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Radio World

Buyers Guide:
 Antennas,
 Towers & Cables,
 see p. 53

Vol 17, No 10 Radio's Best Read Newspaper May 26, 1993

Compression Stacking Mars Audio

by Frank Beacham

LAS VEGAS The combining of two or more data compression schemes in a broadcast audio chain can result in severe sonic degradation of overall audio quality, a recent series of independent tests found. The "dueling algorithm" tests, revealed at NAB '93, were conducted by Chief Engineer Herb Squire of New York City's WQXR-FM and WQEW(AM) with cooperation from ABC Radio, WNYC(AM), Corporate Computer Systems, Moseley Associates, Northeast Broadcast Labs and various audio consultants.

"Most, if not all, of these compression systems sound very respectable when performing and standing alone," Squire told an NAB engineering session. "The problem occurs when you start combining systems."

Original recordings

In the tests, Squire and company routed several original uncompressed music recordings through a series of digital devices and signal paths that use data compression algorithms. As the signal path grew in complexity and the audio was subjected to repeated compression, tape recordings revealed severe deterioration in audio quality. In some cases, even a single compression pass resulted in undesirable artifacts.

Sonic impairments revealed in the tests

- included:
- Loss of stereo image ("Lost even through the first or second pass," Squire noted.)
- High frequency smearing
- Veiling of overall sound ("Like putting a table cloth over the speakers," Squire said.)
- Low frequency flutter on sustained notes ("It's variable," he said. "Even with the same equipment, certain things will have it and certain things won't.")
- Intermodulation distortion on certain voices

- Very brittle sound distortion on transients ("Like the sound of a bad speaker in your car...when the voice coil is rubbing on the magnet," Squire said.)
 - Beat notes and "birdies" layered in the audio
 - Swishing background noises swirling left to right
 - Record ticks turn into "chirps"
- Other impairments were revealed but were not fully tested this round, Squire said. One of the most surprising artifacts

was increased distortion when the audio is played back at low volume levels or through small speakers.

"I'm finding small speakers—probably because of the non-linear frequency response—are changing the balance of the spectral masking," Squire said. "Because it is psychoacoustic—letting the ears do all the patching of the audio back together—if you confuse the ear all bets are off."

Squire speculated that most manufacturer testing of the compression algorithms was done with panels of listeners in controlled environments with good speaker systems.

"What happens when you use small speakers in portables or clock radios?" he asked. "No one listens to radio in a controlled environment. Many times radio is in the background rather than the foreground."

Not a problem

Manufacturers promoting equipment with compression schemes contend multiple passes are not a problem with their own systems, he noted. "But no one company has tested the various combinations and permutations," Squire said. "You have infinite possible combinations." (The tests Squire conducted did not assess repeated passes through the same data compression scheme.)

Other possible impairments that warrant more testing, he noted, are pre-compression and post-compression audio processing, repeated A/D and D/A conversion and associated frequency response anomalies such as phase shift and group delay.

continued on page 8 ▶



Booming Business:
 The record crowds at NAB '93 filled sessions and exhibitor booths to capacity. Post-show coverage begins on p. 25.

Mobile DAB Demo Canceled

by John Gatski

LAS VEGAS In the immediate aftermath of a disastrous turn of events at the NAB convention, the folks at USA Digital were scrambling to find replacement custom chips to get its mobile in-band, on-channel digital FM radio system working for further research.

While USA Digital's IBOC (in-band, on-channel) digital AM system at NAB was impressive (see May 12 RW), the planned mobile in-band FM system never aired at all.

The USA Digital consortium (CBS, Gannett Radio and Group W) had planned a series of bus demonstration tours for the duration of the NAB show to allow people to listen to the IBOC FM digital transmission.

According to USA Digital's Paul Donahue, the USA Digital mobile transmissions had been successful prior to the show, but bad luck soon followed.

A power inversion

First, according to Donahue, several pieces of equipment were damaged in shipment the weekend before NAB started. However, after they fixed or replaced the shipment-damaged equipment, bad luck turned worse. A DC-power inversion blew a variety of ICs including the prototype ACT (Acoustic Charged Transport) chips that are the heart of the IBOC system.

In the week following the April 18-22 convention, USA Digital had no FM

continued on page 8 ▶

Running Radio

Equipment and Applications for Radio Production and Recording, pp. 13-24

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NEWSWATCH

NRSC Begins In-Band Process

LAS VEGAS The National Radio Systems Committee (NRSC) has approved a plan for evaluation of in-band, on-channel digital audio radio systems.

At the NRSC's meeting at NAB '93, Delco's Randall Brunt and Al Resnick, of Capital Cities/ABC were named co-chairmen. The plan is to use data compiled by the Electronic Industries Association's Digital Audio Radio Subcommittee on in-band and allow NRSC to develop an implementation plan from that information.

Earlier this year, the EIA agreed, under pressure by the NAB, to allow the NRSC to guide the in-band evaluation and decision making phases. Originally, EIA was to evaluate all systems and make a recommendation to the FCC.

The NRSC's involvement, however, has confused the process by adding an extra step, according to some DAR systems proponents.

House Telecom Subcom Passes Auction Plan

WASHINGTON The House Telecommunications Subcommittee passed a spectrum-auction plan developed by

Subcommittee Chairman Edward Markey (D-Mass.), designed to improve and accelerate the allocation of spectrum for new technologies while at the same time insure that entrepreneurs have access to spectrum as well as large companies.

Momentum for competitive bidding of spectrum grew when the Clinton Administration endorsed it as a way to reduce the federal deficit in its economic plan released last February. A number of Senators, led by Communications Subcommittee Chairman Daniel Inouye (D-Hawaii) and subcommittee member Ted Stevens (R-Alaska), support a trial auction of 30 MHz to test the new allocation process.

The Inouye-Stevens plan exempts broadcast spectrum from auctioning. The

Markey plan does not explicitly exempt broadcasters, but limits auctions to spectrum meant for pay-per-use services, such as personal communications services. (See related story, page 10.)

Mason to Join Group W

NEW YORK Former Cook Inlet Radio Partners President Dan Mason will join Group W Radio, effective June 1.

Mason began his career in 1975 with WZGC in Atlanta. In 1977, he joined WPGC-AM-FM in Washington as station program director and also national program director for the station's owner, First Media.

Mason also worked at KTSA and KTFM in San Antonio, and later became general manager of KFMK-FM in Houston with First Media again. In 1985, he was promoted to executive vice president of First Media, and named president of the group when it became Cook Inlet in 1988.

Group W owns and operates 16 stations in
continued on next page

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New EBS Technologies Debated at NAB Sessions

by Randy Sukow

LAS VEGAS The scheduled "EBS Summit" during NAB 1993 turned into an EBS debate between representatives of TFT Inc. from Santa Clara, Calif., and Sage Alerting Systems Inc. out of

Stamford, Conn., the two leading companies in new Emergency Broadcast System (EBS) development.

But in the end, said Helena Mitchell, director of the FCC's Field Operations Bureau (FOB) EBS department, all debate may be moot. The FCC plans to test the Sage and TFT systems as well as 14 other separate devices this summer during field tests in Colorado and Maryland (RW, April 14).

"The commission probably will not come up with one system or the other," Mitchell said. "What we're looking at is finding the best system—taking the best features of both—and allowing you at the station to decide which is the option you want to purchase."

According to schedule

If all goes according to schedule with the testing, the FCC plans to release a proposed standard by September and have it approved by late 1993, Mitchell said. Stations will then likely have six months to two years to complete the upgrade.

The commission is seeking a number of enhancements in the next EBS system, including longer and more detailed emergency alert messages and more efficient networking than the current "daisy-chain" approach. The new system also will likely shorten the current 25-second test tone, to which, broadcasters say, the public has become desensitized.

Broadcasters could install the TFT Emergency Information System (EIS) with minimal expense. The system uses current EBS receivers (70 percent of which now in operation are TFT models, the company estimated) with an EIS message decoder. Radio broadcast data service (RDS) capability for radio stations is an available option. TFT said it will begin large-scale manufacturing of the decoders in the fall.

RDS is the key element of the Sage proposal. It is built into all elements systems,

including consumer radio and TV receivers. "I think the big difference in our approach to this concept is that EBS is a system and not a black-box solution," said Jerry LeBow, Sage executive vice president. LeBow estimated AM-station conversion to Sage/RDS at \$2,200; \$3,000 for FM stations and \$38,000 for TV.

TFT proposes a "web" network to replace the daisy chain. A web is "fairly robust," said Fred Baumgartner, TFT's EIS product manager. "But the biggest advantage is that there are multiple entry points." Instead of receiving information from the next broadcast station in the chain—resulting in a breakdown of the system if a critical link is down—stations receive EBS alerts from a number of stations as well as police and other local public-safety services.

"It is extremely redundant," Baumgartner said. "The information gets geometrically stronger as it moves through the web." A public-safety official who sends an alert should be able to know quickly whether the message is getting out because it should reflect back to him from several sources.

Similar scheme

Sage/RDS uses a similar multiple-entry-point scheme, LeBow said, but with a few

differences. "We don't have one station as a primary station, but many and all of them are monitoring with a frequency-agile radio, which scans and looks for the appropriate station," he said. The system is designed to narrow the reception of emergencies to the areas that are affected, he said.

EIS employs what Baumgartner called an "intelligent signal" to send significantly more information than current EBS alerts provide, including the nature of the emergency, the amount of time it is expected to last, the areas affected and the originator of the message.

RDS technology in consumer Sage receivers will allow for much longer messages and provides for more creative ways to get the word out, LeBow said. One Sage-licensed consumer electronics company, for example, is marketing a smoke detector with a built-in EBS receiver.

Another licensee is marketing a TV set that automatically switches on and delivers the EBS alert when it receives the correct code over the second field of line 12 in the vertical blanking interval.

"If you can't operate systems automatically at 2 o'clock in the morning and tell people a tornado is coming to their home, you really haven't done much more than change your (EBS) protocol. You haven't improved it," LeBow said.

NEWSWATCH

▶ continued from previous page eight of the top ten markets.

AM Stereo Standard Could Invigorate AM

LAS VEGAS The AM stereo standard process now making its way through the FCC may give AM radio a much-needed boost, according to remarks at the NAB convention by Gary Shapiro, group vice president of the EIA's Consumer Electronics Group.

"With an AM stereo standard in place, we may see a reinvigoration of the AM market and a blossoming of AMAX," Shapiro said during his NAB keynote speech, April 18. AMAX is the voluntary industry tuner standard for improved AM performance that includes noise blanking, extended frequency response, external antenna connection, and adjustable bandwidth.

As mandated by Congress in 1992, the FCC must make the C-QUAM AM stereo system, the most widely used system worldwide, the national standard by the end of the year.

Of other potential technical improvements for AM, Shapiro made reference to Motorola's new AM stereo/noise blanking chip, available in late 1993.

Shapiro also said the EIA opposes a possible requirement to make manufacturers add AM stereo to radios

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RAB: Beating the Bushes for Radio

WASHINGTON This is *RW*'s convention wrap-up issue, and you will find it spilling over with new product information and coverage of the big issues that were discussed at the convention. One of the biggest issues seems to be digital compression and whether it is a good or bad thing.

You can look to the experts for their thoughts on the issue, and you can find many of them right here in our pages.

We had so much NAB information, in fact, that we didn't have room for any of our feature columns. They will return next time out, so you won't miss a thing.

★ ★ ★

Time moves on, however, and business keeps happening. The Radio Advertising Bureau (RAB) released figures for combined national spot and local radio advertising revenue for the first quarter of 1993. Numbers show that the industry is up nine percent for the first quarter versus the same quarter in 1992. According to the figures, based on the RAB radio revenue index of 100+ markets, combined revenue for March 1993 was up 13 percent.

Radio ended the first quarter with year-to-date gains of 10 percent and six percent for local and national spot, respectively, for a combined increase of nine percent.

The year-to-date local revenue picture showed at least 10 percent gains across every region of the country except the West, which posted a six percent gain. The West leads the country in national spot increases, however, mostly due to the fact that its national revenue figures fell so low in 1992.

March local revenue was up 13 percent versus March 1992, and national spot increased by 11 percent, with both the East and West posting their strongest growth figures since 1992.

RAB President Gary Fries believes the numbers underpin a real improvement in the business climate. In a release, Fries said, "The March revenue numbers are right on target. They are important

because they tell us that February's phenomenal numbers were no fluke." He added: "Radio is on solid footing on both



the national and local levels."

All this good news from the RAB made me think about that association's role in the business. To be sure, it does a great job of amassing and distributing information that could benefit each and every station in the U.S. Its co-op and vendor programs and "On-Line Express" are valuable tools every radio sales department should lobby to receive.

But the RAB does so much more than just churn out statistics. By the time you read this column, the RAB's spring board meeting will have come and gone. But its impact will hopefully be felt for months to come. The board of directors agenda for May 16-18 included "more than housekeeping duties."

In what was scheduled to be a continuation of a practice begun in the October 1992 board meeting in Los Angeles, the RAB board broke up into teams and went calling on advertisers in the Detroit area. Based on the success of the Los Angeles meetings, the board voted to hold its subsequent semi-annual meetings in major cities to call on potential radio clients and advertising decision-makers.

The meetings scheduled for Detroit included: General Motors, Ford Audio, Chevrolet Motor Division, Chrysler, Pontiac, GM Acceptance Corp., Domino's Pizza, Pro Golf America, Ford Parts and Services, Ford Motor Division, Kmart, Saturn, The Stroh

Brewing Co., Ford Credit Corp. and Cadillac Motor Division.

The RAB believes that the visits can result in meaningful increases in advertising budgets allocated to radio. About the meeting in Los Angeles, Fries said: "Those meetings launched a meaningful dialogue and opened the door to new possibilities... Many of the advertisers learned about new ways to use radio—and they challenged us to help them come up with solutions to their toughest marketing problems."

Radio-friendly corporations make for radio-friendly subdivisions and regional outlets. This can only help local sales managers and stations.

Until that trickle down effect is felt, however, there are tools you can use. The RAB recently mailed the newly-issued "Radio Marketing Guide and Fact Book for Advertisers" to both RAB member-stations and advertisers across the country. This little guide book includes a section on station formats and audiences they attract, radio reach of non-newspaper readers, radio reach of consumers of specific products, and results of a study on radio as a major news source.

If you or your station aren't RAB members yet, maybe you should consider looking into what Gary Fries and his dedicated staff have to offer you.

★ ★ ★

The Sony Corp. of America is in the news again. This time the company announced it has established a divisional company, Sony Sales and Marketing of America (SSMA). In addition, the company announced several management appointments within its four main business groups.

Mike Vitelli was named senior vice president of sales and marketing for the Business and Professional Products group (BPPG). He was previously senior vice president and general manager of the Personal Audio Products company in the Consumer Products Group. Also in BPPG, Andrew Mougis was appointed senior vice president of sales. He had

been serving as senior vice president of the tape division at Sony Recording Media.

Wataru Ogawa is the new president of the Recording Media Products Group. Ogawa was previously senior vice president of logistics. Bill Midgely, formerly vice president of customer services at the Consumer Sales company was named senior vice president of logistics, succeeding Ogawa.



Harris Allied named Geoffrey N. Mendenhall vice president and radio product line manager for its broadcast division. Mendenhall succeeds Thomas E. Yingst, who will continue to serve the division as part-time consultant focusing on high-power radio transmission opportunities. Mendenhall joins the company from Broadcast Electronics Inc., where he served as vice president of research and development. Mendenhall previously worked for Harris Broadcast from 1973-78 as a design engineer.

AKG Acoustics has reorganized its marketing services group and hired Amy Herndon for the position of marketing communications manager. In her new role, Herndon will oversee marketing for AKG/dbx/Orban/BSS. Most recently Herndon ran her own consulting business specializing in communications and entertainment industries.

Katz Hispanic Media, a division of the Katz Radio Group, has opened a dedicated office in San Francisco and named Doreen Cappelli-Sofia sales manager there.

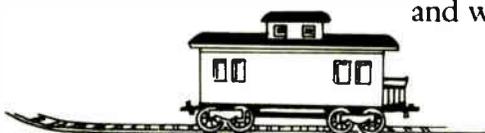


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More tower-safety points

Dear RW,

The article in your March 10 issue by Cris Alexander on power density was excellent and, I hope, served to take the issue of calculating these fields out of the "witchcraft" area for some folks and into the realm of the possible. Hopefully, they will use these formulae for the purpose intended.

If you own or manage a tower with multiple applications and lots of rigging activity, you need to know and use this stuff to promote a safe and compliant working environment. A once-a-license period calculation or measurement by your consultant, for licensing purpose, will not do in these cases.

As the manager and engineer for a 1,000-foot, multi-use tower in a major market, I have been looking at power density levels for almost 10 years now and have used the "standard formula" shown in Alexander's article to good effect. I have it living in a computer which stores the technical database for our tower (4 Class-C FMs, two full power Us and about 300 channels of communication at everything from DC to the speed-of-light) and have made a few modifications to allow for specific radiation angles and reflections.

For FCC filing purposes, the given formula serves well. We use it at our company, prior to rigging or climbing work by anyone, even for the communications equipment. While not really required by the Part 73 rules, we need it to clarify our responsibilities as owners and to promote a safe working environment.

To be honest, the riggers love us for it, and the tenants with equipment on the tower have greater respect for our company as responsible tower operators.

I wanted to offer a couple of comments on this area. First, please be aware that you may need to locate and calculate the reflected energy from objects other than the ground. These include other antennas, buildings, tower members and more.

This, I hope, is sufficiently vague to stimulate thought.

Each site is different and each reflection is specific to its own site, so you need to employ some skull sweat. You really can't use FIMs or a spectrum analyzer to find some of these reflective nodes and to determine the source thereof, but they will certainly be there.

Naturally, there is a reflection from the ground, which is taken into account with the formula shown, as is the isotropic/dipole conversion. Bounce from buildings and metal objects may be a different subject.

Before you minimize this, please consider that if you have a worker exposed to a field above the ANSI limit, regardless of the source of that field, you have to delineate it and be able to show that you can make it go away (at least below the limit) before you send a worker into that space.

Hypothetically, let's consider a worker in an area that you can show mathematically is a "dead zone" in a straight-line shot from the COR, but which is also the landing point for a beam which has bounced off your generator housing or the door to your shack or "something." Even if there is no direct radiation, you must quantify the reflection and control it before work can take place. Interestingly, you must do this for your station and for the other stations involved, as Cris points out in his article.

You might also want to try it on for "virtual fields" caused by the interaction of two full-power stations producing a mix product. (These products are real and can contain some serious energy, but you can also drive yourself nuts trying to find them all and it's not required or really worth it unless you like that sort of thing.)

That brings me to the second point: metering to detect these fields.

I am probably wrong about this (these are the '90s) but the last time I looked at measuring instruments for these fields I had profound reservations about their usefulness in fields where same-station cancellation takes place, and fields in use by UHF television.

As for same-station cancellation, we have a panel antenna serving two FMs on our tower in which the design uses a portion of the backwave from the panels as a method of pattern control. While most of the energy is directed out of the front of the panel, some of it goes back and cancels in the geometrical center of the tower. In this example, a meter designed to measure these fields *might* show a zero reading, or a falsely low reading because of the cancellation when in reality, the field would be twice the value of each individual panels contribution. See what I mean?

(I suppose you could design something using heating or come up with a receive element that was sufficiently orthogonal to detect some implied phase differences and give you a reading of some sort. Maybe somebody has.)

Assuming one station only, if the radiation behind panel A is .66 mW and if panel B is identical to panel A, then the energy at the intersection of the fields behind the panels would be A+B or 1.32 mW, which is illegal.

(I see eyebrows going up. The assump-

Compressing Business Awaits

For some time now, a number of engineers have been quietly expecting it. Now they have the empirical evidence. Digital audio can withstand only so many compression schemes before compact-disc quality becomes sub-broadcast quality.

Herb Squire of WQEW(AM)-WQXR-FM New York laid the problem out fully in his technical paper at the NAB convention.

"Dueling algorithms," the stacking of one compression system on top of another in the broadcast chain, can damage audio quality.

Thousands of dollars worth of test equipment were unnecessary to determine the audio quality of Squire's demonstration tapes. It could be read in the contorted faces of those who heard the loss of stereo image, audio distortions and several "chirps" and other noise the Squire tests produced.

The problem is compounded when compressed audio is heard—in radio often is heard—in less than optimal conditions, with small speakers at low volume.

It is a wonder that this problem did not achieve a high profile earlier. Compression algorithms are well established in several links in the chain, from backhaul and STL's to digital audio tape recorders and disk-based cart machines, providing ample opportunity for dueling.

Some broadcasters may already be suffering audio degradation without realizing it, Squire says.

Obviously, it is time for broadcasters and equipment manufacturers to seek solutions. The first step will be to enlist the participation of those digital equipment manufacturers who still say there is no problem. To say that co-existence in the digital domain is not as easy as once believed is no reflection against their products.

Next, a working group—perhaps from the NRSC or within the AES—should be formed. (Liaison with brethren from the video world, where digital audio compression is an issue during the transition to high definition television, might also be a good idea.)

Can there be a universal algorithm for all applications? Unlikely. Is there a future market in digital-to-digital standards converters? Perhaps. Will broadcasters simply have to accept that there are limits and do without some digital devices if their algorithms do not play well with others? Maybe.

The WQXR tests have opened up this Pandora's Box. The industry needs to get on top of this before the situation gets even more complicated and difficult to solve.

—RW

tion that this should be A-B is untrue since you cannot use either the sign or the phase of this kind of field for the purpose of determining the effect of RF radiation. Sign and phase will certainly effect the way the antenna works, but not the density of the RF fields for compliance purposes. For these purposes, you must use the same sign and assume phase linearity.)

While it is true that in this case the fields cancel there is twice the energy present. Direct metering *might* give a result of zero since the fields would also cancel in the detector of the meter.

Picture two flashlights shining on the same object from opposite sides. What happens to the light energy? Does it cancel? Sure, some of it does if you can detect it canceling, but you still have twice the light on the object.

So remember, voltage or current sampling meters would not necessarily show this. (That's why FIMs don't work and why spectrum analyzers might not.)

If you are taking readings on the ground, you need to be profoundly aware of this as the reflections from ground objects described above *will* effect your readings.

There are examples of rooftop installations in which there are carefully delineated walkways in yellow paint on the roof which are the "compliant paths" to and from the transmitters and radiators.

When using a meter, if it reads anything at all, determine the source, the angle to the source from the COR and then calculate it. The meters sold are good, but you still need to use the formula.

In addition to all this, you need to either calculate, or measure the RF in and

around your transmitter. While not specifically called out in the rules, you need to know this. Remember, RF can "leak out" or improperly designed cabinets, through meter holes, and might expose a worker to an RF hazard in what had been assumed to be a "screened" transmitter shack.

To sum up, you need to change your thinking about these fields if you are going to work with them regularly. Train yourself and your employees to recognize that RF can come from places other than antennas.

One way to help with this is to recognize that for total cancellation to take place in these fields you must have a conditions where the levels of the fields are identical, *but* twice as high as each individual field source can produce.

My rule is simple: If you aren't sure, turn it off before working.

Fred Baumgartner
TFT
Santa Clara, California

solution to May 12 puzzle

H	A	A	T	I	S	I	S	E	S	P
A	U	D	I	T	R	O	N	I	C	S
L	N	A	S	P	M	S	K	E	C	S
I	O	N	U	M	P	T	E	E	N	D
K	O	N	O	R	I	B	A			
A	U	D	I	O	M	E	T	R	I	C
I	E	C	R	O	R					
N	A	U	D	I	O	P	A	K	S	
E	X	N	S	P	A	O	S			
N	O	D	I	G	I	S	T	O	R	T
F	A	S	O	E	P	A	O			
R	F	O	W	N	E	R	S	H	I	P

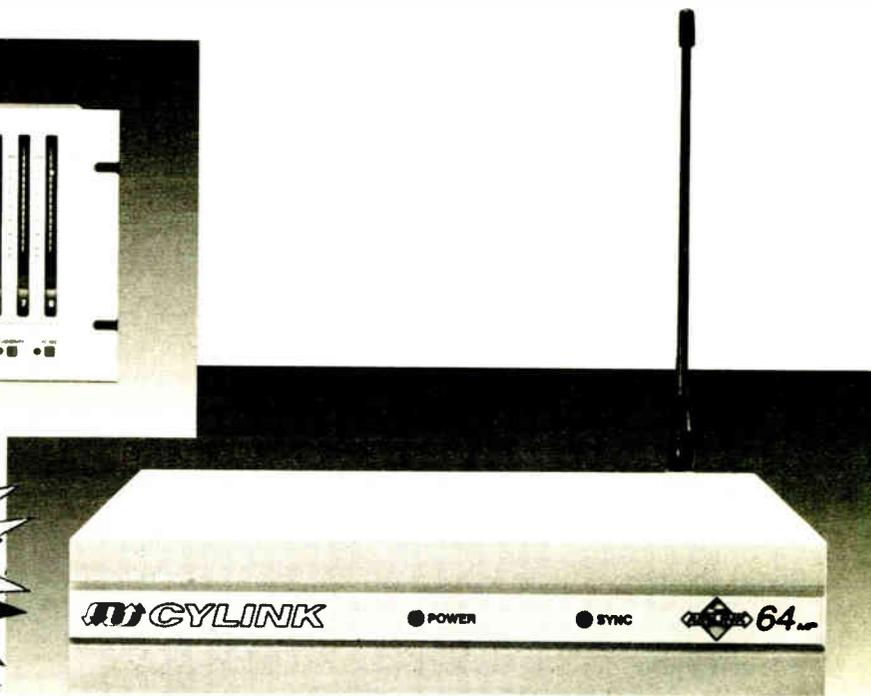


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June 9, 1993



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Broadcasters Get Full Dose of RDS

by John Gatski

LAS VEGAS At NAB '93, broadcasters got a taste of what consumer electronics dealers witnessed at the Consumer Electronics Show: RDS.

The RDS technology (or RBDS, which is the name of the standard and the more commonly used tag for the U.S. version of the European technology) was prominently displayed and demonstrated at the NAB convention center before the people who will decide whether it is worth the cost to implement at radio stations.

According to an Electronic Industries

Association survey, 62 percent of radio station general managers and 45 percent of chief engineers said they would add RDS when the radios become available. At press time about 50 stations were already on the air. The survey also revealed that station personnel had overestimated startup costs at \$5,000 instead of the actual \$2,500 basic encoder price.

Twelve of the 50 stations airing RDS are Las Vegas broadcasters. They beamed their signals to equipment manufacturers and proponent users at NAB to demonstrate the RDS functions.

Companies at the main convention hall dis-

play included RE America, Rohde and Schwarz, Teli, VGE, Axxcess (palm-top computer receiver/decoder pager system) and Coupon Radio. RDS companies elsewhere

An EIA survey shows 62 percent of managers and 45 percent of engineers would add RDS when radios become available.

on the convention exhibit floor were Modulation Sciences and CRL. Sage Alerting, an early proponent of RDS' use as a replacement for the existing Emergency Broadcasting System (EBS), also had an exhibit.

What's all the fuss? Proponents say that RDS allows a higher degree of broadcaster interaction with listeners. The technology allows broadcasters to transmit data that can perform multiple functions when received on RDS-equipped receivers. The functions include call letter display, scrolling display (ads, perhaps), station search by format, and translator/alternative transmitter switching. The RDS format also allows for traffic alert and EBS override of programming.

Coupon Radio offers interaction with the listener (viewer?) to an even greater degree. The goal with this product is to tie in programming material with related alphanumeric data.

According to developer David Alwadish, a computer card writer/reader built into the radio can allow radio stations to conduct promotions via "electronic coupon," in which the user merely inserts a card to retrieve the information. The promotional coupon card (or printed version) can be taken to a participating advertiser to be honored.

The chances of RDS succeeding in the U.S. are good, according to proponents. The National Radio Systems Committee RDS standard was finalized in January, just in time for the winter consumer show, which got the retailers interested, according to interviews with store owners.

Now with the major broadcaster show of

1993 now history, proponents are hoping that the market will take over; receiver manufacturers making radios and radio stations buying the encoders.

As evidenced by NAB vendors there are already enough RDS encoder manufacturers to supply the market, but industry analysts predict that RDS' success with broad-

casters will depend on how quickly the receivers are produced and promoted.

"I would look for major radio markets to be up and running by the close of this year," RE America's John Casey predicted.

SBE Show Deal Offered

by John Gatski

LAS VEGAS After months of speculation, the Society of Broadcast Engineers (SBE) informed members that the NAB has made an offer to SBE to let it take over the technical and engineering sessions at the NAB's spring convention.

During an SBE membership meeting at NAB 1993, SBE President Rick Farquhar told members that the Society of Broadcast Engineers (SBE) was trying to strike a deal with the NAB.

"NAB has made a gesture to SBE to do the engineering sessions at the spring (NAB) show," Farquhar said. "In return, of course, we would not hold our annual show."

For the past two NAB conventions, SBE has sponsored "SBE Day," scheduling a number of activities, sessions and workshops, but the pending agreement would allow SBE to become much more involved.

