they are at the concert.

Fix in the mix

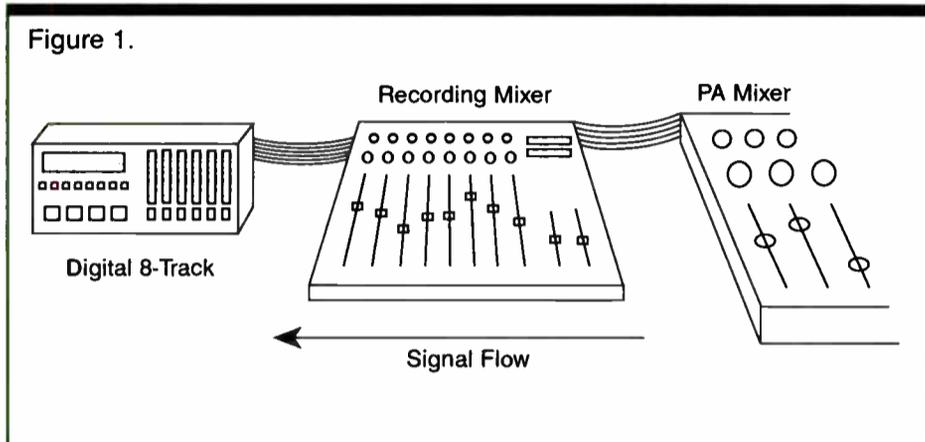
The next day in the studio, I played the eight-track tape through the mixer. The kick drum sounded "papery," so I cut EQ at 400 Hz. A great kick sound emerged — a powerful low-end thump plus a clear click.

Sometimes a little leakage is a good thing. The guitar and drums sounded dry until I brought up the vocal mics. The leakage into the vocal mics added life to the sound.

Thanks to the digital multitrack, we ended up with a mix that we were happy to play on the air.

□ □ □

Bruce Bartlett is a microphone engineer and technical writer, and the author of Practical Recording Techniques published by Howard Sams. Jenny Bartlett is a technical writer. Bruce can be reached at 219-294-8388.



month later. We considered two different ways to record the concert: Either split the mics to feed both the P.A. mixer and the recording mixer or take direct-outs and group-outs from the PA mixer into the recording mixer.

Which option is best? A mic splitter is expensive but provides isolation from any level imbalances or distortion happening at the PA mixer. Taking feeds from the PA mixer costs little, but you need to depend on the skill of the PA engineer to give you clean signals.

Since I trusted the PA engineer — Phil Toepp — to do a good job, we went with the PA mixer feeds.

Making tracks

A week before the concert, Phil and I consulted with each other and came up with these track assignments:

- 1: Drums submix (from PA mixer group out)
- 2: Kick (from PA mixer direct out)
- 3: Bass (direct out)
- 4: Guitar (direct out)
- 5: Guitar (direct out)
- 6: Synth (direct out)
- 7: Vocals submix (group out)
- 8: Audience (my own mic)

Since the direct outputs were pre-fader, PA fader moves would not affect the recording levels.

The PA mixer outputs described fed my 8 x 2 recording mixer. The recording mixer's direct outs fed a Tascam DA-88 modular digital multitrack (Figure 1). I used the mixer to set recording levels for the DA-88.

I could have mixed live to two-track DAT, but my mixer was next to the PA mixer where the band's sound was very loud. It is difficult to monitor and mix over headphones in that situation, so I opted to record to multitrack and mix later.

This method does take longer, but it results in a much better mix. And because all you do is set recording levels, the pressure is off during the concert.

1. Fast-forward the tape to the end and rewind to the top. This loosens the tape pack for smoother motion and distributes the tape lubricants more evenly.
2. Clean the heads with a dry tape cleaner.
3. Format the tape.

This procedure assures a clean format track that is essential to prevent glitches and dropouts.

Sound check

A few hours before the concert, I set up equipment, plugged everything in and cleaned the heads one last time.

Now came the scary part. I turned up each fader to listen for room noise. Most of the channels were OK, but two of them had a loud buzz. Was it caused by the connection between the two mixing boards?

It turned out that one channel's buzz was due to a bad snake pair between the stage and PA mixer. The other buzz was

Nice Pad You Have Here

Not everybody needs an eight-track feed from a PA console, but we all need this circuit. Pads for reducing a balanced +4 dB signal to -10 dB unbalanced for interfacing with semipro equipment are essential tools in the clever producer's bag of tricks.

Figure 2 shows how to accomplish this. The resistive L-pad circuit presents the proper loading necessary to reduce levels to a point tame enough for -10 dB inputs.

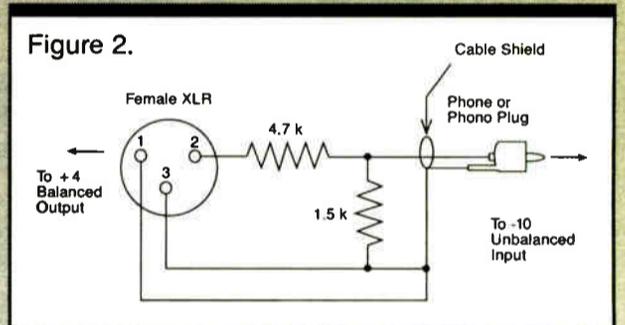
The entire pad circuit can be wired inside the XLR shell with small precision resistors. Several such connectors should be constructed in different configurations; such as XLR to quarter-inch, TRS to mini-plug... whatever connections you predict you will eventually have to make.

If you hear distortion when the pad is in use, omit or lift the connection to XLR Pin 1.

It is wise to build a couple of "gender-swapped" pads as well. In spite of best intentions, there are times you will encounter connections that go against the "signal-follows-prong-direction" custom for XLRs. Be ready for anything, even the dreaded Pin 3 Hot syndrome.

Label these connectors clearly as 12 dB pads, so in the heat of battle they will not be mistaken for simple adapters when grabbing connectors out of the bag.

—Bruce Bartlett



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DIGITAL DOMAIN

Enhancements to ADAT Tape Format

by Mel Lambert

LOS ANGELES In the early days of consumer video, we had Beta and VHS. It was not long before the technically-superior format was eclipsed by the one promoted more aggressively.

In the world of low-cost modular digital multitracks (MDMs), it might seem surprising that two rival formats have retained separate market shares. Introduced in 1991 as the world's first modular digital eight-track selling for less than \$4,000, the Alesis ADAT format utilizes standard S-VHS tapes running at three times normal consumer VCR speeds.

The Tascam DTRS format uses Hi-8 videocassettes running approximately 10 percent faster than home camcorders. To complete the overview, Fostex offers the ADAT-compatible RD-8 recorder, while Sony recently unveiled the PCM-800 DTRS-compatible machine.

By and large, Tascam/Sony DTRS digital multitracks have found their way into the post-production market, where their enhanced lock-to-timecode and faster search-to-cue speeds have made the hardware more appropriate.

ADAT machines — primarily because of their lower costs and market profile — have found greater appeal within project

studios and related industries, including radio production. Industry insiders tell me that there are in excess of 65,000 ADAT machines in use around the world.

Raising the stakes

Now, the format war is destined to enter a new phase, with Alesis recently revealing a double ace up its collective sleeve.

Unveiled at the recent AES convention in New York, the firm's dramatically improved ADAT-XT machine addresses

Industry insiders tell me that there are in excess of 65,000 ADAT machines in use around the world.

Both of these new machines will sell from less than \$4,000; there is expected to be a close-to-\$500 price differential between the slightly more inexpensive ADAT-XT and the more enhanced MDA-1. Alesis will be building both machines in its West Los Angeles manufacturing complex.

In essence, Alesis has taken the original ADAT digital eight-track and incorporated a number of features that were previously offered on the optional BRC remote control. In addition, the transport's operating software was completely rewritten, resulting in a claimed four-times improvement in fast-forward, rewind and search-to-cue speeds, without sacrificing gentle tape handling.

An efficient electronic interface constantly monitors all transport status modes, "intelligently" memorizing appropriate locate points and then providing optimum transport response. A Dynamic Braking System enables the -XT transport to move quickly between locate points, effectively eliminating the possibility of overshooting or undershooting specific time references. A laudable achievement indeed. And, yes, all existing ADAT tapes will be fully compatible with these new offerings.

On-board editing

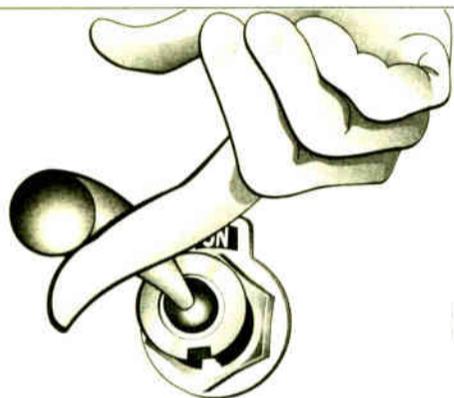
Other features include on-board digital editing, with direct track-to-track copy, programmable track delay and programmable tape offset. This allows individual or groups of ADAT tracks to be delayed against one another, to correct, for example, inter-mic distances on a multi-mic array.

There is an on-board 10-memory auto-locator (with auto-play, auto-return and auto-record loop functions), 20-bit/8X oversampling A/D converters and 18-bit/128X oversampling DACs and selectable 44.1 or 48 kHz sampling rates for full compatibility with DATs, workstation, CD-Rs and related projects.

Input/output connections are made via unbalanced -10 dB RCA connectors, servo-balanced +4 dB through a single multiway ELCO connector and multi-channel ODI digital I/O.

The XT's Track Copy creates a digital clone of a single track or a group of tracks, allowing assembly of composite tracks for digital editing. Tape Offset enables shifting of time reference between multiple units, allowing composite performances to be duplicated, assembled and then edited with a claimed accuracy of 10 ms. Track Delay enables the time reference of a track to be delayed up to 170 ms. Shifting tracks using the Track Delay facilitates changing the feel of a song or fixing slight

continued on page 35 ►



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Live Multitracking for Broadcast

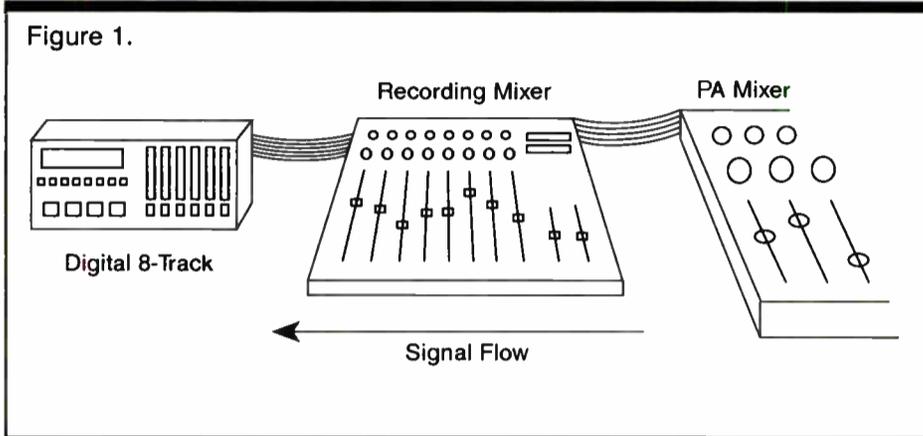
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The PA mixer outputs described fed my 8 x 2 recording mixer. The recording mixer's direct outs fed a Tascam DA-88 modular digital multitrack (Figure 1). I used the mixer to set recording levels for the DA-88.

I could have mixed live to two-track DAT, but my mixer was next to the PA mixer where the band's sound was very loud. It is difficult to monitor and mix over headphones in that situation, so I opted to record to multitrack and mix later.

This method does take longer, but it results in a much better mix. And because all you do is set recording levels, the pressure is off during the concert.

1. Fast-forward the tape to the end and rewind to the top. This loosens the tape pack for smoother motion and distributes the tape lubricants more evenly.
2. Clean the heads with a dry tape cleaner.
3. Format the tape.

This procedure assures a clean format track that is essential to prevent glitches and dropouts.

Sound check

A few hours before the concert, I set up equipment, plugged everything in and cleaned the heads one last time.

Now came the scary part. I turned up each fader to listen for room noise. Most of the channels were OK, but two of them had a loud buzz. Was it caused by the connection between the two mixing boards?

It turned out that one channel's buzz was due to a bad snake pair between the stage and PA mixer. The other buzz was

from a DI box not connected to anything.

Finally the band arrived and set up. When the PA engineer plugged into the synth amplifier output, we heard a loud buzz again. The synth amp was defective. We ended up miking the amp's speaker.

A quick sound check followed. After the PA engineer set levels and tweaked the mix, I adjusted the recording levels going to the multitrack. Once the levels were set, I could pretty much take it easy and enjoy the concert.

We heard some buzz in the bass guitar signal. Apparently the guitar cord was picking up interference from stage lighting. Cutting EQ at 10 kHz removed most of the buzz.

During intermission I recorded audience noise (room tone) for later use. In the broadcast production of the concert,

announcers will talk over the recorded audience noise, in order to sound like they are at the concert.

Fix in the mix

The next day in the studio, I played the eight-track tape through the mixer. The kick drum sounded "papery," so I cut EQ at 400 Hz. A great kick sound emerged — a powerful low-end thump plus a clear click.

Sometimes a little leakage is a good thing. The guitar and drums sounded dry until I brought up the vocal mics. The leakage into the vocal mics added life to the sound.

Thanks to the digital multitrack, we ended up with a mix that we were happy to play on the air.

□ □ □

Bruce Bartlett is a microphone engineer and technical writer, and the author of Practical Recording Techniques published by Howard Sams. Jenny Bartlett is a technical writer. Bruce can be reached at 219-294-8388.

Nice Pad You Have Here

Not everybody needs an eight-track feed from a PA console, but we all need this circuit. Pads for reducing a balanced +4 dB signal to -10 dB unbalanced for interfacing with semipro equipment are essential tools in the clever producer's bag of tricks.

Figure 2 shows how to accomplish this. The resistive L-pad circuit presents the proper loading necessary to reduce levels to a point tame enough for -10 dB inputs.

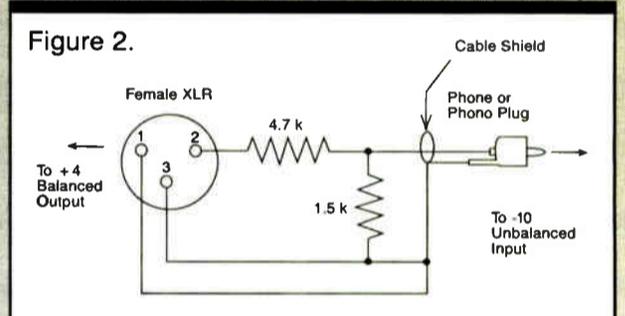
The entire pad circuit can be wired inside the XLR shell with small precision resistors. Several such connectors should be constructed in different configurations; such as XLR to quarter-inch, TRS to mini-plug... whatever connections you predict you will eventually have to make.

If you hear distortion when the pad is in use, omit or lift the connection to XLR Pin 1.

It is wise to build a couple of "gender-swapped" pads as well. In spite of best intentions, there are times you will encounter connections that go against the "signal-follows-prong-direction" custom for XLRs. Be ready for anything, even the dreaded Pin 3 Hot syndrome.

Label these connectors clearly as 12 dB pads, so in the heat of battle they will not be mistaken for simple adapters when grabbing connectors out of the bag.

—Bruce Bartlett



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Focus Group Was 'Remotely' Entertaining

by Alan R. Peterson

WASHINGTON Few moments in the biz are more rewarding than helping decide on the future product line of a major broadcast equipment manufacturer. The skills and knowledge a broadcaster gains from using such products over the years is highly valued by the people who design and build the stuff.

While at the New Orleans Radio Show, I was pleased to participate in a focus group for a leading manufacturer of telephone interfaces and remote controls. This forced me to be uncomfortably serious for at least four hours; for anyone who knows me well, this was a major effort on my part.

You must know I am the sort of man who gleefully mangles consumer surveys by returning postcards filled with totally fabricated data. Telemarketing machines that randomly call me with prerecorded pitches don't stand a chance when I give responses to their prompts.

Why, somewhere on the dial at this very moment, some poor jock is cueing up "Which Way You Going, Billy" or "Pac Man Fever," thanks to my (ha ha) participation in some consultant's auditorium music test.

But this time it was different. The company I sat in with makes products that

jocks use every time they are in the studio. I was not about to complicate the issue for my fellow performers. Where even the occasional weekenders better know the studio up and down, the last thing they need is a phone box that is impossible to work. Naturally I was happy to be of service.

Plus, we all got fed ... DJs always come a'running when they hear that free dinner bell.

The screening process

My contribution to the phone discussion was minimal, but I will be interested to see if my sole suggestion gets implemented. I'm not about to give away any proprietary pizza recipes, but I will say it has to do with consolidating the number of CRT displays in the control room.

Between the hard-disk commercial playback monitor, the screen displaying transmitter status, the weather radar direct from the airport, the call-screening monitor, the CCTV security system for the parking lot and the jock's own portable TV to watch "Animaniacs" at 4 o'clock, the average radio personality is getting a daily four-hour skull X-ray. Something has to be done. Maybe now it will.

My real pride and joy came from my participation in the remote control applications discussion. Dealing with these

boxes can be likened to a visit from the devil. Whether they are the early Step/Home "ricka-ticka" jobs or the telemetric wizards of today, remote controls have always had a love-hate relationship with jocks.

Those old steppers would go out of sync and knock the AM off the air while jocks thought they were reading FM plates. False levels of AM antenna base currents were routinely logged when readings were taken during modulation. And who has never experienced a panic attack going through 3-Raise-7-Raise-Raise-8-Lower-10-Raise-Home? Except, of course, before sunrise in winter, when it was 1-Raise-3-Raise-6-Lower-14-Raise-7-11-Open 24 hours.

Don't even get me started on the ones that talk to you over the phone in synthesized English.

This is why I was enthused about the company's new concept for a remote control device. Again, not going into dirty details, it is computerized, simple, can quantize and read nearly anything and — with the proper modular interface — could probably even fire up the coffee maker a half hour before the morning man arrived. Very tasty indeed.

But will jocks understand it? The simplest remote I ever used was the oldie with the phone dial. Dial "2" and get plate voltage. Dial "7" and verify the tower lights worked. As computerized as the main studio is getting, a huge number of jocks still know squat about computers; a good chunk of that group simply

refuses to learn. How will they react to yet another computer in the control room?

Just read on

Which is why I am proposing my own criteria for a new and improved noncomputerized remote control here in *RW*. (Attention manufacturers: My idea is free. You are welcome to steal it for next year's NAB show.)

This remote control should be capable of simple, discreet on and off functions to provide power to specific components.

It should be designed to easily interface with those components that require power management. A standardized AC plug-in protocol is recommended.

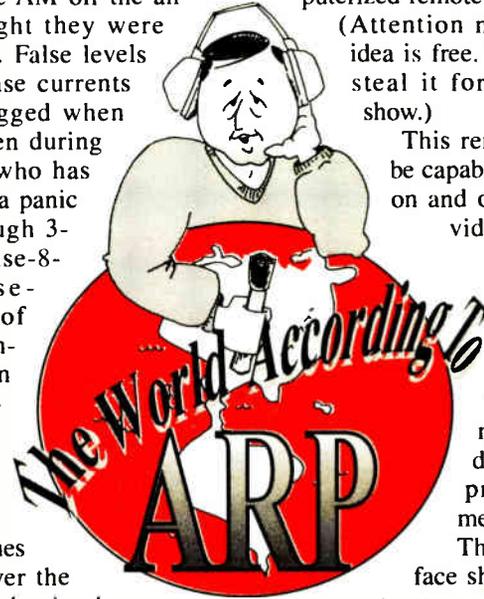
The actual user interface should be 100-percent transparent; a user should not

be conscious of its presence, only its function. Control over power switching and distribution should be performed with an absolute minimum of operator involvement. User commands should be simple to comprehend and easy to execute.

Finally, the actual control unit should be unobtrusive and located out of the traffic path so as not to interfere with the jock's duties or take up valuable rack space.

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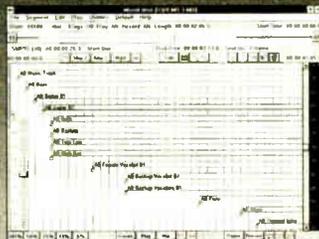
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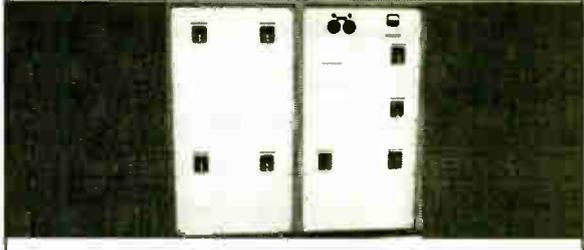
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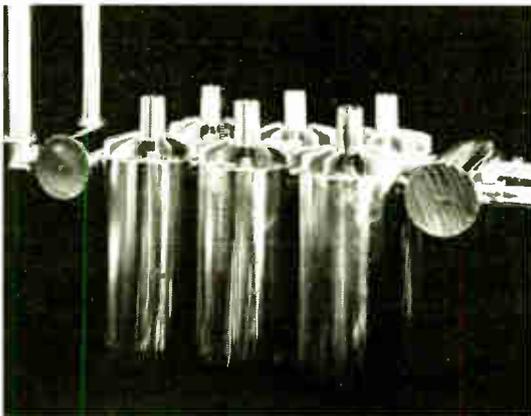
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DIGITAL DOMAIN

Enhancements to ADAT Tape Format

by Mel Lambert

LOS ANGELES In the early days of consumer video, we had Beta and VHS. It was not long before the technically-superior format was eclipsed by the one promoted more aggressively.

In the world of low-cost modular digital multitracks (MDMs), it might seem surprising that two rival formats have retained separate market shares. Introduced in 1991 as the world's first modular digital eight-track selling for less than \$4,000, the Alesis ADAT format utilizes standard S-VHS tapes running at three times normal consumer VCR speeds.

The Tascam DTRS format uses Hi-8 videocassettes running approximately 10 percent faster than home camcorders. To complete the overview, Fostex offers the ADAT-compatible RD-8 recorder, while Sony recently unveiled the PCM-800 DTRS-compatible machine.

By and large, Tascam/Sony DTRS digital multitracks have found their way into the post-production market, where their enhanced lock-to-timecode and faster search-to-cue speeds have made the hardware more appropriate.

ADAT machines — primarily because of their lower costs and market profile — have found greater appeal within project

studios and related industries, including radio production. Industry insiders tell me that there are in excess of 65,000 ADAT machines in use around the world.

Raising the stakes

Now, the format war is destined to enter a new phase, with Alesis recently revealing a double ace up its collective sleeve.

Unveiled at the recent AES convention in New York, the firm's dramatically improved ADAT-XT machine addresses

Industry insiders tell me that there are in excess of 65,000 ADAT machines in use around the world.

Both of these new machines will sell from less than \$4,000; there is expected to be a close-to-\$500 price differential between the slightly more inexpensive ADAT-XT and the more enhanced MDA-1. Alesis will be building both machines in its West Los Angeles manufacturing complex.

In essence, Alesis has taken the original ADAT digital eight-track and incorporated a number of features that were previously offered on the optional BRC remote control. In addition, the transport's operating software was completely rewritten, resulting in a claimed four-times improvement in fast-forward, rewind and search-to-cue speeds, without sacrificing gentle tape handling.

An efficient electronic interface constantly monitors all transport status modes, "intelligently" memorizing appropriate locate points and then providing optimum transport response. A Dynamic Braking System enables the -XT transport to move quickly between locate points, effectively eliminating the possibility of overshooting or undershooting specific time references. A laudable achievement indeed. And, yes, all existing ADAT tapes will be fully compatible with these new offerings.

On-board editing

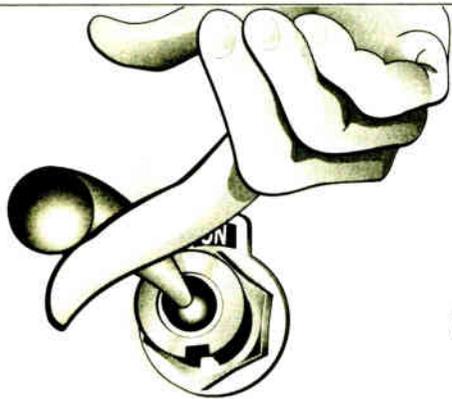
Other features include on-board digital editing, with direct track-to-track copy, programmable track delay and programmable tape offset. This allows individual or groups of ADAT tracks to be delayed against one another, to correct, for example, inter-mic distances on a multi-mic array.

There is an on-board 10-memory auto-locator (with auto-play, auto-return and auto-record loop functions), 20-bit/8X oversampling A/D converters and 18-bit/128X oversampling DACs and selectable 44.1 or 48 kHz sampling rates for full compatibility with DATs, workstation, CD-Rs and related projects.