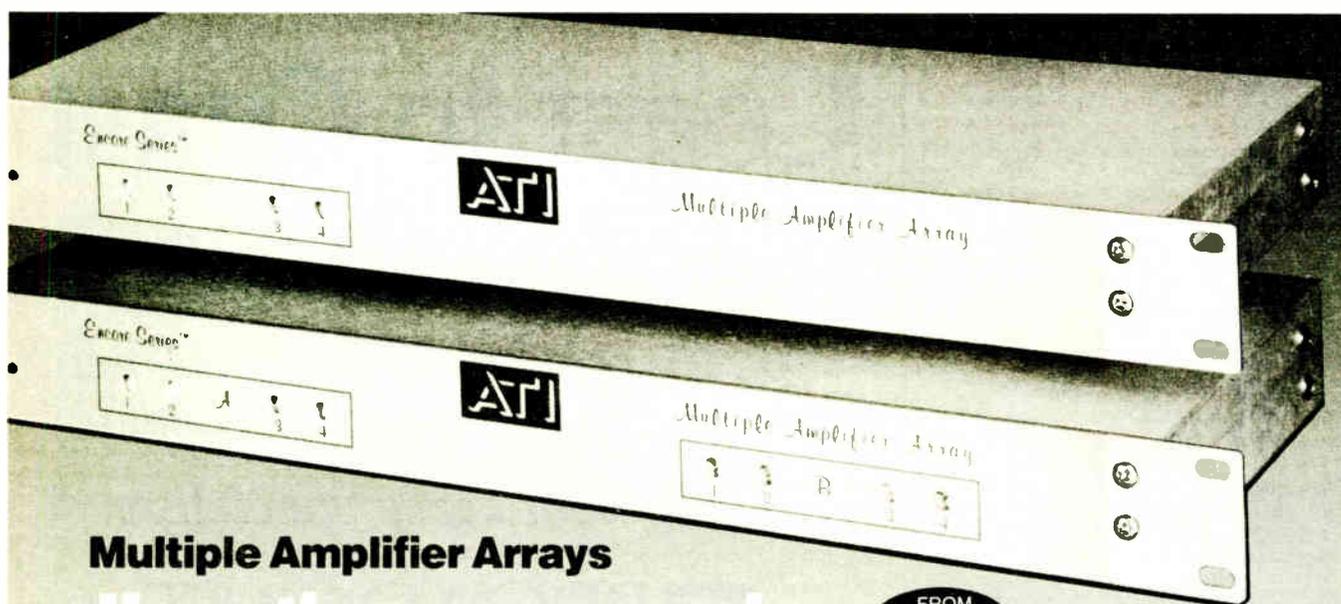
Neither the SBE nor the NAB released the details of the offer, but many SBE members see it as a good

move in light of problems with national SBE shows in recent years.

With its philosophy of spreading the national SBE convention around the country each year, many of the shows in non-geographically central locations were not well attended and lost or made little money. SBE members cited the shows in Denver and Dallas as examples.

At last year's NAB, SBE leadership was criticized for the money losing shows as well as being unresponsive and secretive about SBE matters. Over the last year, the SBE board has worked to dispel its tarnished image by increasing communication with its members. An alliance with NAB on the national show also may warm relations between the board and members, according to members.

Any SBE agreement with NAB will not affect SBE's scheduled national convention in Miami, later this year. As with the 1992 show in San Jose, it will be held jointly with the Radio Television News Directors Association (RTNDA).



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Compression Stacking Harms Audio

► continued from page 1

"What if you change the relationship of the noise floor to the music level?" Squire asked.

The testing, conducted over a period of several weeks, employed a variety of devices and systems common to "real world" conditions in radio today, Squire said.

The devices used in the tests included a Moseley DSP 6000 digital transmission system for studio-transmitter link applications (APT-X compression at 128Kbps per channel); a Corporate Computer Systems CDQ 2000 CODEC for digital phone lines (Musicam, 112Kbps, joint stereo mode

Squire warned broadcasters to avoid data compression in their audio chain.

using Switched 56 telco lines); Sony MZ-1 MiniDisc recorder/player; and a Marantz DD-82 DCC recorder/player.

The signal paths included ABC Radio's Satcom C-5 satellite link (SEDAT, two discrete channels, 128Kbps each) and the network's KU Band VSAT backhaul satellite system (Comstream Version 1, apt-X at 128Kbps).

In the simplest tests, audio was passed through only one compression device. In the worst case scenario, the audio made

two passes through ABC's program and backhaul feeds, twice through a Switched 56 line and was then recorded onto DAT. The DAT was then dubbed to MiniDisc and played back through the STL link to the transmitter. (At this point, Squire joked about giving out motion sickness pills to listeners of the test tapes.)

Real concern

The audible degradation revealed in the tests, coupled with the rapid proliferation of non-compatible data compression devices in radio stations, is causing "real concern" among his broadcast engineering colleagues, Squire said. "I'm hearing some horror stories. We had better put the brake on before we get too embedded in too many things," he warned.

"A lot of broadcast engineers are going to run into problems," Squire continued. "They are going to be on the front line and get the flack when a spot goes on the air and it goes through one step too many. The client hears it and complains that it sounds funny and distorted. They say, 'Why don't you fix your equipment because the commercial sounds horrible.' But you can't do anything. What is there to fix? Everything tests OK by itself."

Many radio stations, without realizing it, may already have "dueling algorithms" in the audio chain, Squire said. Broadcast applications currently using data compression technology include:

- Low bit rate CODECs on digital phone lines
- VSAT KU band backhauls of programs

- Satellite-delivered network programs
- Mass program storage devices
- Floppy disk-based "cart" machines
- Digital audio workstations
- Delay systems for time offsets of network programs
- DCC and MiniDisc recorder/players
- Computerized spot distribution via dial-

up phone lines

- Studio-transmitter links

Squire warned broadcasters to avoid data compression when possible in their audio chain. He also called for creation of a standards committee to deal with these issues. "The scary thing is this is also the basis for DAB," he said. "This can't wait. A lot of serious damage can be done."

□ □ □

Next Issue: An industry response to the issue of "dueling algorithms."

Mobile Demo Canceled

► continued from page 1

system to operate pending special manufacturing of ACT chips.

"They cannot even make it work liked it worked at the other demonstrations—New Orleans in 1992 or Los Angeles earlier this year," Donahue said.

He said that Comlinear/EDI was manufacturing new chips but the process takes longer than if it was a normal production cycle of readily available ICs.

Donahue said it was too bad that the NAB attendees did not get a chance hear USA Digital's IBOC FM demonstration, but he emphasized that it would be demonstrated "as quickly as possible" once the equipment is ready.

Donahue said he did not believe the delay caused by the damage of several prototype chips would set back the system's overall development schedule.

The USA Digital System was discussed extensively in NAB sessions. Proponents of DAB systems, such as AT&T (in-band, adjacent channel), NASA/VOA (satellite), and Eureka-147 DAB (new band) agreed that if the USA Digital System works as promised, it would become very popular.

IBOC Doubts

Representing Eureka-147 DAB, Thomson's Clint Pinkham said: "If the IBOC systems works as well as they say it does, it will be implemented worldwide." However, Pinkham and the other proponents said they don't believe that IBOC

can be as robust as systems with new or additional spectrum.

In another presentation, Comlinear's Dr. William Hunsinger said the USA Digital engineers have made "tremendous progress" in research and development on the IBOC system using the ACT technology, but "there are (extreme) situations where the system will not work yet."

Hunsinger said further research will help the engineers to deal with problems such as extreme multipath.

In other DAB discussion, Donahue confirmed that USDA Digital will likely submit its systems to the National Radio Systems Committee (NRSC) for evaluation.

In late 1992, USA Digital pulled out of the Electronic Industries Association (EIA) Digital Audio Radio Subcommittee testing schedule, claiming that the endeavor did not have the support of the broadcasters and the NAB.

NAB officials said they objected to the EIA testing plan because it did not give enough broadcaster input. NAB said the testing should be handled by the NRSC, a joint standards-making group of the EIA and the NAB. Also, the NAB said broadcasters were not interested in testing of any systems other than in-band.

Because of the broadcaster dissent, the EIA agreed in March to give data evaluation and decision-making responsibilities concerning in-band testing to the NRSC.

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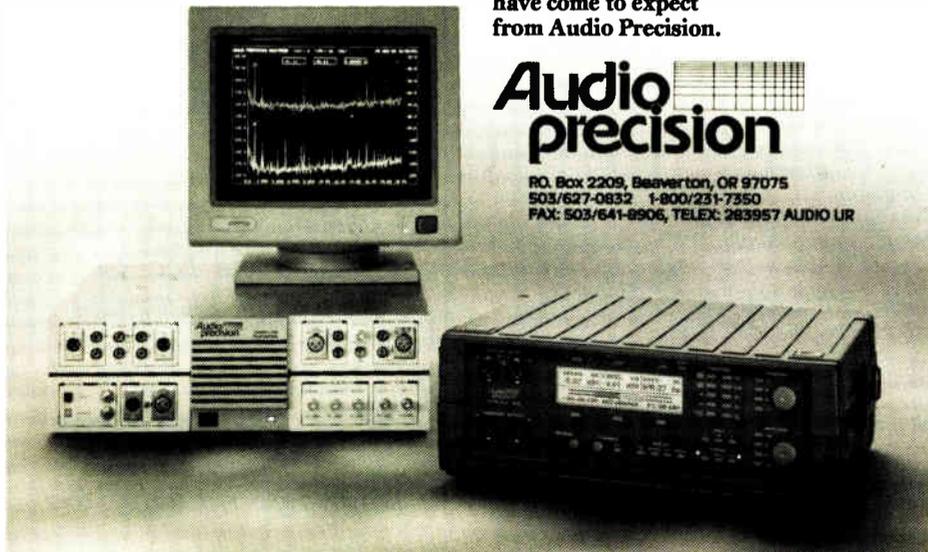
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The Truth About Digital Automation Systems

Part Two

A casual, non technical discussion of the really important stuff that you need to consider before you purchase any kind of digital audio satellite controller, CD automation, live assist system or cart machine replacement system.

Ignorance is not bliss, it's just Ignorance

"What's your price?" We heard it too much at the NAB from too many good people that really should know better. Price is important, but if that's all you're after, then you've set yourself up for the prospect of a real disaster.

Is There Really Any Difference?

If you really think that all digital audio systems are just alike, then you haven't been reading the material you've received, you're getting bad advice from someone, or both. There are vast differences in the operating capabilities of the various digital systems and surprisingly, none of it has anything to do with price. And, there are some low cost systems that are real dogs, and they are not a bargain at any price.

Ask The Questions Or Lose

Are you afraid that you will appear ignorant if you ask questions and do an active comparison of all the available systems? Well, it's true that some vendors *hope* that you feel this way so that you won't expose their obvious weaknesses. Is your sense of pride so inflated that you can absorb the indignity of getting a system that doesn't work or that cost thousands too much just because you're too inhibited to ask the obvious questions and get the complete story? If you won't read, if you won't ask questions, if you aren't interested, then you'll get just about what you deserve. *Caveat Emptor!*

Get the Right Stuff

Do it right. Set some goals. Talk to your staff. Make a plain English wish list. Make it as simple or as complicated as you want. Leave out the computer stuff. You don't need to know it. Remember, this is about broadcasting, and you know a *lot* about that, or if you don't, then you should get an independent non-aligned professional to help you. Set some goals. Decide the minimum that you want to accomplish and then decide what you would really like to do if money weren't a factor. Write it all down and make copies. Then, send your wish list to every vendor that you know about and ask them to respond with a complete Proposal. Only the better system vendors will bother.

The Next Step

After you get your Proposals, make copies and send each one of them to their competitors representative. Ask each vendor to give you a *written* comparison of their proposal versus those of their competitors. Now you'll start learning something. Don't worry about the so-called privacy of the vendor Proposal. It's *not* sacred. Why would it be? Remember, this is *your* money and *your* system and there is no such thing as a *private* Proposal. If the vendor won't let you do this, then there's something badly wrong and you'd better back off that system.

Do Your Homework

Read all the responses and read all the Proposals again. By this time you will have a good sense of who is really capable and who isn't. Start calling the most likely vendors and asking questions. Ignore the BS and cut through to the bottom line about performance and price. Be tough. Compare everything.

Don't Make Assumptions

Don't *assume* that just because you'd like for some feature to be in your system that this feature is automatically in every system that you will examine. Be sure that everything you want is spelled out explicitly in the Proposal. If it's not, and it is a feature that you feel is absolutely necessary, then find out why it is not mentioned. If you don't get a good answer, then run.

References

We all have them, and you should pay attention to them. But remember that a referenced user can only know what their system does, not what other later or more capable systems may do. References are generally useless as a comparative tool, but they do indicate a level of satisfaction with the company itself.

Dumb Reasons to Buy

1. If you buy a system because of *quick* delivery and have to suffer for it for years, is this a *good* deal? It only indicates that the vendor doesn't have enough backlog of good business, or that they are willing to stiff another customer in order to meet your delivery date. Do *you* want to deal with a company like this? Is this a good reason to buy a system from them?
2. Buying a digital system from the old guy you've known for years that works for a large company that sells everything from transmitters to toothpaste and who smiles and says "I'll take care of you", without giving you a solid Proposal and comparative justification, is like flying a kite in a rainstorm. Good luck when you try to get service.
3. Because your competitor has one. (!)
4. Because your spouse likes the color.
5. Because you've been promised a spiff or kickback if you show and reference the system.

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World Radio History

User Fees Loom Over Broadcasters

by Randy Sukow

LAS VEGAS Congressional leaders and staff at the NAB convention had ample opportunity to comment on the budget deficit and various ways broadcasters are likely to help reduce it.

The Clinton Administration seeks to raise about \$4 billion over the next few years through auctioning almost all new assignments, including new broadcast TV and radio stations.

And although it has not yet proposed them, the administration also is eventually expected to seek several million dollars in extra funding for the FCC through new user fees on all FCC licensees.

Little opposition can be expected to either fees or auctions from the minority party. "Most Republicans like the concept of auctions," said Cathy Reid, minority counsel of the House Telecommunications Subcommittee. Republicans are waiting to endorse the Clinton auctions until more details on the proposal are discussed in the coming weeks, she said.

Auction blocks

The Clinton auction plan still faces two major stumbling blocks, including controversy over the administration's decision not to exempt broadcast spectrum from bidding.

Significant Senate support has rallied around an auction bill written by Communications Subcommittee Chairman

Daniel Inouye (D-Hawaii) and Subcommittee Member Ted Stevens (R-Alaska) that would exempt broadcasters and others the administration would include in the process. At least one Communications Subcommittee member, John McCain (R-Ariz.), has expressed



Spectrum-auction and fee questions have been narrowed to "When?" and "How much?," say Capitol Hill staffers. Pictured (l to r): Kristan Van Hook, House Telecommunications Subcommittee; John Windhausen, Senate Communications Subcommittee; Cathy Reid, Telecommunications Subcommittee; Agnes Bundy, Senate Budget Committee; and David Leach, House Energy and Commerce Committee.

doubt that spectrum auctions could pass without such exemptions.

The Inouye-Stevens bill also would limit auctioning to 30 MHz on a trial basis, while the administration would prefer to auction all available spectrum.

A key philosophical point dividing the administration and the Senate bill sponsors

is over the purpose of auctions. The Clinton economic proposals list it as one of many revenue-raising techniques to reduce the budget deficit. Inouye and Stevens see the move as insurance that spectrum will be assigned more quickly and wisely in the future than it was during

cellular telephone allotments. Many FCC critics say cellular service was delayed in the U.S. for several years by the lottery assignment process.

Used for deficit reduction

Deficit reduction is a beneficial byproduct of auctions, bill supporters say. "The lottery has just not worked....There are private auctions going on. Why not have the government hold the auction? You do get some money, but you also get the license more quickly in the hands of the people who are serious about building a system and providing a service to the public," Communications Subcommittee Counsel John Windhausen said.

On the House side, an auction bill has been introduced by Telecommunications Subcommittee member Michael Oxley (R-Ohio) that would not exempt broadcasters in all situations, but does exempt more than the administration.

So far, however, most of the spectrum-auction discussion in the subcommittee has centered around more efficient ways to assign frequencies for new personal communications services (PCS). A subcommittee hearing was held on April 22.

Markey and other leaders of the Telecommunications Subcommittee's parent Energy and Commerce Committee have traditionally been cool to the spectrum-auction approach. At the hearing, Subcommittee Chairman Edward Markey (D-Mass.) questioned whether auctions "represent a step forward for budget policy

and communications policy....I am particularly concerned that in our efforts to maximize revenue, we do not lock up all the spectrum in the vaults of large companies."

But there is a growing acceptance that auctions in some form will eventually be approved. "Our committee has been 'reconciled'—the term we use. We have been directed (by the administration) to enact legislation to raise \$7.2 billion in the next five years, and that's likely to come from auctions" and other sources, Energy and Commerce senior staff member David Leach said.

The fee frame

User fees for FCC licensees will also be likely in the future. The Bush Administration in 1991 and 1992 failed to win Congressional approval of user fees to raise about half the FCC's annual budget (over \$60 million). The Clinton Administration did not include fees in its proposed budget for fiscal year 1994, but it is widely believed that they will be proposed in next year's budget.

The FCC is facing a budgetary crisis, commission staffers said, in large part because of the expenses involved in implementation and enforcement of the 1992 Cable Television Consumer Protection and Competition Act.

The FCC has proposed a 30-cent per subscriber annual fee payment for cablecasters. In addition, some say, there should be a fee levied on "those who the Cable Act benefits," such as TV broadcasters (and radio to a smaller extent) who will reap the benefits of retransmission consent, the FCC's Lauren Belvin said.

The commission's proposal is for a \$12 million supplemental appropriation for fiscal year 1993 to come out of the general treasury and a \$16 million supplemental appropriation for 1994 to come from some other source. "Since fees and forfeitures are the only two mechanisms we have available to us, it will probably be the fee process," said Brian Fontes, chief of staff to interim FCC Chairman Jim Quello.

"I would expect that Congress wants the Cable Act implemented. They intend to give us the resources to carry it out," Mass Media Bureau Chief Roy Stewart said.

"If I have to take people off the processing lines and there are no more sales and renewals and licenses and facilities changes, (then) we're going to have a real dilemma, because the broadcasters are ultimately going to pay the price," Stewart said.

Some conventioners thought that might not be a bad price to pay, especially if it delays FCC approval of more new FM licenses under Docket 80-90.

"If staff were taken off processing new FM allocations, I think that the industry would be no worse off. It would be better off," one NAB official said.

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FCC's Fine Review Plans Revealed

by Randy Sukow

LAS VEGAS High-level FCC staff, appearing in a number of NAB Law & Regulation Conference sessions, added detail to Interim Chairman Jim Quello's pledge to review the commission's fine and forfeiture structure.

While some fines will likely be reduced, the staff said, stations should not assume enforcement will be reduced nor that stations will be let off lightly for certain serious infractions.

Some of the penalties in the commission's latest fine schedule, approved in 1991, are "rather heavy-handed, especially

for smaller radio stations," Quello said during his NAB convention appearance (*RW*, May 12). FCC fines "should remind the licensee of its obligations under the commission's rules and should deter licensees from similar infractions in the future.... They should not be punitive and they should not be disproportionate to the nature of the offense," he said.

A fine misperception?

"We're just trying to inject some rational thinking into the forfeiture process," said Brian Fontes, Quello's chief of staff.

However, Richard Smith, chief of the FCC's Field Operations Bureau (FOB),

disputed the idea that the commission has been unduly harsh in its enforcement.

The perception, Smith said, seems to stem from the increase in individual fines due to the 1991 schedule and to stepped-up efforts by the commission to publicize fines when they are imposed.

Broadcasters should continue to be aware of infractions that could still set them back financially and damage their standing at renewal time, according to Mass Media Bureau Chief Roy Stewart. "The area of LMAs (local marketing agreements) can be a dangerous situation for the licensee that does not act like a licensee," Stewart said. The licensee is

responsible for whatever infractions the lessee of the station may commit.

Stewart also urged stations to take preventative measures to avoid fines, especially for technical violations. He suggested that every station send for a copy of the FOB's inspection checklist "and periodically go through the station as if you were from the field."

Potential safety violations, such as inadequately painted and lighted towers or violations that could create interference to public-emergency vehicles or aircraft, should be checked especially closely during self inspections, Smith said. "Those violations are getting looked at first when our field inspectors go out there, so that might be the first area you take a look at," he said.

As the forfeiture review is carried out, Commissioner Andrew Barrett will be especially interested in maintaining adequate penalties for both safety and equal employment opportunity (EEO) violations, according to Barrett's senior advisor, Robert Bramson.

"If we can give a \$600,000 forfeiture for indecency, perhaps a forfeiture of more than \$20,000 is warranted in the EEO area where you may be denying the opportunity for people to have jobs," Bramson said.

DAB doubletakes

Commission staff also had several comments to follow up Quello's NAB statements on satellite digital audio broadcasting.

"What would be the effect on local radio service if we had 30 to 50 new radio voices from a satellite in every community? It seems we've already flooded the market in the name of competition and diversity," the interim chairman said.

But the staffers unanimously agreed that Quello's statement and FCC policy should not be interpreted as rejection of satellite DAB. In fact, satellite DAB is probably unstoppable, they said.

"I sympathize with terrestrial broadcasters. I have feeling for them. I understand the contribution they make to localism and I understand what the impact of satellite DAB may be on them in terms of fractionalizing audience and revenue," Stewart said. "Having said all that, I don't think the commission can hold up its hand and say, 'This area of technology will not be in the United States.'"

In any case, said John Hollar, legal advisor to Commissioner Ervin Duggan, the FCC is still early in its DAB consideration. Any damage satellite DAB causes terrestrial broadcasters is still speculative and years away, he said.

"I think it's important to keep in mind at this point that the proceeding the commission has opened is simply a spectrum-allocation proceeding that is designed to implement the United States' position at the most recent World Administrative Radio Conference (WARC 1992)," Hollar said. "We also have accepted applications for specific DAB systems, but that particular part of the satellite DAB process is in a very preliminary stage."

Fontes suggested that broadcasters might have already solved the problem of competition from satellite DAB by giving up the effort to secure an L-band (frequencies near 1500 MHz) for the U.S. for terrestrial and satellite DAB as the government was working out its positions for the WARC in fall 1991.

"The bottom line is, we're stuck with an S-band allocation and I'm not sure how effective S-band will be for digital audio broadcasting," Fontes said.



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Studio Sessions



Sony PCM E7700 See p. 21

Equipment and Applications for Radio Production and Recording

Troubleshooting Hum in the Studio

Part I of IV

by Bruce Bartlett
with Jenny Bartlett

ELKHART, Ind. Hum can be a problem in any audio production system. It's caused by all sorts of things: audio cables picking up interference from power lines or lighting, faulty grounding, and improper connections between audio equipment.

Fortunately, you can prevent hum pickup by following good wiring practices. In the next several columns, we'll explain these practices, as well as other techniques to keep your audio clean and hum-free. Providing a secure ground connection to your audio equipment is one way to reduce hum. We'll describe several ways to do this.

If you look at a modern AC outlet, you'll see three holes. The U-shaped hole is the "safety ground" or "power ground." This terminal connects by a long wire to the power company's earth ground: a copper rod driven in the earth, a skyscraper's underground steel structure, or a cold-water pipe.

Many electronic devices have 3-wire power cords; the round ground pin on the cord is connected to the equipment chassis. A "chassis" is a metal housing that surrounds the circuitry in a piece of audio equipment. When you plug a device's 3-prong power cord into an outlet, the chassis of the device is connected to the safety ground.

If a short-circuit accidentally occurs between the chassis and a hot power line, the chassis current will flow to the safety ground rather than through someone touching the chassis, preventing shocks.

Installing a safety ground

Suppose you're doing a remote in a building with older wiring which lacks a third-wire safety ground. For safety, and to reduce potential hum or RFI, you'll probably need to install a safety ground. (Caution: If you're unfamiliar with electrical wiring practices, hire an electrician. Make sure you know what you're doing before you start fooling around inside the circuit-breaker box.)

Be sure to check your local electrical code before doing any AC power wiring. First, look inside the main circuit-breaker box. Inside the box, near the bottom, is a heavy copper plate called the "ground bus bar." All the building's ground wires (bare or green) connect to it. The ground bus bar is connected to earth ground, such as a cold water pipe or a copper rod in the earth.

Also look on your mixing console for the "ground bus," a terminal, plate, or screw connection to the console chassis. Run a No. 4 gauge insulated wire from the mixing-console ground bus to the circuit-breaker ground bus bar. An alternative ground connection is to the metal screw that holds the cover plate to the wall outlet.

Check to see whether the metal screw is actually grounded by connecting a neon

tester between the screw and the outlet sockets. If the tester glows in either of the sockets, the screw is grounded. If not, you can't use it. An audio component other than the mixer might have a ground terminal. If you hear hum

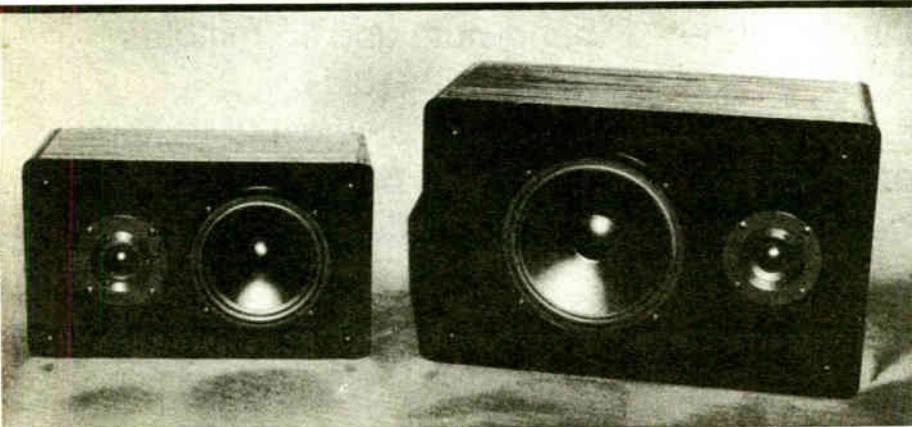
in your system, try connecting this terminal to the safety ground.

Prevent hum in cables

We'll cover grounding in more detail in future columns, but now let's turn our attention to audio cables. They can pick up hum from oscillating fields radiated from power lines in the walls. How does this

continued on page 15 ▶

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World Radio History

The Tape Recorder Arrives in the U.S.

Part II of II
By Frank Beacham

Les Paul, legendary guitarist and inventor, is credited with some of audio's major innovations, including the solid body electric guitar, multitrack tape recording, sound-on-sound, over-dubbing and the electronic echo effect. He was also eyewitness to the events that led to the manufacture of the first commercial tape recorder in America, the Ampex Model 200. During Frank Beacham's interview, Les Paul tells the story of how the 1943 AEG Model K-4 Magnetophon tape recorder from Germany was transformed into the first truly modern 1/4-inch high-fidelity tape machine.

The inventor/guitarist recounted the following story to Mr. Beacham and members of the audience before a recent performance at Fat Tuesday's in New York City.

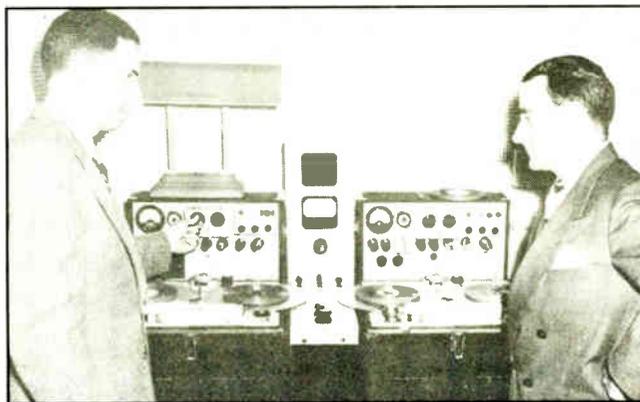
I'll tell you the story of how the tape recorder came to America. I was working with Bing Crosby on the Kraft Music Hall in California and Bing says to me: "You know, I wish there was a way I could do like you do. You have all your (transcription & wire recording equipment) at home and you can record your stuff in your garage. I have to go down to the studio and do everything. I can't play on the golf course. I'd rather do it right at the club house if I could."

It just so happened that Judy Garland and I were doing a broadcast on Sundays in New York City. We had to fly from California to New York, and it took 19 hours. We were playing at 53rd and Broadway and a little old man came up to me, this was about 1945 or 46, and he said his name was Dick Ranger and he had a tape recording machine. He said he picked it up when we invaded Luxembourg in the

big push to end the war (World War II).

This was big news to me. Colonel Ranger said he walked into a radio station and saw this tape machine and grabbed it. It was too big to carry or ship back, so he dismantled it and brought it back to the States piece by piece. Colonel Ranger took this tape machine, it was called a Magnetophon, to Orange, N.J., and put it back together. Then he made a copy of it that he called the Rangertone.

Meanwhile, I go to Bing Crosby and tell him there's a man that nailed me at



Jack Mullin (left) and his radio show producer, Murdo McKensie looking over Ampex Model 200 audio tape recorder and Magnetophon.

53rd and Broadway with a tape machine. I said "That's your guy. You can put that machine right on the golf course and you can record your show from there. Just get your trio to play behind you and there you go." So Bing says find the guy and bring him out here.

I called Colonel Ranger, brought him out to California, and he demonstrated the recorder at KNX, which is CBS out in Hollywood. Bing said "I'll take 50 of them." But Ranger said he could only make one a year. This guy just wasn't a good businessman. Bing says "I want someone who can make 50 of them and I need them now."

Well, there was another guy named Jack Mullin who also had one of the German recorders in his garage but he hadn't put it together yet. Finally, Mullin put his together and took it over to Ampex. The people at Ampex took a look and said let's go with it. But first, they said, they had to have some money...so they went to Bing for the cash. He said "how much do you want?" They said \$50,000. Bing wrote out a check for fifty grand with no interest. He said "I don't want any part of the Ampex company. I don't want anything to do with you guys other than have you deliver me those machines."

And so it was that I worked on the very first broadcast with tape (Bing Crosby Philco Radio Time, 1947). If one of the reels on that machine broke it could have killed five people in the room...it was going so fast. The tape that the Germans were using was made of paper. It was like fly paper. The Germans would just scratch some iron dust on it. Later 3M provided the first version of "Scotch" recording tape to replace that German paper stock.

So that's how the tape machine got to America. It just floated up on our shores and Ampex made a fortune from it.

Let me say one more thing about tape, since I was there from the beginning. Anybody out there who thinks they've got something stored away on tape had better think twice because we don't know how long tape is going to last. It's almost like a (heart) bypass, unless

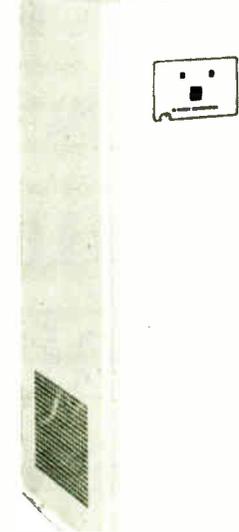
someone stays around long enough to tell us we won't know how long it's going to work.

□ □ □

Editor's Note: The EQ for Jack Mullin's re-designed circuitry of the 1943 Magnetophon became the basis for the NAB curve. The first pair of Ampex Model 200 tape recorders—serial numbers 1 and 2—were delivered to Jack Mullin at the Bing Crosby show in Hollywood in April, 1948 to replace Mullin's original Magnetophons, which were being used to record the Crosby radio show.

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Troubleshooting Hum

► continued from page 13

occur? One type of hum pickup by cables is due to electrostatic interference. Power lines act as one plate of a capacitor, while the conductors in audio cables act as the other plate.

An oscillating electrostatic field is set up between these two plates, causing hum to be transmitted (coupled) from the power lines to the cable conductors. An electrostatic field couples best at high frequencies, and so is heard as a buzz including harmonics of 60 Hz. The conductors can be protected from this electrostatic field by a surrounding shield. Shields must be connected to ground to be effective, because the ground provides a drain path for shield charges caused by the electrostatic fields.

If you connect a metal chassis to ground, the chassis becomes an effective shield against electrostatic hum fields. The greater the shield coverage, the better it rejects hum, so use cable with foil shielding for permanent wiring.

Hum pickup in cables also is caused by magnetic interference. Power lines and transformers also act like electromagnets, radiating magnetic lines of force that oscillate at 60 Hz and its harmonics. These lines of force cut the conductors in audio cables, causing the conductors to generate electricity at 60 Hz and its harmonics. Magnetic fields couple best at low frequencies, and so are usually heard as a low tone at 60 Hz. A magnetic hum field is directional, so you can detect it by rotating the device that is producing hum. If the hum level varies, the hum is magnetically induced. A shield must be made of a magnetic material (steel or mu metal) to block magnetic hum fields. This shield need not be grounded unless you also want to use it for electrostatic shielding.

Avoid using fluorescent lights in the studio because they radiate strong magnetic hum fields. If fluorescent lights can't be removed, be sure the lighting fixtures are grounded, and replace faulty ballasts. Inside each fixture, install a noise filter (available from electronics supply houses). Also avoid SCR dimmers (those that use silicon control rectifiers); they put "hash" and buzzes on the AC line.

No fluorescent lights

Instead, use multi-way incandescent bulbs to vary the studio lighting levels. Power transformers in audio equipment also radiate magnetic hum fields, so install your equipment at least several inches from the large power transformers in power amplifiers.

Power cables and extension cords radiate hum fields that audio cables can pick up. So separate these two types of cables by at least one foot. If they must cross, do so at right angles and space them vertically; this reduces the coupling between cables. Buzzes in on-location work are often caused by interference from stage lighting circuits. Use AC isolation transformers or line filters (available from electronic supply houses). Keep lighting cables and power wiring well away from audio cables. Again, if these cables must cross, cross them at right angles and separate them vertically.

Portions of this article were excerpted from the authors' book, "Practical Recording Techniques." More on hum prevention next time.

(Editor's note: In making this article available, RW assumes that readers working with electrical components are properly trained and utilize the correct tools and equipment.)

□ □ □

Bruce Bartlett is a microphone engineer and technical writer for Crown International. Jenny Bartlett is a technical writer. Bruce can be reached at 219-294-8388.

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World Radio History

DIGITAL DOMAIN

Connecting Inside Your Digital Facility

by Mel Lambert

LAS VEGAS A technical session at this year's NAB Convention provided a useful overview of the ways in which we should connect digital system components.

Titled "Designing a Serial Digital Plant," and chaired by C. Robert Pulson of AVP Communications, the session spotlighted various techniques that we need to consider while implementing an all-digital broadcast facility.

By way of an example, Pulson described the OmniMedia Digital Fiber Highway Network, which provides up to 600 Mbps (megabits per second) of throughput via conventional fiber-optic links. During the convention, such a system, with components from Meret

Impedance mismatches can easily cause reflections and data errors.

Communications and Pesa Switching Systems, were used to interconnect digitized audio and video between various exhibitor booths.

The fact that the system ran flawlessly speaks well of the future potential of such serial interconnect schemes.

Cable types and impedance

Obviously, the extended bandwidth requirement of a digitized NTSC video signal places a high demand on data throughput. (Uncompressed NTSC composite video runs at some 143 Mbps.) But even conventional stereo audio at a sample rate of 44.1 kHz produces some 2.8 Mbps of AES3-compatible information. Without due care and attention to cable types, impedances and good engineering practice, we run the risk of intermittent errors.

As we should all now realize, using normal microphone cable to interconnect workstations, recorders and editing systems is not a good idea. Most audio cable has an impedance of 50-60 ohms; we need to specify 100/110-ohm cable, which is available from several vendors.

Impedance mismatches between source and destinations can easily cause reflections and data errors. It has been estimated that cable runs of at least 1,200 feet are possible via good-quality cable and XLR connectors.

A soon-to-be published appendix to the AES3-1992 Recommended Practice will discuss the alternate use of 75-ohm coax cable and BNC connectors. Although we can expect increased EMI emissions at accidentally unterminated patchbays and so on, there's no denying that coax is better suited to carrying square-wave signals in the megahertz range than twisted-pair connections. (I hear that certain European broadcasters are specifying the use of brown sheathed coax to designate AES-format digital signals.)

Looking at MADI

For multichannel applications, the AES10 Recommended Practice ("MADI") describes a technique for carrying up to 56 channels of AES3-compatible data at sampling frequencies

between 32 and 48 kHz, over a single coaxial cable or fiber-optic link for distances up to 150 feet. In this way, stereo pairs of AES3-format signals can be multiplexed into a serial bitstream and carried via a single 75-ohm coaxial cable. For longer cable runs, maybe up to several miles, larger station might need to consider FDDI (Fiber Distributed Data Interface) connections of the type used to transmit data over conventional local area networks (LANs).

Unlike two-channel AES3 interfaces, MADI runs asynchronously and is accompanied by a dedicated sync signal. MADI also allows varispeed operations. Irrespective of the number of channels being carried or the sampling frequency, MADI transmissions run at a fixed data rate of 125 Mbps. (A four-to-five encoding scheme reduces the data throughput to 100 Mbps.) During varispeed mode, additional data words are added to the bitstream to maintain MADI's fixed throughput rate.

An inexpensive scheme for sending between eight and up to 24 channels of digitized audio from one location to another would be of particular relevance to radio facilities. While AES3 serves our two-channel requirements, MADI might prove overkill (and expensive) for the average station. Also, digital audio data reduction schemes might also be used to reduce serial bandwidth required to carry large amounts of data from between multiple workstations, for example.

A synchronization source

Of equal importance when considering all-digital plants is the use of a common synchronization source. As many RW readers are already aware, AES11 Recommended Practice provides a useful set of guidelines for making sure that components in a digital studio lock together successfully and provide reliable, trouble-free transfer of digital data. If all components in the studio are frequency and phase-locked to the same sync source, then glitch-free transfers between different units should be a breeze.

Also discussed during the technical session were the various sampling rates that stations might encounter, particularly if timecode is involved, or if the project needs to be synchronized now or later to a video/film source. Of the more prevalent sampling frequencies, in addition to the CD-compatible 44.1 kHz rate, what about 44.056 kHz (a digital processor locked to NTSC 29.97 fps/color-time video); 47.952 kHz (audio locked to NTSC video after film-to-video telecine transfer); 48.048 kHz (audio locked to NTSC video before telecine transfer); or 48.000 kHz (digital VTRs, for example, locked to NTSC video and DAT recorders)?

Not forgetting, of course, 50.000 kHz for audio locked to European PAL video after telecine transfer, and 48.048 kHz (for audio locked to European PAL video before telecine transfer).

With so many different rates, thought needs to be paid to providing several assignable sample-rate converters (SFCs) within a medium-size facility to handle these critical transfers. Several firms are now producing cost-effective SFCs, some of which also include digital

format converters and even multichannel mixing. Versatility might prove to be the key to a successful future in the all-digital radio studio.

Also worthy of attention is a potential conflict between digital operating levels. As was pointed out during the NAB session, SOP at most radio facilities is to set a nominal operating level at either +4 or +8 dBu, with a clip point of +24 or +24 dBu, respectively, to provide 20 dB of headroom. In Europe, however, the

EBU Technical Recommendation R66-1992 calls for an alignment level that is 18 dB below clip.

□□□

Mel Lambert has been intimately involved with the production and broadcast industries on both sides of the Atlantic for more than 15 years. Now a principal at Media&Marketing, a consulting service for the professional audio industry, he can be reached at 818-753-9510.

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Sampling In the Studio Using MIDI

Part II of IV

by Al Peterson

NEW MILFORD, Conn. Last month we plugged into the MIDI possibilities of the Yamaha SPX90. For many of you with DSPs on a higher order of complexity (the Yamaha box can only do one effect at a time), I hope it prompted you to drag out the manual to look up what's on the MIDI implementation chart.

But is that all MIDI is good for, going from one echo to another? Not at all.

Remember the initial objective of this dandy datastream was to make music, and that's what we'll be doing this month with a general talk about synthesizers and samplers. Both have their places in the production person's bag of tricks, and there are distinct differences in each that make them special.

Samplers get to go first, as there are more of them out there in one form or another (be it a rackmount Akai, Ensoniq keyboard or the sampler add-on board for the Harmonizer).

Samplers do just what they say; they

"sample" a moment of reality and record it as digital information. The first folks to make it really affordable were Ensoniq with their Mirage DSK sampling keyboard—still a great device if you can find one used. Two guys I admire who use sampling to an art are WQHT New York's Rick Allen (who used to do it by splicing) and Brian James at Tampa's Power Pig.

Stuttering effect

The most obvious use—and the one most overused—is the stutter effect. The same one mentioned in last month's article on the Yamaha SPX90. A word or phrase is loaded into the sampler ("win cash," for instance), and by rapid manipulation of the MIDI keyboard the pitch and speed of the sample is altered as it's played back. Some samplers such as the Roland S10 allow you to reverse the sample, giving added texture to your production.

So is a sampler merely a one-trick pony? Hardly. While it's fun to load a burp or a dog bark to see what happens, music production is where a sampler shines. Since most machines now are polyphonic (they can play more than one note at a time) and multi-timbral (sound more than one instrument at a time), an

being written all the time and can give new life to a keyboard already many months old. Such models include Yamaha's SY line, Korg's phenomenal M1 and WaveStation, Ensoniq's neat SD-1 and almost everything Roland makes.

Also desirable in the radio environment is a minimum of "tweakers," an overabundance of controls designed to tailor a sound from scratch. Frankly, the high-speed demands of the production room dictate sounds ready-to-go, rather than attempting to scale a velocity curve and filter cutoff limits. If you have the time and luxury to create sounds from nothing, by all means go for the big babies with a dial for everything. For the rest of us, a \$49.95 ROM card update will do.

Understand there is a big difference here. With the exception of some hi-priced machines, synths and samplers are not the same thing. You cannot sample with a synthesizer, just as you can't start from zip on a sampler and come up with a killer sound. Both have their own purposes in the scheme of things, and both can co-exist in the radio production studio.

A recommendation

If you're aiming for minimum outlay, here's the rig I recommend: scare up a two year old sampling keyboard you can live with, and MIDI it to an expansion

With the exception of some high-priced machines, synths and samplers are not the same thing.

interchangeable orchestra can be placed right in the production studio. With sample data on diskettes, the sound of a sampler changes every time you slide in a floppy.

Manufacturers and third-parties are coming up with new collections all the time. Four bars of a dance or housemix can be sampled and looped for your station's own rap tune (no splicing, either—the looping occurs inside the sampler). The morning show can use a sampler on-the-fly for punched-in sound effects and creative music tracks live during a show.

Right now there is a very funny radio contest called The Elevator From Hell, where contemporary hits are redone as if by a background music company. While these guys have a lock on the name, someone with a sampler and some string diskettes can accomplish pretty much the same thing. I do a similar contest with my own gear called "Bargain Basement Bagpipes."

Get aggressive with synths

Synthesizers on the other hand, came first. Remember the old Moog units we see on 1960s and 1970s record jackets and the Tomita albums hidden in the production library. My old station WHEN in Syracuse had a MiniMoog for a long time.

Not now. Contemporary synthesizers pack a wallop. Nearly all are multi-timbral and really add an aggressive edge to station production. While you may be tempted to pick out that old Roland D-5 or D-10 from the used rack, synths with "ROM slots" are more desirable as new sounds are

module; basic ally a MIDI synthesizer without the keyboard (you already paid for the one on the sampler). Really good ones include the Roland SC55 Sound Canvas and Yamaha's new TG100, both under 800 bucks.

Aim higher in price and come away with one of the MIDI modules now being made by Emu (the Proteus line), or the expandable Korg Wavestation SR or 03R/W.

If you're looking to modify on a bread and water budget, pop a Roland SCC1 circuit card into your copywriting PC to turn it into a Sound Canvas expansion module. Other cards include Turtle Beach's MultiSound and the Wave Blaster from Creative Labs, among many others.

Smaller and cheaper? OK, there's Yamaha's QY10 and QY20. Both contain drums, lots of voices, an autoarranger and can connect to the MIDI world for maximum versatility. Both are the size of a VHS cassette. No kidding.

Tie everything together and now you've got a terrific little MIDI rig. The sampler will spit back your "win cash" stutter, the expansion module will provide the music tracks and your SPX-90 will be processing and reprocessing your voice. Now, where does all this connect to?

Next month, the role of the sequencer in your studio.

□□□

Al Peterson is Production Director for WLAD/98Q, Danbury CT. In mid-March, Al hosted his second MIDI radio workshop at the Intercollegiate Broadcasters' (IBS) Convention in New York City.

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On the Job Using MIDI

by Al Peterson

MOBILE, Ala. To be a MIDI user for radio production is to be a member of a growing movement of creative pros content with nothing less than the best work possible...even if it means "rolling your own." Two MIDIFIED facilities I've admired in print for awhile have been WABB in Mobile, Alabama and New York's Z-100.

Dave Foxx filled me in on the specifics of his studio at Z-100. "I'm using the Roland D-50 synthesizer, the D-110 MIDI module, and the older MKS-100 sampler. I still have the MSQ-700 sequencer, too," he said.

Does he use the rig often? "Yes, for parody songs on Z-100's morning show. I consider MIDI a necessity, especially when you need to create music tracks which come as close to the original as possible. Right now, I'm using ProTools as my sequencer; this can set up my Harmonizer and reverb right away via Sysex. (System exclusive: a MIDI command that addresses only one make and model of gear to alter parameters. Other boxes in the MIDI chain ignore Sysex information not intended for them).

Chip Maples at WABB has a room overflowing with Roland and Tascam/TEAC MIDI magic, although it's not as busy as it was only two years ago. "Our chief engineer, a musician, saw the value of MIDI for making jingles and music tracks in-house. Song parodies, not so much, since most CDs coming in have instrumental mixes. We use those to do our takeoffs and goofs."

Among Chip's bigger pieces, the Roland S-50 sampler; remarkably handy for storing generic liners and logos when "flying in" parts of a multitrack mix, or for accomplishing the now standard "Headroom" stutter.

How could future MIDI developments help the creative process? Dave Foxx says, "Some kind of interface where MIDI can send a "start" command for a cart machine.

"When I'm dubbing from computer to cart, lag times can vary (Z-100's carts all have a 150 ms fuse) and it's hard to be consistent. I'd like it so I can hit the computer, and once it gets rolling, it will send a MIDI Note On message to fire the cart machine."

Additions to the original MIDI specifications now include MIDI Show Control and MIDI Machine Control, so the possibility of tripping studio gear via MIDI commands is already here. Any equipment manufacturers ready to bang out a "boxx" for the Foxx?

SIGNAL-TO-NOISE

Encountering A Digital Backlash

by Frank Beacham

NEW YORK Are we beginning to see a digital backlash? Evidence that we are entering a season of digital discontent came on day one of NAB during Herb Squire's explosive "Dueling Algorithms" demo at NAB 1993. The test recordings orchestrated by Squire, chief engineer at New York's WQEW (AM)-WQXR-FM, left little doubt that certain combinations of digital compression don't mix well in the audio chain. (See related story on page one, this issue.)

Then we heard several audio equipment manufacturers on the NAB exhibit floor bragging that their particular product did *not* use data compression. One manufacturer who went out of his way to sound a digital alarm was Marvin Caesar, president of Aphex Systems of Sun Valley, Ca., a manufacturer of analog processing equipment.

"This is a very subjective business," Caesar said. "Everybody has his own idea of what sounds good, especially in terms of long term listening. But what it really comes down to is how does the music make you feel. With digital we are finding that the impact, the emotional power of the music, is diminished."

Caesar said the quality of most digital audio systems using a single data compression scheme is "acceptable," but not nearly as good as it can be. Stacking compression scheme upon compression scheme, as is happening in many broadcast stations, is far worse, he said.

"I find it a very positive development that people are starting to listen to the effects of data compression," he said. "Because in doing so they are also hearing the effects of uncompressed digital. Now the people who thought the analog heads were all crazy; that digital was perfect, are understanding there are very specific limitations to digital.

"We are trading off sound quality for lower noise," Caesar said. "The listening world is in major trouble. The public needs to be aware there are costs to digital."

Caesar recommends that radio stations and audio production facilities design production, transmission and receiving methods that minimize "the deleterious effects of data compression." Make sure your audio signal doesn't "get stepped on" in multiple ways by various compression schemes, he said.

Pressure equipment manufacturers using data compression to flag audio that has been compressed, Caesar insisted. "I think people should spend the money to have more data storage and go into that storage media uncompressed. If you can afford the bandwidth, transmit uncompressed. Use a CD jukebox instead of recordable discs that use compression. And scream as loud as you can for an HDTV format with uncompressed audio."

As evidenced from letters received at Aphex, Caesar appears to be expressing the sentiments of a growing number of audio professionals. Suddenly, data compression has snowballed into a major audio issue. No doubt we'll be hearing from both sides of the aisle on this one in coming days.

NAB Goodies: Now the fun part. Prices of audio editing systems, both digital and analog, are dropping like rocks. Check out the new low cost digital multitrack hard disk recorders from Akai and Yamaha. And Roland's new stereo digital audio workstation for PCs is almost unbelievable at \$599!

The analog Fostex GT10 Multimedia Recorder has some intriguing possibilities for audio production on a

affordable. Neumann's new no-compromise TLM 193 studio condenser microphone is priced at under \$1300. Apparently manufacturing costs for the 193 were reduced by offering the new microphone with a single pickup pattern: cardioid.

Shure's portable mixer guru, Michael Pettersen, produced an audio show stopper at NAB. The new and improved Shure FP32A portable mixer is 30db

"With digital we are finding that the impact, the emotional power of the music, is diminished."

Marvin Caesar
Aphex Systems

low budget. It features four-track high speed recording on standard cassettes with Dolby S Noise Reduction, a dedicated timecode track and intelligent MIDI interface. It can be controlled from a PC with Passport's Producer software or with a new hardware controller coming from Fostex. At under \$1,300, the GT10 has some real possibilities as a radio production tool.

Attention microphone connoisseurs! That rich, natural signature sound exclusive to Neumann large diaphragm studio microphones is becoming more

quieter than its predecessor, crammed with new features and so tough it kept on ticking after a 12-foot drop to concrete and being run over by a car. List price is \$1795. Also check out Shure's new super quiet FP22 stereo headphone amp at \$375. This little box is so quiet and clean it can be used for high quality music listening at home.

□ □ □

Frank Beacham is a writer, director, producer and consultant. His address is 163 Amsterdam Ave. #361, New York, NY 10023.



SMARTS POINT-AND-PLAY

We here at SMARTS have just revealed the revolutionary POINT AND PLAY Touchscreen digital audio system. Imagine a simple computer screen that displays the program log on the right side, and all the stuff normally clipped to your board - from weather forecasts to news headlines, on the left. Touch the spot on the screen - it changes color to indicate it's ready to play. Touch another and the same thing happens. Touch the play button to the screen, and the spots play, and are logged on the permanent log. If you want to add a spot, just touch the spot in the alphabetical list, then touch the log where you want it to be - The spot is inserted in the log as easy as that! It's the perfect system for a live station - and interfaces directly to SMARTS and many other popular traffic systems.

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The Politics of Sound Manipulation

by Ty Ford

BALTIMORE You can tell a lot about a person's audio politics by the language they use. Take the issue of fidelity, for example. The central issue of which is whether or not you think it's OK to mess with the audio from the original source.

There are lots of ways to mess with the audio: EQ, clipping, compression, limiting, harmonic processors, hot-rodded bias circuits, tape compression, impedance mismatches, over or underdriven circuits. If you have a problem with changing the shape of the signal, you call it distortion. If you are more open to it, you can split somewhere down the middle.

Maybe you've noticed the "rhubarbing" going on about how appropriate it is to EQ or otherwise process music for airplay. If the issue really was pure fidelity, the argument would be over before the final master mix was ever made.

The EQ debate

Having produced about half a dozen albums and CDs and a bunch of smaller music projects, I must confess (or confirm) that part of the music producer's job is to use the technology to shape the music. This shaping can start as early as making decisions as to which instrument to use. For example, the guitarist may have several acoustic guitars. Typically, a conversation

occurs between the guitarist and the producer as to which guitar will give the best sound for a specific part of the song.

Following that decision, more decisions are made; like which and how many microphones are used and where they are placed, which preamps are used, the reflective and/or absorptive nature of the recording environment. Each and every one of these decisions changes the original sound of the instrument, and obviously the final mix.

So maybe you don't draw the line until the stereo master mix is made. Well fine, but then you really don't want to know anything about what goes on during the mastering process, especially since the advent of digital mastering systems. There is nothing standard about the EQ curves producers use to make master mixes.

If you don't believe me, compare the top twenty CDs on the chart over a quality system. Listen to the overall EQ contour, listen to the difference in brightness and bottom. Note the differences in playback level and dynamic range, which reveal how much limiting and compression have been used. The Sonic Solutions system, on which I mastered a CD recently, is impressively powerful. It allows you to digitally change the level, EQ and dynamics of the whole mix or of any selected portion of the mix.

Much magic goes on here. If you're a faithful-to-the-original sound fanatic, you'll want to burn these systems and their operators at the nearest stake.

Air chain processing

Let's not forget the processing that happens in a station's broadcast sound chain; namely compression, limiting, clipping, bandwidth limiting (which is, of course, mandated by the FCC for AM and FM), and any other EQ or spectral or harmonic enhancement boxes a station might apply. (While you're at it, if you're still adamant that the music should not be messed with, then tell me about your plans to remove tone controls, graphic equalizers, spatial enhancers from all consumer sound systems and boom boxes.)

After all of this perhaps you've guessed that I'm reasonably in favor of a radio station processing music before it hits the air. Especially if the intent is to make the music more consistent so that the processing can handle the music without producing even more badsounding side-effects.

Where I will draw the line is when the audio crosses into the digital domain, or rather how and how many times it crosses the line. To put it bluntly, for the professional market, data reduction is unacceptable. We've already accepted that we need more than 16-bit audio to do any sort of EQ reverb or delay processing in the digital domain, which is another way of saying 16-bit is the absolute minimum for unprocessed transfer of digital audio.

In fact most manufacturers are touting that they already have, or plan to implement 24-bit or higher resolution circuits in response to demands of the industry. Are manufacturers trying to test the envelope by pushing the same data reduction circuits they plan for consumer recording into the professional market? Well they did it with CD players, but that's not the point. After we all got over how quiet the first CDs were, some of us said, "Well they're quiet, but the sound sure has an edge to it."

What do you expect when you ask one D/A converter to switch back and forth between two channels to decode the bitstream. And incidentally, some of those analog output amps were pretty cheesy too. We complained and they changed. Things sounded better.

This time, however, I think we should all complain very loudly so that the manufacturers don't waste their time and our money on products that are guaranteed to hit the wall of science and shatter. Let them make their money on the consumer market. They've been wanting to do that since the first DAT machine hit the streets. Then, invest the profit from consumer sales on R&D to find acceptable increased storage and higher bit rates for the professional market.

□□□

Ty Ford had just returned from the NAB convention as he began to write this article. He's happy to report that his spleen, and those of many engineers he spoke with, are now empty.

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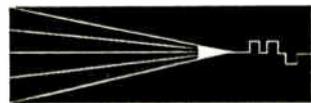
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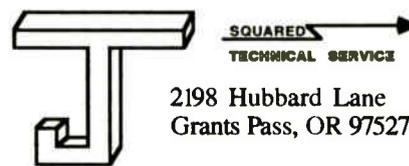
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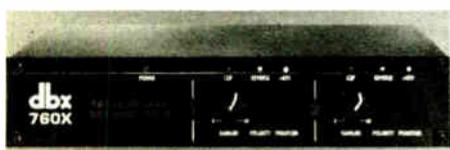
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PRODUCT GUIDE

Companies with new product announcements for Studio Sessions Product Guide should send them to Radio World, C/O Studio Sessions Editor, 5827 Columbia Pike, Suite 310, Falls Church, Va. 22041.



dbx Debuts Mic Preamp, Buffer Amplifier

SAN LEANDRO, Calif. dbx introduced two low-cost studio products at NAB 1993: the dbx 760X dual microphone preamp and the dbx 1024 buffer amp.

The two-channel 760X can be used for direct-to-DAT or sampler recording, field recording as well as a performance upgrade for existing preamp stages. The unit's performance is virtually flat from 20 Hz to 20 kHz, the company said.

The 1024 buffer amplifier is designed to connect equipment that output at different levels, such as studio effects processor to -10 consoles, or consumer tape or CD players to professional consoles.

For more information, contact J.X. Loeb at AKG Acoustics at 510-351-3500; or circle **Reader Service 103**.



Maxell's Pro Studio Tape

FAIRLAWN, N.J. Maxell's professional audio tape lines are intended for the radio production studio as well as music recording facilities.

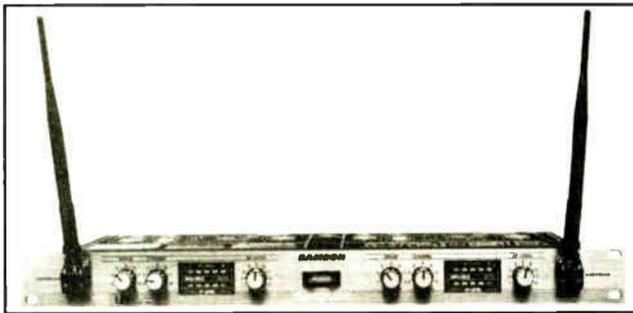
The company is emphasizing the R-120 DM DAT, MS-Studio tape, and the 3/4 inch Digital Audio Mastering Tape lines for the studio.

For more information, contact Maxell at 800-533-2836, or circle **Reader Service 22**.

Samson Wireless Microphone Systems

NEW YORK Samson's new UHF Synth Series wireless microphone system is designed for operation in crowded wireless environments. The LED display shows exactly the amount of RF interference on any given frequency so the user can quickly lock in on a clear frequency. The unit also has dbx noise reduction.

For more information, contact Samson Technologies 516-932-3810, or circle **Reader Service 95**.



JBL 4400A Studio Monitors

NORTHRIDGE, Calif. JBL showed its new 4400A monitor lines at the NAB convention in Las Vegas.

The two-way, eight-inch woofer-based 4408A is ideal for the broadcast control room or smaller recording studio, according to the company. The 4410A is a three-way system with a 10-inch woofer. The 12-inch woofer of the 4412A's three-way system is said to supply extended low frequency output.

For more information, contact Bill Threlkeld at JBL at 818-893-8411; or circle **Reader Service 29**.

Sony Dual Deck DAT Editor

PARK RIDGE, N.J. Among its new line of broadcast products, Sony introduced its PCM-E7700 dual deck DATstation at NAB 1993.