Input/output connections are made via unbalanced -10 dB RCA connectors, servo-balanced +4 dB through a single multiway ELCO connector and multi-channel ODI digital I/O.

The XT's Track Copy creates a digital clone of a single track or a group of tracks, allowing assembly of composite tracks for digital editing. Tape Offset enables shifting of time reference between multiple units, allowing composite performances to be duplicated, assembled and then edited with a claimed accuracy of 10 ms. Track Delay enables the time reference of a track to be delayed up to 170 ms. Shifting tracks using the Track Delay facilitates changing the feel of a song or fixing slight

continued on page 35 ►



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PRODUCT EVALUATION

Sampling Spots with Roland MS-1

by Don Davis
with Alan Peterson

BALTIMORE Recently, Jack Daniels Productions was asked to test out a Roland MS-1 tabletop sampler.

We are a production house specializing in "hype" commercials. Club owners and concert promoters look to us for spots that are real clutter-busters. We create our characteristic "Jack Daniels" sound with special EQ and compression tailoring and quick jump-cut music tracks. In evaluating the Roland MS-1, I kept this concept in mind to see how adaptable the unit would be to our everyday operation.

The MS-1 is a table-top sampler that weighs less than two pounds. There are eight pads on the surface of the unit that play back a desired sample when pressed (also controllable via MIDI). A 16-character LCD screen displays information on MIDI channels, time remaining in memory, record level and more.

Internal memory is only 384KB, but Roland R-DAC compression technology allows extended sampling time for this finite amount of RAM. At a standard sample rate of 32 kHz, the MS-1 can hold nearly 28 seconds of mono audio. (The MS-1 can sample mono or stereo sources at mic or line level.)

Memory can be enhanced with the addition of PCMCIA "flash disk" memory cards. With a 20-meg card, users can store approximately 25 minutes of audio at 32 kHz; somewhat less when sampling

memory runs out or the red button is punched a third time. The MS-1 allows truncating a sample to eliminate dead space before and after the chosen sound element.

The memory capacity was not as long as I would have liked since the unit did not come with a PCMCIA card. As it was, I needed multiple short samples, so the Roland's eight samples per bank and four-voice playback worked for this task.

Product Capsule: Roland MS-1 Sampler



Thumbs Up

- ✓ inexpensive and easy to use
- ✓ free sampling CD
- ✓ manual easy to understand
- ✓ expandable memory



Thumbs Down

- ✓ no MIDI pitch change
- ✓ needs more internal memory

For more information, contact Roland at 213-685-5141; or circle **Reader Service 168**.

Please hold

The MS-1 keys behave much like a keyboard sampler would, inasmuch as you need to hold down a pad to complete playback of a sound. Lift your finger, and the sound ends. I found that somewhat distracting, especially when playing several samples concurrently.

Roland included the option to "hold" a sample in the MS-1, but this involves another keystroke to engage the feature. If you want to get a drum loop going and build elements on top for a music bed, the Hold feature is desirable.

MIDI function only allows triggering of a sample; the pitch does not transpose if playing the MS-1 from a MIDI keyboard.

Finally, in a welcome move, the Roland manual is easy to understand. In the section on sample editing, however, the

at the top rate of 44.1 kHz.

The demo program that came packaged with the MS-1 was a fun-sounding hip-hop loop. Clearly, this was one of the uses the sampler was meant to address when released. I was more interested in how it worked in radio production.

Cutting spots

The MS-1 was right on the money when I needed background noise or a sampled effect—fight bells and a synth flyby. I tried sampling voice to see how well it could handle "drops." When adding the sampled vocal effect during creation of a basic voice track, the quality of the sample did not stand up; it was not crystal clear. It was clear enough for home use, however.

This could be due to the sampling rate that was selected or the chosen input level on the MS-1; this must be carefully set, as it is very easy to overload. I ended up not using sampled voice on any of our client spots, but did get to use background-effect samples on 10 spots produced here at Jack Daniels.

In effect, the MS-1 came in handy as a multiple "cart" deck filled with the effects we needed instant access to.

Free CD

Samples can come from anywhere, but Roland packed the MS-1 with a CD containing 99 samples so users can begin assembling grooves right away.

The CD features drum patterns, vocal effects and instrument sounds that can be sampled and looped into the MS-1. The sounds are very realistic and life-like, and I almost wanted to keep the CD after sending back the MS-1, but was eager to incorporate our own samples and use them in the "heat of the battle."

Recording into the machine is fairly easy. Hit the red Record button, and the display prompts you to assign the sound to a pad. Choose the button you want, then hit the red button again. The MS-1 begins sampling and will stop when

manual contains diagrams showing edit points along a waveform. To the uninitiated, this may give the impression that waveforms can be displayed on the LCD screen for editing. The display will show start and end points in numerical form, but not as a wave.

Conclusion

The field of performers and studios requiring low-cost sampling is crowded and the next real step up from the Roland would probably be a pricier Akai S01 or S950 sampler. Roland makes the high-end S-760 rackmount sampler as well, but this is much more expensive.

There is only so much one can expect from an inexpensive sampler. As an idea "scratchpad" (comparable in concept to a portable multitrack cassette deck), a stutter-box or a device to assemble rudimentary hip-hop loops, the MS-1 is a capable, easy-to-use sampler.

It could be fun for jocks to load show sound effects and play them back live at club gigs or remote broadcasts. Stations and studios looking to experiment with sampling or adding this capability to a budget keyboard may want to investigate the MS-1.

□ □ □

Don "Double D" Davis is associate producer with Jack Daniels Productions and air talent on WXYV-FM, Baltimore. Alan Peterson is technical editor of RW.

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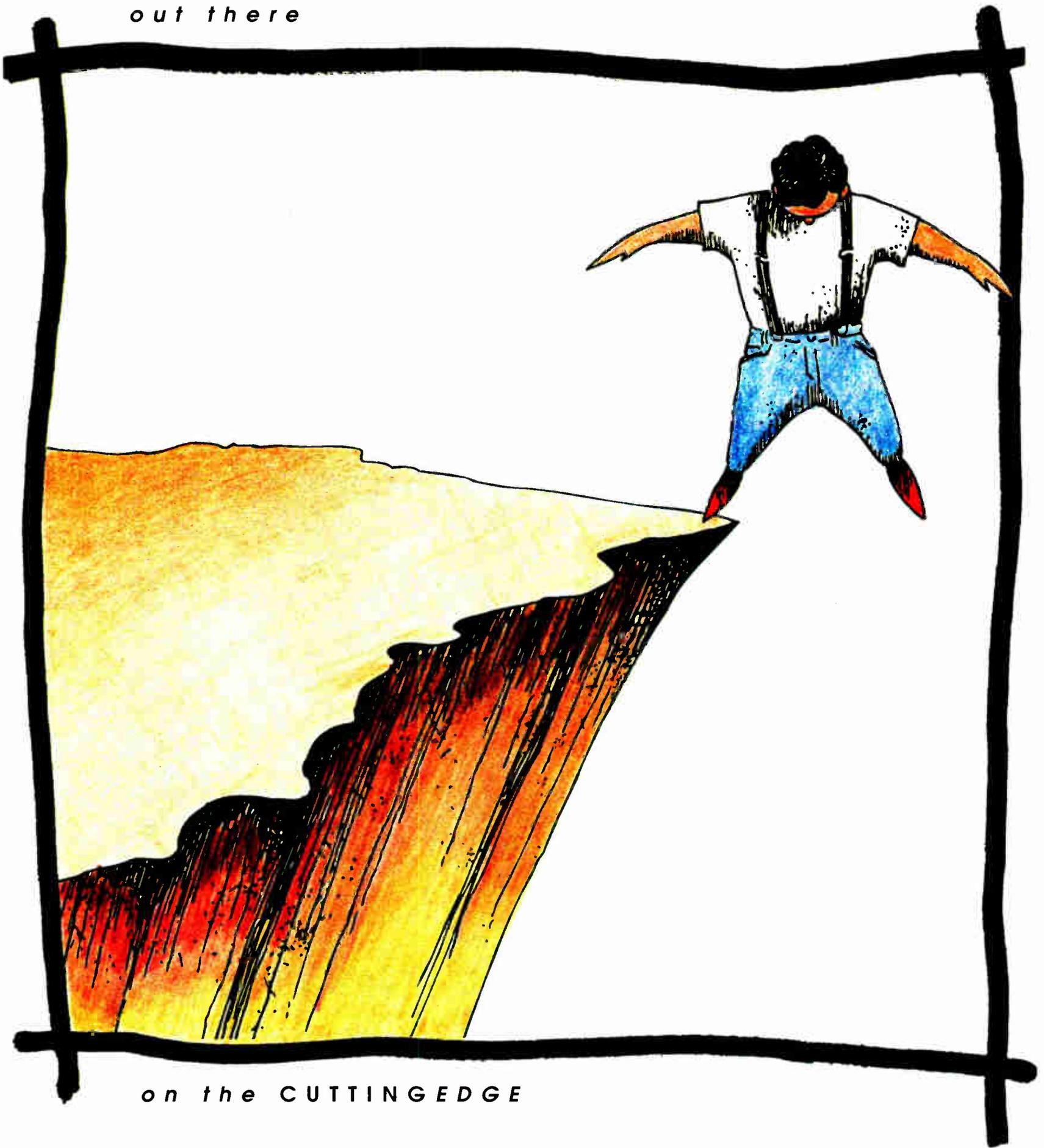
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Digital Satellite Distribution FAQs

by Rich Rarey

WASHINGTON This month, it seemed appropriate to take a peek at the changes in the Public Radio Satellite System. This new digital system offers tremendous possibilities to public radio broadcasters and to commercial broadcasters who wish to use the system to distribute programs to their subscribers.

While extensive documentation on the new system is distributed with the down-link equipment, public station engineers and producers have asked questions that are not covered in the manuals or video.

I asked Greg Monti, technical manager of the Future Interconnection System Project Office (FISPO) to answer some frequently asked questions, or FAQs.

Greg has a deep working knowledge about the system's design and implementation, and has graciously given us access to his FAQ. Reproduced below are the highlights of Greg's entire FAQ.

Q: What are the main features of the new Satellite Operating Support System (SOSS)?

A: Custom software will run under the IBM OS/2 Warp operating system on an IBM-compatible PC. A real-time, run-time operating system called Quadron Control Facility will run on a high-

speed serial port co-processor card called an ARTIC within the PC. The custom software set will let you do the following:

- set up the computer and its peripherals to match station preferences;
- receive, view, copy, extract, sort, filter and print DACS messages;
- receive satellite transmission schedule;
- electronically mark which satellite transmissions you want to capture and to assign demods and tape recorders to capture them;
- type in local events that can be used to record feeds from other audio services or to automate your radio station.

In the new DACS (Direct Access Communication System), each message will consist of a header that contains the "to," "from" and keywords, the message in plain ASCII text, and an optional binary attachment which can be a file of any size or format.

Many e-mail systems allow file attachments to messages and the new DACS system will allow them, too. The person sending the DACS message (whether they are at NPR or calling in on a modem) will be able to specify and load in a file to be the binary attachment for each message they send.

For example the binary attachment could be:

- a word processing document in Microsoft Word or Word Perfect (Mac, DOS, or WIN format);
- a .tif graphic file that the receiving user can import into a drawing or graphics program;
- a Microsoft Excel 3-D pie chart graphic or Lotus 1-2-3 spreadsheet;
- it could be a piece of software intended to be shared with the stations, a copy of a database readable in dBase, or a file of simple text that a station can format and use in its own way later;
- it could be an audio or video file in .Wav, .Au, .Ra, .Avi or other format.

You will be able to use the binary attachment feature to send out:

- art work promoting a program or series, or for use in station program guides;
- format clocks for programs;
- charts and tables showing pricing, rights, availability or other aspects of programs;
- annotated drafts of contracts or other legal documents;
- electronic advertising slicks.

Q: What is the bandwidth and response of the new satellite channels?

A: For the 256,000 bits per second (bps) discrete stereo channels used for standard public radio service, the RF bandwidth is 307.2 kHz. For the 128,000 bps mono channels used for standard public radio service, the RF bandwidth is 153.6 kHz.

Frequency response for the standard public radio service channels is 15 Hz - 20 kHz, ± 0.5 dB. The demods also support data rates of 192 and 64 kbps which will not be part of Public Radio Standard Channel service.

If an independent producer or distributor were to buy a channel of either of those sizes and proper coding, the demod could receive them. The RF bandwidth for 192,000 bits per second is 230.4 kHz. Response is 15 Hz - 20 KHz, ± 0.5 dB. The RF bandwidth for 64,000 bits per second is 76.8 kHz.

Only the 128 kbps mono channel is equivalent to an analog channel in the old Public Radio Satellite System. By comparison, a mono, full-bandwidth channel in the old analog system occupied 180 kHz of RF bandwidth and has an audio bandwidth of 15 kHz, ± 0.8 dB. So, the digital system is slightly more spectrum efficient.

Q: What is the S/N ratio?

A: Better than 82 dB, from peak clipping point of +18 dBu to the unweighted noise floor measured out to 22 kHz. In the analog system, this figure is 75 dB, unweighted.

Q: How much crosstalk is there between sides of stereo pairs, particularly at high frequencies?

A: Better than 80 dB down at any frequency at the maximum level of +18 dBu. The analog figure is "better than 85 dB," which would be 10 dB below its

own noise floor.

Q: How will the new Audio Recording Automation (ARA) system interface with the hard disk audio storage and retrieval system I am planning to buy?

A: The short answer is the SOSS will interface to your hard disk system the same way it interfaces to a tape recorder, through contact closures.

Q: One of the digital outputs of the new demods will be ISO/MPEG Layer 2 format. Can I record this signal on a hard drive storage system directly?

A: Probably. Media Touch Systems has introduced such a system with Layer 2 in and out. Expect some other manufacturers to follow suit.

Before choosing a hard disk storage system with Layer 2 inputs and outputs, ask the manufacturer the following questions:

- What modes and data rates are supported? Possible modes are mono, discrete stereo and joint stereo.



PUBLIC DOMAIN

Possible data rates in the PRSS are 64, 128, 192 and 256 kbps. The standard channels will only be in 128 kbps mono or 256 kbps discrete stereo.

- Do the beginnings and ends of individual recorded items on the hard disk occur at the boundaries between Layer 2 frames?
- Can items be cued up, including back-cueing, to determine the start of the desired audio?
- Does the system depend on the one-frame error concealment inherent in the algorithm or are full error detection and correction features provided?

Q: Can the taping of desired programs be scheduled from more than one OS/2-based computer? Theoretically, assuming multiple OS/2 machines, can I distribute the function of tape-scheduling across our LAN?

A: Yes. The OS/2 Schedule Editor and DACS Viewer applications can be networked. The contract we have with IBM requires them to test and to successfully implement networking using one combination of network environments which NPR must choose. We polled stations to see what LAN types were already in use. The most common was Novell Netware over twisted pair ethernet.

The main caveat: The ARA/DACS PC should not be used as a file server. Use another computer for that. The file server does not need to be running OS/2, even if it's a peer-to-peer network.

Detailed instructions for how to do it will be included in the documentation that is delivered with the DACS/ARA PC, software and training video.

□□□

Rich Rarey is technical director of NPR's *All Things Considered*. For a complete e-mail copy of Greg Monti's FAQ, please send your request to the E-mail address rrarey@npr.org

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Alesis, Panasonic ADAT Machines

► continued from page 30
timing errors.

For enhanced transport stability — and improved rigidity in rackmount applications — the new machine features a custom-designed, die-cast aluminum chassis that is said to eliminate flex and torque on internal parts.

A new multi-element vacuum-fluorescent display provides normal or enlarged meter scales of record and playback levels (with three modes of peak display) as well as absolute/relative tape counter time.

As with current ADAT machines, record times are approximately 40 minutes for an standard ST-120 S-VHS tape, dependent upon sample rate. This figure increases to approximately 70 minutes with ST-180 tapes. And, of course, multiple ADAT-XT machines can be hooked together via timecode sync to provide enhanced track capacity.

Notable differences

To offer a concerted front against the immediate competition, both the Alesis ADAT-XT and Panasonic MDA-1 are virtually identical in appearance, features and physical I/Os. There are notable exceptions, however. The ADAT-XT is finished in a dark, brushed aluminum finish, while the MDA-1 matches the light gray coloring used on the new SV-4100 Pro-DAT machine. In addition, unlike the XT's single ELCO connector for +4 dBu I/Os, the MDA-1 features multiple XLR connectors.

Finally, the MDA's analog output circuits are equipped with muting relays

WORKBENCH

► continued from page 22

is to power down everything before changing anything.

Not only is it important to keep the SCSI cables short, but it has been Robert's experience that placement also has an effect. After all, we are dealing with transmission lines.

A final tip is to beware of using the same SCSI address for more than one device. The results are erratic performance which can lead to system crashes. The problem is very hard to troubleshoot. Robert suggests reading the manuals, and learning how to set the addresses. Again, don't forget the computer itself. Robert Cham can be reached in Vermont at 802-453-4369.

★ ★ ★

Trying to pick up a few extra bucks for the holidays? Take five minutes and jot down some of your best tips for the *Workbench* column. *RW* will provide you with a handsome honorarium (\$\$\$), and the published submission will qualify for SBE Certification credit.

□ □ □

John Bisset is a principal with Multiphase, a contract engineering and special projects company based in Washington, DC. He can be reached at 703-323-7180. Fax submissions to 703-764-0751. Reach him on-line at rwbench@aol.com Printed submissions qualify for SBE Certification credit.

and feature a proprietary Panasonic circuit topology with servo-balanced, capacitor-coupled ports. The use of muting relays on the outputs is described as greatly improving the unit's signal to noise ratio in stop mode, while also preventing power on/off transients and other funnies that can cause speaker damage.

I expect that the availability of this duo of new, enhanced ADAT-compatible machines from two leading vendors will help strengthen the format's position within the recording and pro-

duction marketplace and attract more followers from the radio-production industry.

I wonder, however, how they will fare in

ADAT-XT machines can be hooked together to provide enhanced track capability.

the long term against the new generation of low-cost recorders based upon fast hard drives and removable Magnetic-Optical

(MO) media. Time indeed will tell.

With reference to last month's column spotlighting the new Fairlight Dali-2T two-track recorder/editor, I failed to mention that the unit comes complete with PD Coding and related software for use with external CD-R recorders. In this way, material edited on the Dali-2T can be offloaded directly to a CD-R drive while preparing jingles, ads, station promos and other material intended for CD playback.

□ □ □

Mel Lambert has been intimately involved with the production and broadcast industries on both sides of the Atlantic for almost 20 years. Now principal of Media&Marketing, a Los Angeles-based consulting service for the professional audio industry, he can be reached at e-mail mediapr@aol.com or telephone 818-753-9510.

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On Air
Screen

Navigator (KDLT)

00:04:14 intro: 09
00:00:00 intro: 00

All Around The World
11:00:00 -> 11:49:10 00:49'02

A	04'23	All Around The World - Lisa Stansfield	19"
M	04'10	I Wish - Stevie Wonder	T 18"
M	04'29	Set Them Free - Sting	35"
C		START DAT2	
	01'19	[Bottom of the Hour]	
M	00'03	R-r-r-r-Radio -	
M	00'45	Casual Furniture -	
M	00'30	Harley Davidson -	
M	00'35	News Call 1 -	
T	00'34	Cancer	
T	00'34	Japan	

"Hot Keys"

Carts

ON

1
Applause

2
Window Crash

3
Roar II

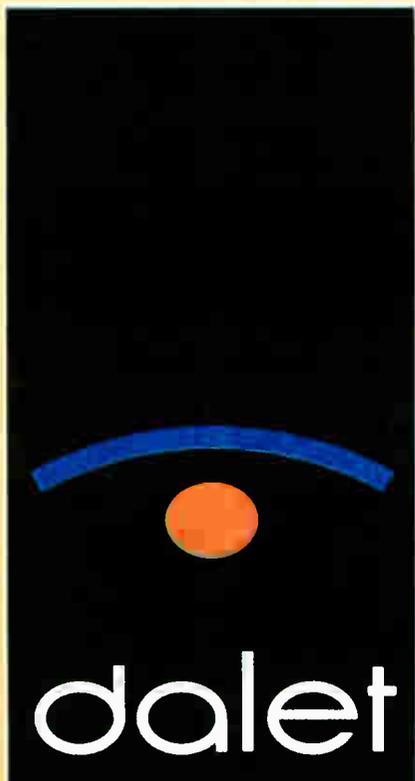
4
Plane & Car Crash

Inflight M

All Around The World	I Wish
fade out...>	fade in....>
xfade.....>	begin off...>
end off....>	att. (dB): 1:

00:04:108
00:03:459
04:23:280

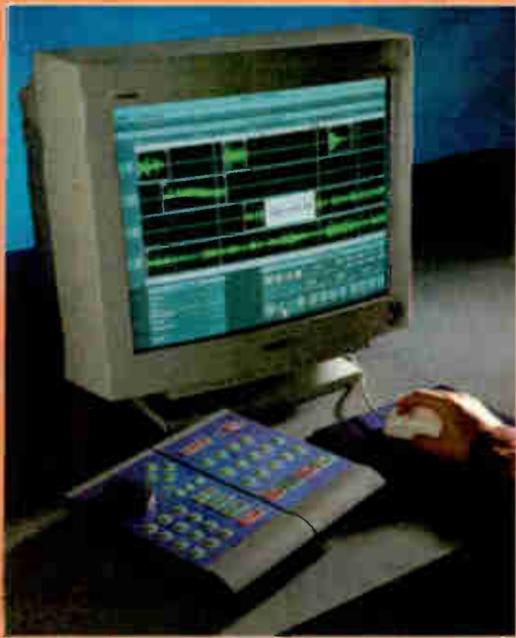
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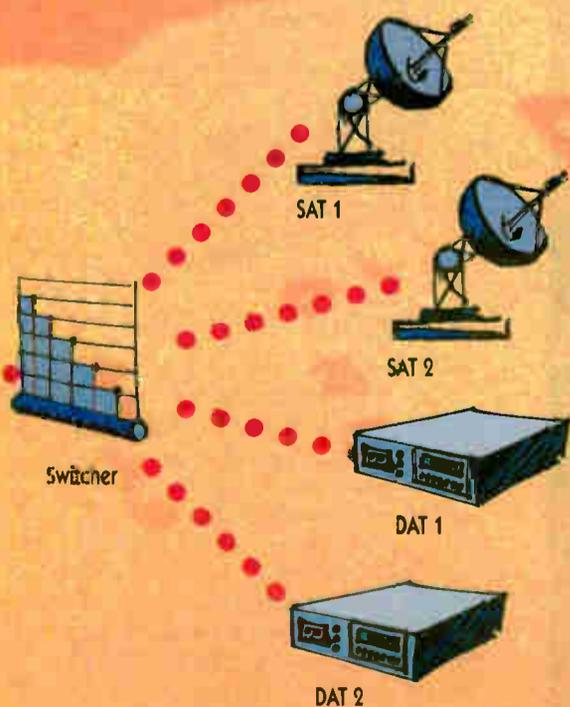
"We have been using the Dalet System since June 1993. We have been so pleased with its performance and development that we are implementing the system in our network studios for the "Music Of Your Life" satellite network that we are currently developing."

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PRODUCER'S FILE

Affordable beyerdynamic MC 834

by Ty Ford

BALTIMORE In the condenser microphone marketing domain, there appears to be a price boundary. I noticed it most recently in comments on the net. Lots of requests for information about condenser mics for less than \$1,000.

It probably has something to do with the addition of another digit (\$999 to \$1,000) and how much the market is willing to pay for a certain quality level of an existing technology.

It also has something to do with the "maximum sell point" — the highest figure at which an acceptable amount of

product may be sold. Pricing the mic more than that point means reduced sales. It's like peaking the grids and dipping the plates, only with money.

Anyway, that is where the beyer MC 834 (\$999) is priced.

The goods

The MC 834 is a large, single-diaphragm, internally-charged condenser microphone. It uses the same preamp and electronics as beyer's MC 740 five-pattern mic. The MC 834 has only one pattern (cardioid), requires 12-48VDC phantom power and is equipped with -10 and -20 Db pads and

low-frequency roll-offs at 80 Hz and 160 Hz.

According to the generic frequency response curve in the documentation, the MC 834 is flat from about 125 Hz to 1.5 kHz, it takes a decibel lift around 3 kHz, comes back down and wiggles a bit until at 9 kHz, it forms a +2 dB plateau that begins tapering off at about 15 kHz. By 20 kHz, it's 4 dB down.

Meanwhile, back on the bottom, the bass starts rolling off smoothly at about 125 Hz and is 4 dB down at 40 Hz. After reading the specs, the MC 834 sounded like I expected it to when plugged into an Amek/Neve 9098 mic preamp.