The transportable unit allows digital recording and editing on the go, but eliminates multigeneration degradation of field analog systems. Features include real-time jog, automatic assemble editing from the EDL, and digital cross fade. The product is scheduled for shipment in late 1993.

For more information, contact Sony at 800-635-SONY, or circle **Reader Service 57**.

New 3-M CD-R Media

ST. PAUL, Minn. 3-M now offers 63- and 74-minute recordable CD media that meet the Orange Book Part II standards.

The discs are available in off-the-shelf packaging or customers can "private-label" the discs through 3-M's custom labeling service.

For more information, contact Jim Hoskins at 3-M at 612-736-5019; or circle **Reader Service 182**.



Hafler PRO2400 Amplifier

TEMPE, Ariz. Hafler's PRO2400 studio amplifier is the successor to the well-utilized P230.

The 120-watt per channel (eight ohm) amp features an oversized transformer, J-FET front end, eight Hitachi MOSFETS, and XLR connectors. Specifications include 400 watts mono in bridged mode and 100 db SNR.

For more information, contact Rick Gentry at Hafler Pro at 800-366-1619; or circle **Reader Service 142**.

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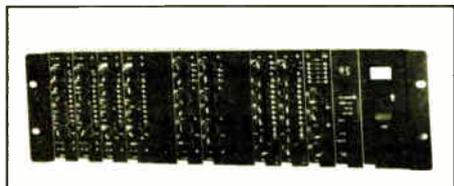


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UREI's New PLATFORM Series

NORTHRIDGE, Calif. UREI's new PLATFORM Series uses a "building block" approach to signal processing that can benefit a production studio, home studio or other applications.

The unit features a series of signal chain electronic cards that tailor it to almost any use. The rack-mountable unit can hold up to eleven stand-alone or computer-controlled modules. Six modules are now available including gate, compressor/expander, parametric equalizer, input/output, and CPU 1 and CPU 2.

For more information, contact Bill Threlkeld at UREI at 818-895-8190; or circle **Reader Service 65**.

Fostex D-10 DAT Recorder

NORWALK, Calif. Engineered for broadcast, post-production and studio applications, Fostex debuted the D-10 DAT recorder at NAB 1993.

The \$2,295 deck offers Auto Cue and Instant Start, SMPTE time code, RAM-based and tape-based Scrub, Auto Rehearse, Auto Record and Jog Shuttle.

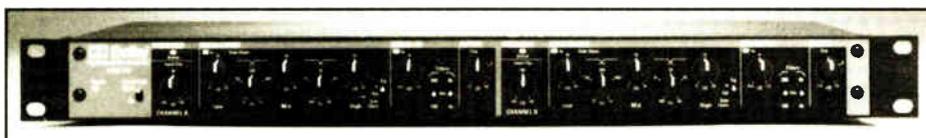
For more information, contact David Oren at Fostex, 310-921-1112, or circle **Reader Service 130**.

Soundcraft LM-1 Portable Mixing Console

NORTHRIDGE, Calif. Unveiled at NAB 1993, Soundcraft's LM-1 location audio mixer can be used for broadcast location recording.

The unit is available in six- to 12-input channels and can be battery powered. Each input features three-band equalization, high pass filter and two AUX sends.

For more information, contact Bill Threlkeld at Soundcraft USA at 818-893-8411; or circle **Reader Service 171**.



New Dolby Product: Spectral Processor

SAN FRANCISCO Dolby's Spectral Processor can be used as a dynamic equalizer for production and post-production "sweetening."

The processor can raise low-level si-

DigiDesign Unveils New Pro Tools 2.0

MENLO PARK, Calif. DigiDesign introduced its latest version of Pro Tools for the Macintosh at NAB 1993.

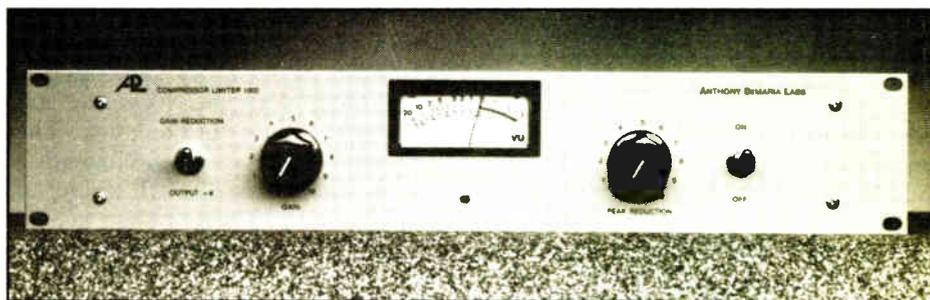
Recording, mixing, signal processing,

gnals as much as 20 dB without affecting the high level signals, according to the company. For noisy program material, you can switch in up to 12 dB of noise reduction.

For more information, contact Kevin Tam at Dolby at 415-558-0200; or circle **Reader Service 40**.

automation, waveform and event editing are now incorporated into the Pro Tools 2.0 program. The software is applicable to radio production, audio for video production, and music recording.

Also available from DigiDesign is the Sample C, a new stereo 16-bit, 32 voice,



ADL 1000 Compressor/Limiter

NEW PALTZ, N.Y. Anthony DeMaria Labs has taken the old UREI LA-2A compressor/limiter design and updated it for studio use.

The tube-based unit, which is being used in a number of recording stu-

dios, large and small, has been upgraded to be "quieter" and with a "fatter" sound than other tube compressors, according to ADL. Each ADL 1000 is hand-built to the customer's specifications.

For more information, contact Anthony DeMaria Labs at 914-255-7229; or circle **Reader Service 4**.

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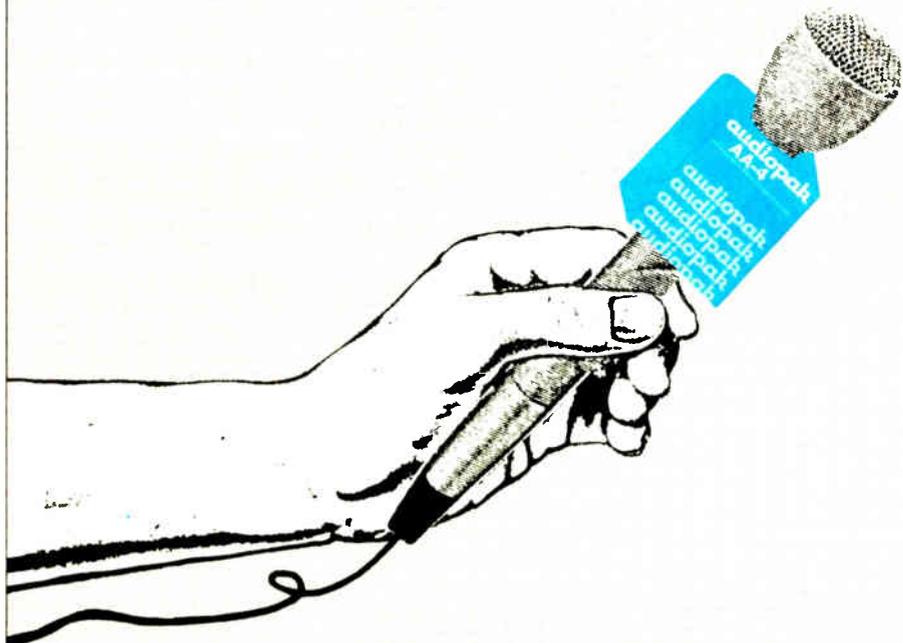
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ACD-5B CARTRIDGE WITH ATS BAR CODE.

The new DN-961FA Drawer-Loading CD Player is Denon's answer to the many broadcasters who *formerly* had to choose between the drawer-type player they needed and the Denon performance they wanted.

Its Eject-Lock during play adds another most-wanted feature to its list of attractions. Meanwhile, the new DN-951FA CD Cart™ Player dramatically improved functionality with its Auto Track Select (ATS) system, which reads bar-coded carts to *lock-in, lock-out* or *auto-cue* to a specific track.

That's not all; three-in-a-rack mounting, true instant start, and end-of-message signals with selectable time-to-end are just a few more key features of these cost-effective new players.

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NAB

convention coverage

'93

Engineers Seek AM/FM Improvement

by Tom McGinley

LAS VEGAS During the AM and FM Improvement engineering session at NAB '93, six papers were presented covering everything from economic solutions to AM antenna problems, new AM and FM digital transmission products, a new digital AM receiver design, optimum FM antenna selection criteria, and the unveiling of NAB's new test CD.

Tom Osenkowsky, a radio engineering consultant, used three case studies to demonstrate that fixing AM directional antennas does not always have to be an expensive ordeal.

Osenkowsky discussed the use of an RF generator and OIB to establish a baseline profile of impedance and bandwidth characteristics for each part of the system at carrier and each 10 kHz sideband.

Evaluation of such data will isolate changes or failures in the system since it was last working properly. It will also help identify bandwidth bottlenecks. Osenkowsky stressed the importance of adjusting common point phase so that a symmetrical load is presented to the plate or combined drains of the final PA, not at the output terminals of the transmitter.

He also noted that in the vast majority of cases, instabilities and breakdowns in DA systems are caused by corroded sample line connectors, burned or corroded coil clips, and bad capacitors which appear okay physically, but test defective.

New NHK transmitter

Japan Broadcasting Company, aka NHK, unveiled a new medium wave radio transmitter design using hybrid modulation. The hybrid scheme uses digitally produced

switching class F modulation, enhanced by an analog component which further reduces distortion. This combination achieves a THD figure of only 0.4 percent at 80 percent modulation, plus overall efficiency of 86 percent.

Previous pulse-width modulation designs attained efficiencies of only about 65 percent. This hybrid configuration incorporates a 12-bit A/D converter and 16-power output switching modules, consisting of four, 150 watt MOSFET devices at the one-kilowatt level. Each of the 16 output modules forms 1/16 of 90 degrees of the modulated output AM waveform.

The analog modulating component is derived through an eight-bit D/A converter. Without the analog smoothing, distortion approaches 5 percent. The 1 kW transmitter is now available in a standard 19-inch rack cabinet. NHK will be adapting this design for higher power versions up to 500 kW.

Amidst all the excitement over digital audio broadcasting, Motorola has introduced a digital-based AM stereo receiver. Sangil Park, a design engineer for Motorola, detailed the architecture of this novel design which is built around the popular DSP-56002 chip. It enables a full digital solution for receive decoding of C-QUAM, which is the de facto world AM stereo standard.

All receiver functions which are programmable are reduced to the single DSP chip, thus dramatically reducing chip size and total component count. DSP allows tailored EQ, noise attenuation, sound effects enhancements, digital stereo, and software solutions for any future improvements. Even front-end tuning is done by the DSP which runs at 33 MHz.

The mixing scheme uses a 450 kHz IF and produces a 25 kHz carrier for both the I and Q carriers. A sampling rate of 100 kHz yields 12-bit linear resolution via the DPLL. Both carriers are demodulated by a digital envelope detector. A frequency compensation stage recovers high frequency response rolled off in the IF to achieve effective audio response out to 9 kHz. The receiver attains stereo separation of better than 30 dB with harmonic distortion under -40 dB.

All-digital FM

For stations pursuing the all-digital FM radio station, consider the Harris digital approach to an FM exciter. Ron Frillman, sales manager of Harris-Allied's broadcast division, unveiled the specifics of the digital exciter which would complete the last link in the console to transmitter, all-digital chain. The unit accepts an AES/EBU digital input and will soon offer an optical converter to handle left, right, and SCA analog audio.

The digitally derived signal process overcomes many of the old analog exciter problems, including instability, micro-

phonics, and limited noise floor. Using a 20 MHz clock, a 32-bit sample is truncated to 16 bits. The final DAC has been the most difficult design challenge, and yields only one-bit resolution with quantizing spurs.

All-digital exciter

The spurs are eliminated through a band-pass filter. Even though the up converter contributes the largest part of the noise floor, the digital exciter achieves operational S/N performance of 92 dB. Measured THD is only 0.004 percent, with stereo separation at 60 dB and AM noise and AM sync noise at -60 dB. Although Frillman did not reveal the A/D sampling rate, he said it would support a composite FM signal.

Karl Lahm, a well-known Washington consulting engineer now working for the Voice of America (VOA), presented a paper studying optimization of FM antenna elevation patterns. The layman's subtitle would read: "How do I choose the best performing FM antenna design for my application?"

Lahm discussed the various considerations affecting this decision including: available transmitter power, available antenna aperture (length), radiation hazard

continued on page 26 ▶

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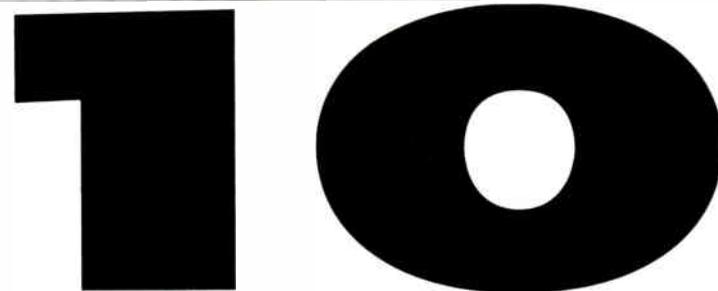


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Circle (144) On Reader Service Card

FAA Yields on Empire State Stripes

by Randy Sukow

LAS VEGAS The Federal Aviation Administration (FAA) apparently will not require the Empire State Building to be painted with orange and white stripes, said broadcast engineering consultant Neil Smith during the NAB convention's "FAA-FCC Workshop" session.

A Smith client operating from a tower at the top of the Empire State received a letter from the FAA recently. The agency had decided "to permit us, under the circumstances, to continue to operate with red sidelights operated 24-

hours a day, just as we have done since 1952," Smith said.

Despite the good news about New York's beloved landmark, the session

The FAA side of the FCC vs. FAA debate failed to show up.

turned out to be a bit of a disappointment. The annual FCC-FAA session is meant to give broadcast engineers and technical consultants the chance to grill

an FAA official on its treatment of broadcasters, which moderator Dane Ericksen of Hammett & Edison Inc., San Francisco, said, "has been outrageous."

Failed to show

Unfortunately, the FAA side of the debate failed to show up. Gerald Markey, chief of the FAA's spectrum engineering division, canceled two days before the session, Ericksen said.

Those who did attend showed some restraint in their FAA attacks since there was no one to respond. In fact, Richard Smith, chief of the FCC's Field

Operations Bureau, said the "cooperation between the two agencies has improved."

The FCC and FAA have long been at odds over issues such as tower placement and illumination and painting, due to overlapping jurisdictions. The most heated battles in recent years have been over a proposed FAA computer model to be used to determine tower-construction approvals.

FCC staff and broadcast engineers claim the model eliminates construction

continued on page 32 ▶

Techniques For AM/FMs

▶ continued from page 25

limitations around the base of the tower (radhaz), surrounding terrain, population density near the antenna, and cost and practicality of the element feeder system.

With half- and 3/4-wave spaced element antennas becoming quite popular because of radhaz limits, there are now many combinations of power, number of elements, and spacings available for any given ERP requirement. The downward radiation pattern (energy not directed at the horizon), may cause radhaz problems but can also cause antenna induced multipath distortion zones in the first or second null areas.

According to Lahm, one of the most important considerations often overlooked when selecting an FM antenna design is not only controlling the "grading lobe" (straight down) radiation for radhaz, but also controlling where the nulls fall. Pop counts should be done to determine where the nulls can be placed and/or filled in to avoid having them cause heavy multipath in high population areas.

The new and improved version of the NAB's Test Signal CD was given an impressive overview by John Bisset of Multiphase Consulting. The new CD full of specialized test signals has been under development since late 1991 and incorporates many of the suggestions received by users of the first version.

The most significant change was lowering the output level of all tracks from zero dBm to -15 dBm which produces a more typical source line level for console outputs of +4 dBm. Noteworthy tracks include: (1) enhanced flutter calibration tones for DIN (3.0 kHz) and NAB (3.15 kHz) standards. (2) stereo IMD test tones for L+R and L-R IMD measurements. (3) A 400 Hz out of phase tone to check mod monitor linearity. (4) A quick sweep track of 20 Hz to 20 kHz tones for instant response checking on an oscilloscope. (5) A 4.5 kHz left channel-only tone to enable precise FM transmitter tuning for minimum AM sync noise while monitoring a 67 kHz SCA demodulator. (6) Slot tone tracks of 3.25 and 10.25 kHz for linearity testing. (7) "Soft burst" tones of 140, 700, and 3150 Hz for use in conjunction with a Potomac Quantaural 100 to measure processing artifacts. (8) A complete series of reference tones and sweeps for cartridge and reel tape machine alignment.

Included is the new "DB" test signal which is a multiplex of pink noise and 15 kHz for precise azimuth adjustment.

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Tom McGinley is director of engineering at Cook Inlet Radio Partners and technical advisor to RW.

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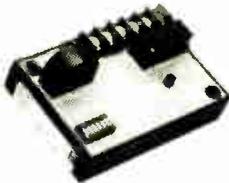
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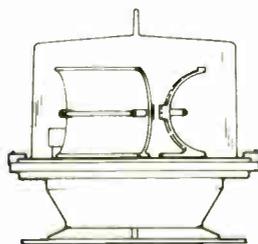
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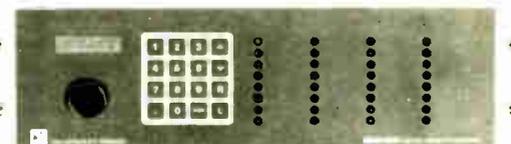
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READER SERVICE NO. 49

International Companies Target U.S. Market

by Alan Carter

LAS VEGAS The potential of the U.S. broadcasting market continues to attract manufacturers and distributors from the international arena.

The 1993 National Association of Broadcasters (NAB) convention and exhibition brought many companies that are well-known throughout Europe.

Making an aggressive move into the U.S. market is **AEQ**, which recently opened a new division, **AEQ America**. Headquarters are in Tempe, Ariz., where Gerardo Vargas, formerly of Circuit Research Labs, is director.

Vargas said the Arizona operations will support and supply the full **AEQ** line of consoles, frequency extenders, digital telephone hybrids, distribution amps and audio monitors.

AEQ America will cover the U.S., Canada, Latin America and South America to Brazil. Brazil and countries south will be covered by an office to be opened in Buenos Aires, Argentina.

To the U.S.

Among those ready to test the market stateside is U.K.-based distributor **HHB Communications**, which was at NAB for the first time. A leading pro audio distributor, **HHB** products will be distributed in the U.S. through a new company called **Independent Audio** that is headquartered in Portland, Maine.

The range will include such products as the Cedar DC-1 De-Clicker for restoring sound in CD remastering; the HHB CDR-1 indexer for translating start ID markers from a DAT source to corresponding CD-R increment flags; HHB digital audio tape; and the SCM 100 A active studio monitor.

Sandar, a high-end manufacturer of audio, video and broadband routing products from Norway, promoted its audio distribution amplifiers. In particular, **Sandar** highlighted the ADA-850 dual audio distribution amplifier for radio with features including: dual 1 to 12 ADA; transformer balanced inputs; 10 x 80 ohm and 2 x 600 ohm electronic balanced outputs; gain adjustable from -4 dB to +10 dB; and up to 20 cards in **Sandar** 2360 3RU multipurpose.

Neutrik from Liechtenstein, which has a U.S. operation in Lakewood, N.J., exhibited the new A2 audio measurement system, designed as a comprehensive system for all areas of professional measurement.

Ghielmetti of Switzerland displayed its line of analog and digital jackfields, and **Gotham Cable** also of Switzerland, with distribution by **DGS Pro Audio** in Arlington, Texas, showed its range of audio cables and accessories.

Transmission equipment

In the area of transmission, **Elenos** of Italy showed a full range of new FM

equipment including a SF series of amplifiers based on MOSFET solid-state technology. **Elenos** is distributed in the states by Renato Carpeggiani in Plymouth, Mass.

AEV of Italy introduced new FM products including the "Exclusive FM" processor in which the processing parameters are controlled on each of the 10 bands.

CTE of Italy offer a range of new transmitting equipment ranging from a new 250 W radio transmitter to 1.5 W and 6 W UHF studio links.

CTE also showed the new automation

equipment and **Thomson-CSF** with medium wave and shortwave gear from France were at NAB, as well as U.K.-based **Marconi**, which has offices in Reston, Va.

Svetlana of St. Petersburg, Russia, promoted its line of power grid and modulator electron tubes in the U.S. and has opened offices in Huntsville, Ala.

RDS worldwide

And looking aggressively on the developing RDS market in the U.S., which is behind the development of that in Europe,

were **Teli** of Sweden, and **VG Electronics** of the U.K. European companies already in the U.S. with an eye on this market include **RE Technology** of Denmark and **Rohde & Schwarz** of Germany.

Audio Processing Technology (APT) of Northern Ireland, which operates in the U.S. from California, promoted the codec systems and the apt-X processing technology the company



CTE manufactures the Audiomatic control system.

system, the Audiomatic, designed as a digital stereo recording and broadcasting system for up to 10 hours of jingles, advertising and programming.

TEM, another Italian transmitting manufacturer, offers a complete range of radio and television gear including FM exciters, encoders, translators, amplifiers and transmitters.

DB Elettronica of Italy also promoted its range of FM transmitting products including transmitters and amplifiers.

Itelco from Italy also was represented by its transmitter line, along with **Sira**, which presented an array of antenna systems for both radio and television.

And although they did not have a booth, representatives of **RVR** from Italy were on the exhibit floor.

Itame of Spain promoted its line of FM equipment from the Supergalaxy series, Galaxy series and range of associated accessories.

Both **Thomson-LGT** with FM transmit-

developed.

Dalet of France also demonstrated its computer network system designed for radio that works on Windows 3.

Others on the exhibit floor included **Penny and Giles** of the U.K. that has offices in California to promote its line of controllers; **Soundcraft** of the U.K. that has offices in California to promote its line of consoles; and **Pro-Bel** of the U.K. that has offices in Georgia to promote its line of test and monitoring equipment.

Augan from the Netherlands showed the 408-OMX optical recorder/editor, a multi-track digital audio editing system that uses removable optical disks for storage.

From Canada, **International Data-casting** exhibited a range of satellite interface and transmission products. **France Telecom** promoted its services in satellite radio distribution, digital distribution, point-to-point distribution and satellite news gathering services for radio.



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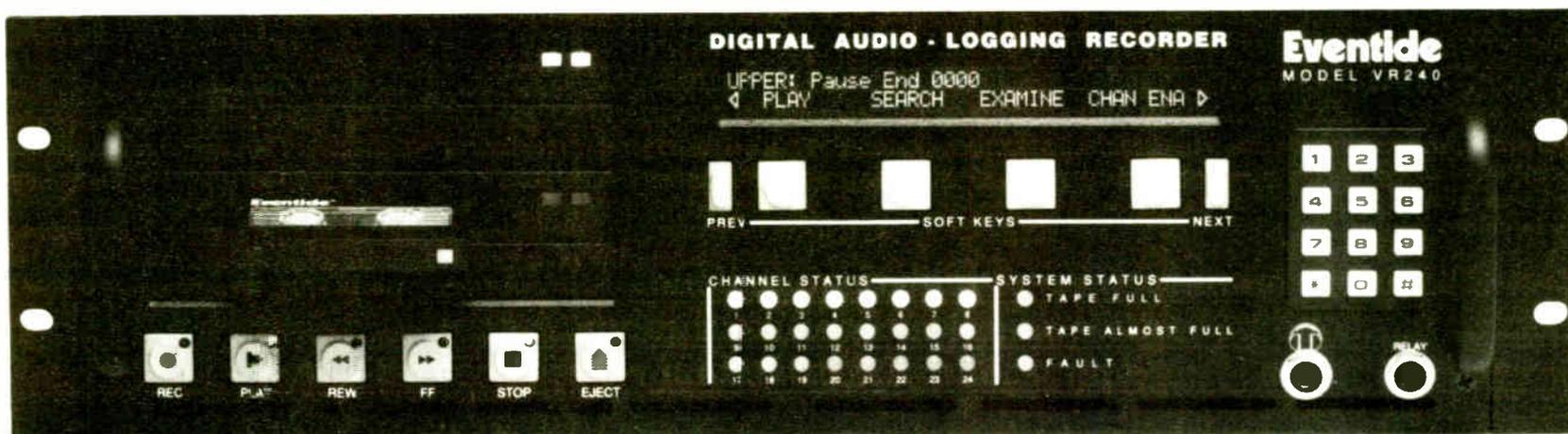


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Circle (209) On Reader Service Card

World Radio History

Coordination Makes Good RF Neighbors

by Edwin Bukont

LAS VEGAS A panel of engineering professionals addressed RF interference during a session scheduled on SBE Day at the NAB convention. Coverage included interference caused and received by broadcast equipment.

Interference may occur wherever we share power, real estate and RF spectrum. This article focuses on two areas covered in the session.

The first area concerns the proper use of radio auxiliary spectrum for RPU and STL links. Richard Rudman, chairman of

the SBE National Frequency Task Force and a broadcast engineer spoke on frequency coordination. Rudman described the main ingredient of frequency coordination as "good manners."

No station, group or network owns any channel in the broadcast auxiliary service. Because of the unique nature of Part 74 licenses, Rudman said, "Coordination is a do-it-yourself project." Manners and laws require that local users have priority; first on-air has priority, and on-air program delivery has priority over coordination and camera-tally use.

Rudman advised that TV and ENG users, who use RPU heavily for non-program purposes, might consider using business-band services instead.

Use diplomacy

Good diplomacy, good engineering practices and constant dialogue with other users are the basics of avoiding interference. The FCC encourages the role of a local frequency coordinator and in many communities this is done by the local SBE chapter. Planning, review and inspection of RPU and STL systems was covered by Paul Montoya of Broadcast Services of Denver, and by George Whitaker of Practical Radio Communications in Arlington, Tex.

Montoya also covered alternative means of connecting with remote venues. Whitaker showed several examples of how new or modification construction may cause RF path and reception problems. He advised that careful record keeping can provide data for comparison of operating conditions when a problem arises and may quickly reveal a problem's source, thus shortening the time and expense of correction.

The second area of concern is dealing with your neighbors, either at the studio or near the transmitter. Birken Olson of Current Technology in Richardson, Tex., addressed grounding considerations in the sensitive electronics environment.

Electrical ground is the path in a circuit

at which there is zero voltage potential and is a reference for the creation of voltages and signals. The ground path also used to drain away undesired voltages. Each device's ground is tied to the common circuit which is terminated in an earth ground. Earth represents the reference between all users of electrical power. Unfortunately, proper grounding is often overlooked.

Tenants who receive utility service from the building core, should be aware that electrical code minimums are not adequate for proper grounding. Currents flowing in a ground path may be two-three times higher than that carried by the electrical branch service.

Good grounds

The ground circuit must be built to withstand these currents. Resistance, in the form of corrosion, undersized wire or connection to unsuitable materials such as building steel and plumbing will corrupt the ground. Resistance will cause a voltage potential to develop between your equipment and earth ground. At the very least, this will corrupt the flow of digital signals which recognize the difference between ground and a positive voltage to read "1"s and "0"s.

Shields on audio cables and equipment cases may prevent noise but rather will act as an antenna if they do not readily find ground. If the ground is missing entirely, there can be enough voltage difference to cause equipment damage and injury or death to personnel. Most equipment today identifies the ground connection point by an inverted triangle surrounding a lightning bolt or ground symbol.

Stan Salek, P.E. at Hammett & Edison in San Francisco, talked about resolving broadcast-related interference to consumer electronics equipment. Salek cautioned that your responsibility is

only to assist in identifying causes of interference and advising on corrective action.

In no case, Salek emphasized, should station personnel or contractors disconnect, adjust or modify a resident's equipment. Local and federal legislation require that properly licensed and bonded personnel perform such services. To do such work at a resident's premises can expose the station to litigation. You may elect to provide replacement equip-

ment, but leave the connection work to the resident. Keep records of contacts with residents and be sure you have the owner's written authorization before examining the premises.

Do-it-themselves

Various snap-together chokes, coils and plug-in filters are available at Radio Shack and other stores. These can be installed by the homeowner or a contractor hired by him. In more severe cases, the choke may have to be installed within the device. You may supply the materials, but allow the resident to perform or hire someone to have the work done.

It is often as important where you put the filter as what filter you use. Install filters as close to the affected device as possible. Of course, not all problems are related to your transmitter site. When garage door and VCR remotes or the cordless phone don't work, look for the obvious. Are the batteries and antenna good? Is the power supply plugged in? Was the item recently dropped?

Richard Smith of the FCC spoke on getting help from the FCC on interference problems. The FCC publishes many guides to interference resolution and complaints can be addressed to your nearest FCC field office.

Consulting engineer Karl Lahm spoke about MW reradiation from simple vertical structures' such as water towers, signs and other structures that may exist near your AM array and cause unintentional shifts in your pattern which may be reflected in your monitor point readings.



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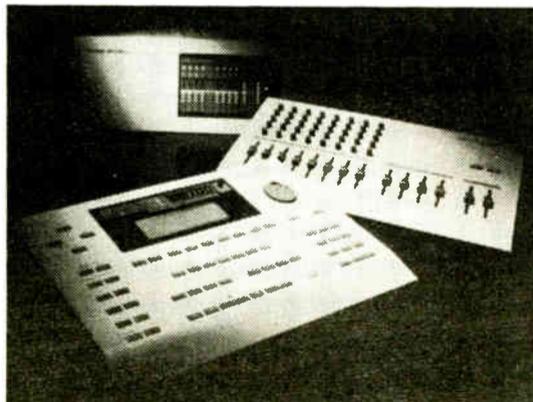
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The Obstacles to Standardization

by Dee McVicker

LAS VEGAS Several guest speakers during the NAB session "Broadcast Standards: Roadblocks or Guideposts" named AM stereo as an example of how not to set a standard.

Included in that consensus was Lawrence Eads of the FCC's Mass Media Bureau, Audio Division. Stated Eads, "Because there was a strong belief in the industry that the commission wouldn't decide a standard, the changes in the commission's decision created such acute uncertainty that it contributed to extensive delays and had a very negative effect." Given that process, he said, "I would count it a failure."

Eads then went on to comment on the recent decree by Congress to select an AM stereo standard. "I think it will be a whole lot easier to adopt a standard at this point given the direction the industry has taken," he stated during the six-speaker session, which was organized by IEEE to represent points of view in television, radio, manufacturing and consumer industries.

Speaker Al Resnick of Capital Cities/ABC, New York, also commented on the upcoming selection of an AM stereo standard. "The best choice might be a proponentless system, a system that no proponent had advanced simply because they don't have the intellectual property rights on the system—one that would have the features of the best of all of the systems," Resnick said.

In closing, Resnick urged broadcasters to push for effective digital standards, citing variances in equipment sample rates and DAB as two examples of digital standard disparities facing broadcasters today.

Similar arguments for digital standards were expressed by other speakers during the session in hopes of preventing another AM stereo failure from happening to DAB and AM and FM stations now utilizing digital products.

"We have a lot of things before us," said Joseph Donahue of Thompson Consumer Electronics, who was a member of the RCA team that developed standards for the first TV picture tubes and brought to the session the consumer manufacturer's point of view.

DAB, DCC and multimedia are just a few of the issues facing broadcasters, he said.

Speaker Larry Thorpe of Sony, who has been an active member of several technology groups for setting standards, stated that the convergence of broadcasting with other industries such as the computer industry will require compromise and "the recognition of reality."

But just as pressing, Thorpe said, is the need for more engineering participation in standards-making. "Look what's happening in our broadcast industry today. The end users were always so well represented by some fine engineering teams from the broadcast networks, with a sprinkling from the rest of the broadcast community. No longer true."

Speaker David Fibush of Tektronix Inc., who is a member of SMPTE and along with Thorpe offered a manufacturer's point of view, also pressed for engineer participation and invited session attendees to get involved in the process.

"I think we all agree that standards are important for the industry," he said. "Standards are the guideposts and the lack

of standards are the roadblocks," said Carl Girod of the Public Broadcasting System (PBS) of Alexandria, Va., who brought the television broadcaster's point of view to the session.

Eads wrapped up the session's formal presentations by clarifying the FCC's position on standards-making. "We really don't develop standards, we adopt them," he stated.

Furthermore, he said, "The commission is underfunded. We can't do our own research so we depend almost entirely on the industry to provide us with the information that we need to adopt appropriate standards."

After the presentations, speakers were again called to the microphone, and several panelists were added to the panel for the discussion that followed. Among the additional panelists were Gerald Berman with Voice of America, Isaac Blonder of Blonder Tongue, and George Hanover with the Electronic Industries Association (EIA).

Discussions kicked off with questions posed by Dane Ericksen of Hammett & Edison, who inquired about the next step for in-band DAB. Eads responded with, "I think the next step from the commission point of view would be either a petition for rulemaking or a request for notice of inquiry."

Hanover also responded to the question, stating, "I would imagine the next step may be, as far as the FCC is concerned, a request for notice of inquiry or petition for rulemaking. But within the EIA and NAB there are other next steps, which will be very helpful to the FCC long before the NOIs or anything else happens."

AM stereo also was brought up in the panel discussion when one attendee posed the question of proprietary system royalties, and whether or not foregoing royalties on systems would have resolved the lack of a standard sooner.

The panel closed with a discussion on the urgency to test and implement bit-rate coding standards, a topic of importance to both radio and television broadcasters with the advent of digital radio and multimedia.



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Listening for the Right Equation

by Dee McVicker

LAS VEGAS NAB attendees got an earful at the session on digital audio systems when speaker Herb Squire, engineer for WQEW(AM)-WQXR-FM New York played a Johann Sebastian Bach concerto through several digital compression algorithms.

Words like "harsh" and "motion sickness" were used to describe the result, prompting one attendee to take exception to the tests. The attendee, whose company manufactures ISO/MPEG (International Standards Organization's Motion Picture Experts Group) equipment, argued that the demonstration was not an accurate representation of cascading algorithms because one link in the chain did not follow the ISO recommended data rate.

Squire countered that the demonstration was based on "real-world broadcast conditions in a commercial radio environment," the reason for the tests and his primary objective in conducting them.

Squire's presentation, "Duelling Algorithms: A Real World Test of Multiple Digital Compression Treatments of Audio by Different Devices," subjected attendees to a series of recordings as referenced to a master DAT recording.

Listening for flaws

The audience was told to listen for sonic impairments, which graduated in intensity with each new codec added to the audio chain.

Six recordings in all were played back to those in the crowded session, with the final recording the result of at least 10 codec systems through the audio chain. Codec systems used in the demonstration included apt-X, AC-2, ISO/MPEG Layer II, and SEDAT.

Applications included telco lines, KU-band satellite, ABC network feed, microwave STL, and MiniDisc with equipment typically running at 128kbps (kilobits per second) data rates. The only exception, according to Squire, was an ISO/MPEG Layer II codec unit for Switched 56 telco lines, which ran at 112kbps joint stereo.

Although tests conducted by ISO and CCIR do not recommend running ISO/MPEG layer II at this reduced data rate, as pointed out by one attendee, Squire said he was nonetheless forced to use this data speed because "that's the real world of switched 56 telephone lines."

According to the results of the listening tests conducted by Squire, at least nine audio artifacts were produced by lining up algorithms through the audio chain.

The first audible artifact, Squire noted, was loss of stereo image, then high-frequency smearing. Other artifacts as they appear in order of severity included a veiling—or muffled—effect of overall sound, low frequency flutter on sustained notes, intermodulation distortion on some vocals, brittleness, whistles or birdies, swishing background noises, and chirping.

Other factors

Before playing back the recordings, Squire warned that cascading algorithms also could be affected by other considerations not demonstrated in his recordings. He included preprocessing, post processing, limited bandwidth, and hum or noise

from analog sources as potential problems that could further aggravate cascading effects of codec and further degrade the audio.

Moreover, he stated in his talk, it is very difficult to test all possible combinations of codec equipment and applications now available to broadcasters. "The combinations and permutations of all these equipment hookups is approaching infinity," he said.

Squire named a few applications where codec might be used in radio stations today, including telco lines, KU-band, satellite delivery networks, mass storage on computer, floppy disk-based cart machines, digital workstations, STLs and delay systems for time alternate programming.

The issue of digital compression in the audio chain was also discussed by the session's two other guest speakers: Tom Lookabaugh of Compression Labs Inc., who covered the ISO/MPEG algorithm standard, and Dr. Richard C. Cabot of Audio Precision, who covered performance assessment of digital audio. Lookabaugh gave a brief tutorial and

update of the ISO/MPEG algorithm and Cabot spoke of a new measuring technique to predict the results of subjective listening tests for digital equipment.

The new demand for digital products, Cabot said, has shifted focus to testing techniques "that will simulate music and allow

the user to avoid having to set up a listening test for every possible combination."

New measuring technique

The new technique suggested by Cabot and his company entails applying multiple sine waves simultaneously to the device or system being tested. By applying this technique to digital equipment,

Cabot said, "we can look at what the device does in response to the signal. We can also look at the distortion products caused by intermodulation between various signals and harmonics of the signals."

The technique, he summarized, "gives you a quick way of getting some answers."

When asked by one of the attendees if he had conducted tests of the cascading effects of algorithms, Cabot replied, "I've done a little bit of experimenting with

We're at a cusp in terms of the development of video and audio transmission. The cusp is the change to digital.

Tom Lookabaugh
Compression Labs Inc.

passing signals through one of these encoder/decoder systems, recording onto RDAT, passing it through again. And there is definite digital degradation, (which) appears to be much worse in cross systems than if you use a single system."

Cabot surmised that the reason audio worsens through mixed codec systems is most likely due to the different masking techniques used by the various algorithms. "I don't know if that's due to the differences in how they split up the frequency band, and the fact that they don't exactly overlap and, therefore, more errors are made in deciding whether a product will be audible or not audible," he offered.

In his presentation, Lookabaugh warned session attendees of the effects of cascading algorithms in an audio chain, and the importance of standardizing. "We're at a cusp in terms of the development of video and audio transmission. The cusp is the change to digital," Lookabaugh said. "We're going to see what happens the next 20 to 30 years in this country and in the world with how we interoperate internally within broadcasting."

"Standards like ISO/MPEG," he concluded in his presentation, "are critically important in this application."

FAA Spares Empire State

► continued from page 26

of towers that any experienced, reasonable engineer would say could never create interference to aviation spectrum users.

Over the past year, Richard Smith said, FCC and FAA staff have been meeting monthly to discuss individual cases and ways to improve the FAA's computer model.

More favorable

Individual contacts to the FAA have been more favorable recently as well, Neil Smith said. He appealed one recent client's tower construction permit, turned down due to potential interference, and won a reversal with a few small conditions. "It was an extremely reasonable response.... That is something that has been lacking in the past," he said.

But Richard Smith was pessimistic about the chances that the computer-model conflict will be settled soon. The key problem is the FAA's refusal to submit the model to a traditional government rulemaking procedure, which the FAA claims it does not have to do because of its public-safety mandate, he said. "I really don't believe we're going to get closure on this issue until that happens."

Ray Benedict, communications manager for Group W Broadcasting, said it is time for the Congress to step in. "The interference issues, I think, should be firmly mandated by Congress as being in the FCC's area. That's where the expertise is," he said.

At the same time, there are responsibilities now being handled by the FCC that could be transferred to the FAA. What is needed, Benedict said, is an act redefining each agency's role. "We see in the FAA what happens when an agency that doesn't have the expertise gets involved," he said.

The Empire State story, Neil Smith said, started several years ago after several radio and TV stations left the tower to broadcast from the new World Trade

Center. One of the remaining Empire State tenants then applied to the FCC for a facilities change—a reduction in tower height—and filed the required FAA notification.

"It was some time later that it was discovered that (the FAA) in so acknowledging, checked the box on the form that (the building) has to be painted orange and white," Smith said. "This produced some consternation. The Empire State management and the landmark commission didn't think that was a good idea."

FAA regulations had apparently never been amended to exempt such landmarks. Neil Smith's conclusion: "It's not just the interference problems that

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Sympathy for the Standard Setters

by Edwin Bukont

LAS VEGAS What makes it possible for a CD stamped in 1982 to play today and to continue playing tomorrow? In a word, your investment is protected by standards.

However, we often criticize the cost of maintaining "broadcast standards." An excellent session at NAB '93, coordinated by the IEEE Broadcast Technology Society, addressed the "Why, How and When?" of broadcast standards.

While we have all heard of ANSI standards, the American National Standards Institute (ANSI) does not create standards but oversees the activities of standards development organizations (SDOs) such as IEEE, AES, EIA, SMPTE and others to be sure that 'due process' is observed.

George Hanover of the Electronic Industries Association (EIA), which provides consumer electronic standards, outlined the reasons for standards. He emphasized that the intent of standards is to protect businesses and consumers by ensuring that competing products are compatible wherever possible.

The standards determining process, Hanover said, "can be confusing and frustrating while simultaneously being creative and democratic."

Defining a standard

Standards must not be so brief as to be ambiguous nor so detailed as to be onerous. A standard must address "the short term needs of today and have long term value tomorrow...(but) too much flexibility can cause discontinuity and a lack of implementation," Hanover said.

The characteristics of a proposed standard must be analyzed to separate generic from proprietary qualities. SDOs frown on standards that introduce patented technology into the interface with the outside world. If a patented system becomes a standard, its application must be done either without compensation or under reasonable terms that do not restrict competi-

tion. A standard should allow enough product variation to encourage improvement and provide a forum for product comparison that reduces consumer confusion.

ANSI serves as the 'watchdog' as competing standards are gathered, presented to industry and the public for comment, revised and voted upon to obtain a final proposed standard for submission to appropriate agencies.

A deeper look into the "how" was provided by Ken Davies of the Society of Motion Picture and Television Engineers. "Standards," Davies said, "define the common language of program exchange...allowing for quick yet complex assembly of flexible systems...for reliable delivery of signals."

Some variation is tolerable as it allows the program provider to choose the quality best suited to their needs.

The cost and delays of standards development are offset by economies of scale in the manufacturer of compatible products. Standards may be arrived at by several paths: de facto standards—reliance on compatibility with a particular brand such as "MS-DOS compatible"; the "golden rule"—he who has the gold, makes the

rules as in David Sarnoff's demand for a change in the FM band during the 1940s; Darwinism or survival of the fittest—while there are many mics and small mixers, certain models are considered "standard" equipment in field production.

Carrot and stick approach

Standards compliance is considered 'voluntary' but is often enforced by government (FCC) or international cooperation (CCIR). In private industry, Davies said, "it's enforced by the carrot and stick approach, join or be left out of new products."

Davies noted that standards require constant education and maintenance to ensure compatibility. Standards may be withdrawn or updated as technology changes. Davies also stressed that the process relies on consensus, not unanimity.

Almon Clegg, a consultant who has served the industry in many capacities, described two experiences with standards development. In 1982, the IEEE, responding to the demands of new technology, began a ten-year project (due process takes time) that resulted in the February 1992 release of an updated standard for "VU" meters. Originally con-

ceived in 1936 by Bell Labs and the major networks, and last updated in 1958, the 'VU' was a means for measurement of program levels where studios and distribution circuits met.

The new standard describes two meters—a SVI (Standard Volume Indicator) that is similar to the previous VU meter and a new PPM (Peak Program Meter) to monitor peak levels which are important in analog to digital conversion.

A hot topic on the NAB floor was RDS (Radio Data System) which began ten years ago in Europe. Clegg described the three-year evolution of European CENELEC RDS into the U.S. RBDS (Radio Broadcast Data System) that was completed in January of this year. The process began at NAB Radio '90 and involved the participation of 45 to 75 individuals including manufacturers, broadcasters and other advisers.

While European RDS is designed only for FM delivery, the U.S. RBDS must eventually accommodate delivery via AM broadcast as well. Clegg emphasized that RBDS is a data delivery standard, not a standard for broadcast transmission. Reaching a successful standard by consensus in such a short period of time was achieved because of industry wide participation, effective working groups and ready support from the EIA and the NAB, Clegg said.

Audio-Computer Links

by Ty Ford

LAS VEGAS Audio people who missed some of the engineering sessions held on the first day of the NAB show missed the real action.

Although not every paper presented was riveting, the discussions concerning the emergence of cross-country and station-wide digital networks and the use of data compression to increase the efficiency of existing digital storage systems provided valuable insight to the problems and promises of digital audio.

One of the most enlightening papers

was Herb Squire's, titled "Dueling Algorithms." Squire augmented his presentation by playing audio that had undergone processing by a series of different data reduction algorithms. (For a full account of this session, see Frank Beacham's story on page 1.)

Squire also noted that, "artifacts from these algorithms are more obvious on smaller speakers than on larger monitors. The problems that you don't hear on the big studio monitors are a lot more apparent on smaller system. Low playback levels also reveal more artifacts. And this is at 112 Kbps. Imagine what AM DAB, which will use 96 Kbps will sound like?"

Replacing carts at CBS

Greg Coppa of CBS TV Engineering in New York gave a paper titled "Digital Audio Workstation Network: A Replacement for Carts at CBS." Coppa said the automated digital audio network now in use by the network, DAWN (Digital Audio Workstation Network) is a large-scale automated PC-based system that manages up to four thousand electronic "carts," provides automated record and playback, and handles billing, production orders and royalties accounting.

There is very little paper usage because copy appears on the system's screens for the announcers. Another of the system's screens is configured to resemble the familiar wall of carts found in most studios. This scrollable electronic cart wall shows three columns of carts and information about each one. Other features include automatic purges of outdated copy and recordings.

A file server acts as a central distribution point for all parts of the DAWN system. Eight dial-up phone lines allow access to the server. The system uses 386 PC/AT-compatible PCs running Novell network software and Digigram PCX3 digital system board recording at 48 kHz 16 bits, that provides real-time data compression using MUSICAM or WB48

algorithms.

DAWN audio files require 1MB for thirty seconds of stereo. Remote modem transfers to the file server require ten minutes for thirty seconds of stereo. These files are sent at 19.2Kbps. The system uses 200Mb Winchester hard drives for storage. System redundancy is provided by mirrored drives in the file server so you can continue to work if part of the system goes down.

A new mindset

Hank Lam of Roland Pro Audio filled the gap caused by the cancellation of one of the scheduled speakers. He suggested that operators, "Must develop a new mindset" and warned that old ways of thinking will "act as a restraint, especially if you continue to think analog."

In the Sunday afternoon sessions, Rick Fritsch from KBCQ in Lawton, Okla., described the PC-based automation and digital storage networking system from Systemation in Decatur, Ill. The system holds 400 mono minutes of audio that can be configured as up to two thousand tracks. Regular backup takes two-and-a-half hours. Fritsch also uses Norton Utilities to optimize the hard drives. Before investing in any of the digital automation and mass storage systems, he recommends getting references from users.

Bruce Bartlett from Crown directed listeners to look closely at their applications. He also provided insight as to how the design and features of some of the systems might best be applied.

Eugene Novacek of Enco highlighted the benefits of their DAD486X digital audio cart replacement system, which uses a 486 50 MHz PC and Dolby 480S as part of a low cost single-channel system.

In a related event, a series of focus groups conducted by the Brand organization asked radio engineers to determine which of the many cart replacement technologies, if any, they preferred. Because the study was privately funded, the results have not been publicly divulged.

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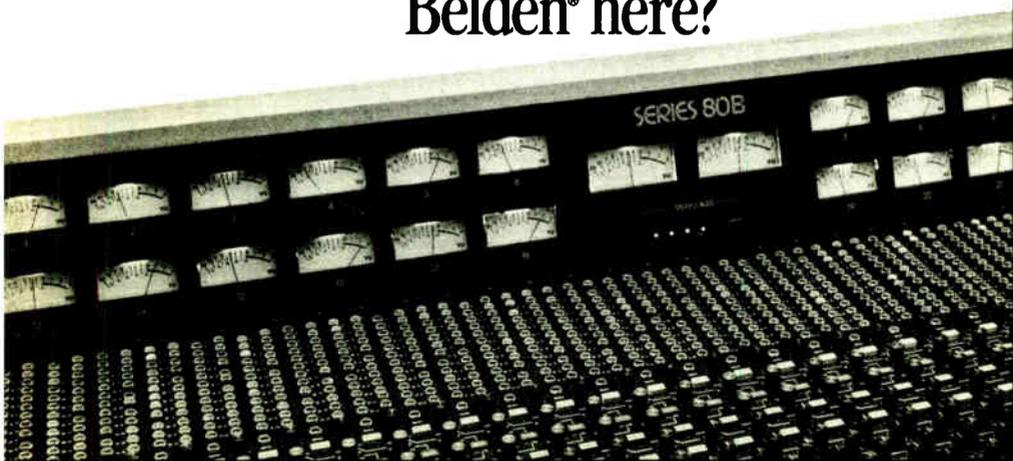
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Audio Consoles Enter the Digital Age

by John Bisset

LAS VEGAS Digital consoles are here. Sony Corp. unveiled a full line of digital audio products at this year's NAB, including the DMX-S6000. In addition to true digital signal processing, the console provides audio snapshot automation as well as fader automation.

Yamaha displayed the DMC-1000 digital console, which not only provides fader level automation, but automates all channel parameters. It is a 22-input console with ten buses and is designed to interface with the company's DRU-8 digital recorder.

Traditional excitement

Digital wasn't the only excitement. Many of the more traditional console manufacturers unveiled new models or refinements as well.

Pacific Recorders & Engineering Corp. showed a number of support items, such as line selectors, DA's and the new program-select switcher.

Ram Broadcast displayed the modular SS-9200 on-air console with two mix-minus buses and a built-in intercom. New for Ram was the AA-9400 on-air console with four output buses.

Harrison's AP-100 permits any channel to be set-up for either mic or line level. It features three seven-input preselectors for plenty of remote capacity. To the right of the console is a presettable count-up-down timer.

Radio Systems RS-Series consoles were displayed with several timer and clock options. These consoles are available in six-, 12-, 18- and 24-channel versions, and sport a two year warranty.

Wheatstone demonstrated the new A-300 featuring a small footprint and low profile to conserve studio space. This model has been designed with no dedicated slots to permit module placement any-

where in the console. Laser-trimmed components are used. The 12-channel version runs about \$14,000.

Small is beautiful

Neat things come in small packages too. Autogram displayed the new Mini-Mix-8 with improved slide faders. The new faders are longer, giving a more professional feel. The Mini-Mix is ideal for satellite-formatted stations requiring a basic eight-channel mixer.

Arrakis showed its new 12,000-TURBO series consoles. Using a mainframe design, these consoles differ from the standard Arrakis boards in that the fader/mixing channels are modular. This console also adopted a "universal bus" design,

meaning any module can be placed in any position. The console mainframes support eight, 18 or 28 module channels.

LPB displayed a sleek-yet-rugged version of a slide-pot console. The Series 7000 is priced to compete with the Wheatstone, Audioarts and Radio Systems consoles. The 12-channel, 24-input, three-bus console lists for under \$7,000. Rugged has always been this company's middle name, though their designs were more functional than pretty. This console captures both, with a low profile and LED-indicator pushbuttons that are double supported to prevent damage from heavy handed jocks.

If banning drinks in the studio has been difficult to enforce, look into Logitek's Mariner. When this board was first released a few years ago, the layout of the PC boards to insure a moisture barrier made for some very difficult maintenance. The Logitek redesign greatly simplified the module while not compromising on its water shedding ability. The Mariner has four mixing buses plus a cue bus that can be used for IFB/talkback.

This series console had one other unique feature—module identification labels on the overbridge. Too many consoles leave little, if any, room for labeling module inputs. Logitek provides wide plastic-protected strips for this purpose. Since they are located on the overbridge, changing modules means no relabeling.

On-air mixing

Fidelipac Corp. introduced the Dynamax MX Series of consoles, designed for more cost-effective on-air mixing. Consoles are available in six-, eight-, 10- and 12-channel configurations.

The MR-40, a four-track/on-air console was introduced by Audioarts Engineering. It features four- and two-track bus assigns, three-band EQ and an on-air monitor section.

In response to the increasing number of local marketing agreements and satellite-formatted stations, Auditorics displayed its Destiny 2000. This console is designed to operate under computer control, as an interactive console using live talent with commercials and music automated, or as a manual console. This console will communicate via internal computers, with both jukeboxes or standalone hard disk storage systems.

One of the more interesting twists to this year's NAB is how the offshore market is expanding into this country. U.S. broadcasters are being viewed as fair game by companies manufacturing consoles in other countries. This includes Studer, which showed its 961/962 on-air consoles, and Soundcraft, whose new SAC-2000 combines a multitude of features into a smart, compact console design with generous module widths and an uncluttered layout.

Ward-Beck's Renaissance series is designed for live-assist and features a very sleek, low profile. It comes in eight-, 16- or 24-input versions. The eight-channel version costs less than \$8,000.

For more expensive tastes, Neve offers its Series 55 broadcast consoles. These boards have more features than you could

imagine, including 10 output buses.

Of all the international fare displayed at the show, the BC-500 from AEQ in Madrid, showed the best value. Here is a four-mono input, six-stereo input console with three output buses, a talkback system and a phone hybrid control module for \$4,000. This console is not for everyone, but if you're on a very tight budget, give this console a closer look. U.S. manufacturers of broadcast gear should keep their eye on this company. Not only do they build consoles, but DA's, digital telephone hybrids and a host of other ancillary equipment.

Remote gear

For remote broadcasts, the Automatic Mixing Controller from Sound Design, San Francisco, is designed to improve the performance of multi-mic live sound systems. Eight VCA channels patch into any mixer's input channel insertion points.

The controller uses a patented stepless gain limiting system, which means that under ambient noise conditions, all mics are attenuated to equal the gain of one normal mic. When one person speaks, the other mics are attenuated and only his mike runs at normal gain. If another person speaks, the gain shifts instantly to that mic. If two people speak at once, each mic is attenuated 3dB to give a consistent output.

The demo, using mics and headphones on the crowded NAB floor, showed how simple field mic arrangement can be. If you do remotes, contact Dan Dugan at Sound Design for more information on the Automatic Mixing Controller.

Broadcast Electronics returned its established line of consoles with a convenient improvement to its AIR TRAK 90 model, a new LED source-select, bus-select switch.

New audio mixing models were also introduced by Neotek Corp., Chicago, and GML Inc., Van Nuys, Calif.

Murphy Studio Furniture, Spring Valley, Calif., introduced the STEALTH SERIES, designed in production and on-air configurations digital audio studios. The name is taken from the furniture's characteristics, which resemble the design of the Stealth fighter.

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Plentiful Test Gear To Satisfy the Feds

by Barry Mishkind

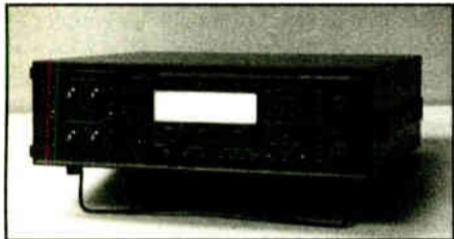
LAS VEGAS In the 1980s, new terms kept popping up into the lives of broadcast engineers: OSHA, EPA, RF exposure, NRSC-I and II and more. Deregulation reduced much of the paperwork burden, but ensuring the station operation is within legal limits is not always easy.

The new test gear at the 1993 NAB convention was directed toward making it easier to stay legal. Increased FCC fines have whetted interest in ensuring compliance with EBS and tower-lighting regulations as well as accurate remote transmitter readings.

Gorman-Redlich's new portable EBS monitor is a cost-effective way to confirm reception and action on EBS tests and activations. With modern telephone remote control units, an alert message can be put on the air from almost anywhere.

Potomac Instruments displayed two new products designed to provide peace of mind over two areas of concern. The 1750-TLM monitors tower lights and reports "good" or "bad" indications. It can send an alarm if there is even a single bulb failure on a circuit containing beacons or obstruction lights.

The new PI 1730-AC deals with digital



Audio Precision's audio test system

remote control systems tracking exponential meters, such as the power meter on most transmitters. After calibration at 100 percent, one popular transmitter's power output meter can read over 107 percent while the remote reading is 104 percent. PI's analog computer eliminates such tracking problems.

For stations wanting even more accuracy in power measurements, the new **Dielectric** model 7000 series Calorimeter is available, complete with remote options including an RS-232 interface.

Modulation monitoring is always a hot item with program directors wanting to squeeze out that last one percent of modulation, while the engineer fights to stay within limits. The growth of radio data system (RDS) installations adds yet another component to be shoehorned into the modulation packet.

TFT has added RDS monitoring as an option to its model 884 FM Mod Monitor. TFT also showed a new Model 923 AM Mod Monitor, listing for less than \$1,000.

Inovonics' new model 530 modulation analyzer allows accurate display of the various modulation components. Based on the Sentinel Audio Analyzer, the 530 has eight station presets for instant comparison of stations in the market.

Belar Electronics Labs showed several new monitors and analyzers, including "The Wizard" for both AM and FM stations, which stores and reports on the

station's modulation so the engineer can easily analyze the modulation package. Software for the PC allows graphic display of the peaks, average modulation and other characteristics.

For checking the entire audio chain, **Audio Precision** upgraded their Portable One Plus test system, added a GPIB interface and packaged it in a rack mount. The ATS-1 Audio Test System is designed to run an automated test suite and also be easy to use for manual testing.

Amber Electro Design's new model 7000 is another test set designed as a complete system for automated or manual testing. Built around an 80386 computer, the 7000 is complete with a screen and Windows software. Both systems are capable of generating hard copy printouts of the measurements.

A more compact, yet automated audio test generator was shown by **Schmid Telecommunication**. The Siat-Max can run up to 16 pre-programmed test sequences, yet is simple enough that a field reporter can handle it.

For digital signals, **CRL Labs** displayed its new DAA-50 digital audio analyzer. The hand-held unit identifies the signal format and various checks on the data itself.

Information on RF/electromagnetic radiation has become important on several fronts. EPA, OSHA and local authorities often require stations to protect workers and public by knowing where "hot" spots are located. **Holiday Industries** specializes in field meters to verify compliance with the various laws.

Of course, when sending a climber up a tower, those RF fields can be impossible to avoid. When several stations share a tower, it can be very difficult to get everyone to cooperate and lower the power for worker safety. **Doty-Moore RF Services** has come up with an effective answer with the NAPTEX suit. A climber wearing NAPTEX fibers can work his way past multiple 100 kW FM emitters or even a five megawatt UHF station without exceeding 0.1 mW/cm² inside his suit.

Tektronix and **Delta Electronics** both showed established lines of stereo monitors. Tek also introduced the new TAS 400 series of analog scopes for bandwidths of 60 to 200 MHz.