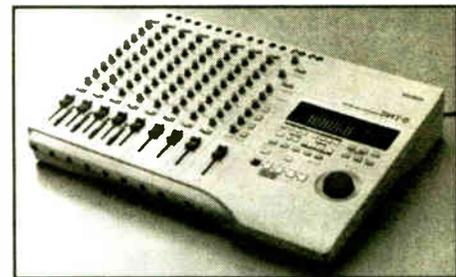
The MC 834 has a relatively high output; at least 6 to 8 dB higher than the Gefell UM70, and 2 to 3 dB greater than the Gefell M900. This may be a plus if you have mic preamps that are somewhat noisy at high gain, but it also means you need to adjust your preamp levels before any evaluation. The MC 834 will handle SPLs of 130 dB without padding. Above 130 dB, the -10 dB and -20 dB pads will come in handy.

Because the body is very sensitive to handling and vibration, the optional EA834 suspension mount (\$139) should

continued on page 41 ▶

PRODUCT GUIDE

Companies with new product announcements for Studio Sessions Product Guide should send them to Radio World, c/o Studio Sessions Editor, 5827 Columbia Pike, 3rd floor, Falls Church, Va. 22041



Fostex Digital Eight-Track Recorder

Fostex Corp. of America announced the introduction of the DMT-8 compact hard-disk recorder/mixer/editor.

Comparable in appearance and function to cassette-style multitrack recorders, the DMT-8 records CD-quality, 16-bit data to an internal 540 MB hard drive, providing 12.5 minutes of recording time across all eight tracks. The front panel includes a jog wheel and large fluorescent meter that displays absolute time, MIDI time code or beat/bar information.

The self-contained recorder includes an 8 x 4 x 2 analog mixer with 2 aux sends and 2 stereo returns and dual parametric EQ.

Digital editing is nondestructive and performed through several cut/copy/paste editing keys.

Suggested price of the DMT-8 is \$2,795.

For more information, contact Fostex at 310-921-1112 or circle Reader Service 203.



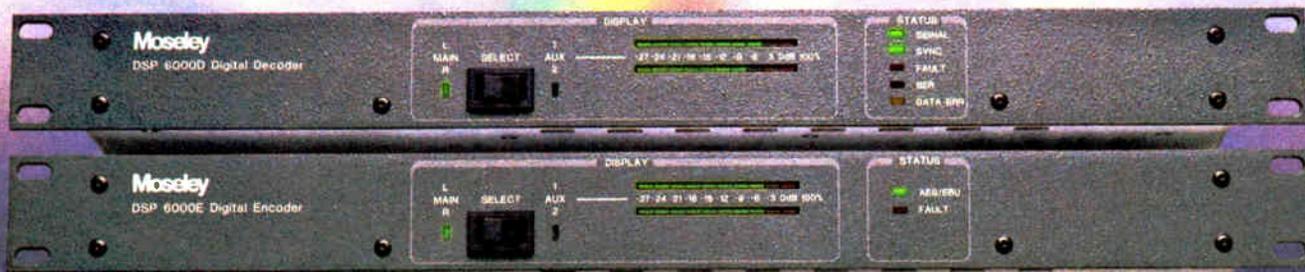
Mothers Cassette Duplicator

Now! Recording Systems of New York is importing the Mothers M-2010 cassette duplicator. The M-2010 is for studios and stations needing multiple dubs of commercial or jingle demos and clean copies of seminar or lecture material.

As a master recorder, the M-2010 can produce 10 original first-generation audio cassettes from any line source. As a cassette-to-cassette duplicator, it can dub nine stereo/mono tapes in real-time or 2x speed.

For information, contact Now! Recording Systems at 212-768-7800 or circle Reader Service 5.

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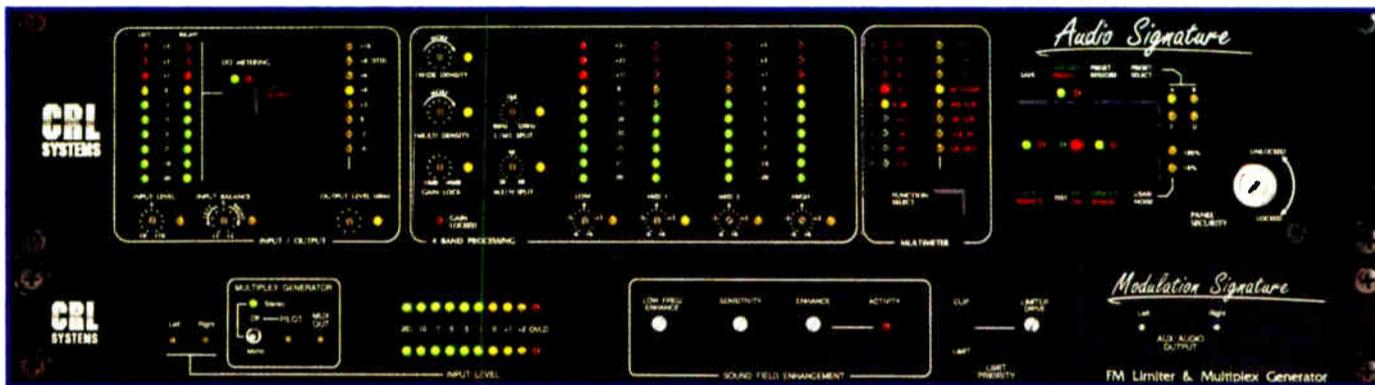


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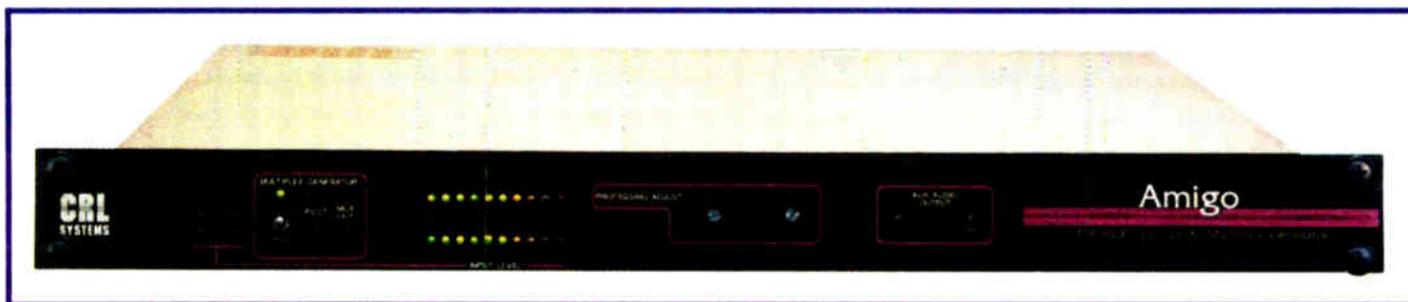
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SHORT TAKE

MR-1 Has Tiny Price

by Alan R. Peterson

ROCHESTER, N.Y. For years, customers have griped about the price of digital processors. Manufacturers listened.

Digital reverbs evolved from the two-grand Yamaha REV-7 to the killer \$300 devices we have now. Given the over-\$10,000 price tag of analog plate reverbs once upon a time, this is a revolutionary achievement.

Was it enough? Evidently not, because everybody screamed "make it less expensive!"

Well, now you've done it. Applied Research and Technology (ART) of

Rochester, N.Y., recently answered the challenge and introduced the MR-1 digital reverb; a full 16-bit reverb processor in a durable steel case no bigger than a portable CD player.

To get cheaper reverb than this, you would have to mic an empty coffee can; the MR-1 lists for only \$159.

Certainly there are limitations. The reverb is solely mono; there are only 16 programs to pick from, and the enclosure is not a rackmount unit. But for the price, the plug-in-and-go MR-1 is an enormous value.

The steel case provides remarkable protection against RF and hard knocks. Additional shielding is provided right

on the double-sided PC board in the form of etched ground planes on the soldered side. ART's own proprietary DSP chip provides the brainpower, and a socketed ROM containing the sixteen programs runs the show.

Two simple dials control effect mix and program selection, a pair of buttons selects mic- or line-level (-10 dB) in and out and, yes Virginia, there is a real live Bypass switch.

Being a tabletop device, the MR-1 is free to be located where it is comfortable

and easy to reach by the user. The three cables that need to be connected to the unit might be cumbersome, but this is a small tradeoff given the low cost of the MR-1.

Sixteen-bit reverb may not get much less expensive than this. For smaller commercial project studios or a jock's home production rig, the MR-1 is worth looking into. □□□

For more information, contact ART at 716-436-2720 or circle Reader Service 13.

Expand Board Inputs With 'Audio' Switcher

by Alan R. Peterson

WASHINGTON What do you do when the production board runs out of inputs and the budget won't allow for a new console? Get an audio switcher.

Normally a fixture in the main control room, a production room switcher can add 10 or more stereo inputs to one fader.

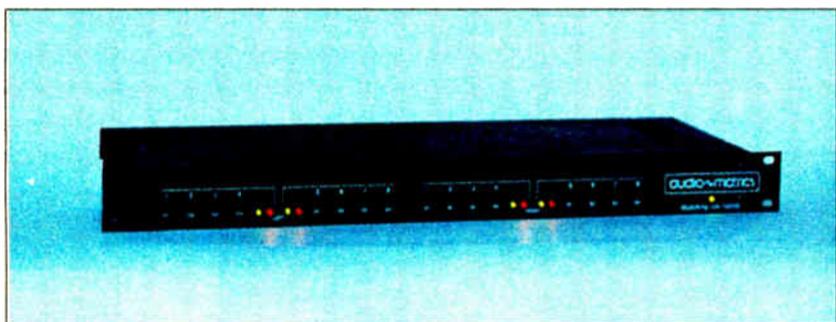
Stations that have gone a long time between major equipment upgrades are

of a bigger, more powerful console. Until the comptroller caves in and buys one, the most economical solution is a simple audio switcher.

Typical units are shown here: a Zercom PS-2 and a Conex AS-101, both stereo 10-in by 1-out switchers. Many manufacturers build similar devices, including Broadcast Tools, 360 Systems, and Henry Manufacturing. Switchers can be passive or active devices and some allow users to trim levels

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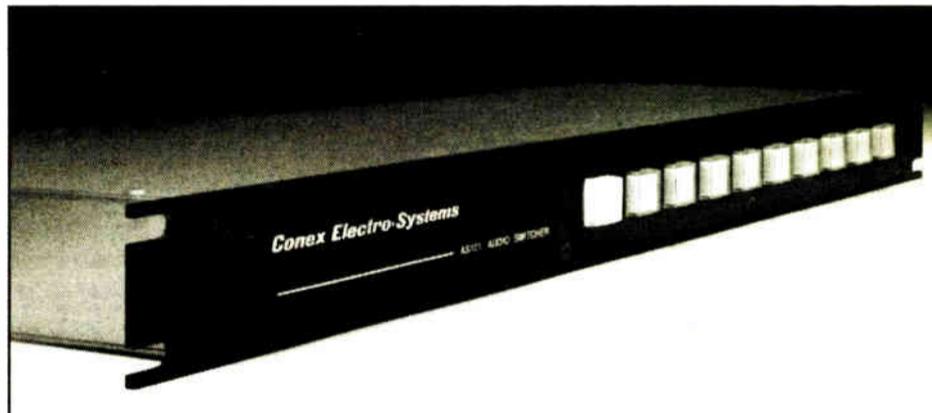


A Source Switcher from Zercom ...

experiencing growth problems in main and secondary production rooms. Many early upgrades were designed to accommodate the technology of a former era; a couple of turntables, reel decks, cart machines, mics and a cassette deck.

so every input hits the board at +4 dB.

The idea is to devote a single fader on the console to the switcher to handle lesser-used inputs not often combined with each other. For example, satellite services, a spot delivery system, two Marti channels,



... and one from Conex; both useful in production room.

Along came multitrack tape, eating up four to eight inputs. New CD players needed to coexist with turntables, so two more inputs disappeared. In came the DAT deck and out went another channel. Finally, the foldback for the special effects box took away the audition bus and that last fader at the end of the console.

Until the transition

Today's studio still requires most of these while making the transition to the next level, which will likely include a hard disk playback device, several satellite services, a dial-up spot delivery system (DGS, et al.) and a digital audio workstation.

Optional inputs might include MIDI music feeds, patch lines for a field cassette/ DAT recorder, a portable DJ turntable rig for airing live urban mix shows and perhaps a newly-acquired LMA piped through the studio between production projects.

Naturally, the answer lies in the purchase

of an optional MIDI rack and a pair each of -10 and +4 line inputs all can be assigned inputs on the switcher.

OMG lines

Those extra line-ins are sometimes referred to as "OMG lines," as in "Oh, My God (I need another input!)." These serve to connect to DJ rigs, VCR audio outputs for lifting TV sound bites, a submix board for blending live music to air or anything requiring a quick, clean connection directly into the production console.

Audio switchers can begin as low as \$250 and head into the thousands, depending on your need. The Zercom shown here is under \$400, the Conex lists for under \$900.

You may get a nasty look for wanting to buy more gear, but the price of a switcher is a fraction of what a new console would cost and would get the job done while leaving jocks with the familiar feel of a console they already know. Until it's time for the big upgrade, switch to a switcher.

Testing beyerdynamic's MC 834

► continued from page 38

be used to prevent vibrations from crawling in through the stand. You can save \$50 by ordering the MC 834 mic with the EA834 mount together as an "834 Set" at \$1,099.

Polar response

The side-to-side high-frequency polar response is moderately wide, which may be a benefit for voice applications where the talent needs to move around

Of the two foam balls, the coarse filter worked the best. With it, I was able to work the mic in my usual position without popping.

At that position, I was back to being within two inches of the mic so the proximity effect boosted the bass in my voice nicely. The mesh filter did a similar job but left the mic sounding slightly more open.

Incidentally, I've seen some smaller mesh filters recently about three inches in diameter. I don't know who makes them or how much they cost, but they are a lot easier to work with than the larger ones.

I tried the mic through both the

Amek/Neve 9098 System preamp and the Mackie 1604. The MC 834 has neither the full bottom nor the top-end sizzle of the AKG 414. It has less bottom but slightly more sizzle than a Neumann U87. It has less proximity than either.

The sound

The 9098 was smoother, whereas the edge on the sizzle hardened slightly using the 1604's preamps. The 9098 gave the MC 834 a warmer, more pronounced mid bass. The Mackie 1604 made the mic sound a bit stark.

In a second "male-voice" trial comparing the MC 834 with a Neumann U87

and AKG C414, using API mic preamps, the MC 834 was almost identical in sound to the U87 at a working distance of 10 to 12 inches. I also noticed that while the MC 834 had as much bottom as the C414, it was higher in frequency than the C414.

Microphone choices are the result of very personal and subjective criteria as much as they are the result of matching the right specs to the right application. If you like the idea of a high-output, single-pattern condenser mic, but have found them too sensitive to low frequencies, try the beyer MC 834.

□ □ □

Ty Ford voices and produces audio tracks for a wide variety of commercial purposes. When not in session, he can be reached via e-mail at Tford1010@aol.com or by phone at 410-889-6201.

Product Capsule: beyerdynamic MC 834



Thumbs Up

- ✓ high output
- ✓ low proximity effect



Thumbs Down

- ✓ may exacerbate sibilance

For more information, contact beyer at 516-293-3200; or circle **Reader Service 41**.

somewhat. The mic nulls nicely at 90 degrees off axis, and even though it is a cardioid pattern, the unit is sensitive to both low and high frequencies from the rear.

If you have really good ears and are planning to hang the MC 834 such that the back of it is near any hard reflective surfaces, you will want to make sure that pickup from the rear of the pattern is not adding any unwanted reflected sound. Using my voice, I worked the mic around both hard wood and glass surfaces with only very minor audible reflections.

The proximity effect doesn't really kick in until you are three inches or closer. However, I found that my usual positioning of the mic (45 degrees off the side of



beyerdynamic MC834 Mic
with Optional Suspension Mount

my mouth, and two to three inches away, with no pop filter) resulted in unacceptable popping.

I went to "Plan B:" positioning the mic above my mouth several inches out and angled downwards towards my mouth. Because the off-axis high-frequency response of the mic is as good as it is, that worked, but it took some getting used to.

I then tried both coarse and smooth foam pop filters and a mesh screen filter. Foam balls work well, but they also knock off a noticeable amount of top end.

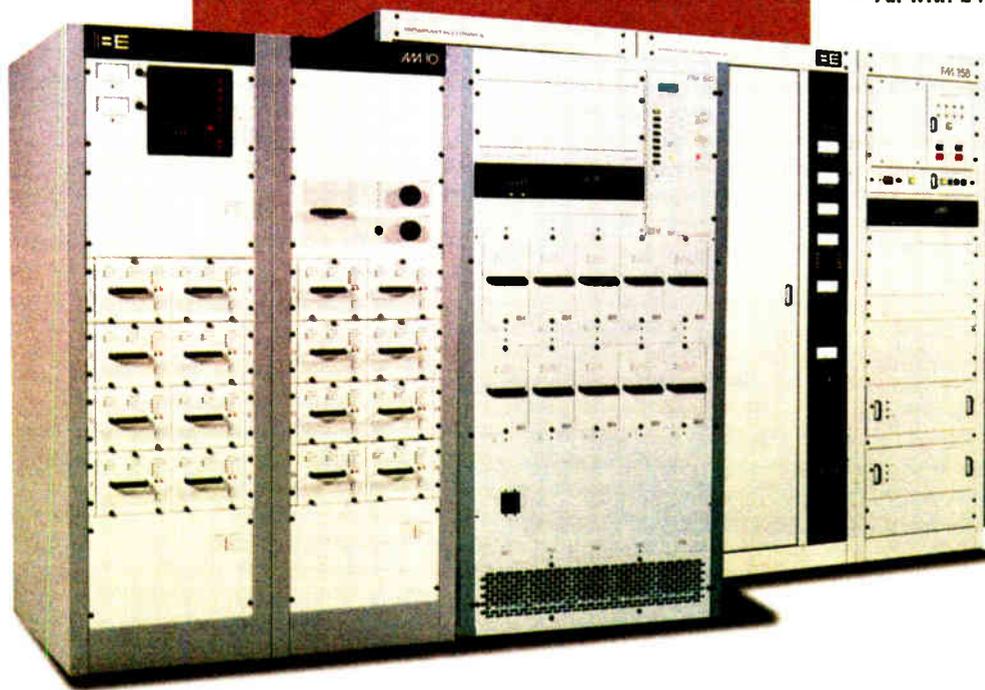
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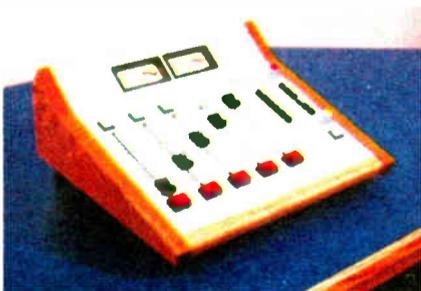
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Designed for the radio station of the digital '90's, the 1200 series high performance console has a dynamic range of over 100dB which makes it ideal for use with digital audio sources such as CD players and digital audio workstations. High quality mic preamps assures you of the lowest noise and distortion that current technology can provide. Active balanced in and out, the 1200 is the high performance, professional solution to your studio's needs.

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SPECIAL REPORT

Evolving with RBDS Technology

by William Ammons
Circuit Research Labs

New Promotional Methods and New Revenue Streams for Your Station The RBDS (Radio Broadcast Data System) standard allows your station to transmit additional information like the artist's name, song title, or additional promotional information. These new information streams consist of your station's call letters, format, updates of time/date display and program service text. In addition, some of the new smart radios allow for radio text reception, which enables you to send for information like the artist's name, song title or additional promotional information.

In addition, the RBDS system has some non-public data streams that give your station potential revenue sources. These include paging networks, global positioning information and sign/billboard control. New applications such as stolen

ator for phase reference. The RBDS generator then adds the RBDS subcarrier to the FM stereo program and any SCA subcarriers now in use.

The RBDS signal

The RBDS signal is transmitted as a bi-phase coded signal with a data rate of 1187.5 bps. The signal is made up of 16 possible data groups. Each data group has four blocks of information with each block being 26 bits long. Each block of 26 bits contains 16 bits of usable information or data and 10 bits of check word or error correction (see figure 2).

Data groups

Of the 16 data groups available under the RBDS standard, 13 of them are currently defined (see figure 3). The three undefined groups await future applications. Your station could be the one to come up with new uses or applications. The newest generation of RBDS generator, the CRL SC-100 is DSP (Digital Signal Processing) based,

each of the 16 groups. The automated tuning features found on "smart radios" use the PI code as signal identification. Many of the enhanced services that RBDS offers also use the PI code as the station identifier.

Radio text

The RBDS Radio Text (RT) is a message up to 64 characters in length and can give your listener information like the artist's name and title of the song. Other applications include promotional messages and advertising. Some radios will scroll this text across its LCD display while others will require the listener to step through the message in eight character segments.

A full function RBDS generator such as the SC-100 will allow you to store a number of text messages and send them by time of day or in a sequenced order. Messages can also be sent real-time by RS-232 data communication. In addition, stations that use automation systems will be able to have radio text information loaded directly into the RBDS generator.

Program type

Have you ever traveled by car out of your area and wanted to listen to a particular type of format? With the new "smart radios" you have a choice of up to 31 different program types (PTY) (see figure 4). On "smart radios" that are equipped with PTY search, you scan through format types on your radio. Then select the format you want and your "smart radio" will scan the entire FM band for those

stations putting out a RBDS PTY code that matches. The radio will then queue up on the first matching PTY found and let you scroll through others that it has found.

Alternate frequency

Now picture yourself driving along in a car that has a RBDS "smart radio." The signal of the station you are listening to becomes weak. If that station is using RBDS and has a translator, the Alternate Frequency (AF) portion of the RBDS signal has automated tuning information available. If the "smart radio" has AF, the radio may be switched on to seek the alternate frequency. You are kept tuned to your favorite program. This feature was mainly designed for networks and stations that have translators. The RBDS standard supports a list of up to 25 AF's.

Future "smart radios"

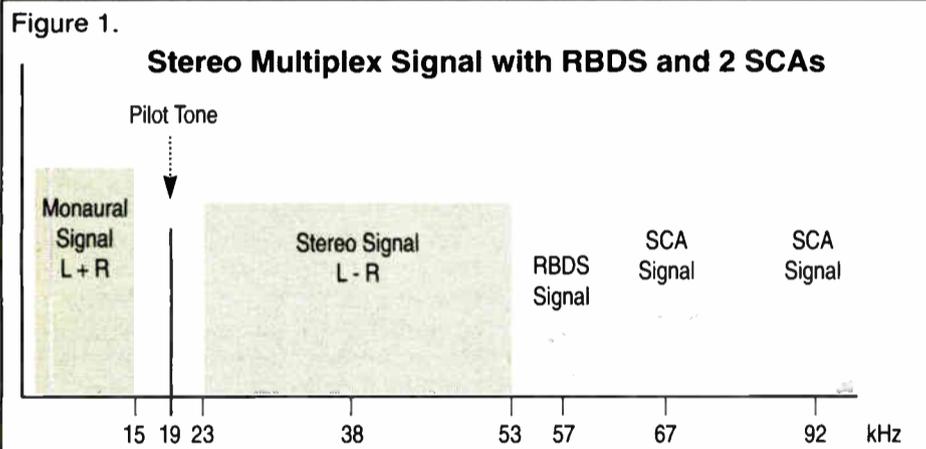
Future generations of "smart radios" may be able to tune to alternate stations by Program Type Name (PTYN) or Extended Other Network (EON) information. This will allow some creative ways of letting a listener stay tuned to a particular syndicated program or network as they drive from city to city.

Ideas to make the applications a reality are now being developed. The use of PIN (Program Item Number) will allow a listener to program his radio to turn on when a certain program begins. Some radios will even be able to start a cassette recorder/player to tape the desired program.

Traffic Announcements

With urban traffic that seems to get worse every year, the new generation of "smart radios" will give your listener a helping hand with traffic delays. The

continued on page 45 ►



credit card notification services and newspaper teletext are quickly coming on line. As these services become available, their providers will want to lease parts of your RBDS signal.

What is the RBDS Standard and how does it Work?

The RBDS system for FM radio stations is an outgrowth of the RDS (Radio Data System) that has been used in Europe for some time. The RBDS standard was developed for the U.S. radio market and is a close sister to the RDS standard.

Transmitting RBDS

The RBDS signal is transmitted on your FM station on a 57 kHz subcarrier. The RBDS signal is inserted between your station's normal stereo signal and any SCA carriers that you now use. The RBDS signal is quite narrow in bandwidth and is normally injected at only two percent of the total modulation (see figure 1). The RBDS signal uses your station's stereo pilot signal as a reference to insure interference-free operation with your current signal.

The RBDS generator is usually placed at the same location as your stereo generator. A sample of the stereo generator's output signal is used by the RBDS gener-

ator which makes it easy to add new data groups by simple-to-install software updates.

Many of the older RBDS generator/encoders on the market today were not designed to support all of the defined groups. In addition, many of these older designs cannot be upgraded to support new groups and uses in the future.

What exactly will the RBDS "Smart Radio" give my listeners?

New information

There are a number of additional information sources that the new "smart radios" give their owners. Use their features to help your station's identity stand out even more. For the mobile listener, most "smart radios" will display the station's program service (PS) name. The PS is up to eight characters in length. For example, your PS could be ROCK 97, HOT 102, WQFQ 103 or contain a sports message like GO SUNS. Or you could change the PS message by time of day for different dayparts and program themes.

PI code

The program identification (PI) is a unique code for each station. This PI code is transmitted at the beginning of

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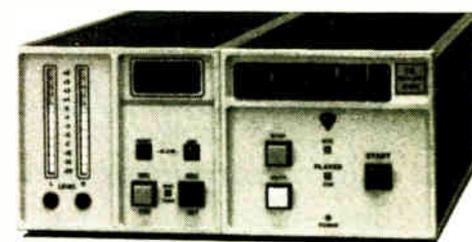
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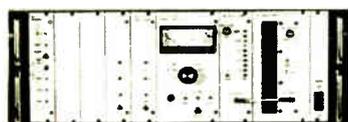
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RBDS Is Smart Radio

► continued from page 43

Traffic Announcements (TA) section of group zero allows your station to transmit an announcement flag that will either stop a cassette being played or turn the radio up to a preset volume level. This feature allows your traffic announcements to get through to your driving listeners. Future generations of "smart radios" may also have the ability to let the listener know when newscasts are coming up.

Time and date updates

Group four of the RBDS standard transmits the time, day, month and year to the listener's "smart radio." This time-keeping function is done

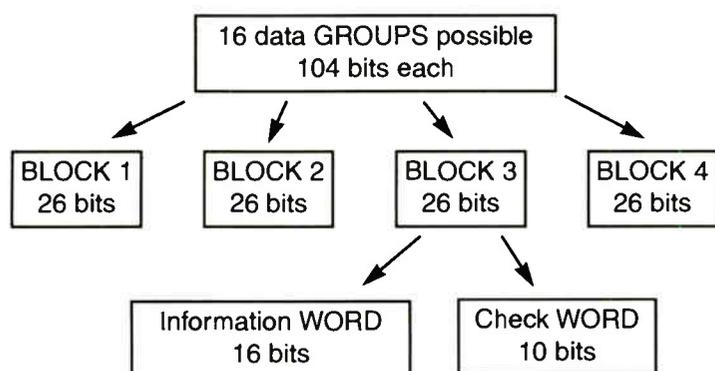
seven. You can quickly form a paging network that equals your current coverage area. You can lease group seven out or use it for in-house applications. If you are using the CRL SC-100 you have two powerful terminal paging options available to you:

Full TNPP paging

The first option is the ability to lease out group seven to an outside party for a large paging system. The lessee would then install a paging terminal at the location of the RBDS generator and collate paging messages from phone lines or satellite sources. Your FM station's RBDS signal can support up to 10,000 pagers and provides a coverage area of at

Figure 2.

RBDS Signal Structure



once a minute and will change the time on the listener's "smart radio" when passing through different time zones or at the change to and from daylight savings time. Newer radios that have the CT (Clock Time) feature set the time within one minute of finding an RBDS station.

*What else can RBDS do for my station?
How can my station use RBDS to make money today?*

Multi-point communication link

Your RBDS signal is a point-to-multi-point communication link. This means that the signal is sent from one location to many receiving locations. The value of this system is that the cost of the transmission hardware is fixed. As you send messages or data out to more locations, the cost per message goes down. The RBDS offers a number of non-public features that your station can use to generate new revenue streams. As you take advantage of each new service your revenue streams increase.

Non-public messages

These non-public messages/text services use groups three, five, six and seven of the RBDS signal. You can lease out portions of your RBDS signal to various providers or use them for in-house applications. Be sure that the RBDS generator you choose fully supports these data groups. Not all generators support or can be upgraded to fully take advantage of these new revenue sources.

RBDS paging

On of the most exciting aspects of advanced RBDS features are the paging applications that are available on group

least equal to your one millivolt contour. The CRL SC-100 fully supports the Telocator Network Paging Protocol (TNPP) industry standard.

In-house paging

The second paging option that the CRL SC-100 supports is a self-contained "in-house" paging program. No additional paging terminal is needed. The control program works from either the front panel keyboard or via the Windows VT-100 dumb terminal program. A built-in directory lets you enter the name, pager number and the number of pager repeats desired. To send a message, look up the directory location, type in the message and hit "enter." This is a perfect system for your station's staff. You own the equipment and transmitter, so there are no monthly fees. The built-in system supports up to 300 pagers. You might want to lease out part of your in-house system to selected advertisers, etc.

Sign control

You probably have seen articles that talk about automated billboards and LED sign displays. These new promotional tools can be controlled from group six of the RBDS signal. Group six is called the "In-House Applications Group." In addition, this data group has other potential applications including network switching and special ID signals.

The billboard/sign control capability is by far the most popular use for group six. The data is picked up by special FM RBDS receivers and converted to a data stream which is sent to the billboard or LED sign controller. Each billboard or sign can have an individual address. This allows many different promotional messages to be sent in a short period of time. While many think of billboards and

signs as fixed-location promotions, LED sign boards could be easily mounted in city buses or mass transit transfer points. Each receiving location uses a small RBDS data receiver. Since each receiving location is addressable, you could feed news texts to transit stations, advertising to on-board bus signs and control highway billboards at the same time.

Expanded LAN system

Group six of the RBDS signal can be compared to an expanded wireless LAN (Local Area Network). By using this portion of the RBDS signal, you can send simplex messages or updates to many other networks.

Let us say that your station has a wide coverage and advertising sales area. Instead of your sales staff first driving to the station to pick up daily reports, call sheets and advertising slot avails, this data can be sent via group six to their home computers. They could drive from home directly to their first client armed with up-to-the-minute information. An inexpensive RBDS receiver PC card is now available that will allow many pages of text information to be sent. In many cases you will only need an hour or so for all data updates. You could also lease out unused blocks of time to other parties.

Global positioning

Group three of the RBDS signal has been defined for Differential Global Positioning (DGPS) use. The GPS is a multi-satellite

system that uses small hand-held receivers to show a person's location within a few hundred feet. The receiver reads signals from several satellites and then computes the physical location and elevation of the receiver. Depending on the number of satellite signals that are available and the technical refinement of the receiver, the accuracy is usually limited to around 330 feet (100 meters).

Do you like to fish? Have you ever wanted to find that special fishing hole out on the lake again? Here is how your RBDS signal will help you out. The RBDS signal is used as a refinement source by the DGPS receiver to correct small amounts of error that are introduced by atmospheric conditions. Selective Availability errors and relative angle to the satellite. The local DGPS correction information transmitted by RBDS signal allows the accuracy of the DGPS receiver to be much greater (typical accuracy is 20 feet or closer). On your next fishing trip, take your DGPS receiver with you. If you find a good fishing hole, store its location in the receiver's memory.

You can lease out group three of your RBDS signal to a DGPS receiver company. They will come to your transmitter location and verify the tower's physical location down to the foot. Then they will connect their terminal with localizer information updates to your RBDS generator. These DGPS updates are constantly being calculated and sent out. The

continued on page 46 ►

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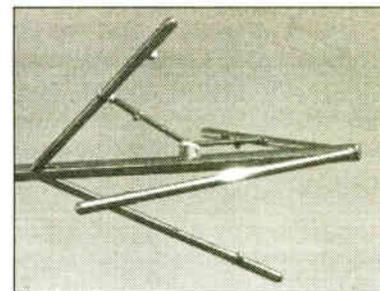
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USER REPORT

BE FM-20B Pleases the Hard to Satisfy

by **Marty Wind**
Executive V.P./G.M.
KLUX(FM)/KHOY(FM)
Diocesan
Telecommunications
Corp.

CORPUS CHRISTI, Texas

Over years of consulting, systems design and station management, I have had experience with just about every major manufacturer of FM and AM transmitters. A tough guy

noncommercial KLUX(FM) on Channel 208, was granted a CP to upgrade. The upgrade was unique because it involved a master antenna/combiner operation that affected local TV channel 6. We succeeded in obtaining authority to exceed the ERP levels set by FCC interference rules by more than 400 percent. By advance agreement, continuing the operation was contingent on operational stability and noninterference with channel 6.

At that time we selected the newly released BE FM-20B. We were especially interested in this single-tube transmitter because of the folded half-wave output cavity and its integrated second harmonic suppressor, which works on the second harmonic at its source, maintaining maximum efficiency.

The BE Automatic Power Control (APC) was not new to us by virtue of its presence in our other BE transmitters. The APC took on a new importance, though, as it would afford the easy starts and exacting output power

control (typically ± 1 percent) demanded by our agreement with channel 6.

The need to know

The MVDS (Microprocessor Video Diagnostic System) metering via the integral CRT in conjunction with extensive analog metering satisfied my need to know what was going on, especially in relation to

the VSWR and the match between the PA and IPA sections. If you have never experienced the bar graph display on the MVDS as a tuning aid, you need to check it out at the next convention.

Little downtime

We ordered the FM-20B in the configuration that allowed

auxiliary) in the cramped transmitter vault. We also included the filament voltage regulator option, MT3 expansion interface with RC-1 remote control, as well as the three-phase AC metering package (which proved very valuable when the power company dropped a phase).

We received one of the first

For me, Broadcast Electronics FM transmitters do it right and are a source of satisfaction.

us to locate the HV power supply in a separate cabinet. This configuration permitted us to line up the FM-20B with the older FM-3.5 (now our

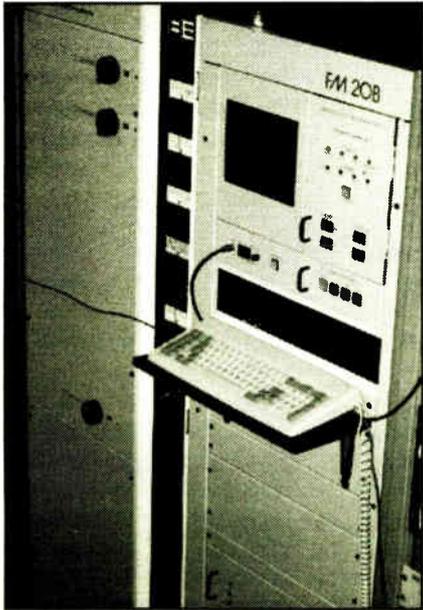
FM-20Bs and began 24-hour operation in December 1989. We continue to operate today at the original licensed power levels with all the stability we

expected and no problems regarding channel 6. Since 1989, with the exception of some 50 hours of downtime for semiannual maintenance or utility failures, we have only lost 23 hours of full-power airtime due to failures on the FM-20B. Twenty of those hours were the result of shipping time required to obtain a replacement neutralization capacitor that failed during a surge accompanying a lightning strike.

The only other problem was the early failure of a small switching transistor in the FX-50 exciter that erroneously indicated an AFC fault and opened the interlocks. Not bad for five years.

Also to be noted is the resolution of problems initially encountered with the life of the Eimac 4CX12000A tube in this transmitter. Our original 4CX12000A failed after only 6,000 hours — an unacceptable life span.

continued on page 48 ►



KLUX upgrades with the BE FM-20B

to please, I am one of those dreaded "neat freaks" who feels that doing it right makes maintenance easy and pays big dividends in the long run. For me, Broadcast Electronics FM transmitters do it right and are a continuing source of satisfaction and pride in our multistation operation. The BE FM-20B is no exception.

In 1988, our flagship station,

RBDS Evolving Radio

► continued from page 45

addition of group three does not diminish the use of any other RBDS groups.

How do I get started with RBDS?

Installing RBDS

If you currently broadcast in stereo, there are no modifications needed to your transmitter. Adding RBDS is an easy job for your engineering staff. For example, it only takes about 10 minutes to do the base installation of the CRL SC-100 RBDS generator. The

quality of your stereo signal.

RBDS signal calibration

When using the CRL SC-100 RBDS generator you do not need additional modulation monitoring equipment to do the initial setup. The 57 kHz RBDS signal is far below the normal program level of your station's signal. On conventional stereo modulation monitors it would be very hard to read the exact level of the RBDS signal as a percentage of program level. A better way to calibrate the RBDS signal is to compare it to the stereo pilot signal.

In just a few minutes you can enter all of the standard "smart radio" information. If you were using enhanced features such as the "in-house" paging program, a 20 pager network could be set up in about 15 minutes.

RBDS signal security

Since the RBDS generator will be possibly having several different people feeding it information, there needs to be some access management. The CRL SC-100 has three assignable password levels that restrict access to various parts of the programs that can be based upon the user's skill level or job-related duties. This ensures that unauthorized personnel will

RBDS Data Groups

- | | |
|-------------------------------------|---|
| Group 0 - Basic Tuning/ Switching | Group 8 - Traffic Message Channel (TMC) |
| Group 1 - Program Item Number | Group 9 - Emergency Warning Systems |
| Group 2 - Radio Text | Group 10 - PTY Names |
| Group 3 - GPS | Group 11 - Undefined |
| Group 4 - Clock Time & Date | Group 12 - Undefined |
| Group 5 - Transparent Data Channels | Group 13 - Undefined |
| Group 6 - In House Applications | Group 14 - Enhanced Other Networks |
| Group 7 - Radio Paging Services | Group 15 - Fast Tuning & Switching Info |

SC-100 does not require a PC for the initial setup or static operation of the unit. The RBDS generator is installed where your station's current stereo generator is located. For stations that use a composite Studio-to-Transmitter Link (STL) system, the RBDS generator is usually installed in your studio.

There are two ways of connecting the RBDS generator to your current stereo signal. One method is to insert the RBDS generator in your signal path after the stereo generator. The other is to take a sample of your stereo generator's output and feed it to the RBDS generator as a phase reference signal. The RBDS generator is then fed into a Multiplex port on the exciter or composite STL. Both hook-up methods maintain the

This signal is read on most high-quality modulation monitors.

The CRL SC-100 has an internal test function that allows it to be quickly calibrated to your current stereo signal. The SC-100 develops a 19 kHz test signal (the same as your stereo pilot signal) which is read on your existing modulation monitor. You then calibrate the SC-100 to read 10 percent pilot injection. The whole procedure takes about 30 seconds. No other RBDS generator offers you this quick and very accurate method of calibration.

Data entry

All of the standard information can be entered from the front panel of the keyboard of the SC-100 or via the RS-232 PC connection.

not cause illegal operation of the unit or change programmed information.

That is all there is to setting up RBDS in your station. You can install the RBDS generator and program in all of the "smart radio" information in just a few minutes. You can then program other features and

groups as you begin to use them. There is no extra license requirement or need to notify the FCC about your RBDS startup.

What can I expect in the future from RBDS technology?

Future enhancements

You can expect a lot of enhancements from RBDS in the next year or two. Currently there are three undefined data groups that are in search of applications. In addition, Emergency Warning System information will be made available over group nine. Enhanced Other Networks (EON) will be made available on later generations of "smart radios." The EON information

continued on page 63 ►



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USER REPORT

The Bee Is Buzzing with Quantum

by Pryor E. Neuber Jr.
President and GM
Bee Radio Network
Marnu Inc.

MIFFLINBURG, Pa. When a radio station contemplates the replacement of its transmitter, the decision all too often becomes a compromise between what the engineer wants and what the station can afford.

QEI Corp. is one of the few companies to succeed at bridging this gap. Here at WWBE(FM) and WWBV(FM) — the Bee Radio Network — we now have two QEI transmitters in service. Both have

been working very well with minimal maintenance and/or attention.

Immediately on air

We are extremely pleased with our most recent addition, the QEI Quantum 3.6 kW, for our WWBE facility. The transmitter arrived in beautiful condition and immediately put us on the air at our newly authorized power when connected to the electrical power and coaxial transmission line. The ease of placing this transmitter into service was amazing. The QEI operates significantly quieter than the transmitter it replaced, occupies less than a quarter of the floor space and produces

twice the power at an amazingly efficient 73.5 percent.

Advances in combiner and amplifier design developed by QEI have allowed for significant technological improvements with little impact on pricing. Our QEI Quantum solid-state FM transmitter was actually priced less than some of its competitor's tube models.

If you are accustomed to looking at older tube transmitter designs, the QEI Quantum's looks might surprise you. No tuning controls to adjust, no external power supply — just a big on and off button and a power raise and lower

switch. The Quantum solid-state offers simplicity of operation and eliminates costly maintenance associated with tube transmitters.

Increased efficiency

By adding the desired number of 600 W FET amplifier modules, power levels between 1.2 and 9.6 kW may be achieved, affording us the ability to buy precisely the power level required. This unique feature not only reduced the initial cost but also increased the overall electrical efficiency by operating at the designed power level.

Modularity of the amplifier also reduces the chance of off-air failure by using the inherent redundancy of multiple amplifiers in place of a single tube.

The QEI Quantum transmitter design offers simplicity and performance. We are sure this new QEI transmitter will function with the same dependability that we have experienced with our other QEI transmitter at the WWBV facility.

For information, contact Jeff Detweiler in New Jersey at 800-334-9154; fax: 609-629-1751; or circle Reader Service 170.

Satisfied With BE

► continued from page 46

The BE engineering staff was responsive, and after discussions with Varian in conjunction with research from other owners, revised the nominal filament voltage setting and published a revised filament maintenance program utilizing a 105 percent power knee concept.

The result: Our current 4CX12000A has more than 40,500 hours of airtime and is still going strong. Incidentally, Varian replaced that first tube at no charge.

Notable highlights

Other notable highlights of this transmitter include its high efficiency. Operating by the direct method, we nominally achieve an efficiency of 78 percent after giving up approximately 1 percent for optimum AM noise and headroom.

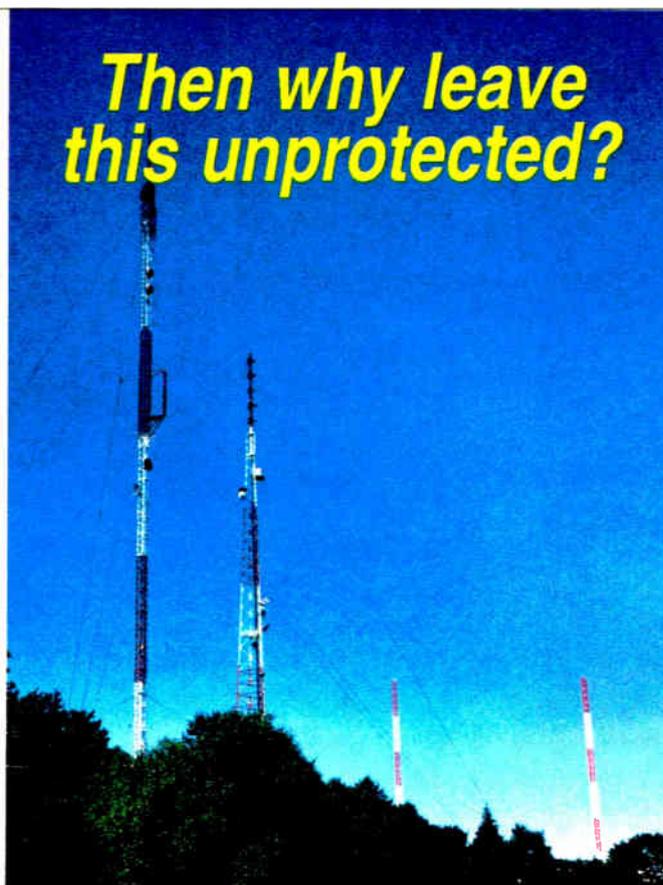
Automatic restarts after power interruptions are another plus. Generally, the only time we touch the "plate switch" is for semiannual maintenance.

While the feature has fortunately never been called upon in our FM-20B operation, the VSWR power foldback — integral to the Automatic Power Control — has prevented catastrophic damage in our other installations on several occasions.

For you other neat freaks out there, check out the AM noise measurement port on the APC panel. We keep a scope connected to it all the time.

The FM-20B continues to represent quality, stability and no-hassle maintenance. Its ease of tuning, metering, computer-grade components, engineering and construction design have continued to impress me over the years. The best thing this neat freak can say about this piece of equipment is that, if the occasion arises, we would purchase another one.

For information, contact Tim Bealor in Illinois at 217-224-9600; fax: 217-224-9607; or circle Reader Service 162.



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SPECIAL REPORT

Turn Billboards into MusicBoards

by **Allen Hartle**
President
The Smart Radio Store

BELLEVUE, Wash. Imagine driving down the highway and seeing an enormous radio with your station's call letters and a display showing the song and artist on right now. Think about the promotional possibilities. That is what a few of my associates and I did a few years back.

As a result, we devised MusicBoard, which takes information from a station's playlist and sends it for display to RDS radios, billboards or LED messaging signs. Critical to the success of MusicBoard is a

reliable way to send a data stream to a display. Originally we used SCAs and even phone lines. Now, thanks to RDS technology, MusicBoard's promotional potential has become affordable as well as reliable.

Manual or automatic

MusicBoard is basically IBM-compatible software developed to import information from the station's music database. MusicBoard works with just about every music selection program available and is compatible with automated stations as well as those that rely on a database but play selections manually.

The entire system is designed to be

integrated seamlessly into a station's studio. The station has the flexibility to



A MusicBoard attracts the attention of Philadelphia drivers.

operate the system automatically or manually and provide a number of user-defined parameters: for example, "three in a row" song selections.

When a station's music director prints the music log for the next day, the log also gets printed to a computer file for MusicBoard to use. The MusicBoard computer can be hardwired to the music source of the control room console and operate automatically or it can be operated manually by clicking one or more music selections from the playlist.

MusicBoard "reads" a start pulse from selections and also knows the time of each selection. The software prepares it for the RBDS system and the information is delivered to the RBDS encoder for insertion into the RBDS stream. The data is broadcast along with an FM station's audio on the 57 kHz subcarrier.

At the display end, a Modulation Sciences Inc. RDS-X data receiver decodes the information for the display or readout. The RDS-X receives the signal and filters out all but the MusicBoard data. The RDS-X is flexible enough to be configured for the exact application needed and its diversity antenna makes sure the strongest signal is received.

The billboards, and more recently, LED signs are specially designed to work with MusicBoard software. The MusicBoard system makes sure the song title and artist are displayed. If a station is between songs, pre-recorded messages promoting the station appear.

More options

RDS is fast becoming a technology that gives stations more options than ever. Recently, we unveiled two new products. The first uses MusicBoard to display song and artist on portable LED message signs. This is ideal for station reception areas or remote broadcasts for a "Now Playing" display.

The second gives stations the option to make money using RDS and our software to operate a completely independent information service for private businesses. LED signs anywhere could be used to display sports scores, business and stock information, news headlines and even advertising and promotional messages. The service could be sold to advertisers to bring in additional revenue. We call this new service RadioACTIVE.

The Electronic Industries Association (EIA) selected our software for its RDS promotion to the top 25 markets. We have placed billboards in major markets like Houston, Los Angeles, Seattle, Philadelphia, San Diego, Atlanta and even Paris and the United Kingdom.

And about that gigantic radio. Many of our stations' billboard designs feature a

three-dimensional radio measuring 24 feet across and 10 feet high. A 14-foot by three-foot display shows the title and artist as songs are played. It was probably unintentional, but these turned out to be the largest RBDS radios ever.

For information, contact Allen Hartle in

Washington state at 206-641-9043; fax: 206-562-9566; World Wide Web: <http://www.rbds.com/rbds> or circle Reader Service 114.

SPECIAL REPORT

MSI RDS-X Offers Compatibility

by **Allen Hartle**
President
The Smart Radio Store

BELLEVUE, Wash. Using billboards and LEDs for station promotions, songs, and even to generate revenue as information services would not be possible without a reliable RDS data receiver to convert the RBDS data stream into information that can be read and displayed.

Addressability and selectable functions, along with reliable reception of the RDS subcarrier are also critical.

Relevant data only

Compatible with the MusicBoard and RadioACTIVE products we offer, the RDS-X from Modulation Sciences Inc. is a flexible receiver that can be configured to output only the data relevant to a particular need. The addressability of the receiver lets a single RBDS data stream be used for multiple simultaneous applications while the receiver's selectivity allows us to extract just the data needed for each service.

The RDS-X has diversity reception with inputs for two antennas. This means the receiver will switch to the best signal to ensure reliable operation. The RDS-X is easy to set up and has an audio output so it can play a musical selection even as it displays the name of the song being played.