The NASA-1000A, introduced by **Avcom**, combines spectrum and network analyzing in one unit. **Eventide** returned its VR240 logger to NAB, which records a station's signal (or competitor's) on 24 channels to store 252 hours on a single DAT cassette.

Among the companies exhibiting digital input measurement systems were **Wohler Technologies** and **Dorough Electronics**. Both read AES/EBU standard data.

Modulation Sciences again featured its established ModMinder modulation analyzer, StereoMaxx spectral image processor and other units. **ESE**, El Segundo, Calif., showed its extensive line of audio tests systems, including its PC-compatible family of products. **Rohde & Schwartz** showed its established microwave and spectrum analyzers.



Bring your station into the 90's with CAT-LINK—the digital STL/TSL.

"It's a dream system—we get specs like the microwave wasn't even there. CAT-LINK has completely eliminated the STL delay."

Jeff Andrew, WGCI-FM, Chicago

"CAT-LINK solved all our problems in 4 minutes—2 minutes to install each end. Performance has been impeccable."

Paul Christensen, WIVY-FM, Jacksonville, FL

"CAT-LINK makes money for us, and it improves the sound of the station."

Mike Callaghan, KIIS-FM, Los Angeles CA

"CAT-LINK has held up through extreme heat, a hostile RF environment and nasty summer lightning storms."

Dick Byrd, WZGC-FM, Atlanta GA

Two-way multi-channel communications

CAT-LINK digitizes the entire composite signal with no data compression, so you can run the stereo generator and processing at the studio, where they really belong. At the same time, CAT-LINK sends and receives up to four customized auxiliary channels with no crosstalk—SCAs, control channels, voice communications, RS232 data, AM audio, transmitter readings and satellite or remote program feeds. What's more, CAT-LINK gives you extra capabilities like transmitter building surveillance via closed circuit TV and an analog telemetry channel.

Transparent digital transmission

CAT-LINK encodes the fully processed composite signal, then decodes it at the transmitter. You always get full stereo separation, without the phase or amplitude variations that plague two-channel STLs. Dynamic range is up to 84 dB, and your processed composite signal can use virtually all of it. You hear clear, clean, undistorted audio—all the time.

No audible delays

CAT-LINK's real-time digital encode/decode process doesn't introduce audible delays as data compression can. Jocks can monitor on-air without problems.

Flexible signal path options

• 23 GHz

Stations across the country are avoiding 950 MHz problems by using 23 GHz with CAT-LINK. They've stopped worrying about frequency congestion and interference, repeater-induced signal degradation, and fresnel zone clearance fading. 23 GHz dish sizes also reduce wind loading and tower space requirements.

• DS1 (T1) Data Line

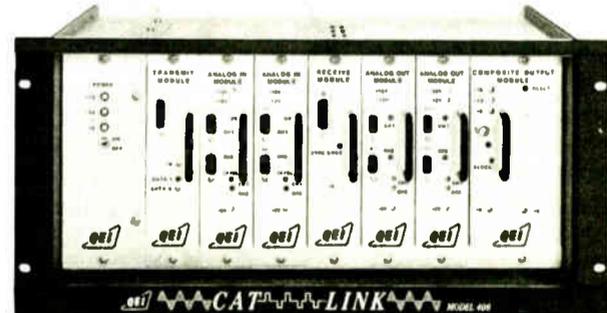
CAT-LINK is cutting phone bills for stations that don't have a clear microwave path. With CAT-LINK, a single bidirectional DS1 line replaces multiple Class A telco lines, providing multi-channel STL and TSL over the same link. Already available virtually anywhere, DS1 service is getting cheaper every day.

• Fiber Optic

CAT-LINK and its optional fiber optic modem provide direct connection to discrete fiber.

• Twisted Pair

CAT-LINK will drive up to 5000 feet of twisted pair wire without repeaters. Four wires provide full two-way multi-channel capabilities.



Turn the weak link in your signal chain into one of the strongest.

Call QEI toll-free at 800-334-9154 for more information on CAT-LINK—the digital STL/TSL for the 90's...and beyond.

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Circle (90) On Reader Service Card

New DAWs Offer More Features; Lower Cost

by Edwin Bukont

LAS VEGAS As noted in the RW NAB preview issue, the legions of digital audio workstations, and their features, continue to grow. In many cases, prices have decreased or offer more standard features than a similarly priced unit last year. While there were many new products, the emphasis was on refinement and improvement of existing products, a second generation of DAWs in which products are now offered in specific radio, audio, video or multimedia packages whose standard offerings reflect the actual needs of the user.

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Digital F/X'S **WaveFrame DCS** (Digital Compact Studio) was displayed at the Digital F/X exhibit and MultiMedia World to show off the many configurations possible. Real-time I/O of eight or 16 channels is standard and can be expanded beyond in eight-channel increments.

Assignable by track

Waveform editing is now available and assignable by track which takes maximum advantage of processing power. In addition to existing audio recording-mixing-equalization-editing functions, and many analog, sync and digital I/O ports, the system now supports magneto-optical storage, time compression, a general-purpose interface for machine control and up to 14 SCSI devices. The WaveFrame DCS files adhere to the emerging Open Media Framework (OMF) standard for file sharing between digital workstations. Typical pricing of broadcast configuration is under \$20,000 including computer hardware.

Micro Technology Unlimited displayed the MicroEditor 2.1 version of software for their Windows-based MicroSound workstation. Version 2.1 greatly enhances the ability to interface with other studio systems such as video sync, SMPTE code, ADR, outboard effects devices and LANs.

Within the next two months, MTU plans to release versions 2.12 and 2.13 which will offer four channel I/O and more on-board effects. A version with noise removal is also targeted for late summer release. Systems with broadcast features range in price from \$7,500 to \$11,000

With radio in mind

German-owned **Corporate Computer Systems (CCS) Europe** traveled to Las Vegas with its PACE, the PC-based digital audio editing system introduced at the March Audio Engineering Society exhibition in Berlin. The company claims the system is geared especially for radio studios and newsrooms. It employs MUSICAM compression to save PC memory while losing no audio quality. Among the features are five independent effects processors on a single PC card and an eight-channel mixing card.

Digidesign has begun offering a line of products tailored to radio production, the Session 8 and Session 8/XL with balanced audio I/O. These streamlined products replace various video and film functions found in the larger, popular Pro Tools with functions necessary for radio production such as eight real-time channels, a simple machine interface, remote control and use on either a PC/Windows or Macintosh platform. All this at the broadcast friendly price of \$6,000, not including the recommended 486 PC.

Studer Revox premiered the DYAXIS II and MultiMix 1.2 software for Macintosh that has already begun shipping. The system offers eight to 48 channels of digital audio, automatic transfer of EDL files and Macintosh System 7 software. A new "Plug and Play" option allows recording, editing and playback directly from optical media without time consuming back-up and restore routines. Enhanced real-time mixing and audio processing options include digital overdub and direct recording of on-screen mixer settings. A basic system for radio production, without

computer, costs \$28,950.

Spectral Synthesis displayed its new product, the PRISMA 12-track digital audio system which will begin shipping this summer. Based upon their AudioEngine series of DAWs, the Prisma card uses a 24-bit DSP and appropriate A/D interfaces to run under Windows using one slot in an ISA bus compatible computer.

The system includes recording, mixing, equalization, editing, on-board effects and external effects routing. Direct connection to other digital audio products and converters is supported as are magneto-optical and SCSI drives. Pricing is not yet available.

AKG displayed its continually evolving 486-based product, the DSE 7000 which is now shipping with version 3.0/3.5 software. New tape-style transport functions include 80-120 percent vari-speed, 2X and 0.5X speed listening, enhanced cueing, autolocator and punch in/out functions. Enhanced functions allow you to save favorite settings for use in future productions and do word-processor like editing and file manipulation, automatic saving (Shadowing), sampling, multitrack DAT backup and flexible memory management. Designed especially for broadcast use, system prices including editor, stand, memory and backup options start at \$33,000.

Pacific Recorders and Engineering (PR&E) displayed its ADX series of digital products that includes the ADX Workstation and ADX Mixstation. The Workstation offers real-time I/O of eight to 32 channels and four to 16 track hours of recording. MIDI, SMPTE, AES/EBU and Magneto-Optical hardware are accommodated.

The system uses a custom control surface and a Macintosh computer. Separately, or with the Workstation, one can use the console automation Mixstation to interface a console and eight I/O channels. The system includes moving faders, three-band EQ, alphanumeric displays on each channel, fully digital processing with no VCAs and can interface with analog tape machine audio and control circuits. A basic Workstation with 1.6 GB drive and computer costs \$33,980. There are two versions of the Mixstation costing from \$18,000 to \$19,500.

Otari displayed new processing and screen software for its workhorse ProDisk-464 DAW that can handle up to 64 tracks. The hardware is modular so you can assemble and modify the system to suit a facility's needs. You can display the information you want, in a style that you want through the GUIDE (Graphical User Interface for Digital Editing) screen software. Tracks, waveforms and 24 channel meter readings are all available screens.

The system runs on a Macintosh. Price for a basic eight-channel system with DSP and backup drive, without computer, is \$29,950.

Roland displayed several new peripherals for its DM-80 workstation including, Magneto-Optical support, a video sync resolver and sample rate converter. Enhanced operation of the DM-80 Hard Disk Recorder is possible with a Macintosh and "Multitrack Manager

System" software that allows locking of four DM-80s to attain 32 tracks. This software does require some specific hardware support. Pricing begins at \$14,000 for the basic system with remote control and fader options.

Digital multitrack

Korg introduced version 3.0 of its self-contained Soundlink 8-track recorder/editor. The unit does not require additional computer or peripheral hardware to operate. The system offers alphanumeric file searches, stereo sample rate conversion and time compression/expansion, stereo equalization, reverb, level compression and noise gating, enhanced video display of automation and control surface settings and the ability to make real-time changes in the mix file. Designed for demanding production environments with many audio, sync, digital interface and machine control requirements, the system costs \$37,000.

TASCAM displayed its new product, the DA-88, an eight-channel digital multitrack that uses an 8mm cassette. Control and operation is similar to other TASCAM audio products. Remote control, digital I/O and sync options are available. Multiple units may be locked together for a maximum of 128 tracks.

The DA-88 lists for \$4,500. A simpler 2 track recorder/editor, the RA-4000 is planned for late summer release.

Alesis displayed its S-VHS based ADAT system for recording eight channels in a manner very much like analog multitrack. Up to 16 ADATs may be interconnected for a total of 128 tracks without requiring peripheral interfaces. A master remote control allows paste and copy functions between tracks, or, with the Optical Digital Interface, between tracks in different ADATs. Direct digital mastering, sync, SMPTE, AES/EBU and MIDI are all supported. Among the lowest priced digital multitracks, the ADAT costs \$3,995.

AKAI Digital displayed new and upgraded products in its growing family of digital audio tools. New is the DR4 hard disk recorder with the feel of an analog four-track in a single unit. Up to three units may be slaved with a master for 16 track production. Jog-Shuttle and copy/move/insert editing are possible. MIDI, SMPTE, SCSI and additional digital I/O support are offered.

The system uses RCA connections for the analog I/O. A remote control panel is planned for Fall 1993. A line of MIDI stereo samplers, the S3200/3000/2800 and a CD-ROM sampler, the CD3000 were shown. New software was demonstrated for their DA1200 (8mm) and DD1000 (magneto-optical) series of digital multitrack recorder/editors. Pricing depends upon configuration.

Arrakis showed its Trak*Star 8 and Trak*Star 2 editor-mixers, which allow for editing of up to eight tracks of audio simultaneously from hard disk. (**Harris Allied** also markets Trak*Star models.)

Studio Technologies, Syracuse, N.Y., introduced a number of components for the digital audio studio, including a central controller and control console.

NAB93

“The thing is just impossible to screw up! The DM-80's non-destructive editing is the only way to go, and revisions are extremely easy and very quick!”

—David Esch, Director of
Commercial Production
WPNT Chicago

“We looked at DAW's for a year—no other product could even come close to the DM-80's price/performance ratio. And it doesn't break!”

—Bill Robinson,
Production Director
WQCD N.Y., NY

“I love this machine! It's reliable, and user friendly. I can edit in 1/3 the time, and I wasn't familiar with disk recorders—the DM-80 is easy to learn and use.”

—Michael Cook,
Program Director
KSJJ/KPRB Redmond, OR

Broadcast professionals speak out about the DM-80 Digital Audio Workstation!

“I've been editing on tape half my life, and was hesitant to give up “rocking the reels”—but I found this machine is incredibly easy to edit with. And its expandable storage put it way ahead of the competitors we looked at.

—George Zahn,
Operations Director
WVXU Cincinnati

“All our engineers were amazed at how easy it was to do things on the DM-80... We'd gotten demos from most of the other DAW manufacturers, but once we got a demo on the DM-80, we were sold—it does more, and does it a lot faster.”

—Lynn Debin, Director of Engineering
Key Market Communications
Augusta, GA

“We originally chose the DM-80 because of its user friendliness. Then we discovered the real magic of this device: a promo announcement that normally would take 4 hours can be done in 30 minutes.

—Tom Collins, Director
International College of
Broadcasting & Recording,
Dayton

“I..used to be a tape guy—I don't touch it anymore unless I have to. I like being able to bounce from track to track without noise build up, and the DM-80's flexibility and sound quality are excellent!”

—Dave Clark, Production Manager
KFRG Colton, CA

“The DM-80 does more than DAWs costing twice as much. It's very rugged—you can set it up and forget about it. And it's easy to use.”

—Tony Diggs, Chief Engineer
WKHK Richmond, VA

“It's like a digital studio in your lap! The DM-80 is a very affordable, portable, high quality digital editing system.”

—Howard Silberberg, Sound Engineer
United Nations Broadcast
Network, N.Y., NY

“We often record commercials and play them on the air without ever going to tape... We own a DM-80 competitor that just collects dust.”

—Bob Mayben, Chief Engineer
WRVR/WOGY Memphis

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Circle (48) On Reader Service Card

World Radio History

New Analog, Digital Source Gear at NAB

LAS VEGAS Although many companies are jumping on the digital technology bandwagon, source equipment suppliers for broadcasters offer a variety of both analog and digital products for almost any use. At the 1993 NAB show, there was an ample mix of the ever-expanding line of digital products as well as analog products.

Sony's booth included its brand new line of digital audio equipment designed for radio stations. The products featured included the PMD-CIP MiniDisc player, and the PMD-C1 MiniDisc recorder/player, designed to replace NAB cart machines. The company also introduced the PCM-E7700 DATStation transportable digital audio editing system.

Denon displayed the new DN-1200F CD changer capable of storing 200 CDs in less space than they occupy in their jewel boxes. The system employs two magazines, each holding 100 discs. These two cartridges flank the CD transport, meaning that the player can move from any track on any disc to any track of any other disc in 15 seconds, maximum.

A computer compatible control system for the DN-1200F interfaces to the computer via a standard serial data port configurable for RS-422 or RS-232 formats.

TASCAM showcased its new product, the DA-88, an eight-channel digital multitrack that uses a Hi8 cassette. Control and operation is similar to other TASCAM audio products. Remote control, digital I/O

and sync options are available. Multiple units may be locked together for a maximum of 128 tracks.

Alesis displayed its S-VHS based ADAT system for recording eight channels in a manner very much like analog multitrack. Up to 16 ADATs may be interconnected for a total of 128 tracks without requiring peripheral interfaces.

Radio Systems demonstrated its new RS-6700 DAT recorder/player. It features front panel LEDs, easy EOM programming, and one-closure function for taping satellite feeds. The company also showed the existing RS-1000 and RS-2000 DAT machine lines.

Stellavox exhibited the new Stelladat pro DAT recorder with time code. This Swiss-made unit is metal-constructed to withstand field operation abuses and offers time code and AES/EBU interface.

AKAI Digital introduced a series of digital source products at this year's show. The AKAI DR 4d is a four-channel digital hard disk recorder with 18-bit 64x oversampling A/D, and 18-bit 8x oversampling D/A. Up to four units can be linked for 16 tracks and each unit features AES/EBU digital I/Os.

The company also introduced the S3200, a 16-bit, 32-voice digital sampler, the S3000, a 16-bit, 32-voice sampler, the S2800, an entry level 16-bit, 32-voice sampler, the S2800 studio, a 16-bit, 32-voice sampler that also includes an 8MB memory, SCSI, and AES/EBU digital interfaces.



Radio Systems' RS₂ noise reduction system

and the CD3000, a 16-bit, 32-voice sample playback unit with a built-in CD-ROM player.

Stanton Magnetics introduced the CD-33 dual CD player. The control options include pitch (plus or minus 12 percent), forward and reverse, variable speed scan and search, 10-selection memory, pitch blend, and instant cue. The company also displayed its full line of turntable cartridges for broadcast.

LPB Inc. unveiled a PC-based digital audio storage and retrieval system: The RCD, direct interface to Macintosh or PC including hardware and software, connects to workstations, compiles libraries, SFX, backups, masters, archives clients data and spots on one disk. Specs include 74/63 minutes, Red/Orange book audio, 580MB CD-ROM, CD-I from the same drive.

LPB also introduced the Meridian CD-R comes with capacity for all digital interfaces and includes Meridian modifications for A/D and D/A conversion, double clock check, AES/EBU, SPDIF, coax, optical, and analog.

Digital Broadcast Associates displayed the dB-Cart, a unit that employs apt-X compression and "Floptical" disc technology. The dB-Cart uses a 3.5-inch, 21 megabyte diskette.

The DigiCart, from 360 SYSTEMS, has been augmented this year with a gigabyte disk drive, storing almost eight hours of stereo audio.

Studer Revox America Inc. featured its new line of third-generation CD-players with improved functionality, AES/EBU connections and reduced power consumption.

Broadcast Electronics' line of source products was showcased including its line of cart machines and the digital Disc Trak, the analog Phase Trak, and the AudioVault digital audio storage machine.

Harris-Allied showed a new Audiometrics personal computer designed for broadcast applications as well as its full line of established source products.

Audi-Cord attended NAB with its product line including the Audi-Cord DL and S-series of cart machines.

Along with some new console products, Fidelipac had its DCRI000 cart machine series, now on the air in more than 30 radio facilities around the world. Fidelipac displayed its line of standard analog cart machines and cartridge tape products.

Among its new line of digital processors and equalizers introduced at NAB, Yamaha showed the YPDR-601 CD recorder.

Accurate Sound displayed its Model AS-4010, 24-hour cassette logger. The logger will record one or two channels continuously over 24-hours on a standard 90-minute analog cassette. The bi-directional system also can be configured as a four-channel recorder with 16-hours of recording time or eight-channels using eight hours.

Audiopak displayed its broadcast carts including black A-2, dark blue AA-3, and light blue AA-4.

DIC Digital offered its established line of DAT tapes, the Professional MQ Series in lengths ranging from 15-122 minutes, as well as a non-abrasive DAT cleaning cassette. The company also exhibited its recordable compact disc in 63-minute or 74-minute lengths.

New degaussers were on display at Garner Industries. The company introduced the model CF 750 Type II and the model I400 degausser, 120 VAC 60 Hz.

Tentel showed its full line of audio and video tape head tools and gauges including the Tentelometer cart tape tensioner.

Success Specialty Sales displayed its line of splicing, hold-down, leader, sensing and stage tape.

3M displayed its line of magnetic film tape (unveiled at last year's NAB) and its line of professional tape and accessories including the 3M 275 digital audio mastering tape, 3M PRO DAT and 3M AUD DAT cassettes, as well as its floptical disk drive.

The Panasonic display included its well-established line of DAT recorders, among them the SV-3900 computer-controlled recorder, the SV-3700 professional recorder and the SV-255 portable recorder.

JVC displayed its line of DAT gear. Maxell showed its line of tape products.

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 **HARRIS
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Towers, Antennas for All-Size Jobs

by Tom Osenkowsky

LAS VEGAS Perhaps the most significant of a sizable number of new antenna and tower products at NAB 1993 was the Scatter-Free Tower, developed by the team of **Central Tower**, Newburgh, Ind., and well-known antenna manufacturer **Jampro Antennas Inc.**

The Scatter-Free Tower's inner members are constructed of composite synthetic materials instead of galvanized metal. The degree of signal distortion created by FM antenna mounting on a tower face is significantly reduced.

Central Tower supplies self-supporting towers up to 500 feet and guyed towers up to 2,000 feet. Jampro Antennas manufactures low- and high-power single and multistation standard and panel FM antennas and also offers pattern range testing services.

Circularly polarized

Electronics Research Inc. (ERI) introduced the SHPX/LPX Series of circularly polarized FM antennas, offering extended bandwidth for improved phase linearity. ERI offers an extensive array of FM standard and panel antennas, multistation combiners, range testing, as well as their Lambda Antenna Mounting System for increased radiation pattern control.

Shively Labs introduced a new FM panel antenna, the model 6016, specifically intended for mounting on four-faced towers. The 6016 features a four-dipole-per-face design allowing optimum radiation from square tower structures.

Also new at Shively is the model 6824 internally fed normal mode helix antenna designed for moderate climates, without radomes or deicers.

Dielectric Communications displayed its popular DCR Series of FM antennas. The DCR Series offers antennas for high- and low-power use. Models are available for one to 16 bays.

A full range of AM, FM, TV, CATV and microwave towers are available from **Utility Tower**, Oklahoma City. The company provides several varieties of uniform- and pivot-base towers to meet all needs. **Magnum Towers**, Sacramento, Calif., supplies guyed towers up to 1,400 feet and self-supporting towers up to 500 feet.

Stainless Inc. introduced its G-36 triangular tower for AM & FM broadcast applications. Stainless provides towers for all applications from simple 50-foot STL to 2,000-foot elevator equipped FM and television towers.

Custom-designed

LDL Communications Inc. markets the **Alan Dick & Co.** line of FM antennas. The FMAC Series circularly polarized antennas have up to 12 bays. Models with six bays or more are center-fed. The Spearhead FM panel antenna series can be custom designed to accommodate single or multistation operation within the entire FM band. ADC also supplies combiner and bandpass systems.

Protecting your antenna investment from lightning damage is a job for **Cortana** products. Cortana offers an entire line of Stati-CAT lightning and static buildup prevention products. Stati-CAT system products attach to your tower and bleed off static potential before it can transform into damaging lightning.

Many towers require lighting at various elevations. Both strobe- and aviation-stan-

dard lighting products are available from **Hughey & Phillips**, TWR Inc. and **EG&G Electro-Optics**. EG&G displayed its Flashguard 3000 medium-intensity strobe beacon. There are 120 model 3000s in operation after a year on the market. Hughey & Phillips and TWR also offer a full line of lighting and control apparatus and replacement parts for existing systems.



Flash Technology's FTS 2100

Tennaplex Systems offers a complete line of custom single and multistation FM panel antennas. Specialized computer software is available to tailor the station's azimuth and elevation patterns to meet specific requirements.

Low-power line-up

SWR Inc. introduced a line of low-power FM antennas for educational, translator or booster stations. The FMEC is a circularly polarized antenna capable of 500 watts per bay. The FMEV is a vertically polarized model with similar characteristics to the FMEC. The FMEH model is a counterpart horizontally polarized antenna. All three antennas feature "N" input connectors and low weight/windloading. SWR manufactures medium- and high-power FM antennas and the "K" line rigid transmission line featuring heavy wall non-finger inner conductors for enhanced reliability.

Andrew Corp. unveiled its HRLine rigid transmission line. Available in six-inch size, 50 and 75 ohms, the HRLine does not contain the usual "bullet" type sliding inner conductor. HRLine is a heliastyle rigid line with bolted inners to eliminate conduction and heating problems often associated with standard bullets. HRLine uses the standard hangers for mounting on a tower,

with the initial cost being comparable to standard rigid line.

Myat Inc. is well known for its rigid transmission line products. This year the company introduced a new field-tuneable quarter wave harmonic stub to attenuate even harmonics. A notch depth of -40 dB can be achieved with less than 0.1 dB loss and 1.04 VSWR. Myat also introduced a new Flexible Section six-inch transmission line which is deflectable to $\pm 30^\circ$ without VSWR change.

Cablewave Systems, a division of Radio Frequency Systems Inc., displayed samples of its wide variety of AM, FM, microwave, RPU, STL and sampling transmission lines and accessories. Cablewave manufactures transmission lines to suit all needs, in both foam and air dielectric models.

Flash Technology introduced the FTS-2100 SMART (System Monitoring and

Reporting Telemetry) tower light monitoring system. Flash Technology also offers factory authorized 24-hour monitoring and FAA reporting services via modem as well as semi-annual certification reports.

AM broadcasters in need of folded unipole antennas in three- or six-wire configurations can turn to **Kintronic Labs**. Kintronic manufactures and supplies ATUs, phasors for directional antennas, RF relays and a selection of tuning coils and transmitting capacitors.

Speaking of AM, **Phasetek Inc.** offers custom-made phasors and ATUs as well as coupling units and multiplexers. Phasetek supplies replacement parts and components for existing AM RF systems as well.

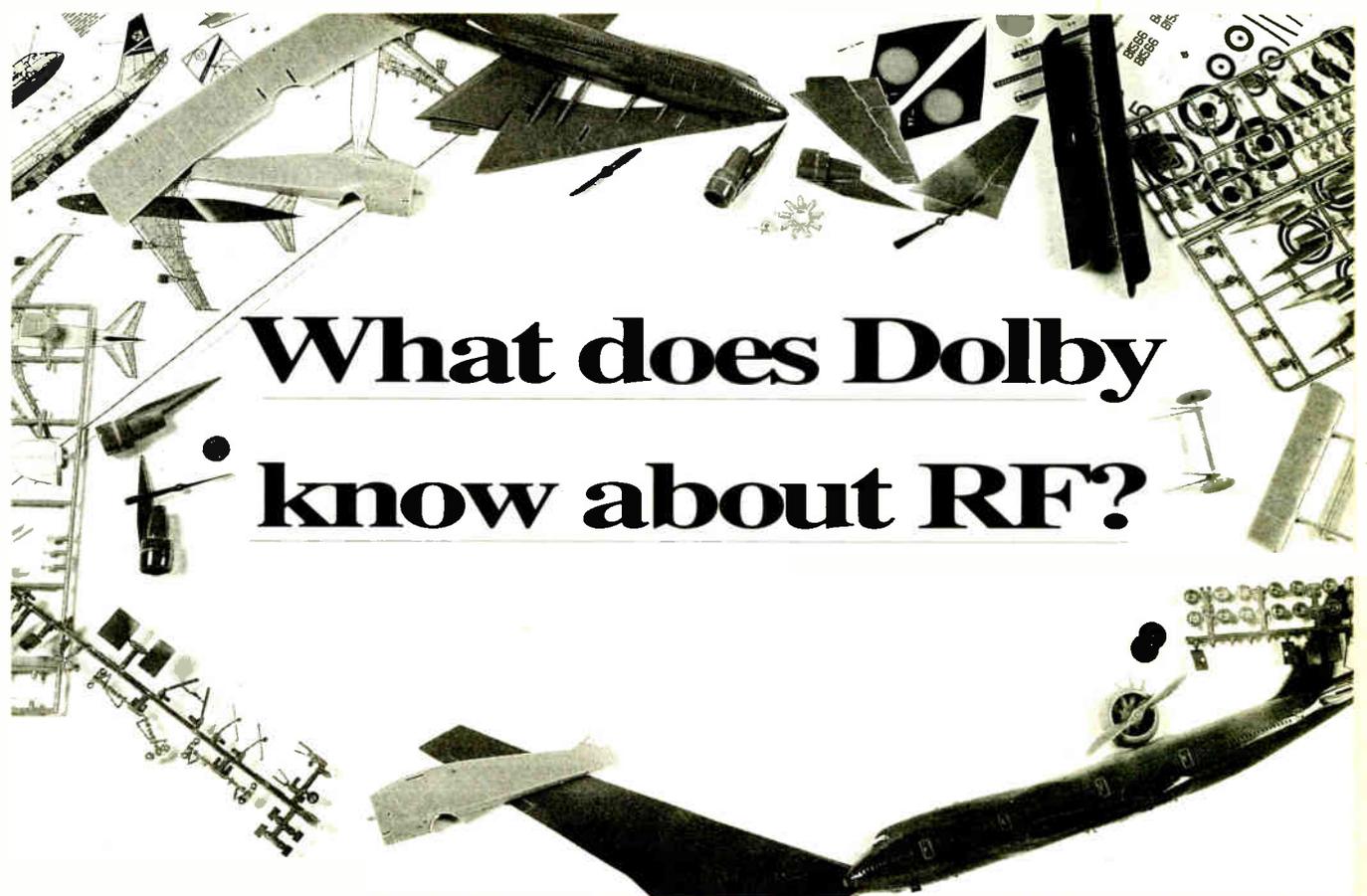
For the small-tower user, check out **Will-Burt's** Hurry Up telescoping mast. The Hurry Up is designed for use with remote broadcast vehicles to allow up to a 25-foot mast to be quickly erected using the vehicle's tire as an anchor. The Hurry Up weighs only 28 pounds and is collapsible to six feet.

Antenna Technology displayed its line of satellite earth stations and related electronic components. The company displayed new and refurbished transmit and receive antenna sizes from 1.2-meter to 32-meter.

On hand as well was the upgraded Simulstat 3.5-meter and seven-meter multi-beam antennas, capable of simultaneously receiving 35+ C- and Ku-band satellites, within a 70 degree arc.