Important information

The front readout of the RDS-X provides important information about its operation, which is invaluable when you are on a boom 80 feet in the air installing a station's billboard.

There are not many choices when a good RDS data receiver is needed. The MSI RDS-X is necessary for any station that wants to make the best use of MusicBoard and RadioACTIVE to reap the benefits of RDS technology.

For information, contact Eric Small in New Jersey at 800-826-2603, or circle Reader Service 52.



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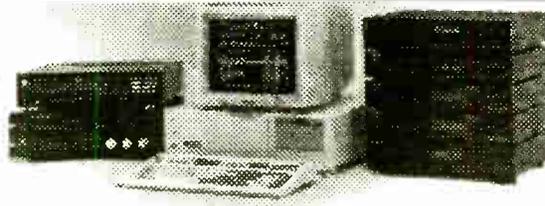
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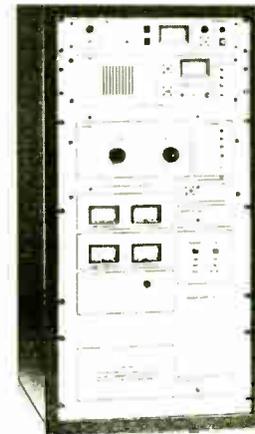


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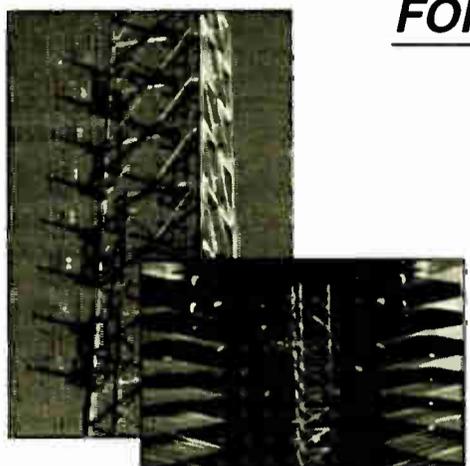
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USER REPORT

Harris Digit Creates Excitement

by Andy Laird
Vice President
Engineering/Radio Group
Heritage Media Corp.

SANTA CLARITA, Calif. Late last summer, Geoffrey Mendenhall of Harris Allied called with an offer to audition the Digit FM Exciter with a digital AES/EBU input.

This digital FM exciter had been on the market for a year with an analog composite input module. The exciter design includes an alternate AES/EBU digital input module containing a DSP-based stereo generator and digital composite processor. The alternate digital input module would be ready later in the fall and an exciter would be made available if we were interested.

Well, we were interested. Our new station in Milwaukee, WEZW(FM), was in

The DJs noticed the clarity improvements without any negative comments. Jackpot!

the process of moving to the southwest side of town to join our other stations there. We were going to use a T-1 circuit as a main STL, and we had a budget to replace a first-tier but tired 10-year-old exciter.

Sonic qualities

WEZW is a lightly processed, soft AC station, and with the digitally transparent, non-bit-rate-reduced T-1 STL, we would be able to judge the sonic qualities of the new exciter. The test was on.

There are two distinct differences between the Digit and other exciters: a digital modulator that generates the complete waveform and the direct AES/EBU digital input module.

Most exciters apply the output of a stereo generator (composite analog) to a voltage-controlled oscillator (VCO) to generate modulation. The average VCO frequency is held on center channel with a phase-locked loop (PLL). These designs include distortion-canceling circuits to make the VCO more linear and, usually, a dual-speed PLL. The PLL is fast so the exciter will lock onto center frequency rapidly upon turn-on and then slow down so low-frequency transients do not unlock the PLL.

The Digit uses a VCO/PLL circuit to establish the center frequency, but it is not modulated. It acts only as a local oscillator (LO). The modulation takes place in the digital modulator module. A 32-bit numerically controlled oscillator (NCO) generates the complete modulated FM waveform.

The output of the NCO is then converted to a precise, conventional FM signal and passed through a bandpass filter. The output frequency is around 5 MHz. An upconverter module mixes the output of the digital modulator module with the LO in a single stage to reach the assigned carrier frequency. This new design eliminates PLL problems (overshoots and

unlocks with heavy, clipped low-frequency processing) and promises lower noise and distortion.

Look ahead

The digital input module provides a direct AES/EBU digital input, a digital stereo generator, digital composite peak limiter and a digitally generated peak reading (0.25 percent accuracy) modulation indicator. The AES/EBU input automatically accepts any rate from 20.8 kHz to 56 kHz. There are also three analog subcarrier inputs in the range of 57 to 92 kHz. The input signals are converted to the composite digital format needed by the digital modulator module.

Stereo is generated in the digital domain using a digital signal processor (DSP). A digital baseband composite limiter is active with the DSP stereo generator. WAVES L-1 Ultramaximizer employs "look-ahead" techniques for control of peaks before overmodulation occurs. It can be adjusted and turned on and off remotely and has no effect on the purity of the pilot or SCAs.

We used the supplied standard rack mount kit, which includes extender rails to mount the Digit in a rack next to the transmitter. Adjustments for the SCA level, main channel deviation, limiter threshold and pilot level are on the top of the digital input module mounted on the

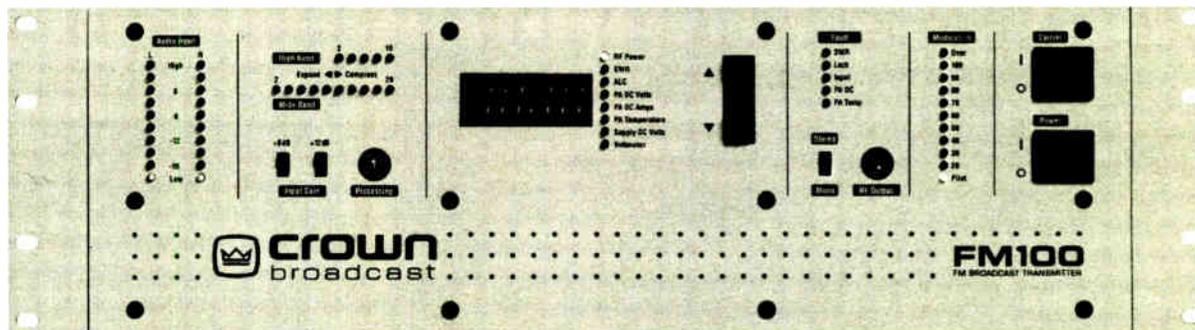
back. These controls are accessed by sliding the exciter out on its rack rails. Cable dressing should therefore take into account the sliding in and out of the exciter while it is operating.

There are DIP switches within the module for selecting the normal operating mode. To get to them you need to remove the module, then the module case cover. The Digit came set just the way we wanted: stereo mode selected, AES/EBU input mode selected and no pre-emphasis.

The AES/EBU input can be muted remotely, automatically rescaling the SCA input gains to allow SCA-2 to be used as an analog composite input (an emergency analog composite input backup mode). This backup mode is really handy, as our T-1 circuit has had its share of problems. A T-1 mute alarm is used to switch off the AES/EBU input and

continued on page 54 ►

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Harris Digit Creates Excitement

► continued from page 53

unmute the output of our backup 950 composite STL. It has automatically covered T-1 outages while the local telephone company spent months finding an intermittent problem in our circuit.

Few adjustments

After the exciter is mounted, you can hook up cables for power, in/out and remotes. A "D" connector on the rear panel is used to access the remote control functions. An optional D-to-terminal strip accessory is available. The only adjustments necessary are deviation, limiter and pilot levels (on the digital input module)

and RF output for correct drive to the transmitter (made from the front panel). The DSP stereo generator requires no adjustments.

The front panel includes fault indicators for RF mute, SWR, temperature and PLL. The modulation-level display is a bar graph made up of three 10-segment LEDs.

Auto-ranging is provided for full scale of 15 percent when the modulation level falls below 15 percent. A 3.5-segment LCD is used for forward power, reflected power, PA amps and PA volts parameters.

Power output adjustment and the display are controlled by four buttons below

the display. A four-segment Digit logo serves as a DC power indicator for the four power supplies.

The top cover allows easy access to the internal modules. The two screws holding the VCO module tight for shipping need to be removed. That is all there is to the installation.

Working with LeRoy Wolniakowski, our director of engineering for WEMP(AM)/WMYX(FM)/WEZW, we installed the Digit in one evening. We decided to perform a "subjective proof" at that point and come back the next night for measurements. The studio move, T-1 STL and installation of the processor at the transmitter site had been completed two months before we installed the Digit. The only additional change we made upon installation was placing a digital I/O card into the audio processor to provide the stereo AES/EBU feed to the Digit. The processor's stereo generator is still used to feed the auxiliary transmitter.

Noise reduction

We listened for 10 minutes while driving from the transmitter and shared our first impressions: a substantial reduction in noise. The old exciter was no slouch.

Digit composite processor. Addition of subcarriers still does not change the noise floor (most of our stations have at least one subcarrier).

Different formats

We have been so impressed that we now have five Digits on the air (four have T-1 STLs and one is co-located) and are waiting for the delivery of our sixth. The stations' formats are all different (smooth jazz, oldies, classic rock, soft AC and hot AC), but the results have been the same: amazed employees.

If you are not heavily processed, you will hear things you have never heard before — maybe some problems in other audio gear in your system. We found an annoying distortion problem in a broadcast chain effects processor at one of our installations. The processor is gone.

We have observed no overshoot. What your processor puts in, you get out. Subsonics? No problem. Your peak ceiling will be reproduced absolutely.

The digital composite processor definitely has a characteristic sound that is somewhat different from a normal analog composite clipper. It stops modulation with no overshoot or wideband composite artifacts. Where we are trying to be what I like to call "pseudo hi-fi," I think the composite clipper is too audible.

Where we process more aggressively, we have found small amounts are useful

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The Master Control Studio, shown right, is one of seven Arrakis studios in Sony's Manhattan network origination center for SW Networks.



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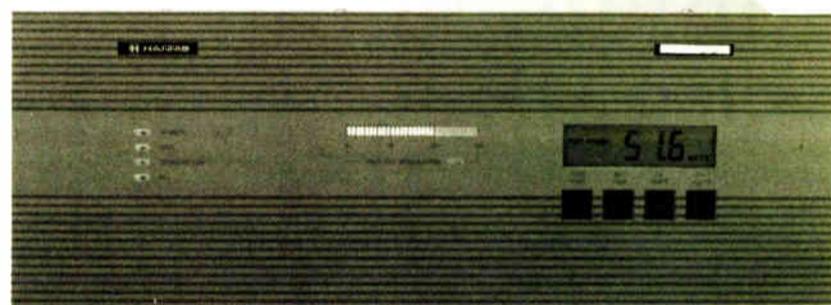
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The Harris Digit offers plenty to get excited about.

Stereo noise measurements constantly came in at -66 to -67 dB. But in the car, the noise floor was obviously improved. Critical listening in the hotel and later at the studios revealed a much clearer high end with the low end gaining better definition and punch.

We were concerned with DJs being able to deal with any additional digital delay. They noticed the clarity improvements without any negative comments. Jackpot!

The following night, proof measurements revealed only the limits of our test equipment. All the stereo measurements came in at the specified performance of our modulation monitors and generator/analyzer. Stereo L or R distortion crept up to about 0.4 percent at 15 kHz due, I think, to a slightly narrow transmitter and antenna bandwidth. You will need the best test equipment to make any meaningful measurements of this exciter.

A careful check with an audio spectrum analyzer reveals the noise floor to be about -79 dB with a possible rise to -77 dB at 100 kHz. This measurement may have been limited by the quality of our main channel monitor demodulator. With heavy modulation, the protection around either side of the pilot goes to the noise floor.

Zooming in on the pilot reveals no modulation sidebands. Above 53 kHz is nothing but the unchanged noise floor; no intermod products even when using the

and unobtrusive. It also could be useful if you are using a bit-rate-reduced 950 MHz STL and you must locate the processor at the studio. While I have not tried this because all our installations have the processor at the transmitter, the overshoot caused by the bit rate reduction might be fixable with the digital composite processor without much sonic loss.

Do not get caught

Do not make the mistake we made at one of our installations with the AES/EBU digital input. We got caught without AES/EBU-specific cable and used a 20-foot microphone line to get it on. All the fine detail in the audio was lost until we replaced it with the proper cable.

What do you do if your favorite processor does not have a digital audio output? Get a high-class A-to-D converter. Eliminate the self-contained stereo generator if it has one. You will be impressed.

Our experience with the Digit is best illustrated by a new transmitter installation, again by Wolniakowski at WMYX. I flew in for the final tests and proof. We left the building laughing in amazement. In our almost 70 years of combined experience in this business, we have never seen anything close to the performance we measured that night.

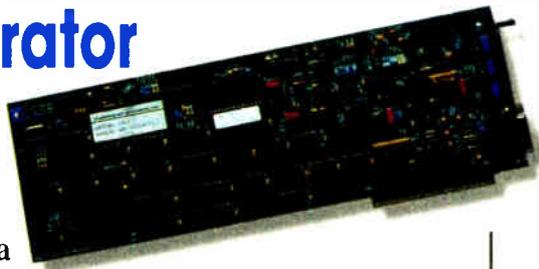
For information, contact Daryl Buechting in Indiana at 217-221-7405; fax: 217-222-0581; or circle Reader Service 157.

RDS ~~OR~~ AND SCA?

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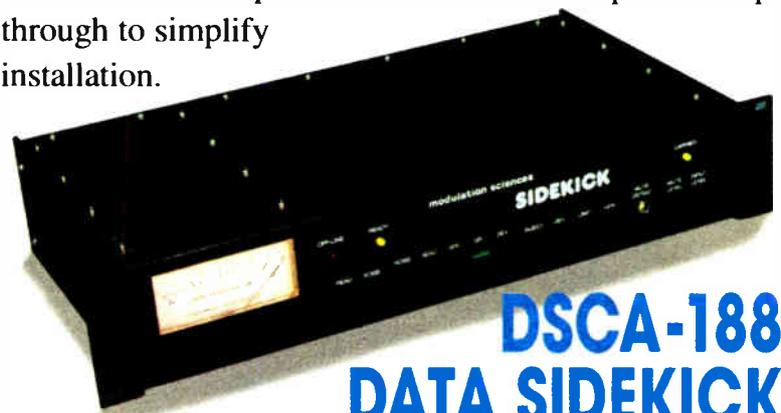
RDS-1 Generator

The RDS-1 is a PC expansion card supplied with software to turn any PC ('286 or better) into a powerful cost effective RDS encoder/subcarrier generator. Store up to 255 radiotext messages of unlimited length, and run full RDS automation locally or by remote control. Buy the PC card and software, or buy the broadcast quality rack mounted PC system preloaded with your messages to go on the air. The RDS-1 is the only fully software definable RDS generator available.



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USER REPORT

ECO-6, MK-22 Are Straightforward

by Paul Titchenal
Senior Engineer
Titchenal and Associates

Owatanna, Minn. I first heard of Energy-Onix transmitters in 1988 when I was approached by a salesman from a California equipment supplier about purchasing them for the radio station group where I was the chief engineer.

I did check out Energy-Onix transmitters, and what I saw from this fledgling company was great promise for the future. That did not surprise me since the founder of Energy-Onix is Bernie Wise, who in 1962 introduced the first grounded-grid transmitters to the FM marketplace. Even with his

strong legacy in broadcast transmitters, however, I shied away from this upstart company in favor of the more established manufacturers.

Rest is history

I continued to watch as Energy-Onix transmitters quickly evolved into a product on par with the big three transmitter makers in both features and quality. I kept a careful eye on it for several years to see that the quality of its product remained at this level. I also watched for stability in the company to ensure longevity. You can appreciate my position. I could not recommend a transmitter until I was sure of the product and the manufacturer.

Just before NAB 1994, I was invited again to stop by the Energy-Onix booth and see the new products being offered. I accepted, and as they say, the rest is history.

Since then I have purchased four Energy-Onix transmitters for my clients and installed two more for owners who purchased them on their own.

The first, an MK-22, was installed at KABD(FM) in Brainerd, Minn. This transmitter has operated nonstop, 24 hours a day, with no problems since I installed it in June 1994.

My second MK-22 installation was in June of this year in Springfield, Minn. This transmitter is performing almost identical to factory test data at 18 kW.

The ECO-6 installed at KLKK(FM) in Clear Lake, Iowa, late this spring is also operating flawlessly. It is my opinion that this ECO transmitter design is one of the best in the industry.

Quick installation

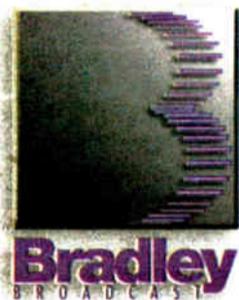
The installation of the ECO-6, like that of its MK Series cousins, was simple and straightforward. It took only two hours from the time it was unloaded until it was totally operational at full power.

This quick setup reflects the company's preparation and testing of the transmitter prior to shipment and ... a well-written technical manual. The installation and tuning instructions in the manual are precise and accurate. I

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The 100 Delta Digital Hybrid

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The ONE Digital Hybrid

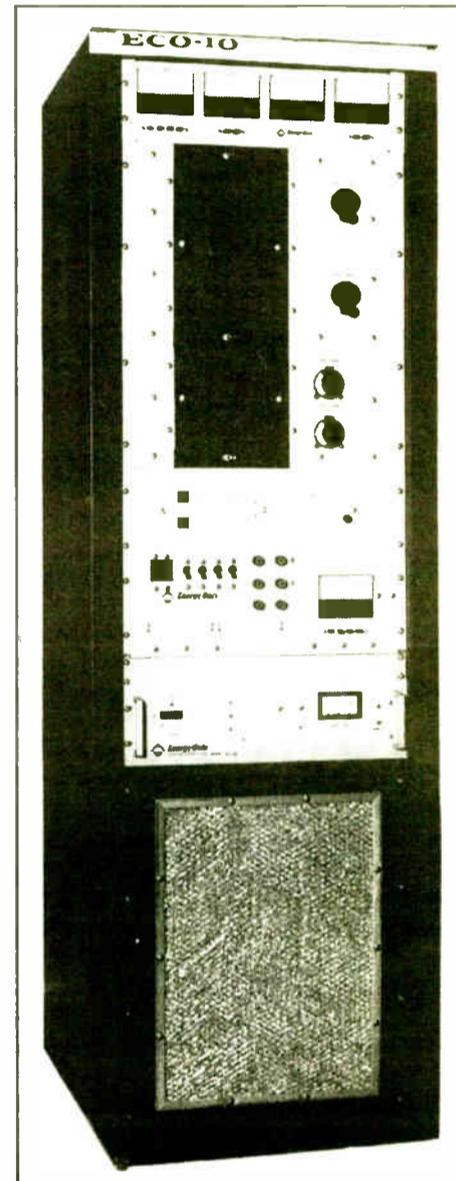
Fast, automatic digital nulling allows smooth conversation without speaker-phone effects, level problems, and distortion. The ONE can be ordered in a rack chassis or compact modem-style case. Or choose the ONE plus ONE, a dual hybrid with built-in mix-minus matrix.

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This affordable system includes all of the telephone interface and control equipment needed for talk show programming. A single rack-mount unit houses a Telos ONE digital hybrid and a six-line, broadcast phone system. For system control, use the desktop Switch Console, also included.

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No one knows Telos better than Bradley does. Call us. We'll help you connect to your callers with great phones.



The Energy-Onix is quick to install.

found the same to be true with the ECO 10 and MK-30 I installed.

My recent visit to the factory made me appreciate even more the care put into the construction of these products. Being a small company, it takes a personal interest in its customers. You will find its product prices are lower, but do not think less of its products because of that lower price. The company has less overhead and passes the savings on to the customers.

No questions

This is one company every owner, manager and engineer should get to know better. Energy-Onix has now been in business for eight years and has delivered several hundred transmitters here and around the world. There should be no question of longevity, company stability or product quality.

For information, contact Ernie Belanger in New York at 518-828-1690; fax: 518-828-8476; or circle Reader Service 48.

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USER REPORT

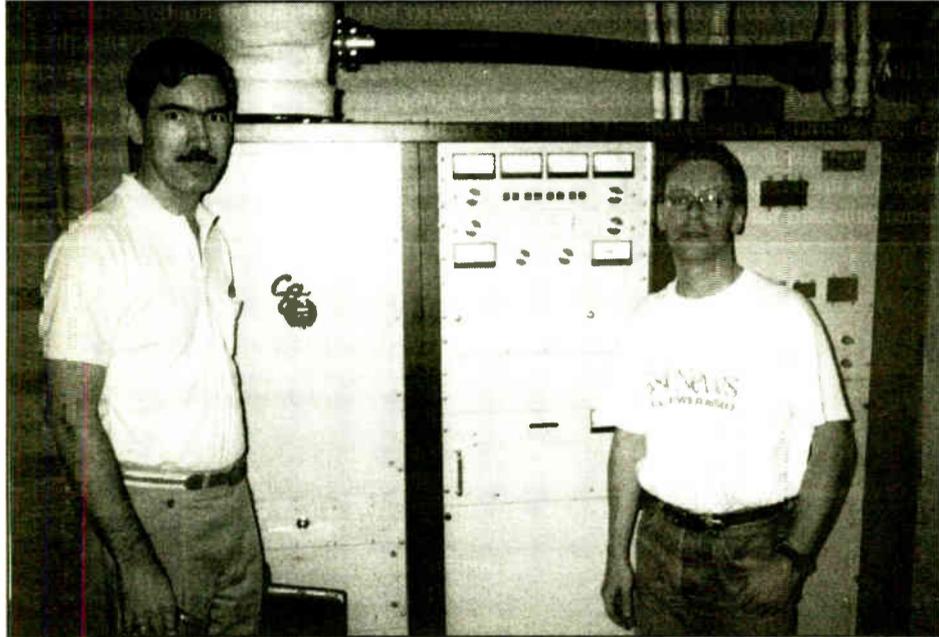
Continental Shift for CHFI(FM)

by **Harvey Parent**
Transmitter Supervisor
Rogers Broadcasting Ltd.

TORONTO Even though both of our Collins 831G2 transmitters, originally installed in 1975, were performing well, CHFI(FM) decided it was time to

selecting the replacement.

The 816R evolved from the basic design of the Collins 831G transmitter, and over the years, Continental incorporated many improvements to make a good design exceptional. The cabinet dimensions of the new transmitter are identical to those of the old transmitter,



Harvey Parent and Craig Sopen install their Continental 816R.

replace one of them with a Continental 816R-2C 21.5 kW transmitter. Superior performance, increased reliability and ease of servicing were factors considered when

which made the installation easy. The PA air exhaust outlet and AC wiring entry are located in the same position as on the 831G.

The new transmitter uses a Coaxial

Dynamics 3 1/8-inch line section at the top of the PA cabinet for monitoring forward/reverse power, which puts the RF output flange approximately one inch higher than on the old transmitter. A flexible Heliac line section was used to connect the RF output to the coaxial transfer switch, as the original hard line section would no longer line up.

Control interface wiring to the 377D2 transmitter controller was straightforward, as Continental provides a separate terminal strip on the 816R to accommodate it. The 820B exciter was removed from the transmitter and

installed in the rack located between our transmitters. This allows us to keep the connecting cables between our stereo generators and exciter composite inputs as short as possible to minimize RF pickup.

With the wiring completed, the transmitter filaments were switched on and preliminary checks were performed. All interlock and time delay circuits checked OK. Plate voltage was then applied, and the output power ramped up to 100 percent as set during the acceptance tests at the factory. After a short warm-up period, we adjusted the tuning controls adjusted to minimize synchronous AM noise and checked the PA efficiency. Then we put the transmitter on the air.

AM synchronous noise is typically
 continued on page 59 ►

SPECIAL REPORT

RDS-1 Decoder by Belar Simplifies RDS Setup

by **Gerald M. LeBow**
President
Sage Altering Systems Inc.
and Director of Engineering
Radio Equity Systems

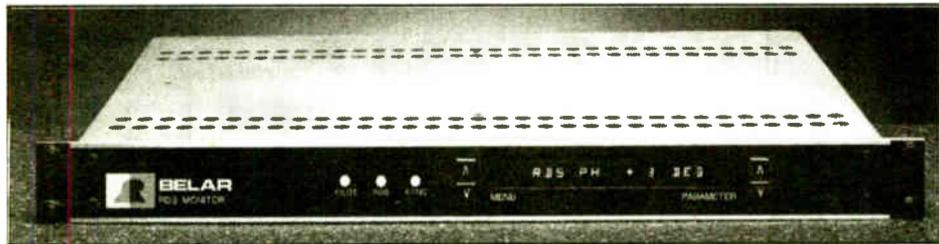
STAMFORD, Conn. RDS (or RBDS as it is known in the United States) was initially developed as a paging format in the late 1970s in Europe but subsequently found its place as an auxiliary communication service for broadcasters and commercial users.

are not canceled with the 19 kHz pilot.

RDS encoders have been available for a number of years. Few RDS decoders, however, are available, prompting many companies to develop their own specialized RDS decoding schemes to monitor the transmitted data and set RDS transmission parameters.

Sage Alerting Systems deploys RDS technology for emergency warning.

Until recently, Sage used its own RDS decoders connected to a personal computer



Belar's RDS-1 can tap the potential of RBDS transmissions.

RDS was widely adopted worldwide and gained significant recognition in the United States over the last two years. More than 500 RDS stations are on the air in the United States today and more are coming on each month.

RDS is a well-organized digital data sub-carrier transmission system utilizing 57 kHz, the third harmonic of the 19 kHz stereo pilot. The use of 57 kHz is significant in that it virtually eliminates the effects of multipath on main and subchannel signals. This is quite different from subcarrier frequencies, which

to determine what bits are set in what groups and what data values are transmitted. It was at the 1995 NAB Convention in Las Vegas that we first saw the Belar RDS-1 decoder, ready to take composite baseband from a receiver and decode all aspects of RDS data and non-channel signals.

Set-up menu

The RDS-1 has a menu allowing a user to set up the initialization parameters of an RDS station, such as RDS
 continued on page 58 ►

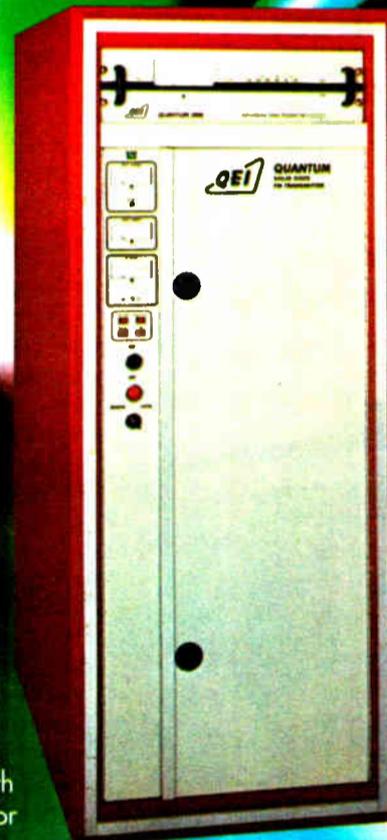
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Simplifying RDS Setup

► continued from page 57

injection level, RDS phase, block error rate, level of the 19 kHz pilot and total modulation.

Before purchasing the RDS-1 we would set phase using a two-channel oscilloscope and a baseband receiver. This method was not terribly accurate. It is important that the RDS phase be set properly to minimize the effect of RDS injection on the composite signal and also to improve substantially RDS decoding with digital RDS decoders, which detect zero crossings. These zero crossings need to be in synchronization with those of the 19 kHz pilot in order to effectively decode them.

My first experience with the RDS-1 was with its companion FM baseband receiver, the FMRR-4, mounted in a compact traveling case. I took it to WKDN(FM) in Camden, N.J., to check the set-up of the RDS encoder and verify the data groups. Once plugged in, it took only a few seconds to get to the menu that showed RDS injection, RDS phase, 19 pilot injection, total modulation level and block error.

To verify the accuracy of this unit, I took along a spectrum analyzer that could accurately ratio the 19 kHz pilot injection to the 57 kHz injection. Using the station's modulation monitor to determine the absolute level of the 19 kHz pilot, it was easy to see how many dB down the

57 kHz was and to ratio the two to get an absolute value for the 57 kHz injection. The RDS-1 and the spectrum units analyzed agreed almost exactly.

First lesson

Setting phase was my first lesson about the RDS-1 that was not in the book. The phase window, as I subsequently learned, is only ± 30 degrees from 0 phase. If the phase falls outside of this window, the display shows four stars with a + or - but no value. I quickly determined that if you continuously rock the phase by 50 degrees, eventually you will come into the ± 30 degrees window and be able to set phase correctly. Lo and behold, the phase setting on a second station I was monitoring was approximately 14 degrees off; we quickly reset using the RDS-1.

The next series of menus deals with the groups that are active and the data that is contained within them. With the RDS-1 it is possible to look at every group from 0 to 15 A/B, including those groups that are defined and those still undefined. It is also possible to see the value in any given block as a hex value or as an ASCII value. This is quite helpful in reading out text messages that are sent via RDS. While the RDS-1 does not provide a binary representation of each bit and block, it provides enough information for most applications.

The unit allows the decoding of the basic functions of RDS, including PTY (Program Type), PI (Program Identification), TP and TA (Traffic Program and Traffic Announcement) and such dynamic functions as radio RT (Radio Text), EWS (Emergency Warning System), DGPS (Differential Global Position Satellite Systems) and others. The RDS-1 is fully equipped to decode paging services using this 7A Group. An extensive set of menus and submenus are available to optimize paging performance. It is also possible to modify RDS-1 parameters, such as integration time, to optimize it for your particular application. A new software package allows the RDS-1 to connect to a PC via an RS-232 for a graphic and comprehensive display of all data.

Learning tricks

Along with all these positive features are some drawbacks. The menus within menus of the first version of the RDS-1 are sometimes elusive and confusing when trying to get from point A to point B. Four arrow keys are used to scroll through the menus. Sometimes I found myself stuck in a loop from which I could not readily extricate myself. In time I learned some tricks.

The other minor problem with the RDS-1 is that the RDS light on the front panel tends to illuminate whenever there is information or energy around 57 kHz. This is often the case with non-RDS stations that have poorly optimized stereo generators with third harmonic energy, stations that composite clip and have a significant amount of "trash" in their baseband, or stations with broadband subcarriers on 67-69 kHz that bleed into the 57 kHz region. Therefore, both the RDS light and the sync light will be on for a valid signal.

Recently, Belar updated the software to make the RDS-1 more user-friendly and intuitive. The company offered us a free upgrade that we plan to take advantage of soon.

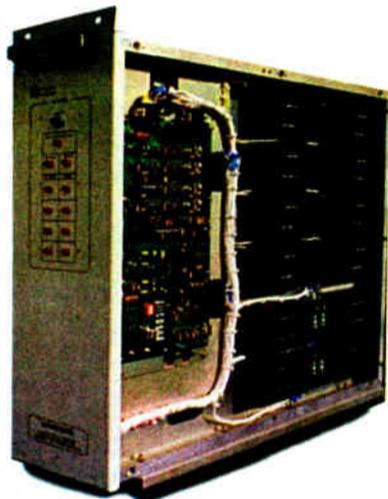
The RDS-1 has become an invaluable tool for my associates and me as we travel around the country and the world setting up RDS stations for emergency alert purposes. The total modulation display digital accuracy correlated well with total modulation as measured with a spectrum analyzer and impressed many station engineers who were still using old analog modulation meters.

The ability to see all the RDS data as it is being transmitted and to set parameters while monitoring in real time makes the RDS-1 the ideal companion for either an individual station wanting to monitor its own RDS transmission or for systems providers installing numerous RDS systems.

For information, contact David Hirsch in Pennsylvania at 610-687-5550; fax: 610-687-2686; or circle Reader Service 9.

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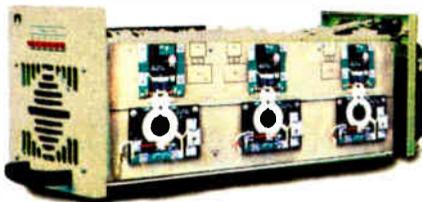
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Nautel Maine Inc. 201 Target Industrial Circle Bangor, Maine 04401 U.S.A. Phone: (207) 947-8200 Fax: (207) 947-3693

USER REPORT

WAFR(FM) Declares Crown the King

by Tom Scott
Director of Engineering
American Family Radio
Station WAFR(FM)

TUPELO, Miss. At American Family Radio, we have finalized an adoption.

We were already a large family of stations and translator sites extending from North Dakota to Texas, from North Carolina to Washington state. After searching for reliable, easy-to-maintain transmitters that would minimize our expenses, we incorporated Crown Broadcast transmitters into our family.

Our experience with Crown Broadcast transmitters began with beta test units and has continued through full-production models. We have not been disappointed. Crown transmitters provide the all-in-one, reliable transmitter package are looking for. We have nearly 80 Crown units in the field, including several of the FM30, FM100, FM200 and FM250 models.

The Crown well-thought-out FM200 is representative of the family. More than just an exciter or amplifier, the FM200 is a self-contained transmission system that is especially good for satellite delivery. One box does it all.

The FM200 combines audio processing, stereo generation and RF generation in

one compact, easily portable unit, making it an economical and flexible stand-alone or standby transmitter. Its integrated design makes installation quick and easy, requiring only an audio source (L/R stereo or composite signal), an antenna and a power source to operate as a complete 200 W FM station. It is an excellent, low-cost upgrade for any station but especially for small stations wanting to upgrade from old exciters or audio processors, while upgrading their old tube IPA to a reliable solid state IPA.

Easy troubleshooting

We use the Crown FM200 primarily in a translator function for our group of stations. It is especially useful to us in this application because many of our translator facilities are manned by non-technical people. When problems occur, the FM200's simple, built-in digital multimeter displays readings clearly, allowing nontechnical staff to easily relay troubleshooting information to our engineers.

Should out-of-field servicing be required, the unit's portability and ease of installation make removal and replacement of the transmitter a quick and simple exercise. The FM200's automatic FSK identification and its automatic shut-off feature for loss of audio

programming are also helpful characteristics for our facilities.

Because the FM200 is frequency-agile, it also provides an excellent backup for our Class A and higher stations. If the exciter or IPA of one of our bigger transmitters fails, we can easily dial up the correct frequency on one of our Crown Broadcast units and use it to drive the larger transmitter.

The FM200 has been highly reliable. In fact, because our experience with Crown transmitters goes back to beta test units, we have been able to observe and participate in the refining process. In early beta units we made some modifications for cooling. We also made observations about the low-pass filter, the power supply and the cooling of the power supply that have led to product improvements.

The only production problem we have observed in the FM200 involved inconsistency in soldering techniques in the power amp section when the unit first went into production. When this problem was brought to Crown's attention, it was quickly corrected.

No matter how satisfactory a piece of equipment is, we can always think of ways to make it better. We asked Crown for composite input and subcarrier input on the back of the transmitter box. The

company has done it. We asked for an upgrade to a 250 W amp. Crown is now producing it.

It would be nice to have the switch that sets input levels at 6 dB or 12 dB upgraded to an adjustable input control so that we could tweak it. While the present switch works fine, an adjustable control would be a nice plus. We haven't told Crown yet, but experience tells us that if we do, the modification is likely to be made. Crown does respond to its customers' needs and requests.

Excellent customer service

When we went shopping for transmitters, we wanted to minimize expense, simplify maintenance and improve reliability. Crown Broadcast not only fulfilled those wishes but also provided excellent customer service as a bonus. We have experienced superb follow-through and an overall good working relationship with Crown Broadcast's sales and customer service staff.

It might be suggested that the amount of Crown equipment we buy influences the amount of service we receive. On the other hand, perhaps we buy a lot of Crown equipment because of the excellent service that accompanies the quality product we receive.

For information on Crown Broadcast products, contact Crown Broadcast Sales in Indiana at 219-294-8050; fax: 219-294-8222; AT&T e-mail: mpotterbaum.com or circle Reader Service 209.

USER REPORT

Shift at CHFI (FM)

► continued from page 57

10 dB better, and more stable than on the 831G2, thanks to the solid state IPA stage. We have been getting 12,000 to 16,000 hours of life from the 4CX1500A PA tube in the 831G, and expect even longer tube life from the 816R as it operates at higher plate voltage/lower plate current.

Easy servicing

Servicing of the 816R is easier because all the assemblies are readily accessible. The PA bias supply and 28 V DC supply, which were difficult to get to in the old transmitter, are easily accessible on the 816R swing-out rear panel. Another improvement is that the SCR control cards and filament regulator card are now mounted in the front-panel card cage. An array of 23 panel-mounted LEDs on the front of the transmitter provide status indications of all important points of the control circuitry.

Continental offers comprehensive technical support 24 hours a day and an extensive stock of spares, should you require any items quickly. The company also conducts transmitter training seminars to allow maintenance personnel to gain valuable, in-depth understanding of the operation of the transmitter circuits.

I would like to thank Sean East, sales representative, Applied Electronics Limited, Mississauga, Ontario, and Steve Claterbaugh, Manager, Canadian Broadcast Sales, Continental Electronics, Dallas, for their assistance in coordinating delivery of the transmitter.

Anyone considering the purchase of a new FM transmitter should check out the performance, specs and features of the 816R series of transmitters. You will like what you see.

For information, contact Steve Claterbaugh in Texas at 800-733-5011; fax: 214-381-4949; or circle Reader Service 105.

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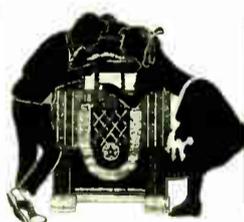
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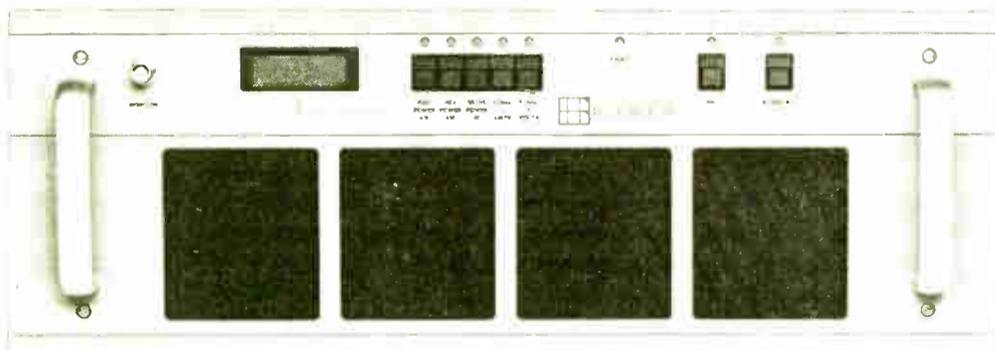


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TECHNOLOGY UPDATES

RE AMERICA

RE America's RE 532 RDS/RBDS Encoder Full Of Features, Meets Specs

WESTLAKE, Ohio RE America recently introduced the RE 532 single-rack space RDS/RBDS encoder, the company's third-generation encoder for the U.S. marketplace. This full-featured unit meets full RDS/RBDS specifications and data input management.

Ancillary RDS/RBDS data services such as paging (Group 7A) and differential global positioning (DGPS, Group 3A) transmissions on the RDS/RBDS subcarrier are emerging as major

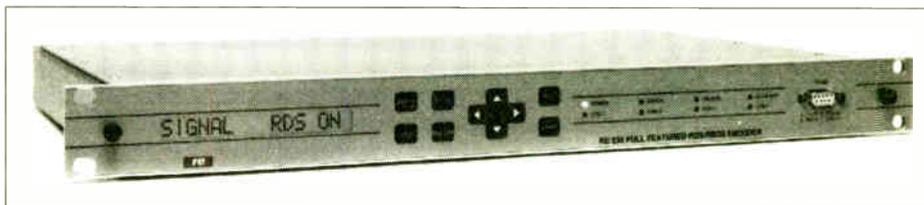
revenue sources for broadcasters.

The RE 532 manages these services and maintains the integrity of the broadcaster's RDS/RBDS data. All five data ports may be prioritized with inherent system security.

The RE 532 can be operated as a stand-alone subcarrier generator or as a composite loop-through, in-line adder. The product comes complete with user-friendly PC control software.

Ultimately, other playlist software products also may interface transparently to the RE 532. Modem communications for data control can be accomplished through any Hayes-compatible modem over standard dial-up phone lines.

The unit is flexible enough to be installed at any FM broadcast facility, whether



located at the studio or transmitter site. Multi-user data management may be handled efficiently with the RE 532 hardware platform, which allows configurable priority and security through five separate RE 532 data ports. External clock sync and remote switching control are also provided from the auxiliary remote port.

The 532 features 16 data records stored in non-volatile memory. It includes a keypad for easy setup

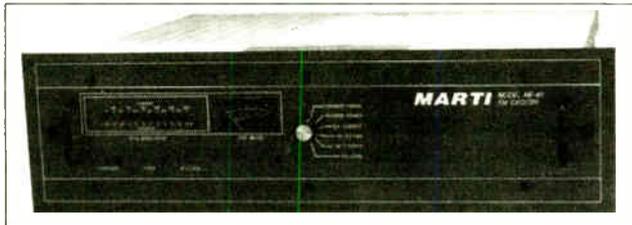
adjustments, as well as a back-lit LCD, both on the front panel. Also featured are two discrete pilot sync inputs for main and backup transmitters.

For information, contact Ron Caird in Ohio at 216-871-7617; fax: 216-871-4303; or circle Reader Service 74.

MARTI ELECTRONICS

ME-40 FM Exciter by Marti Serves Multiple Purposes, Is Loaded with Options

CLEBURNE, Texas Marti Electronics introduced the new ME-40, a 40 W, frequency-agile synthesized FM exciter. Specifications on the ME-40 include: total harmonic distortion plus noise, 0.05 percent or less; SMPTE intermodulation distortion, 0.05 percent or less; phase response, ± 0.25 degrees from linear phase and FM signal-to-noise above 80 dB.



The ME-40 also features a 40 W output, which can be continuously adjusted between 4 and 40 W and a peak-hold baseband modulation LED display.

A test multimeter with forward and reverse power ranges is also included, along with full remote control capability and three

subcarrier inputs (including one that is ready to accept RDS input). In addition, the ME-40 is self-contained and protected from VSWR, high temperatures and over-current power conditions.

Topping off the ME-40's list of features are its capability to function as a stand-alone 40 W transmitter or replacement exciter (without modifications) and a full two-year limited warranty.

For information call Ron W. Pohler in Texas at 817-645-9163; fax: 817-641-3869; or circle Reader Service 115.

NAUTEL

Nautel FM10 Transmitter And Digital FM Exciter Cool, Reliable

BANGOR, Maine The Nautel FM10 is a solid state modular 10 kW transmitter incorporating a 50 W exciter that employs Direct Digital Synthesis (DDS) technology to create the FM signal.

The exciter, with direct digital interface, accepts AES/EBU formatted input, making an all-digital path from the studio to the FM modulator possible. Modulation created in the digital domain results in a perfectly linear system. The exciter is also available with an alternative analog interface for use with standard composite input. This may later be field-upgraded to direct digital input.

Overall efficiency of the transmitter is typically 65 percent, resulting in low power consumption and cool, reliable operation with 40 percent less heat than conventional solid state designs.

Thirty-six RF amplifiers mounted in six power modules are combined using a single stage combiner to achieve 11 kW capability. Nautel's patented 60 degree combiner provides failure isolation without the use of imbalance loads and their associated heat dissipation. This prevents thermal stress even when operating with some amplifiers removed for service. Power amplifier repairs can be made by direct replacement of the MOSFETs without interrupting the transmission.

The IPA Module uses two identical amplifiers that operate reliably at just half of their rated dissipation level. A patch cable is provided to allow the substitution of the IPA using a power module.

Separate switching regulator modules provide redundancy of DC supplies to each power module and IPA while a three-phase AC line transformer is retained to ensure good overall isolation. The FM10 power supply system meets stringent international standards for low-line current distortion and has a near unity

power factor. Current ratings of the service entrance and standby generator may thus be kept at a minimum.

Nautel's design is optimized to achieve maximum operating efficiency at the customer's operating frequency. Should a frequency change become necessary in the field, it may be accomplished by retuning the amplifiers and combiner. No component changes are required other than switching the length of the coaxial cables from the amplifiers to the combiner.

The complete transmitter, including the harmonic filter and directional coupler, occupies just two and one-half feet by three and one-half feet of floor space in a single six-foot cabinet.

A range of 20 kW transmitter configurations are also available, including switching or switchless combined systems with automatically controlled main/alternate exciters.

For information, contact Gary Manteuffel in Maine at 207-947-8200; fax: 207-947-3693; or circle Reader Service 36.

INOVONICS

Inovonics Introduces Simple, Straightforward FM Stereo Generator

SANTA CRUZ, Calif. Inovonics Inc. offers its newly designed Model 708 FM stereo generator.

The new design reflects the refinement of the digital synthesis approach to pilot and subcarrier generation,

resulting in specification and audible performance improvements.

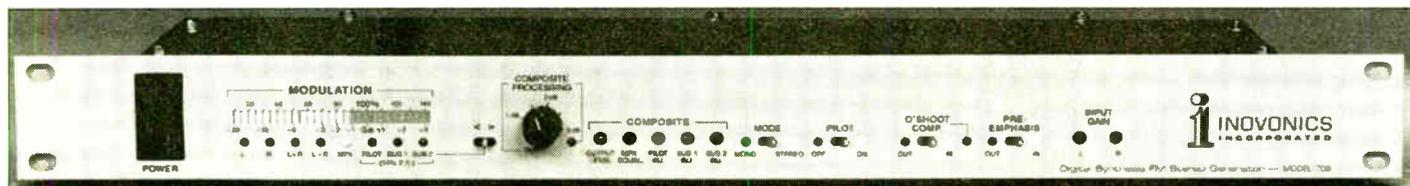
A prime feature of the Model 708 is front-panel metering, which eliminates the need for outboard test gear for proper setup. Other features include internal combining for two RDS or SCA subcarriers, proprietary filter overshoot compensation and a built-in composite clipper.

Composite clipping (variable between 0 and 3 dB) is somewhat mitigated by

performing this function prior to the injection of the stereo pilot and auxiliary subcarriers and before the final output filter.

Finally, the 708 is kept simple with second-sourced parts and straightforward circuitry that is explained in detail.

For information, contact Jim Wood in California at 408-458-0552; fax: 408-458-0554; or circle Reader Service 38.



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The DATAWORLD LMA/DUOPOLY Market Survey Contour maps present a precise electronic verification of overlapping and intersecting contours.

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DTR-8 DAT Recorder



MR-10 Mini-Disc
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CDC-600
CD Changer

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World Radio History

RBDS Evolving Radio

► continued from page 46

(uses group 14) will allow more information to the listener about other alternate frequency stations.

The data in groups five, six and seven have many applications that service providers would like to use. Services that will want your RBDS signal include utility power control, stolen credit card notification services, electronic transmission of newspapers and periodicals, distribution of software and password updates, just to name a few. The key to being able to take advantage of these new services is to invest in a RBDS generator that will grow as you do. Many RBDS generators provide only basic RBDS data and cannot be upgraded or cannot support all available RBDS data groups.

Since your RBDS generator will be doing a number of things at once, you will want an RBDS generator that has quite a bit of built-in automation capability. You need a system that will sequence billboard sign messages, automate paging functions and provide full use of transparent data services.

High-speed data services

You probably have read about proposals for high-speed data services that will be used in the future. Today's RBDS standard is compatible with these new services. The CRL SC-100 supports these new high-speed services via an internal expansion PCB port. A DSP subcarrier generator PCB that will handle all types of future high-speed data as they become available will be offered soon. Or this new DSP subcarrier card can be used as one or two conventional SCA generators. Instead of buying a complete new unit, the SC-100 can be upgraded with an additional board.

As this paper is being written, we are coming up with new products to make your use of RBDS easier and more profitable. The convenience and features of the SC-100 were thought of by our customers. We use the latest in DSP smart technology to keep the SC-100 the most flexible and powerful RBDS generator on

the market. Our system is one that will grow with you for years to come. We have a commitment of over 20 years in the broadcast equipment industry with thousands of stations using our equipment. We understand your need in today's very competitive marketplace. And we provide full support for the unity you buy today, or that very first unit made many years ago. Become an SC-100 owner today - experience all of what RBDS can do for your station.

Above text is reprinted from CRL's "RBDS for your Station" booklet. For more information contact Bill Ammons at 800-535-7648; or e-mail: crlsystems.com or circle Reader Service 78.

RBDS Reference Information/Glossary and Appendix

Common Terms Used in RBDS		PS-	Program Service Name
AF-	Alternate Frequency	PTY-	Program Type Code
CT-	Clock Time and Date	PTYN-	Program Type Name
DGPS-	Differential Global Positioning Service	RBDS-	Radio Broadcast Data System
EON-	Enhanced Other Networks	RDS-	Radio Data System
EWS-	Emergency Warning System	RP-	Radio Paging
GPS-	Global Positioning System	RT-	Radio Text
IH-	In-House Application	TA-	Traffic Announcements
PI-	Program Identification Code	TDC-	Transparent Data Channel
PIN-	Program Item Number	TNPP-	Telocator Network Paging Protocol
		TP-	Traffic Program Identifier

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8	Soft Rock	SOFT_ROCK
9	Top 40	TOP_40
10	Country	COUNTRY
11	Oldies	OLDIES
12	Soft	SOFT
13	Nostalgia	NOSTALGA
14	Jazz	JAZZ
15	Classical	CLASSICL
16	R&B	R_&_B
17	Soft R&B	SOFT R&B
18	Language	LANGUAGE
20	Relig. Talk	REL_TALK
21	Personality	PERSNLTY
22	Public	PUBLIC
23-29	Spare	
30	Emergency Test	TEST
31	Emergency	ALERT!