Micro Communications Inc. introduced new broadband dipole antennas, as well as 7/8 and 4 1/16 coaxial switches, low/medium power channel combiners and bandpass filters. The company displayed its established products, including: coaxial switches, directional couplers, low/medium power channel combiners and bandpass filters.

SSAC Inc. unveiled the new SCR430T tower and obstruction lamp failure alarm relay, which monitors one to four beacon or side lamps and provides a contact closure should one or more lamps fail.



What does Dolby
know about RF?

Mics with New Mobility, Old Warmth

by Randy Sukow

LAS VEGAS A wide set of demands is placed on companies building microphones for the broadcast industry.

Some customers need the latest, most sophisticated wireless mic system capable of clean sound from the most remote of remote sites, transmitted on a wide range of frequencies to avoid interference with other wireless mic users.

New and old abound

A case in point: The big news at **Shure Brothers Inc.**, Evanston Ill., was the new WL93 micro-miniature omnidirectional lavalier mic, its smallest so-far developed. Shure's 839W lavalier, considered the top of the line five years ago, is already considered hopelessly oversized by some customers, he said.

At a frequency response of 50 to 20,000 Hz, the WL93 actually outperforms the 839W. The new mic sells for \$100 retail and is also available in a Shure Wireless L Series package.

A short stroll from the Shure booth, **Mark IV Audio Inc.** companies—including **Vega, Altec Lansing** and **Electro-Voice**—were featuring their latest wireless products as well, including the Vega LM-210 and 210X subminiature lavaliers, similar to the Shure product. But most radio visitors to the booth still turn to the old-reliable **Electro-Voice RE20 Dynamic Cardioid** microphones, a standard model for about 40 years.

The "next-generation" RE27N/D, a wider-frequency-response, higher-sensitivity upgrade of the RE20 has been on the market for two years, but has not yet been sampled by many radio stations, Sanchez said. Those that have placed orders for the newer model now maintain "a good mix" of the two, he said, with the older mic

remaining popular for its "very warm low end." On-air talent, especially on AMs, appear to prefer the RE27 for a more faithful recreation of their voices, he said.

Top-billing

Another old-versus-new example: Top NAB-show billing for **Sennheiser Electronic Corp.**, Old Lyme, Conn., went to the EM 1046 tunable UHF wireless mic receiver system, which has been available since January. The EM 1046 uses a phase-locked loop controlling mechanism to allow the receiver to be tuned to a 24

employs a proprietary technology to maintain high sensitivity and wide dynamic range without increased distortion, Schurer said.

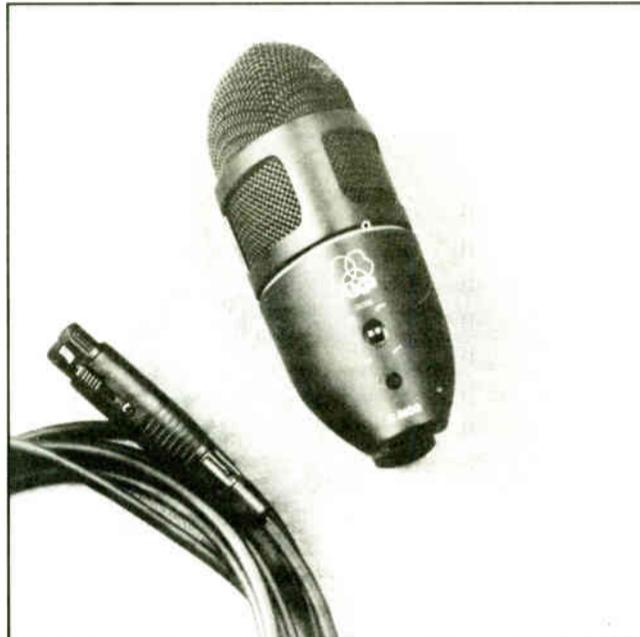
Meanwhile, in the same booth, one of the featured items for Sennheiser-owned **Neumann [USA]** was the U 67 vacuum-tube condenser microphone, which the company originally produced from the 1930s to the 1960s, an item literally returned by popular demand.

Broadcasters over the years have held on to the U 67—favored for its sensitivity, sound reproduction and easy maintenance—which demands a hefty price in resale, said Neumann Product Manager **Jeffrey Alexander**. The company had parts to make only a limited supply of U 67s at its Berlin plant; they are already sold out in Germany. About 400 of the \$5,000 mics were still available in the U.S. as of mid-April.

Neumann had its share of new technology to show as well, such as the TLM 193 large-diaphragm condenser unit. "This is our response to the market for a very high-quality, low-priced microphone," Alexander said. For a retail price of less than \$1,600, the TLM

193 boasts a dynamic range of 130 dB and frequency response of 8 Hz to beyond 20,000 Hz. The microphone will be ready for shipment in September.

AKG Acoustics, San Leandro, Calif., had



AKG Acoustics' C5600 with large diaphragm for processing of complex waveforms

MHz range somewhere within 450-960 MHz. Tuning is done in 5-kHz steps.

Sennheiser also introduced the MKH80 multi-pattern wireless condenser microphone, designed for multiple applications, It is the fifth model in the MKH series that

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In with New and Old

► continued from page 41

three new mics to show, two of them condenser units for music recording applications. The C5900 (suggested price \$449) hand-held mic includes three bass contour curve selections and AKG's InterSpider™ technology to reduce handling noise. The C5600 (suggested price \$579) includes a large diaphragm for reproduction of complex waveforms and a reinforced casing for rugged handling.

The third new AKG mic, the CK68/ULS shotgun, was developed for TV and radio ENG as well as video production. The front tube is removable for short-shotgun applications. Its suggested price is \$649. The mic works in conjunction with the C460/B preamplifier, which sells for \$459.

AKG also added the CK94 figure-eight capsule to its Blue Line mic series, designed for several specialized applications, including radio interview shows. Suggested price is \$359.

Studio Technologies, Skokie, Ill., exhibited its established PreEminence two-channel pre-amp. Benchmark Media, Syracuse, N.Y., showed its MicroFrame series of line amps and pre-amps.

The hottest new mic item for Samson Technologies Corp., Hickville, N.Y., was



Sennheiser MKH80 multi-pattern wireless condenser microphone

the UR-5 UHF synthesized wireless system with a potential 74 switchable frequencies. Shipping has already begun at \$2,500 retail.

Customers "are going into UHF in a big way. There is a lot less interference up there," said Jonathan Cohen of Nady Systems Inc., Emeryville, Calif. Nady showed four different UHF wireless systems, including two four-channel systems, a 10-channel and a 40-channel, adding flexibility and adaptability as supplements to an already substantial VHF product line. The UHF systems range in price from \$800 to \$2,500; the VHF's from \$200 to \$500.

Swintek Enterprises Inc., Santa Clara, Calif., introduced both UHF and VHF wireless systems at NAB in the MARK 1L line. The VHF system comes in hand-held or lavalier configurations and operates within 72 MHz to 330 MHz. The UHF system, also in two configurations, features all-metal construction for RF shielding in the hand-held model. It operates within 400 MHz to 520 MHz.

About 100 Swintek units have already

been shipped to Canada at the opening price range of \$1,600-\$2,000, depending on the options.

Three new ranges of VHF wireless systems were offered by **beyerdynamic**, Farmingdale, N.Y., the S 150, S 250 and S 350. The top-of-the-line S 350 includes a rack-mountable receiver and a flight case.

Like many companies, one of beyerdynamic's more popular mics among the radio stations is an old, established product, the M259 and M260 studio mics. The M260 is a ribbon mic, one of the last still produced, said Robert Lowing, market development manager.

Audio-Technica, Stow, Ohio, had one of

ten prototype multi-mic signal mixers built so far. The system is built with sensitivity threshold control. "The ambiance for a conferencing situation is still there...It mixes so smart and fast, you don't lose a syllable," said William Balmer, manager, special markets. The mixer was initially built with meetings and teleconferences in mind, but "I think is a definite need for it out there" among some broadcasters as well, Balmer said.

Crown International, Elkhart, Ind., introduced the CM-311 head-worn condenser mic, featuring Crown's Differoid® technique for picking up certain desirable background sounds, while blocking out studio noises from the rear. The CM-311, now available, sells for \$198 and the wireless version, the CM-311/E, for \$289.

Comtek Communications Inc., Salt

Lake City, was showing a new 25-channel interruptible feedback (IFB) system with a half-mile range and 80 dB signal-to-noise. "This one is frequency-agile, the thing everybody's been looking for," said Comtek's Ralph Belique. Pricing starts at \$900 without software options; the receiver sells for \$300.

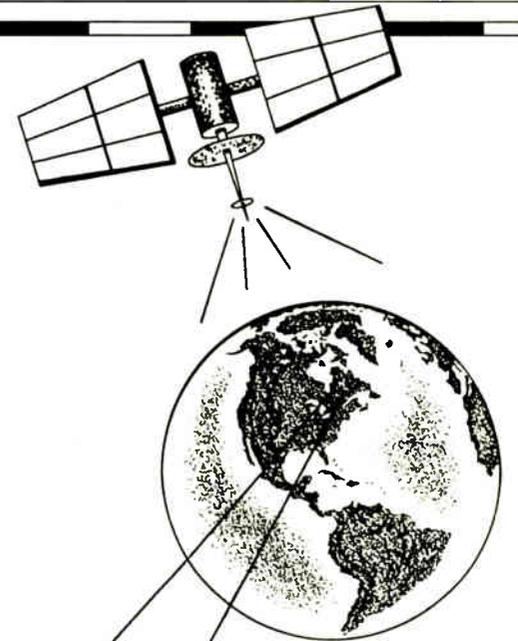
The new line of Model 22 "invisible" mic headsets were on display by **R-Columbia Products Co.**, Highland Park, Ill. R-Columbia claims the system operates simply with a belt-clip control box. The 22-1, compatible with most two-way radios, is \$199. The 22-HT600, compatible with Motorola radios, sells for \$289.

Telex Communications, Minneapolis, returned its two-year-old V-Series telephone/mic sets. Among the more popular

continued on page 44 ►

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**MAKE MONEY BY CREATING A
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Cable to Connect the Digital Studio

by Tom Osenkowsky

LAS VEGAS When most of us think of new audio products while strolling through the NAB equipment exhibition, we picture digital processors and new-media recorder/players. All audio equipment requires interconnection, mostly by some form of cable.

Variety is key

With the increased popularity of digital audio processors and storage systems, cable and accessory manufacturers are meeting the demand with a wide assortment of products to suit a wide variety of

needs and applications.

Belden introduced a prototype AES/EBU digital audio cable, with a nominal 110 ohm impedance, 76 percent VF, Beldfoil shield and 22 AWG crush-resistant configuration.

Audio Accessories introduced the DEC/Audio Accessories AES/EBU digital audio patchbay. The active patchbay

uses standard Bantam TRS patchcords and is available in a 24-channel, half-normal configuration. Proper 110 ohm impedance, termination and waveform are guaranteed. Audio Accessories also supplies an impressive line of standard audio and serial products.

GEPCO International Inc. announced four-pair and 12-pair configurations of

their popular 5524 series of 110 ohm digital audio twisted pairs are now available. Lengths are available to suit the customer's needs.

Wireworks Corp. introduced several new products, including the G5/160i Interconnect Standard with up to 52 audio channels on a single gold plated connector. The new Broadway Latching System option is available on many multicable components to assure solid connections, even under rigorous touring and performance applications. The new TEN-4 speaker cable tester is designed to test SPN series or Neutrik NL4 speaker connectors.

Monitor Developments

► continued from page 43

V-series models, said Telex's Eric Lim, is the top of the line, which uses technology developed by the aircraft industry for outside noise elimination. The sets range from \$600 to \$900.

Monitors

A similar juxtaposition between the old and the new was evident among audio monitor manufacturers at NAB '93. **JBL Professional**, Northridge, Calif., introduced its new 4400A Series monitors, an upgrade of the earlier 4400 models, which "has been very popular in the radio control room," said Hector Martinez, JBL sales and marketing manager for Mexico.

The 4400A monitors feature titanium dome tweeters, meant to reduce distortion as well as a double-grill screen to eliminate refraction distortion. The eight-inch frame (also available in 10-inch and 12-inch) is also a selling point, Martinez said, because "size is always a factor. (Radio stations) are always looking for the compact package with the broadcast range."

The new JBL monitors are now available at a price range of \$325 (eight-inch) to \$675 (12-inch).

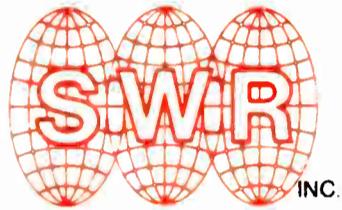
The only audio monitor on display for **Yamaha Corp.** of America, on the

other hand, was the NS-10M stereo model, a standard product for Yamaha for several years. The NS-10M "started as a consumer device, but it has kind of gravitated over the radio and TV broadcasters," said Yamaha's Lon Brannies. Dimensions again are a major selling point. At 15 inches x 8.5 inches x 7.875 inches, it demands little rack space. "Typically this is the one that gets used the most. It is the near-field type. You're not going to get far away from it at all, Brannies said.

Wohler Technologies Inc., San Francisco, promotes itself as the audio monitor specialist. "I think we're the only (NAB monitor exhibitor) where monitoring is our actual business. Everyone else does something else," said Wohler's Patrick Hayes.

Wohler showed its AMP-1A stereo monitor, now with AES/EBU standard input capability. Other features include 10 routing switches and front-panel control. Prices for the AMP series start at \$635 for the AMP-1; \$720 for the AMP-1A, and \$1,100 for the AMP-2, the highest-fidelity, two-rack-space model.

Stanton Magnetics, Plainview, N.Y., showed its established line of earphones and headphones for broadcast announcers.



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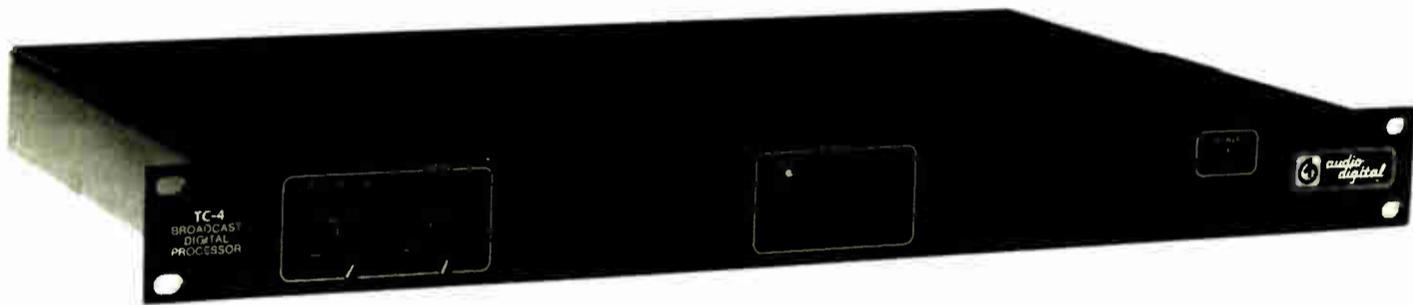
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World Radio History

RF Development Prospers in Every Season;

by Dennis J. Martin

LAS VEGAS Judging by the wealth of new-product introductions, the economy did not dampen the inventive spirit of broadcast manufacturers during the past year. In April 1992, Radio Broadcast Data System (RBDS) was scarcely noticed. This year, eight manufacturers were showing 14 RBDS products.

AM and FM transmitters also enjoyed overwhelming attention. New models, new options and product enhancements could be found throughout the exhibit area. Supporting products and services, such as

transmitting tubes and dummy loads, were also popular.

New products

BEXT was showing its new "D" Series of FM Amplifiers. Available in one, two, three, six, 10 and 15 kW models, each features a built-in IPA that allows the amplifier to produce full power output with only 10 W input. Also on display were the new "L" Series FM Amplifiers. Based on a grounded grid single tube design, the "L" Series amplifiers can be supplied with output power ratings of four, seven, 10, 20, and 30 kW.

The new BEXT HPT is a high-performance booster/transmitter/translator available in three different configurations. The HPT FMR and HPT STL combine an integrated composite receiver with the programmable FM transmitter. The HPT FMR is designed to be used as a booster or translator because of its internal 88-108 MHz receiver; the HPT STL is a combination composite STL receiver and FM transmitter, and the HPT SGN has a built-in stereo generator instead of a receiver.

Broadcast Electronics introduced the AM2.5, a 2.5 kW solid state AM stereo transmitter. High-efficiency Class E power amplifiers and switching power supplies deliver an overall efficiency of 77 percent. The AM2.5 also features a built-in C-Quam™ stereo exciter at no extra cost.

Three other new products were highlighted at the BE booth: the FM-100C, FM500C and the FMIC. The FM-100C is a low-power FM transmitter, rated for 10 to 100 W operation, and uses a MOSFET RF amplifier that is protected against open and short circuits. The broadband design of the FM500C, a 500 W solid state FM transmitter, does not require tuning, and the RF modules are fully protected against over-temperature, VSWR and excessive voltage and current conditions. The new FMIC is a 1 kW solid state FM transmitter which uses four interchangeable 500 W modules for reliability.

CCA displayed two new FM exciters, the FM60G and Ultra 60. The output power of both is adjustable from five to 60 W, and five inputs are standard: one mono, one composite, and three subcarrier. The FM60G has three analog meters, while the Ultra 60 incorporates a back-lit, super-bright LCD display.

In the transmitter arena, CCA introduced the FM1000UA, rated for 500 to 1100 W operation; the FM750G, FM1000G, FM1500G, and FM2000G, rated at 750 W, 1 kW, 1.5 kW, and 2 kW, respectively. CCA also introduced the FM45000G and FM65000G, designed for 45 kW and 65 kW operation, respectively.

Additions, upgrades

Continental Electronics announced the addition of the 316T to its "T" Line of AM transmitters, rated for a power output of 10 kW. The modular design of 316T is constructed of industry-standard electronic parts. Lightning protection, over-temperature sensing, VSWR protection, and low-velocity cooling fans are a few of its features.

DB Elettronica exhibited a broad range of FM transmitters with output power ratings of 100 W to 10 kW. Solid state versions are available up to 1 kW.

Elenos displayed its line of FM transmitting equipment, including the ELC20, a 20 W synthesized FM transmitter; the SF1000, a 1 kW MOSFET FM power amplifier, and the T2000-1, T5000, T12000, T15000, and T20000 FM transmitters, which range in power from two to 20 kW.

Energy-Onix introduced AM 1K, a 1 kW AM transmitter combining high-level plate modulation with solid state low-power circuitry to produce up to 1.2 kW of output power. Reconfigured models in the Legend Series of solid state FM broadcast transmitters were shown, designed for improved performance in 1, 2.5, and 5 kW.

Digit™, a new 50 W digital FM exciter,

is the heart of Harris Allied's DT 20FM, a new 20 kW FM transmitter. The DT 20FM features a single-tube/quarter-wave cavity design that yields a PA efficiency in excess of 77 percent, and an adjustment-free solid state IPA. Digit relies upon 32-bit direct digital synthesis for CD-quality performance; is equipped with digital composite inputs; uses a numerically controlled oscillator for precise modulation control, and incorporates a wideband FET output stage. Digit can be equipped with an analog-to-digital converter for use with today's analog stereo generators.

Also new is the Harris DX 15, a 15 kW digital solid state AM transmitter that boasts a PA efficiency of 92 percent and an overall efficiency of 86 percent. THD+N at 15 kW and 95 percent modulation is 0.3 percent, typical, from 30 Hz to 10 kHz.

On display at the LPB booth was its line of low-power AM transmitters, which includes the AM-5, rated for 1 to 5 W operation; the AM-30P, 2 to 30 W; the AM-60P, 10 to 60 W, and the AM-100P, offering 25 to 100 W of output power. All are completely solid state, with modular construction and are designed to withstand an output mismatch or short circuit.

Nautel announced that a C-QUAM™ stereo exciter is now available as a built-in option for its AMPFET ND Series of AM transmitters. Nautel offers a complete line of totally solid state AM and FM transmitters, which includes the AMPFET ND50, a 50 kW second-generation AM transmitter.

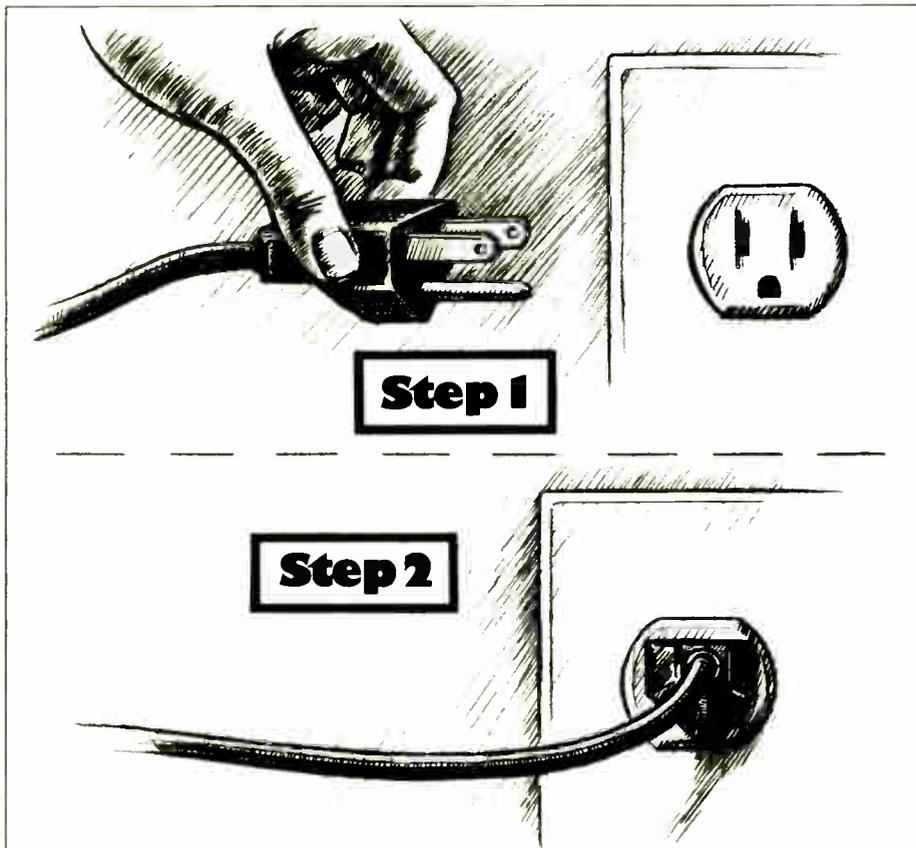
On display at the QEI exhibit was its line of FM transmitting products, including the FMQ-20000B, which can easily be upgraded in the field from 20 to 30 kW. The FMQ-20000B and FMQ-30000B use a grounded-grid triode that never requires neutralization; feature a modular solid state IPA; eliminate unreliable sliding contacts, and include automatic power control.

Rohde & Schwarz unveiled a new generation of solid state FM transmitters. The show featured an NR 410 T, a 10 kW version; other models produce output powers from 1 to 20 kW. Redundant critical modules and conservative operation, along with an intelligent monitoring and diagnostics system, are important features of the new line. In addition, Rohde & Schwarz introduced the NR 420R1, a 20 kW FM tube transmitter. Integrated filament power regulation is said to extend power tube life to a minimum 25,000 hours.

Television Technology Corp. (TTC) highlighted the XL-FM, a solid state FM translator. Using a unique phase-locked-loop design, spurious signals that typically occur in the heterodyne up-conversion are eliminated. This process improves interference rejection yet remains transparent to SCAs. The receiver section of the XL-FM also offers excellent selectivity and overload protection. When combined with the FMS-100, 100 W output is available. TTC also manufactures a comprehensive line of FM transmitters, from 30 W to 50 kW.

TEM (Tecnologie Elettroniche Milanese) was on-hand to show its line of FM transmitters that range in power from 300 W to 10 kW. Three models (300, 600 and 1100 W) are completely solid state, and three high-power models (3.5, 5, and 10 kW) use a single tube.

Thomson-LGT manufactures the FMT Series of FM transmitters. The FMT 5000 S, which is rated at 5 kW, is fully solid state and combines 10 power amplifier



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RBDS on Fertile Ground

modules and five switching power supplies to minimize downtime. Solid state models are available in power outputs of 100, 500, 2000, and 5000 W, and a tube version produces 10 kW.

RF supporting products

Altronic Research displayed air- and water-cooled RF coaxial load resistors. Air-cooled, 50Ω terminations are supplied in 5, 10, 15, 25, 35, 50, and 75 kW models, which collectively form the 6700 Series. Self-contained heat exchangers—known as the 5800 Series—accommodate power levels to 80 kW, and water-cooled single resistors are rated to 300 kW. Air- and water-cooled high-power non-reactive cermet resistors are marketed under the Power Film Systems name.

Since 1969, **Econco** has been rebuilding power tubes. Today the company rebuilds more than 180 different types and has facilities to manufacture replacement glass envelopes and grid and filament assemblies. Econco was also distributing copies of its booklet "Tube Topics—A Guide for Vacuum Tube Users in a Transistorized World." (Contact the company for a copy.)

EEV displayed its collection of broadcast tetrode tubes, which includes the 4CX5000A, 4CX10000D, 4CX10000J, 4CX15000A, 4CX35000C, 4CV100000C/CY1637, CR1501/YL1430 and CR1502/YL1440. An improved mesh filament design ensures concentricity of the filament, prevents warm-up variations and yields better linearity while reducing noise. The 4C family has a 2-year/10,000-hour warranty and the CR tubes carry a 2-year/4,000-hour warranty.

Penta Laboratories announced the introduction of four new power tube types at the convention: the PL4-400CG, PL-8349/4CX35,000C, and 4CV100,000C tetrodes and the 5CX1500C pentode. Penta manufactures an expansive line of broadcast and communications tubes, and can provide custom engineering services.

RCA Broadcast/GE Support Services

offers a variety of products and services that support RCA studio and transmitter equipment: equipment conversions and upgrades, refurbished equipment, maintenance agreements, replacement parts, spare-parts kits, technical seminars and field service.

Uninterruptible power supplies (UPS) and voltage regulators were on display at the **Superior Electric** exhibit. The UPSY Series of UPSs are intended to protect sensitive equipment such as computers from voltage fluctuations and noise, and provide a source of battery backup power. The WHR Series of STABILINE voltage regulators provide a constant output voltage despite wide input voltage and system load variations. The Superior Electric WHR Series maintains the output voltage within ±1 percent, offers a typical efficiency of 99 percent, does not distort the waveform, responds quickly, and can be supplied in configurations from two to 1680 kVA.

RBDS products

AEV was displaying its RDS products: the RDSI 3800 radio identifier, the RDSM 3900 midi coder and the ERDS 3100 radio data coder. The RDSM 3800 is programmed during manufacture or field modified using an available RDS-KEY programming keyboard. The RDSM 3900 is designed to be programmed by an external PC or AEV's RDS-KEY keyboard.

The ERDS 3100 radio data coder offers an exclusive data channel that supplements the RDS channel; an autotracking circuit automatically maintains synchronization with the 19 kHz pilot, and a keyboard, RS-232 interface, and visual display are included.

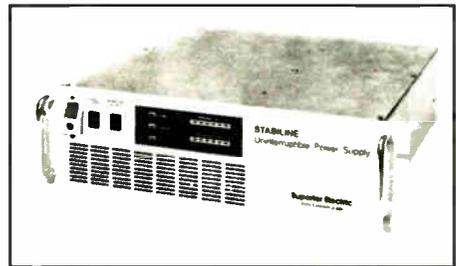
An entry-level, upgradable RBDS system will be available from **Inovonics** in the fall. Its RBDS data encoder/subcarrier generator, Model 710, uses EPROM to statically store data such as two-letter ID and alternate frequency. A plug-in RS-232 board will allow full dynamic operation and control via an external PC. The circuit-

ry for the Model 710 was designed by **Phoenix Communications** in Britain. Inovonics is marketing the product worldwide.

Inovonics was also demonstrating its new off-air FM modulation analyzer, the Model 530. A laboratory-grade FM receiver and highly-accurate demodulation and metering circuits provide LED bar-graph read-outs of total modulation, positive and negative deviation, left and right channels, L+R, L-R, 19 kHz pilot, 38 kHz residual, multipath and RF signal levels.

The Model RDS-1 from **Modulation Sciences** is an RDS coder supplied as a plug-in card for any IBM-compatible PC. This approach allows broadcasters to construct a low-cost, entry-level coder. Parameters or data can be scheduled to change automatically based on time of day. The system can be reconfigured manually using the host PC or from a separate PC using included RDS-Remote software.

RE America was demonstrating two RDS/RBDS coders at its booth: the RE



Superior Electric's uninterruptible power supply

531 and the RE 533. The RE 531 uses electrically-erasable programmable read only memory (E²PROM), which allows frequent default data changes. An included interactive software package permits programming via an external IBM-compatible PC. The RE 533 is a RDS/RBDS low-cost coder that operates as a stand-alone unit

without a PC. Sixteen data records can be stored in non-volatile memory and a "live mode" allows dynamic control.

The DMC 01 radio data codec is a third-generation RDS coder from **Rohde & Schwarz**. Available as a bench model or with 19-inch adapters, the DMC 01 is favorably priced and combines RDS coder and decoder functions.