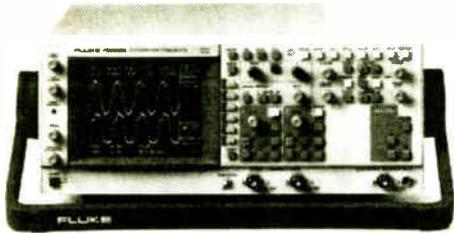
MARKETPLACE

Recently Introduced Products for the Radio Broadcast Professional

Two New Oscilloscopes

Fluke offers two new oscilloscope models to the market with its PM 3370A and PM 3390A. The 3370A and 3390A are two-channel models featuring bandwidths up to 60 and 200 MHz, respectively.

The PM 3370A has simultaneous 100



MS/s sampling, while the 3390A features an equivalent time sampling performance of 25 GS/s. Both models have a standard RS-232 interface that supports full remote control and enables direct connection to a PC, printer or modem.

For information, contact the company in Washington at 800-443-5853; fax: 206-356-5116; or circle Reader Service 91.

Cord Jackets

The Cord Products Division of Belden Wire & Cable introduces three new jacket colors for its plastic-jacketed cord products. Called PowerBrite, these highly

visible colors are initially being offered in neon-like shades of pink, green and yellow.

The colors are useful for applications where a number of power cords are utilized in the same area or where limited work space makes it difficult to identify or classify cables. Initially, these new jacket colors can be ordered with two new series of shorter length, detachable power cords from Belden.

For information, contact the company in Indiana at 800-246-2673, or circle Reader Service 29.

Master Clocks

ESE has added two units to its Master Clock System Family. The ES-126 and ES-127 display time and date side-by-side



in the same enclosure. Viewability of up to 50 feet is possible with two display sizes.

Both units feature a 12-digit ESE Serial Time Code Reader that displays six digits of time and six digits of date in a yellow LED. The displays on the 126 are 0.56

inches high in a single rackmount enclosure and one inch high in a three and one-half inch rackmount enclosure.

For information, contact the company in California at 310-322-2136; or circle Reader Service 80.

Antenna/Power Distribution System

The Sennheiser DAS4015 antenna/power distribution system is designed to be used with up to four EK4015-UHF frequency-agile diversity receivers. The DAS4015 also offers a compact, DC-powered RF system for location film and broadcast.

The DAS4015 uses the standard four-pin Cannon plug for its required 12 to 18 VDC powering, making it adaptable to standard rechargeable batteries. The DAS4015 in turn supplies power to each of the receivers and active antennas.

For information, contact Joe Ciaudelli in Connecticut at 860-434-9190, or circle Reader Service 172.

Wireless Transceiver

RF Industries, Ltd. is shipping its new wireless communications transceiver, the Neulink 9600. The Neulink 9600 incorporates a communications protocol that enhances the performance of digital radio communications. A general purpose wireless communications radio, the Neulink 9600 is designed for a variety of applications, including integrating the modem transceiver into a Global Positioning Satellite (GPS) tracking and location system.

For information, contact Les Perlman in San Diego at 800-233-1728; fax: 619-549-6345; or circle Reader Service 138.

Cassette Deck Recorders

The PMD501 and PMD502 from Marantz Professional Products are rack-mountable cassette deck recorders designed for commercial applications. Both decks offer two motors, two heads, Dolby B NR, a headphone output with level control and mount into three rack spaces without additional hardware or modification.

Extra features on the PMD502 include +/- 15 percent pitch control, defeatable automatic level control, dual quarter-inch microphone inputs and an output level control. Both models come with an RC-5 serial remote control bus that is compatible with other major remote control systems.

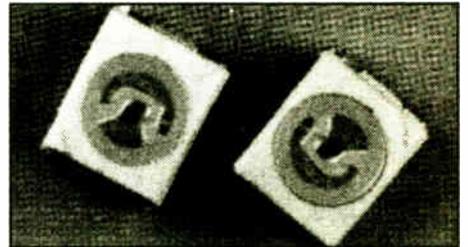


For information, contact Julie M. Clark in Michigan at 616-683-4400, or circle Reader Service 182.

Maximized Light Intensity

Lumex Opto/Components Inc. has introduced a new family of surface-mount (SMT) "Power LEDs" that provide maximized light intensity for their size. The intended applications for the LEDs include computers and peripherals, personal digital assistants, phones, pagers and all types of miniaturized, hand-held electronics.

A combination of inherently brighter



"Power Chips," built-in molded white reflectors that maximize the spread of photons from the chips and opaque, high-temperature composite materials with insert-molded solder pads result in increased light intensity.

The LEDs are available in all standard colors, including blue and amber. Power requirements are two to 20 milliamps, with forward voltage of 1.3 to 2.8 v (Vf).

For information, contact the company at 708-359-2790; fax: 800-944-2790; or circle Reader Service 117.

Automatic Mixing Controller

Dan Dugan Sound Design's new Model D1 is an eight-channel automatic mixing controller designed for simple operation by the elimination of rarely used functions and controls. The D1 features an all-steel cabinet and can be patched into the insert point of mixing boards to provide transparent, no-gating automatic mixing while keeping all of the board's features. Since the D1 is compatible with Dan Dugan Sound Design's Model D, the two can be linked together for up to 100 inputs.

For information, contact Dan Dugan in California at 415-821-9776, or circle Reader Service 118.

TECHNOLOGY UPDATE

CCA

CCA Offers Dependability

FAIRBURN, Ga. CCA has been building radio transmitters for stations in small, medium and top radio markets for 30 years. CCA FM transmitters are available in power levels from 2.5 kW to 65 kW. Utilizing reliable relay-logic technology that is easily adaptable to all remote control systems, CCA FM transmitters provide maximum dependability.

CCA's grounded-grid triodes offer

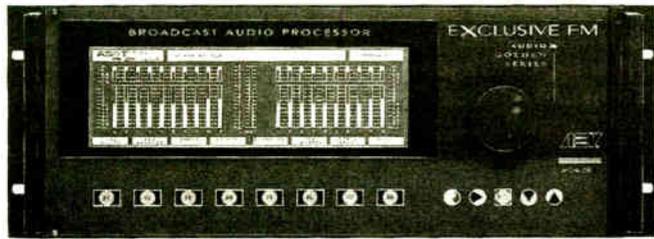
high-performance on-air sound with low power bills. Triode-based FM transmitters are provided by CCA along with its FM100GS and FM60G exciters. CCA transmitters provide the quality needed by today's digital audio sources.

CCA provides a three-year warranty on all of its FM transmitters along with 24-hour technical service and parts availability to support stations worldwide.

For information, contact Howard Ginsberg in Georgia at 770-964-3530; fax: 770-964-2222; or circle Reader Service 120.

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AMPLIFIERS

Want To Sell

Crown DC 150A pwr amp, \$250; Southwest Tech 215A, stereo pwr amp, \$95; Altec 1568A, 50 W tube pwr amp, \$150. D Lundy, Lundy Rcdng, Cumberland Gap Pkwy, Heidrick KY 40949. 606-546-6650.

McCurdy 504 audio DA frames (4), \$350/ea + shp; Hedco dual audio DA in rk mt frame, \$200 + shp; Dukane #60 W PA amp, \$75 + shp; dbx 157 decilinear NR units (5), \$100/all; Crown (3) pwr amps, \$275 ea. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

RTS-405 stereo TT preamp (2), \$140/ea + shipping. B Lord, 3824 SW Myrtle St, Seattle WA 98126. 206-932-4839.

Symetrics headphone amp, \$180. L Houck, Rollin Rcdg, 208 River Ranch Rd, Boerne TX 78006. 210-537-5494.

Want To Buy

QEI 675T300 or 500, wking or not. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

RCA BA-13A program amp w/shelf & knobs if possible. D Dintenfuss, Transcription Service, 7549 27th Ave NW, Seattle WA 98117. Fax 206-784-6963.

Tube Hi-Fi, speakers, tubes. Altec, Marantz, McIntosh, Western Electric, coax/triax and corner speakers, tubes-VT-4C, 845's, etc. 405-737-3312 FAX: 405-737-3355.

Tube Fairchild, McIntosh, Marantz, limiters, record cutting lathes. 612-869-4963.

ANTENNAS/TOWERS/CABLES

Want To Sell

200', UTC-280 flanged, tube leg triangular, 18" face, galvanized inside and out, nds repainting, no hardware or insulator, exc cond, down and ready for pu, \$2500; 10' sections (6), rigid 1 5/8" interbay line w/sqar flanges, no bullets, \$200 + shp; stainless steel brackets (8) for face mting antenna/interbay line to 24" twr, \$50/ea, \$350/all + shp. C Glasgow, KR0P, 120 S Plaza, Brawley CA 92227. 619-344-1300.

FM-Antennas

Brand New, as low as
695.00 per bay
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Factory Direct Sales
800/279-3326

ADC doube TRS patch cords, 3 ft, \$5/ea. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

280' tower, 13 sections of 20', 1 section of 10'. On the ground & ready to ship. Matching top beacon also avail, call for details. D Lacy, Mtn States Bdtg, Colorado Springs CO. 719-636-2470.

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AM phasor, 2-twr in cabinet, plus misc ATU components. B Campbell, KRIG, POB 877, Bartlesville OK 74005. 918-333-7943.

Collins 37 hor 40 kW 4 bay 95.3; ERI-4 CP 95.3; Phelps Dodge 3 bay CP 100.95. JB Crawley, POB 185, Campbellsville KY 42719-0185. 502-465-5764 or 502-465-8884.

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ERI 300', 3-1/8 rigid transmission line, \$2000. C Marker, WHWL, 130 Carmen Dr, Marquette MI 49855. 906-249-1423.

Rohn 200', 20' sections, inc top light beacon, 2 side lights, bolts, guy cables, on the ground, gd cond. Barry, 207-255-3140.

Want To Buy

200' Heliac line, 1 5/8" or 3". J Powley, 1512 Sherwood Dr, Reidsville NC 27320. 910-342-1843.

Multi bay antenna suitable for FM w/C-2 upgrade appvl, must be tunable to 99.3. Andy. 520-855-9000.

10-12 bay high pwr FM on or near 93.3 mHz; Arrakis Digilink, prefer recent mdl. E Moody, KJEM, 216 N Main St, Bentonville AR 72712. 501-273-9039.

Any light weight 6 or 8 bay hor only on 98.5 MHz. F Hollon, WAHI, Rt 1 Box 72, Plymouth IL 62367. 217-392-2340.

High Power FM on or near 107.1, prefer 8, 10 or 12 bay; also high power FM, 8, 10 or 12-bay on or near 105.9. B Michaels, Unique Bdtg, POB 2537, Bay City TX 77414. 409-244-4170.

AUDIO PRODUCTION

Want To Sell

AKG BX-10 stereo revb unit, \$100 + shp; Urei 530 dual graphic EQ, \$100 + shp; CBS 4110 FM stereo Volumax, \$50 + shp; ADC Icon audio block (12), \$20/ea + shp; ADC (12) older type icon audio blocks, \$20/ea; Pultec EQH-2, prgm EQ, tube type, \$575; Urei 565 filter set, little dipper, \$300 + shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

Altec 9069 B variable hi/pass filter, 600 ohms; Altec 9068-B variable lo/pass filter 600 ohms, rack mt pr, \$200; dbx 222 type II NR system, \$475. D Lundy, Lundy Rcdng, Cumberland Gap Pkwy, Heidrick KY 40949. 606-546-6650.

dbx 503 expander/comp \$350; Orban 414-A stereo compressor, \$425/BO; Orban 245-E stereo synthesizer; Ross 15 band stereo EQ/Audimax and Volumax compressor; Altec 352-A. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

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Roland 2450/2453 event cntrlr and prgmable clock, \$50. Joe, JCF Labs, POB 184, Lincoln city. 97367, 503-994-9023.

dbx 3bx dynamic range expdr, 3 bands, perf cond w/manuals, \$150; Tascam PE-40, 4 band, 4 chnl parametric EQ, rk mt, perf cond, w/manual, \$200. D Green, Moonlight Rec, 3433 Winifred, Ft Worth TX 76133. 817-346-6228.

Inovonics 231 MAP II multiband processor, mono, rk mt, gd cond, \$300; Gates Solid Statesman, \$150; Harris/UPI satellite rcvr and digital prgm decoder, \$200 + shp. C Glasgow, KR0P, 120 S Plaza, Brawley CA 92227. 619-344-1300.

QEI stereo generator, exc cond, \$400. J Pittmann, 12104 Old Hwy 169, Hibbing MN 55746. 218-263-3000.

Roland D110 synth module, \$250; Opcode Studio 3 Midi interface, \$150; Onkyo TX15 and Harman Kardon 330C, tuner/amp, \$75. Fitzmusic, 37-75 63rd, Woodside NY 11377. 718-446-3857.

Shure M67 mixers (2), exc cond, \$100/ea; Shure M-68 mixer, exc cond, \$75; Koss headphones (4), \$100/all; Furman RV-1 reverb, \$100. L Wagner, Ardnigva Radio Network, POB 1788, Orlando FL 32802. 407-299-1299.

Teletronics LA-2A vintage tube compressor, gd cond, \$2500; Pultec MEQ-5, mid range EQ, tubes gd cond, \$1000. Joe, JCF Labs, POB 184, Lincoln city, 97367, 503-994-9023.

Valley People 400 mic processor, \$295. GMI Media Grp, 206-839-9414.

California Digital Digimod 2000 cards, 1622-XT for Optimod 8100 w/XT chassis, new in box, \$750/BO. M Guthrie, WFNS, 7201 E Hillsborough Ave, Tampa FL 33610. 813-620-9100.

Eventide H-910 Harmonizer, old but works well, \$650. J Winters, Wintersound, 45 E Washington St, Elizabethtown PA 17022. 717-367-1119.

Lexicon PCM-70 classic reverb, \$1350; dbx 503 expander/comp, \$350; Roland SRV 2000 classic reverb, \$525/BO; Orban 245-E stereo synthesizer; Audimax & Volumax compressors, Altec 352-A vintage audio mixer. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

dbx 166 stereo compressor, \$350. W Gunn, 619-320-0728.

Want To Buy

MXR Neve API, EQ, mic-pres, delays. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

MXR-Neve-API EQ's, mic-pres, delays, etc. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

AUTOMATION EQUIPMENT

Want To Sell

Sony CD Jukebox (2), w/SMC cntrlr, 1 exc cond, 1 nds repair, \$850/BO. G Johnson, WLDY, POB 351, Ladysmith WI 54848. 715-532-5588.

Broadcast Electronics Core 2000, 3 yrs old, inc NSM 3101 (2), 100 disk CD player, Pioneer TM-2, 18 disk player, source cards (7), serial card, exc cond, \$12,000 + shipping. P Reilly, KGRC Radio, 314-221-2221.

Cetec 700 automation system all or parts, level 2, 5046 event memory, terminal, numerous source cards, 250 Carusel parts, spar IC's, more. E Moody, KJEM, 216 N Main St, Bentonville AR 72712. 501-273-9039.

Cetec 7000 automation system w/encoder & cables, (3) ITC PB reels w/racks, (3) IGM 42 tray Go-Carts w/racks, (2) IGM 24 tray Go-Carts w/racks, printer & paper. All machines rebuilt & in gd working cond, BO for all. T Yarbrough, WEDT, 1201 S College St, Winchester TN 37398. 615-967-2201.

SMC MSP automation system, works good, complete w/all manuals, battery backup & 25/1000 Hz tone generator. SMC green racks (3) mdl 452 Carusel (2) ARS 1000 reel PB (3) single cart PB (2) 10 chnl switcher. You pick up in Southern Virginia, \$2250. H Espravnik, WVCP, 1360 Nashville Pike, Gallatin TN 37066. 615-452-8600 or 615-452-3983.

CART MACHINES

Want To Sell

BE stereo cart machine (3), exc cond, \$1200. J Pittmann, 12104 Old Hwy 169, Hibbing MN 55746. 218-263-3000.

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UMC Beaucart 11-113-001 PB unit, gd cond, \$175 incl shipping. D Aloisi, Heart Radio Productions, POB 280, Purchase NY 10577. 914-698-5217.

ITC 3D 3 deck stereo P/B unit, fair cond, \$250 + shp; BE mono daul cart unit, one R/P, one play only, \$100 + shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.



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CRL APP-300 (2), excellent condition, \$500. J Pittmann, 12104 Old Hwy 169, Hibbing MN 55746. 218-263-3000.

ITC S/P, gd cond. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

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ITC SP, stereo play, 3 tones; Tapecaster 700P, mono play, both guaranteed exc cond w/manuals, \$495/both. K Lamson, 510-447-7405.

Tapecaster cart machines (2), 700-P, factory re-built, one spare motor, \$200 + shpg. B Barrett, KZPI FM, Deming NM. 615-399-8059.

Tapecaster RP, 6 hrs running time, as new w/secondary cue tone generator and detector. R Franklin, Supersound Studios, POB 1, Norristown PA 19404, 215-646-7788.

ITC record amps, 3 tone, stereo \$350 or mono \$250. W Gunn, 619-320-0728.

Want To Buy

ITC, BE, Fidelipac cart machines: single, triple, mono, stereo, play & record/play. Call M O'Drobinak @ 619-758-0888.

COMPUTERS

Want To Sell

Olympia dot matrix prntr, \$75. Fitzmusic, 37-75 63rd, Woodside NY 11377. 718-446-3857.

Want To Buy

Tandy 6000 HD with at least one floppy drive. Mel Crosby, 408-363-1646.

CONSOLES

Want To Sell

Harris 5 chnl stereo console, \$300 + shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

Harris Gates Dualux II AM & FM, 8 channel stereo, \$800. D Lundy, Lundy Rcdng, Cumberland Gap Pkwy, Heidrick KY 40949. 606-546-6650.

Shure 200M prologue mic mixers (4), as new, \$85/ea. L Houck, Rolling Recording, 208 River Ranch Rd, Boerne TX 78006. 210-537-5494.

Soundcraft 400B rcdng mixer, 16x4x2m 4 band British EQ, VGC, w/manual, \$950/BO + shipping. Ed, 8 Knot St, E Patchogue NY 11772. 516-654-8306.

Tangent 1202-A 12 channel input, stereo output, mono output, slide pots, pre & post efx, reverb, EQ on each input, excellent condition, \$800 + shipping. S Lawson, KAK Productions, 928 Hyland Dr, Santa Rosa CA 95401. 707-528-4055.

Autogram IC-10 mono/stereo mixer, 28 stereo inputs, like new, BO. J Price, 214-321-6580.

Wheatstone A20 2 mic, 10 line, timer, line selector, A/B select, gd cond, \$4500/BO. R Scott, WHFS, 8201 Corporate Dr, Landover MD 20785. 301-306-0991.

Ramko DC-8M 8 chnl/32 input mixer w/aud & pqm outputs, adv features, spme spare parts, manual, \$650 + shp. C Glasgow, KROP, 120 S Plaza, Brawley CA 92227. 619-344-1300.

Cetec 5 channel mono console mounted in portable cab with cue speaker, program speaker, \$350. E Moody, KJEM, 216 N Main St, Bentonville AR 72712. 501-273-9039.

Harris Stereo 80 console, \$300. KCMG, 800 N Hubbard, Mtn Grove MO 65711. 417-926-4650.

Russko 5 chnl mono console, great shape, \$100 + shipping. B Barrett, KZPI FM, Deming NM. 615-399-8059.

Gates Yard board, new tubes, \$395. W Gunn, 619-320-0728.

Want To Buy

API/Neve whole or parts, wking or not. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

Arrakis slide pot, any model. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

API, Neve, whole or parts, working or not. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

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Want To Sell

White 4002 1/3 octave EQ, perf cond with box and manuals, \$200. D Green, Moonlight Recording, 3433 Winifred, Ft Worth TX 76133. 817-346-6228.

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LIMITERS

Want To Sell

Audimax 4440-A, Volumax 4400-A. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

CVS Volumax 4110, compressor/limiter, good condition, \$500. J Pittmann, 12104 Old Hwy 169, Hibbing MN 55746. 218-263-3000.

dbx 165A (2), compressor/limiter, \$250/ea + shipping; Urei dual LA-3A limiters, rack mount, \$450 + shipping; dbx 160 limiter, older type, rack mount, \$200 + shipping. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

Gates 994-6543-001 (2) clean, work well, \$50/ea + shipping. Ed, 8 Knot St, E Patchogue NY 11772. 516-654-8306.

Orban Optimod 8000 A, gd cond. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

Urei 1176LN pk limiter, \$250 + shp; Eventide (2) omnipressor limiters, \$100/both. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

Audimax 4440-A compressor; Volumax 4000A compressor. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

Want To Buy

Gates, Inovonics, Fairchild, RCA, Urei, Teletronics, solid state, tube. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

Gates M6467 FM top level amplifier. F Hollon, WAHI, Rt 1 Box 72, Plymouth IL 62367. 217-392-2340.

Gates, Inovonics, Fairchild, RCA, Urei, Teletronics (all types), solid state & tube. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

Teletronix LA-2A's, Urei LA-3A's & LA-4's, Fairchild 660's & 670's, any Pultec EQ's & any other old tube compressor/limiters, call after 3PM CST, 214-271-7625.

MICROPHONES

Want To Sell

EV 6x9 B lavolier, \$20; EV RE-50, \$30; EV DS-35, \$60; Realistic hand held UNI (3), \$20/ea; Atlas (6), desk mic stands, \$5/ea; Canare mic cables, 25', \$10 ea. L Houck, Rolling Recording, 208 River Ranch Rd, Boerne TX 78006. 210-537-5494.

Shure SM5B, make offer. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

AKG D-140 dynamic cardioid mics, \$225/pair. R Streicher, Pacific A/V Enter, 545 Cloverleaf Way, Monrovia CA 91016. 818-359-8012.

Sennheiser Binaural MKE 2002 mic with head & all adapters & cables, excellent condition with carrying cases, \$300. J Swartz, Face Company, 237 Frost Ave, Rochester NY 14608. 716-235-4928.

EV PL20 (RE20) mics, good condition, \$325; RCA 77DX mics, re-conditioned with new ribbons; Neumann KM84 pair. W Gunn, 619-320-0728.

Want To Buy

Neumann U87 wking or not. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

RCA 77 DX, Shure green bullet original. T Coffman, Rolltop Music, POB 17203, San Diego CA 92177. 619-571-5031.

77-DX's, 44-BX's, WE KU-3A's On-Air lights, recording lights & audition lights. Top price paid. Fast response. Bill Bryant Mgmt, 2601 Hillsboro Rd, G12, Nashville TN 37212. 615-269-6131, FAX: 615-292-3434.

RCA 77-DX's & 44-BX's, any other RCA ribbon mics, on-air lights, call after 3PM CST, 214-271-7625.

MISCELLANEOUS

Want To Sell

ADC TRS patch bays (16) top row punches on rear and bottom row is wired to campe approx 20 ft, \$125/ea + shp; ADC Pro-patch bays (2), \$125 ea + shp; ADC TT patch bay, \$175; ADC I-WS QCP wall mt panels, \$100/ea; Tellabs 248 RF (3), RF tight case for 4008 amp cards, \$35/ea + shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

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PO Box 1234, Mt. Shasta, CA 96067

Maxitel Sports remote telephone mixer, \$150; NEC 616 telephone systems incl KS and 6 multiline telephones, \$375. E Moody, KJEM, 216 N Main St, Bentonville AR 72712. 501-273-9039.

Motorola AM stereo system, #1400 exciter, #1410 monitor, good condition, Best Offer. M Lamb, Cypress Communications, 415-331-4867.

Gentner SPH-3A analog hybrid, w/manual & remote connector, \$500. S Schwieger, WXLO, 250 Commercial St, Worcester MA 01608. 508-752-1045.

HP 7550A graphics plotter, \$150+ shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

SAE 3200 digital FM tuner, rotary tuning, 5 1/4" high rack mount, \$150 + shipping. S Lawson, KAK Productions, 928 Hyland Dr, Santa Rosa CA 95401. 707-528-4055.

Magnavox antique, flr standing w/built in amp, \$150. L Wagner, Ard-nigva Radio Network, POB 1788, Orlando FL 32802. 407-299-1299.

Rotron Blowers for Elcom, Horris, CCA, CSI, McMortin, rebuilt & new. Goodrich Enterprises Inc. 11435 Manderson St, Omaha, NE 68164 402 493 1886 FAX 402 493 6821

Paradyne 4951-03 equipment rack, black, full set blank covers, \$175. B Lord, 3824 SW Myrtle St, Seattle WA 98126. 206-932-4839.

Columbia C6046 27 pr audio cable, 2 line shield, \$5/ft; McMartin EBX-2 monitor, \$85; Gates automatic tape contrl, 19" rk mt, \$75. D Lundy, Lundy Rcdg, Cumberland Gap Pkwy, Heidrick KY 40949. 606-546-6650.

Realistic PRS 100 UHF-fm transcievers (3), \$95/ea; NiCad battery chargers (10), 9v, \$5 ea; Dynamic MC-101 (5), \$15 ea. L Houck, Rolling Rcdng, 208 River Ranch Rd, Boerne TX 78006. 210-537-5494.

ADC/TRIMN TRS audio patch cables, 6' (6); 4' (84); 3' (52); 2' (74); 1' (17); 6" (4); \$2.50/ea or \$400/all. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

Want To Buy

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Manual for Digital DSP-103 TBC w/schematics; RCA bdg limiter manual & schematics; Ball TE9RT 7-010-0105 schematics. R Perrine, Imagination Industry, 2475 State Rd #22, Cuyahoga Falls, OH 44223. 216-929-3712.

UTC input bridging xmtrs such as A-18, A-19, HA-104, HA-106, LS-19, LS-21, LS-40. Any single piece. L Blackmon, RQ Studio, Larson Rd #4, N Reading MA 01864. FAX 508-668-8973.

Jazz record collections, 10" LP/12" LP be-bop, swing, dixie, highest prices paid. B Rose, Program Recordings, 228 East 10th, NYNY 10003. 212-674-3060.

MONITORS

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Simpson 3.5" audio VU meters (50), \$15/ea + shp. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

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Potomac FIM-21, will pay \$2000 cash. B Walker, 713-452-5645.

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MCI JH-110B in console w/extra electronics, manual, \$1000/BO; Ampex AG-440C, 4 trk, 1/2" w/ extras, mint, \$750/BO; Scully 280 4 trk, 1/2", \$500/BO, all + shipping. Ed, 8 Knot St, E Patchogue NY 11772. 516-654-8306.

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Sony MCI JH24 24 trk analog, 80 hrs use, \$14,500/bo. CZ, 212-265-6060.

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Henry Mix-Minus box, new, \$40 + shpg. B Barrett, KZPI FM, Deming NM. 615-399-8059.

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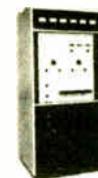
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Visual Electronics DFM-5KB, 5000 W single phase, \$4750. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

RCA 5 kW transmitter, just removed from service, works great, you haul, \$4900. G Wyatt, WPSL, 8245 Business Park Dr, Port St Lucie FL 34952. 407-340-1590.

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1-800-955-6800
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CORNELL-DUBILIER MICA CAPACITORS

FROM STOCK

JENNINGS VACUUM CAPACITORS

FROM STOCK

JENNINGS VACUUM RELAYS

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2215 Faraday Ave., Suite A
Carlsbad, California 92008
(619) 438-4420 Fax: (619) 438-4759

MARATHON PRODUCTS COMPANY

Audio Cartridge Rebuilding Division

Rebuilding/reloading, like new, all brands, any length up to & including 3.5 minutes, \$1.95 for Standard Tape, \$2.15 ea. for HOLN Tape. FOB out plant, 48 hrs delivery. (New rate effective 3/1/95)

New NAB Marathon cartridges prices on request.

35 Years professional experience!
Lifetime member AES R.D. MYERS Sr.
Manufacturers of Audio Devices,
Continuous Tape Mag.

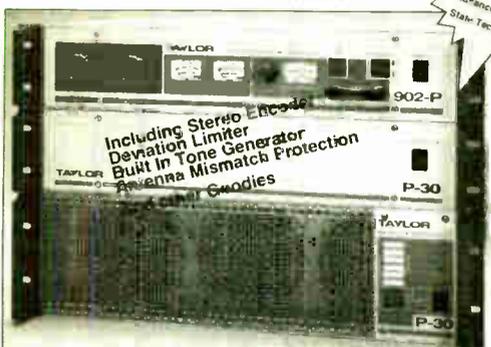
69 Sandersdale Rd. Charlton, MA 01507
1-508-248-3157 or 1-508-853-0988

Circle (2) On Reader Service Card

ADVERTISE!
in **RADIO WORLD's**
Broadcast Equipment Exchange
CALL **703-998-7600**



INCREDIBLE FM RADIO TRANSMITTERS



Advanced Solid State Technology

Including Stereo Encode
Deviation Limiter
Built in Tone Generator
Antenna Mismatch Protection
Antenna Coaxial

TAYLOR
The Transmitter People

Taylor Bros. (Oldham) Limited, Lee St. Oldham, England.
Tel: 44 (0)161 652 3221 Fax: 44 (0)161 626 1736
US Sales Fax: 407 363 2878
Satisfying Customers Since 1965

1 Watt	\$1,138.
50 Watt	\$1,499.
500 Watt	\$3,174.
500 Watt	\$5,960.
K Watt	\$8,716.
2K Watt	\$11,905.
4K Watt	\$20,741.

B-500 BROADBAND FM AMPLIFIER

FEATURES:

- 100% solid state
- No tuning required
- Rugged power supply
- VSWR, current, & temperature overloads
- Power trim standard
- Full remote control capability, with outputs for all main parameters
- FCC notified
- 600 W max output

Broadcast Technology Company
BT
PO Box 751
Lamar, Colorado 81052
tel: 719-336-3902

Want To Buy

10 - 25 kW FM in lower portion of FM band. E Moody, KJEM, 216 N Main St. Bentonville AR 72712. 501-273-9039.

FM 15-20 kW with exciter, spare parts, manuals, must be in working order. Andy. 520-855-9000.

20 kW FM with exciter, prefer Harris, BE or Continental, clean, will consider PU in NE or midwest. D Payne, WZPL, 317-879-9999.

CSI or CCA 12 kW, 20 kW or 27.5 kW FM. J Wilkinson, 801-231-7099.

Harris, Continental, CCA, or QEI, 5 kW, prefer 1975/newer, working or not. P Lopeman, 4359 S Howell Ave. Milwaukee WI 53207. 414-482-2638.

McMartin AM/FM transmitter, any model, exciter or stereo modules. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Broadcasting
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Excellence

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Worldwide Power Tube Leadership

- Largest Selection
- Applications Support
- Committed to Quality

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Svetlana
ELECTRON DEVICES

Quality* Power Tubes

3CX15000H3	4CX400A
3CX15.000A7	4CX350AC
3CX15.000A3	4X350A 8321
3CX15.000H3	4CX250R/7580W
3CX10.000H3	4CX250BT
3CX10.000A7	4CX250BC/8957
3CX3000F7/8162	4CX250B 7203
3CX3000A7	4X150A/7034
3CX2500F3/8251	5CX1500B
3CX2500A3 8161	5CX1500A
4CX15.000A/8281	YC130 9019
4CX10.000D 8171	8560AS
4CX5000A/8170	811A
4CX3500A	833A
4CX1600B	833C
4CX1500A	
4CX800A	

- Watch this list grow.
- Shipment from USA stock.
- Manufactured in Russia's largest power tube factory.
- Generous* warranty based on high quality.
- Honest prices based on quality at low cost.

Broadcasters
Phone: 800-239-6900
205-882-1344
FAX: 205-880-8077

OEMs, Distributors
Phone US: 800-578-3852
Int'l & US: 415-233-0429
FAX: 415-233-0439

Circle (67) On Reader Service Card

TRANSCOM CORP.
Serving the Broadcast Industry Since 1978

Fine Used AM & FM Transmitters and Also New Equipment

For the best deals on Celwave products, Andrew cable and Shively antennas.

1 kW FM 1978 Collins 831C-2	1 kW AM 1966 Gates BC1G
2.5 kW FM 1978 Harris FM2.5K	5 kW AM 1979 Continental 315R1
2.5 kW FM 1983 Harris FM2.5K	5 kW AM 1978 Harris MW5A/B
4 kW FM 1978 CCA 40E	5 kW AM 1977 RCA BTA 5L
5 kW FM 1967 Gates FM5B	10 kW AM 1974 CSIT-10-A
10 kW FM 1968 RCA BTF 10D	
10 kW FM 1971 Collins 830F-1B	
20 kW FM 1974 Collins/Cont 816R-2	
20 kW FM 1968 RCA BTF 20E1	

1077 Rydal Road #101
Rydal PA 19046
800-441-8454 • 215-884-0888 • FAX No. 215-884-0738

Circle (21) On Reader Service Card

TUBES

Want To Sell

ECONCO

Quality Rebuilt Tubes
Approximately 1/2 the Cost of New

Call for Our Price List
800-532-6626
916-662-7553
FAX 916-666-7760

Circle (155) On Reader Service Card

THE Purple Processor™

Finally! A loud, clear an DYNAMIC FM processor without the grunge! We can prove it!
Call 1.800.732.7665 for a DEMO.

ACTION-GRAM

EQUIPMENT LISTINGS Radio World's Broadcast Equipment Exchange provides a FREE listing service for radio stations and recording studios only. All other end users will be charged. Simply send your listings to us, following the example below. Please indicate in which category you would like your listing to appear. Mail your listings to the address below. Thank you.

Please print and include all information:

Contact Name _____
Title _____
Company/Station _____
Address _____
City/State _____
Zip Code _____
Telephone _____

I would like to receive or continue receiving Radio World FREE each month
 Yes No

Signature _____ Date _____

Please Circle only one entry for each category:

I. Type of Firm

D. Combination AM/FM station	F. Recording Studio
A. Commercial AM station	K. Radio Station Services
B. Commercial FM station	G. TV station/teleprod facility
C. Educational FM station	H. Consultant/ind engineer
E. Network/group owner	I. Mfg, distributor or dealer
	J. Other _____

II. Job Function

A. Ownership	G. Sales Manager
B. General management	E. News operations
C. Engineering	F. Other (specify) _____
D. Programming/production	

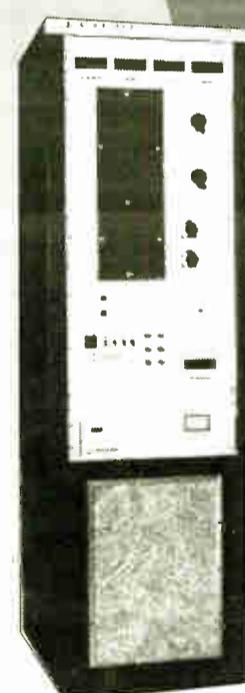
Brokers, dealers, manufacturers and other organizations who are not legitimate end users can participate in the Broadcast Equipment Exchange on a paid basis. Line ad listings & display advertising are available on a per word or per inch basis

WTS WTB Category: _____
Make: _____ Model: _____
Brief Description: _____
Price: _____

*Closing for listings is every other Friday. Please be aware that it does take approximately 1 month for your listings to appear. They will then appear for only 2 issues. If more time is needed, please re-submit your listings.

Broadcast Equipment Exchange Tel 703-998-7600 PO Box 1214, Falls Church, VA USA 22041 Fax 703-998-2966

If you think a new, top quality FM transmitter is expensive... Think Again!



In Powers to 11 KW

- ✓ Reliable Grounded Grid Design
- ✓ Solid State IPA Doubles as Emergency Transmitter
- ✓ Simple Straight Forward Controller
- ✓ VSWR Foldback & Protection
- ✓ Automatic Power Output Control
- ✓ Built-in Line Surge Protection
- ✓ Field Proven Standard Parts
- ✓ **BUDGET PRICED !**

The "ECO Series"... has ARRIVED!

"The Transmitter People"
Energy-Onix
518-828-1690
FAX: 518-828-8476
752 Warren Street, Hudson NY 12534

Circle (44) On Reader Service Card

TUBES...WTS

FOR THE BEST PRICE & 24 Hr service on transmitting tubes call Goodrich Ent Inc at 402-493-1886 day or night, FAX 402-493-6821.

Want To Buy

4X150A, 4CX250B, 4-400, 4-1000, 807, 833, 8874, 8877, RCA, Amperex, EIMAC, etc. Westgate 800-213-4563.

3CX30000A7 and 5CX1500B. P Lopeman, 4359 S Howell Ave, Milwaukee WI 53207. 414-482-2638.

WANTED! Transmitting Tubes

We BUY & SELL all types of transmitting/receiving tubes.

C&N Electronics Harold Bramstedt 6104 Egg Lake Road Hugo, MN 55038

(612) 429-9397 ext.23 (800) 421-9397 ext. 23 FAX (612) 429-0292

Circle (216) On Reader Service Card

TURNTABLES

Want To Sell

Collins pre amp (5) phono EQ, \$50/ea; RCA BQ51 TT, cabinet, stereo or mono preamp, \$250. D Lundy, Lundy Rcdng, Cumberland Gap Pkwy, Heidrick KY 40949. 606-546-6650.

Henry Eng universal TT controller, \$40 + shipping; Technics SP-10MK II (2) w/with base, Audio Technica tone arms, \$100/ea. C Slayton, 738 Jellison Blvd, Duncanville TX 75116. 214-283-3311.

ADVERTISER INDEX

This listing is provided for the convenience of our readers. Radio World assumes no liability for inaccuracy.

Table with 5 columns: Page No., Advertiser, Reader Service No., Page No., Advertiser, Reader Service No. Lists various advertisers and their corresponding page numbers.

EMPLOYMENT

To place ads in this section, use the ActionGram form. To respond to box numbers, write Radio World, PO Box 1214, Falls Church, VA 22041. Attn: _____

HELP WANTED

FM BROADCAST ENGINEER Position requires excellent ethics and character, previous and current employment in rated markets, knowledge and experience in contemporary theory and practice. Resume to: Chris Hicks, 900 East Washington St., Suite 315, Colton, CA 92324. No calls: EOE/EEEO

ENGINEER: WFLS AM-FM/WYSK FM has an opening for an experienced engineer with FCC General License and preferably SBE certification. Our state-of-the-art facility requires maintenance of AM and FM transmitters, digital studios and analog equipment. Our company is newspaper-owned with attractive benefits and growth opportunities. Please send resume to: Human Resources WFLS/WYSK RADIO 616 Amelia St Fredericksburg, VA 22401 Equal Opportunity Employer

DIRECTOR OF ENGINEERING NORTHERN LIGHTS PUBLIC RADIO ALTHOUGH IT'S A HALF-TIME JOB AT NLRP, MARKET IS IN DIRE NEED OF AN OTHER ENGINEER FOR CONTRACT WORK. TAKE YOUR PICK OF STATIONS TO WORK WITH. NLRP HAS 3 CO-LOCATED STATIONS NEAR STUDIOS, 4 TRANSLATORS. MOST EQUIPMENT OF RECENT VINTAGE. MINIMUM 2 YEARS PROFESSIONAL EXPERIENCE. \$13-17,000 (HALF-TIME), EXCELLENT UNIVERSITY FRINGES. WOMEN AND MINORITY APPLICANTS WELCOME. PERSONNEL SERVICES, BOX 8010, GRAND FORKS, ND 58202-8010. OPEN UNTIL FILLED. QUESTIONS: TOM OR JOHN, 800-248-5356.

POSITIONS WANTED

Chief engineer, AM &/or FM, former CE Houston, Miami, Boston, Ft Lauderdale, FCC general, ham, non-drinker. M Gottesman, 758 St Michael St #1005, Mobile AL 36602-1326.

Young, energetic sports guy w/over 6 yrs exper & strong prod skills looking to move up, self-motivated & willing to relocate. Derek, 505-392-5367.

Help me! Young bdcng grad looking for progressive stn to assist my plans for world domination, will divide Nova Scotia, Mara, 405-631-8484.

Due to VOA downsizing, prof anncr for adult std or news-talk announce shift, brd op and prod. Alex, 513-777-8423.

Freelance Mix show/club DJ avail for digitally rcded, custom music mixes, 6 yrs club & radio exper, mix show programming, on-air & pro, set your station apart from the rest. Dave, 313-483-5882.

Good PR skills, great motivator, very interested in sales, good team plyr w/lots of talent, eager & ready to work, you be the judge. Rick, 405-386-6524.

Looking for a different voice for your commercials, VO's, liners & open & closes, give me a call, the first one is on me, incl standard ground delivery, will write &/or produce, when you call ask about our royalty-free buyout, customized jingles, rock bottom prices. Paul, 208-324-2593.

My girlfriend found out about my love affair w/radio & left me, bring "The Slug Bodean Show" to your station. Russ, 307-362-7211.

Program directors; have you been interested in a very knowledgeable DJ specializing in vintage Soul music w/a great personality that can enhance your bottom line by doing a 4-hour (morning, afternoon, evening) show? Free one hour audio tape to see if I can do something for your radio station, The Greg Foster R&B Radio Show, audio entertainment at it's very best! 800-770-7878.

Design/Construction Engineer seeks position in San Diego, 14 yrs exp in major mkt networ/radio and post prod audio studios, avail as staff or freelance. John, 914-477-0117.

HELP WANTED

KLUC/KXNO Radio has an opening for a Chief Engineer. Requirements: Must have a strong background in commercial radio including studio and transmitter maintenance and remote broadcasts. Must know all facets of operation of high power FM and directional AM stations. Computer experience, including knowledge of Novell necessary. SBE certification a plus. Letter and resume should be sent to: Robert Reymont, Director of Radio Engineering, Nationwide Communications Inc., PO Box 5159, Mesa AZ 85211. 602-964-4000. Nationwide Communications Inc is an equal opportunity employer and we encourage women and minorities to apply. It is the policy of KLUC/KXNO and Nationwide Communications Inc. to provide equal employment opportunity to all qualified persons regardless of race, sex, color, national origin or religion in all terms and conditions of employment.

Table listing Publisher, Associate Publisher, Marketing Consultant, Marketing Assistant, Production Director, Publication/Desktop Systems Mgr, Classified/Showcase Production Coordinator, Ad Traffic Coordinator, Ad Production Coordinator, Production Assistants, Ad Coordination Manager, Circulation Director, Circulation Manager, Accounts Receivable, and their respective names.

Advertising Sales Representatives

Table listing Advertising Sales Representatives: U.S. East: Skip Tash, U.S. West: Dale Tucker, International: Stevan B. Dana, Europe: Dario Calabrese, Japan: Eiji Yoshikawa, along with their phone and fax numbers.

Free Subscriptions are available upon request to professional broadcasting and audiovisual equipment users. For address changes, send current and new address to RW a month in advance at P.O. Box 1214, Falls Church, VA 22041. Unsolicited manuscripts are welcomed for review. send to the attention of the appropriate editor.

SUBSCRIPTION/READER SERVICE FORM



FREE Subscription/Renewal Card

I would like to receive or continue receiving Radio World FREE each month. Yes No

Signature Date

Please print and include all information:

Name Title

Company/Station

Address

City State ZIP

Business Telephone ()

Please check only one entry for each category:

- I. Type of Firm
D. Combination AM/FM station
A. Commercial AM station
B. Commercial FM station
C. Educational FM station
E. Network/group owner
F. Recording Studio
K. Radio Station Services
G. TV station/teleprod facility
H. Consultant/ind engineer
I. Mfg, distributor or dealer
J. Other

- II. Job Function
A. Ownership
B. General management
C. Engineering
D. Programming/production
G. Sales
E. News operations
F. Other (specify)

Reader Service

November 1, 1995 Use until March 1, 1996

Please first fill out contact information at left. Then check each advertisement for corresponding number and circle below.

Purchasing Authority

Table with 3 columns: 1. Recommend, 2. Specify, 3. Approve. Lists numbers 001-022 for selection.

Copy & Mail to: Radio World, PO Box 1214, Falls Church, VA 22041, or FAX to: 703-998-2966

Advertisement for Radio World featuring the text 'ATTENTION ADVERTISERS!' and 'Take note of these UPCOMING DEADLINES' with specific dates for November and December issues.

The Auditronics 801 Clean Air Policy.

What we surround ourselves with says a lot. The Auditronics 801 series says you won't settle for anything less than pure, seamless audio. More standard features than the others. Tomorrow's technology with the freedom to add options. The 801 says you know that when you own the best, the sky's the limit. Write or call for a free brochure.

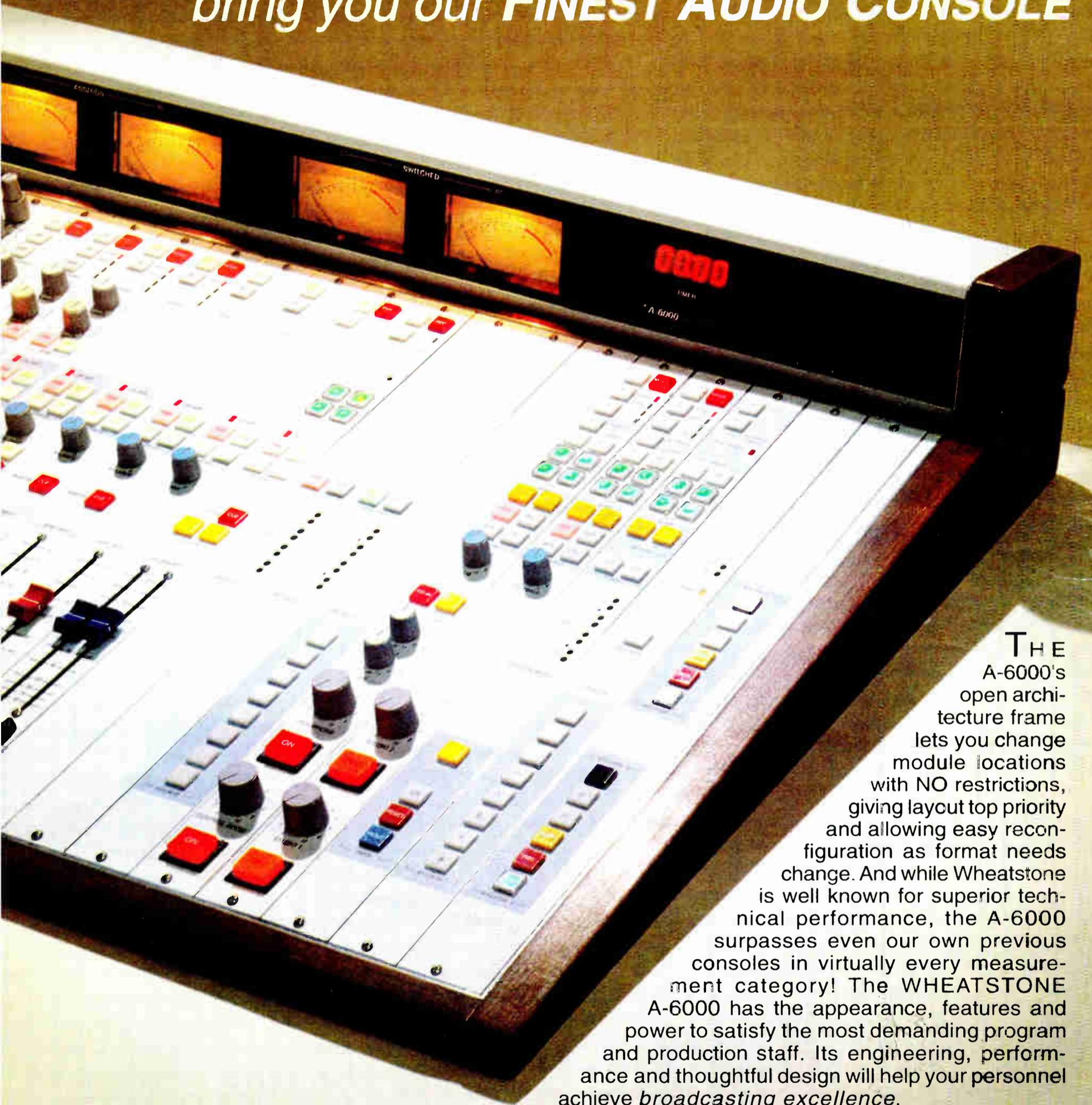


The Sound Of Perfection

AUDITRONICS

3750 Old Getwell Road, Memphis, TN 38118
901-362-1350, FAX: 901-365-8629

*We've taken all we know, all you've asked for,
and the very best of today's technology to
bring you our **FINEST AUDIO CONSOLE***



THE A-6000's open architecture frame lets you change module locations with NO restrictions, giving layout top priority and allowing easy reconfiguration as format needs change. And while Wheatstone is well known for superior technical performance, the A-6000 surpasses even our own previous consoles in virtually every measurement category! The WHEATSTONE A-6000 has the appearance, features and power to satisfy the most demanding program and production staff. Its engineering, performance and thoughtful design will help your personnel achieve *broadcasting excellence*.

A - 6 0 0 0 B R O A D C A S T C O N S O L E

7305 Performance Drive, Syracuse, NY. 13212
(tel 315-452-5000 / fax 315-452-0160)

 Wheatstone Corporation