S.C.A. Data Systems exhibited the RD-57 RDS generator. A DSP-based modulator is used to minimize spurious noise and distortion; default data is stored in non-volatile memory; a front-panel keypad and back-lit LCD permit stand-alone programming, and an RS-232 port is provided for remote programming. A built-in pilot and injection monitor simplify setup.

Two models of RDS encoders are available from **Teli**: the ZRZA 80201 and the ZRZA 80205. ZRZA 80201 is a second-generation encoder, designed for stand-alone operation or as part of a nationwide RDS network system. The heart of the CPU board is an 80188 processor with external EPROM and RAM. An optional control processor demodulates the FM signal, verifies data contents, and checks deviation and phase of the 57 kHz subcarrier relative to the 19 kHz pilot.

The ZRZA 80205, an economical alternative, operates as a standalone encoder transmitting static RDS data. However, when connected to an IBM-compatible PC, the ZRZA 80205 is capable of transmitting all RDS data types as defined by the EBU.

VG Electronics showed three models of RDS coders from its VGE 1076 Series. An entry-level version, a basic, static RDS coder, is available as the VGE 1076E. The VGE 1076D is a fully dynamic model that includes a display; the VGE 1076ND is the non-display version.

□ □ □

Dennis J. Martin is chief engineer for KBIG-FM Los Angeles, and an occasional contributor to RW.

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Programs More than Music to Ears

by Mary Ann Dorsie

LAS VEGAS Program and automation services, which cover a range of items from allocation maps to music libraries to satellite services, made a healthy showing at this year's NAB.

Dataworld introduced its LMA/DUOPOLY study, which is available 24 hours a day via the company's on-line computer system.

After initially accessing the study, the program will ask for the number of stations in the proposed LMA or duopoly. Up to 10 stations can be proposed. The first data items retrieved by the program are the facility records for the proposed LMA stations.

Then it retrieves and prints all geographi-

cally "close" stations and determines one of the following scenarios: if the station is included in the LMA market because its transmitter site is in one of the proposed LMA station's contours; if the station is included in the LMA market because of overlap of its city grade contour with one of the proposed LMA station's city grade contour; if the station is not part of the LMA market because of FCC rules.

Dataworld also showed its FM allocation map book for each of the frequencies from 88.1 MHz through 107.9 MHz. The two-page book consists of full service facilities and translators and boosters.

Format mix

TM Century's libraries include the AC Library, the AC Lite Library, the TM Mix

and TM Country.

The TM Mix includes 897 titles on 47 CDs, with a mix of formats. The TM Country library includes over 800 titles on 44 CDs.

All libraries utilize no-noise processing. Over 3,000 libraries have been sold within the last six years, with 4,000 stations using TM Century's libraries or products.

Manhattan Production Music had its 5-CD set sound effects library on hand, with all effects digitally recorded in stereo.

It's produced with 128 times over sampling, and recorded on a single point stereo. The library contains over 20 genres, and clients receive from six to eight CDs per year.

All discs offer more than 60 minutes of material based on a theme, with almost

every selection pre-edited into four separate time cuts from 10 seconds to 15 minutes.

The **Network Music Library** showed its diverse library, composed of music for business, sports, contemporary productions, solo instruments or specialty, seasonal or comedy styles.

Each month, the company releases a new CD. The new releases often reflect current events such as the Olympics, political elections and holidays.

The library also includes the multiple-edit concept for production libraries.

Halland Broadcast Services Inc. has a variety of CD music libraries. "The Eighties Plus" series has 800 songs on 46 CDs. It includes music from 1980 to 1993, and is updated periodically.

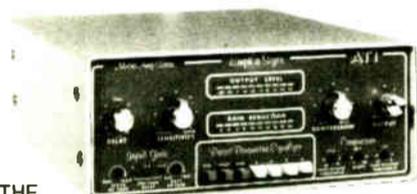
The "Seventies Gold" library contains songs from 1970 to 1979. It contains 545 songs on 30 CDs.

continued on page 78 ▶

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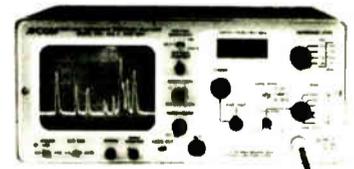
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SCPC-2000E SCPC Satellite Receiver - \$1875

AVCOM's Single Channel Per Carrier Receiver, model SCPC-2000E, has been developed for the reception of FM SCPC signals from satellites operating in the 3.7 to 4.2 GHz band. The SCPC-2000E is a complete receiver that can tune up to 4 specific crystal controlled audio or data channels from a given transponder and adapt to a variety of de-emphasis requirements. The SCPC-2000E is available in either wide or narrow band models and may be used with the SS-1000 (\$1027) Slave for simultaneous reception of additional channels.

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READER SERVICE NO. 100

STL and EBS Gear Follow FCC Timetables

by Dee McVicker

LAS VEGAS The upcoming STL compliance deadline and the advancement of digital were very much in the limelight at this year's NAB convention, bringing into focus STL, telco, RBDS and remote control equipment.

In the STL arena, digital played a starring role at the **Dolby**, **Moseley** and **TFT** booths. Along with its established digital STL system demonstrating two audio and two auxiliary STL channels in a 250 kHz occupied bandwidth, Dolby announced a new digital STL for carrying four audio channels and two RS-232 data ports. The new digital STL is targeted to LMA or duopoly arrangements, and will be available for delivery late in the year. Dolby also introduced a hot standby unit for analog or digital STLs.

TFT Inc. demonstrated its DMM92 series digital STL modems/multiplexers, and announced two new units in the series. One packages 128Kbps stereo over any mono STL and another packages 64Kbps over a conventional RPU. The company had introduced the first in the series last year, which is available as an add-on to existing analog composite STLs for increasing SNR or STL paths and is available in four channels as well as two channels. The new products in the series will be available by the end of the year.

TFT also showed a prototype of its Model 911 EBS system, a multimedia device for directing emergency information. The unit is not available for delivery yet and is awaiting an FCC notice of proposed rulemaking to modernize EBS.

Moseley showed a new version of its digital STL system. The new DSP 6000 STL version now occupies less than 300 kHz bandwidth for two full stereo channels and a data channel, while maintaining the same robust characteristics it had previously carried in 500 kHz bandwidth. The unit is available in T1, 950 MHz and 23 GHz configurations.

Moseley also introduced a touch-screen interface for its MRC remote control products and a new PCL 6000 16-channel STL, which will be available in August.

Marti debuted its frequency-synthesized STL-15C STL system for the 140 MHz to 960 MHz bands, which is available now and listed at \$6,495. Marti also announced a new SC-48 four-inch parabolic STL antenna, which is available now and is listed at \$800.

The new Q-MAX, a plug-in module for its CAT-LINK STL/TSL, was prominently on display at the **QEI** booth for engineers considering 15 kHz discrete audio over DS-1 phone circuits. The module is now available and listed at \$1,500. QEI also introduced its Auto-Mod at the show, a closed-loop FM composite modulation controller for remote control of modulation levels. The unit is listed at \$1,295 and is in production.

Broadcaster interest was definitely on display at the **RE America** booth, where the company showcased live broadcasts from 10 Las Vegas stations who are running RBDS for format scanning and sending advertising text to "smart" receivers.

Featured in the display were the company's full-featured RBDS coder and new streamlined RBDS coder. The new streamlined RE 533 RDS/RBDS is listed at \$2,415 and is available now. RE America also introduced an ISO/MPEG

Layer II/IIA audio codec at the show for ISDN/switched 56 backhaul lines, and the unit is expected to be available in August.

The new SC-100 RBDS coder was also shown at the **Circuit Research Labs** booth and is expected to be available by the end of the year for under \$3,500. **Modulation Sciences** and **Teli** also showed their RDS/RBDS coders during the show, as did **VG Electronics**.

CouponRadio demonstrated its coupon-generating receiver utilizing RBDS, and **Acess Paging** featured a nationwide paging network, also utilizing RBDS.

Switched 56 and ISDN came of age at

this convention with new showings at several booths. **Telos** introduced an ISDN terminal adapter with ISO/MPEG Layer III codec built-in. The unit, called Zephyr, is capable of transmitting 15 kHz stereo audio on a single dial-up ISDN line and will be available by the end of the year for under \$6,000.

CCS Audio Products introduced the CDQ-1000 codec for sending 10 kHz audio over one digital telco line, which is available now at around \$3,000. The company also showed its established codec products CDQ-2000, Micro 56 and Micro 66i.

Comrex showed its portable DX-P

codec during the convention, and **Audio Processing Technology (APT)** showed its DSM100 six-channel inverse multiplexer using an apt-X codec with a new synchronous option, which is available now. APT also showed a new ISDN terminal adapter, which will be available this summer.

J.N.S. Electronics introduced a new digital multiplexer for ISDN or T1 applications, which is available now, and showed three new modules for its modular 8000 series rack frame. One module functions as a line amplifier, another as an FM detector to alert for signal loss, and

continued on page 78 ▶



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Circle (53) On Reader Service Card

Easy Street for Hard Drives, Automation

by Barry Mishkind

LAS VEGAS For many years radio stations running automated programming relied on racks of tape reproducers or converted juke boxes as sources. Today's automation could hardly be more different. Based on computers and hard drives, the various automation systems shown at the NAB's 1993 show truly are a new breed.

Yet, automating the program is not all these systems do. Everything from production to traffic and billing to transmitter control can be integrated as a complete package. You can also mix and match the various products and design your own system.

One of the biggest changes in automation over the past 10 years has been satellite program delivery. Stations choosing this option also benefit from the recent advances in digital audio storage.

Some similarities

Most of the products displayed shared the basic similarities of hard-disk storage, the ability to import information from various traffic programs and to operate as "live assist" or to totally automate a station using multi-CD players or other audio sources. Most support mouse and/or touch screens for control.

Register Data Systems' The Phantom offers several different compression options, extending the storage capacity depending on a station's needs. The Ultimate Digital Studio is designed to make the most of **TM Century's** CD libraries in a live-assist environment. Special attention is paid to timing of each element.

The Management showcased its Digital DJ, a product that includes features such as apt-X™ compression technology; simultaneous record/play, and programmed background recorder option.

Computer Concepts was one of the first to develop complete computer-driven systems. Its Digital Commercial System is evidence of continuing efforts to make the entire system easier to use and more complete and user friendly.

Radio Computing Services' Master Control has several interesting features for stations that want all the important information ready without changing screens. Master Control consists of three video terminals, including one just for live copy. Since it runs on a network, the system can be set so anyone in the station can check the log and edit copy.

PCs as brains

Broadcast Electronics' AudioVAULT now is capable of running as many as

four separate programs from one PC, utilizing multi-CD players and BE's new Disc Trak digital cart machines.

The DigiCenter from **International Tapetronics** uses screens that nicely emulate cart machine controls, making the "feel" comfortable to users. ITC also has taken an aggressive stance on customer support, providing 24-hour assistance and the ability to directly connect to your system for quick diag-

nosis of problems. ITC will also supply kits for expanding the system for those on a tight budget.

Another system with screens that compare to the cart environment is **Enco Systems'** DAD486x, which can display 144 audio events in blocks of 48 buttons. The DAD486x allows instant access to any element you may wish for maximum flexibility.

Improved packages

Arrakis showed another complete station package, made up of the Digilink

Satellite program delivery/acceptability is one of the biggest changes in automation over the past 10 years.

and **Trak*Star** systems, which take audio from multi-track recording in production to a versatile on-air system at an economic price.

At **Harris Allied**, there was a variety of digital automation systems including the **Gentner Audisk** system. Harris said it has sold more of these systems than any other suppliers combined. **Gentner** also displayed the system at its own booth.

Basys showcased the D-Cart multi-user digital audio recording/editing system and the **Newsroom Automation System**.

Broadcasters General Store exhibited automation systems including the **Rodman/Brown & Associates Desk Jockey**, while at a separate booth **Rodman/Brown** also displayed the **Desk Jockey Lite** version.

A-Ware highlighted its **MusicScan** music scheduling and inventory system (distributed in the U.S. and Canada by **Tapscan**) with new features including improved policy flexibility for unlimited format level combinations; hour rotation for titles, artists, and versions of the same song by different artists; enhanced scheduling of "two-fers" and other special sets; and new library-wide editing options.

Concept Productions demonstrated the **Computer Assisted Programming System (CAPS-CD)**, a complete storage and playback system for live or automated radio operation. Music is on CDs; spots, liners, PSAs and voice tracks are on digital hard disk. PC-based software is easy to use and menu driven with single key commands. It interfaces easily to popular traffic and music scheduling systems.

Alden Electronics promoted the **ALRAD II** software, a DOS-based program for receiving, storage and display of all **National Weather Service WSR-88D Doppler Weather Radar NIDS** products.

Datacount released its multi-station version of **DARTS** that addresses a single system for operation of up to eight stations. It is tailored exclusively for multiple station ownership.

Time Logic exhibited the **AirWave** radio automation system for fully automated or live assist that can be combined with satellite feed as well. There is unlimited walk away with 576 CDs on line, 64 cassette players and digital audio record/playback from hard disk.

Salespeople are sometimes suspicious of computer programs because they feel such programs take pricing control and flexibility away from them, Henderson said. But there are ways to adjust the programs to fit an individual station's needs, she said.

"I'm no computer expert and my learning curve may be longer than a lot of people's," she said. "But I've passed from crawling to crawling fast in just a few months."

Maximize Your Ad Sales Using a PC

by Randy Sukow

LAS VEGAS Radio stations traditionally do a poor job of pricing their product, agreed a panel of station managers during a National Association of Broadcasters/Radio Advertising Bureau session. But the tools exist—namely personal computers and well-written commercial software—to set reasonable rates.

A radio station ad inventory may be sold out, but yielding little profit because the product is absurdly underpriced. In other cases, a station may have trouble selling for a particular day or daypart because of the inflexibility of the rate card.

"If you want a test of how bad we are, let me suggest that you try this," said **Arnie Rothschild**, vice president, sales, **WHAM(AM)** Rochester, N.Y. "Go to your sales manager and say: 'Explain your pricing policies.' He probably won't know." What's "real scary," Rothschild said, is asking customers the same question.

Create a system

Yield-management computer programs go a long way toward creating a system, the panel said. Such programs analyze the latest and historical ratings numbers, audience demographics, past pricing patterns and several other variables to predict where prices should be months in advance for each daypart and potential client.

"A pitch in writing is more believable. Well, a pitch in writing produced by a computer is even more believable," said

James Freeman, consultant of **Canoga Park, Calif.** "When you have something to fall back on that's not only in writing but produced somewhat scientifically, it makes it that much more intelligible."

KLAS-TV Las Vegas began using a yield-management program a few months ago, but is already seeing "the numbers are definitely going in the right direction," said

Andy Henderson, general sales manager.

A dramatic case in point, Henderson said, was the sale of availabilities for this year's **CBS-TV** coverage of the **National Collegiate Athletic Association** basketball tournament. "We have faced a pattern of oversells and sold-out areas for the past several years. We felt every year we sold out too quickly and left revenues on the table," she said. "This year we still had five sell-outs, but at elevated rates that were not too high to prevent maneuvering competitively."

Some stations have lost control of their pricing to the advertising agencies and unreliable **Arbitron** figures, said **Muriel Funches**, general sales manager, **KLOL(FM)** Houston. "I can't think of another industry that lets the buyer price the product. Do you think you could check into **Caesar's Palace**, request a suite with a pool-side view and get it?" In-house computer analysis allows stations to take back control, she said.

Political ad regulations

Yield management also can be useful for a station charting the treacherous





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Digital and Analog Boxes Shown on Exhibitor Floor

by Jeff Loughridge

LAS VEGAS Signal processing equipment manufacturers and distributors shipped a wide array of established, new and redesigned products for display at the 1993 NAB equipment exhibition.

Yamaha showed the new SPX990 digital effects processor, the Q1131 Graphic Equalizer, and the GQ2015 stereo graphic equalizer.

Eventide introduced the DSP4000 Ultra Harmonizer, the H3000 Ultra Harmonizer, and several broadcast delays.

Others dealing in delay: **Audio/Digital** with its TC-4 and PAD300 delay units and **Mark IV Pro Audio Group**, which is marketing the **Klark Teknik** line of delays and other processing equipment.

The Project I series of processing systems, including the 266 dual compressor/gate and 274 expander gate

were introduced by **AKG Acoustics**, which also showed the new 120XP subharmonic synthesizer.

GML Inc. showed its Model 9100 and HRT-9100 line level audio mixers. The 9100 is a rack mountable unit. A portable mixer was shown by **AEQ**.

Benchmark Media Systems showed its Junior Audio Director routing switcher. **Datatek Corp.** showed the D2540 Digital Audio Router available for 10x10 or 40x40 systems. **ADC Telecommunications** displayed its digital-ready Digital Audio Patch bay family. **Arrakis Systems** showed its established RS router family.

Distribution amplifiers were displayed by **ATI**, **J.N.S. Electronics Inc.**, **Excalibur Electronics**, and **Radio Design Labs**. **ATI** showed its new line of rack frame-based System 10000 modular DAs, including the LA1000 and MA1000.

J.N.S. Electronics, Inc. showed new additions to its rack frame-based 8000 series including the SDA.8075 and SDA.8225 distribution amps, and the VCA.8292 Voltage Controlled Amplifier.

Excalibur Electronics displayed its CDA-1 composite distribution amplifier, along with the DA1-5C and DA2-5C audio distribution amps. **Radio Design Labs** had its line of stick-on modules, including the ST-DA3 one-in-by-three-out DA, at the NAB show. **Asaca/Shibasku Corp.** and **ADM Systems** showed established lines of distribution systems.

Microphone Processors and pre-amps were displayed by **ATI**, **Orban**, **Air Corp.**, **Symetrix** and **Radio Design Labs**. **ATI** has added mic pre-amps as modules for its system 10000 rack frame-based modular system.

Orban displayed the 787A programmable mic processor and **Air Corp.** displayed its 500PH mic processor for studio and production use, now offering a built in Phantom supply. **Symetrix** displayed its 528 mic processor, featuring compression, noise gate, and parametric EQ and the new 601 digital voice processor. **Radio Design Labs** had the STM-2 stick-on mic pre-amp, offering one input and two outputs.

AKG Acoustics' BSS showed its line of mic splitters and **Altec Lansing**, a Mark IV company, showed the 1674C automatic mic mixer.

Noise Reduction units took many forms this year. **Symetrix** displayed the 511A single-ended noise-reduction unit; **Radio Systems** displayed the new RS2 noise-reduction system, capable of increasing signal/noise ratios by up to 24dB, and **Circuit Research Labs** displayed the Dynafex Noise Reduction unit, the DX-2.

Dolby Laboratories introduced the Dolby Spectral Processor, which can raise low-level signals by up to 20 dB without affecting the high levels.

On-Air processors kept an unusually low profile this year. **Circuit Research Labs** displayed its line of FM and AM systems, including the budget-priced Amigo FM, a single-rack-space processor and stereo generator, and the Amigo AM a similarly priced one rack space AM processor.

Orban FM and AM processors, including the 9100B AM processor; the 8100A/1 FM processor and Stereo Generator, and the 8200 Digital Processor and Stereo Generator were on hand.

Aphex Systems introduced the DigiCoder, a digitally controlled stereo generator designed to work in combination with other Aphex products or separately to provide better on-air quality. Aphex also displayed the Compellor, Dominator II, and Aural Exciter with the Big Bottom. With bottom-end controls labeled "Girth" and Overhang," you might have protests from the local Weight Watchers, in addition to a bigger bottom on the air.

Gentner displayed the Audio Prism II digitally controlled analog processor and the Lazer, a 100-percent digital stereo generator and processor. Future improvements to the Lazer and Digital Prism are to include remote control by PC, further refinement of the processing structure, and software development.

Cutting Edge displayed the new look and sound of the Unity 2000 processor and stereo generator combination. The unit sports a completely redesigned user interface and front panel. Internal improvements include a linear response algorithm for a more musical high end.

The Unity 2000 went head-to-head with its competitors at the Telos Systems booth, where the Dividend composite filter also has a new look, with improved performance for SCA and RBDS use among others.

Modulation Sciences again showed the StereoMaxx spectral image processor and CP-803 composite processor. **FM Systems** had its Audio Level Master 673 stereo and dual mono level control system. **Dolby** showed its DP 90 digital encoder and SDU4 Surround decoder.

UREI introduced a modular signal processing system mic and line mixers, compressors and other components. **AKG's dbx** displayed its established line of audio processors.



USER REPORT

ERI Goes the Distance for KOIT

by Randy Pugsley
and John Buckham
KOIT-AM-FM

SAN FRANCISCO The San Francisco radio market is unique, to say the least. The FM broadcaster is faced with scenic beauty that translates into a great deal of "unfriendly" terrain for FM signals.

People who visit the San Francisco Bay area are always amazed to find many of the pre-set buttons on rental cars set to AM radio stations. Who said AM was dead?

When KOIT-FM was looking to replace the antenna, we had a number of goals in mind. We wanted to make a marked improvement to our in-car signal, and reduce the levels of downward emissions and the required TPO to help save energy costs.

Premium selection

These edicts dictated a higher gain antenna, but because our antenna is located in a community where antenna site space is at a premium, a physically larger antenna was clearly out of the question.

Another area station, KFRC-FM, had installed one of the new ERI half-wave antennas. Although the antennas were on a different site with different circumstances, the station was having extremely good coverage with the new antenna.

After discussing the matter with KFRC-FM's chief engineer, we decided to give ERI a call to see what the company could do for us. ERI was pleased to discuss the merits of both the half-wave space antenna and something new, the LAMBDA mounting system.

First, it was explained that a six-bay

half-wave higher gain required a marked reduction in transmitter output power to produce the same ERP. As a bonus, the new half-wave design would reduce downward emissions substantially, aiding in compliance with ANSI guidelines and



ERI's antenna provides KOIT-FM with a better overall signal, reduced downward radiation and higher gain.

reducing neighborhood RFI complaints.

Second, the company told us the LAMBDA mounting system is a custom tower section sized to optimize the pattern of the antenna system.

We decided the half-wave antenna mounted with ERI's LAMBDA mounting system was just the answer to our antenna decision.

On delivery day all the parts of the antenna and mount system were brought to the transmitter site by the ERI truck. When we unloaded, we found all the parts to be in order and the quality of the antenna, custom mounting bracket and LAMBDA section to be superb.

Ready for setup

It was just what we ordered, and it was easy to install on the 1,000-foot Sutro Communications tower, which serves four FM stations and virtually all of the San Francisco television stations.

The parts were hoisted 700 feet up the tower and assembled by the excellent Doty-Moore tower crew. While they were assembling the antenna, we changed the transformer taps in our transmitter for the new lower-transmitter power output.

The real magic came when we applied RF to the new antenna system. Reflected power was almost zero. ICAM (synchronous AM noise) was lower than before. And when we got in the car to test drive the new signal, the radio began to play when the ignition was turned on.

Strong signals

Once we were on the road, the most noticeable difference was a marked reduction in multipath. Gone was the "picket fencing" effect that was so pronounced with the old antenna system. As we drove farther from the transmitter site, the signal remained. Even when we were 50 miles from the city, it was just as clean and strong as before.

This is due to the higher gain and better control of the vertical radiation pattern afforded by the half-wave design of the

antenna system. Even our listeners noticed a difference: the KOIT-FM signal was delivering better than ever before.

To recap, the new ERI antenna system provides KOIT-FM with a better overall signal, reduces the downward radiation significantly and costs less to run, thanks to its higher gain.

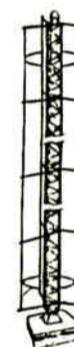
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Randy Pugsley is the KOIT-FM's chief engineer and John Buckham is assistant chief engineer.

For information, contact David Davies in Indiana at 812-853-3318; fax: 812-858-5709; or circle Reader Service 180.

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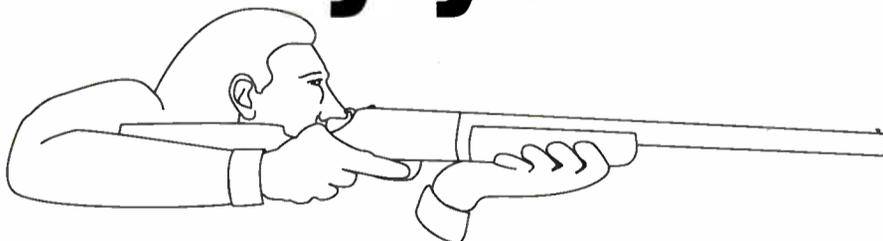
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USER REPORT

Will-Burt Extends WNCO's Reach

by Michael Hayward
Chief Engineer
WNCO-AM-FM

REPUBLIC, Ohio We constantly do remotes from diverse locations, so we need a way to set up and tear down quickly with as little wear and tear on the equipment and operators as possible. Time is an important consideration as well, because several remotes can often happen in the same day from distant locations.

Our solution is a mobile, self-contained radio station, complete with tower. We built a small studio in a van, including three RPU transmitters for simultaneous remotes on both stations and in stereo if needed. Then we installed a Will-Burt TMD-7-34 pneumatic telescoping mast. It gives us both speed and range.

Quick setup

The Will-Burt TMD-7-34 is an aluminum mast that extends to a height of 34 feet in seven telescoping sections when filled with compressed air. With the Will-Burt mast in the van, we can pull into a parking space and be on the air in the time it takes the mast to extend itself, usually three to five minutes.

With the 34-foot height on the mast and the receive antenna 200 feet up the sta-

tion's tower, remotes as far as 50 miles from the station are no problem. The air compressor operates from a 12VDC power supply.

On top of the mast we have a horizontally-mounted Yagi for the VHF Marti. About two feet below that is a five-foot long crossbeam. We have vertically mounted Yagi antennas for each of our two UHF Martis at the ends of the crossbeam.

The antenna cables are fed through coiled tubing, which spirals down the length of the mast. When the mast is fully retracted, the cables are neatly looped around the base of the mast.

Taking aim

A set of periscope-type handles are mounted on the mast inside the van. These allow us to aim the beam antennas toward the station. The mast will turn in a 360 degree arc, so the van can be parked at any heading with the antennas aimed at the station. The mast direction can be adjusted at any point of extension.

The mast has seven sections. We mounted ours in a Ford van body with an extended top, like the ones used for ambulances. We put it just behind the driver's seat, centered left to right.

The compressor is mounted just behind the driver's seat, and the controls are

mounted on the left side of the driver's seat mount. This allows the operator to run the controls from outside the driver's



The Will-Burt TMD-7-34 pneumatic telescoping mast extends to a height of 34 feet in seven sections.

door, making sure it doesn't hit any obstructions on the way up.

In the name of safety, we put a switch on the dash to disable the compressor

when we don't want to raise the mast.

Lowering the mast after the remote is completed is easy. Releasing the air causes the mast elements to telescope back in on themselves. This usually takes less than two minutes, so we can be back on the road and on the way to the next remote quickly.

A rocking issue

When the weather gets cold and there's ice or freezing rain, we sometimes have trouble getting the mast to come down. The metal surface receives a nice coating of ice, and it doesn't want to close. When that happens, gently rocking the van from side to side breaks the mast loose, and the weight of the antennas brings the mast down.

Condensation will build up inside the mast sections. From time to time, we run the mast up and wipe the outside of the sections with a towel. Then we put a small amount of oil in the weep holes near the top of each section of mast.

Without the Will-Burt mast in our remote van, we wouldn't be able to do remotes at such great distances without sending a crew to put up a remote tower.

And it would take considerable time to set up the distant remote. With the Will-Burt mast, one person can set up and be on the air in less than 10 minutes. We wouldn't be without our Will-Burt antenna mast.

□ □ □

For information, contact Steve Pinkley in Ohio at 216-682-7015; fax: 216-684-1190; or circle Reader Service 72.

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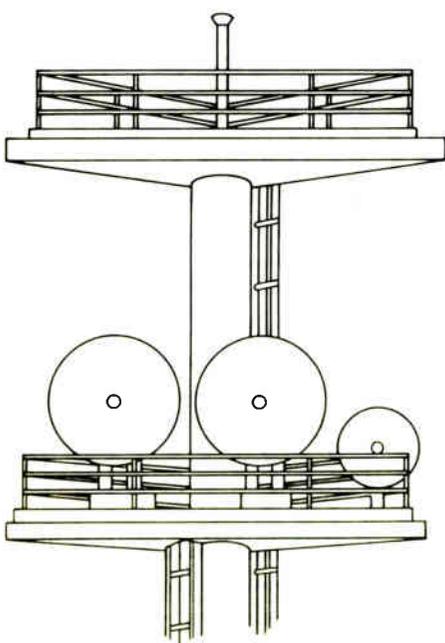
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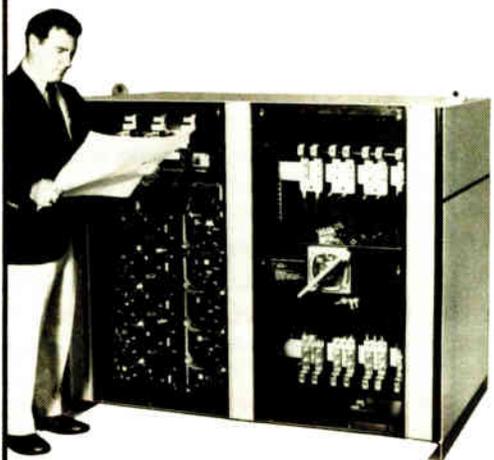
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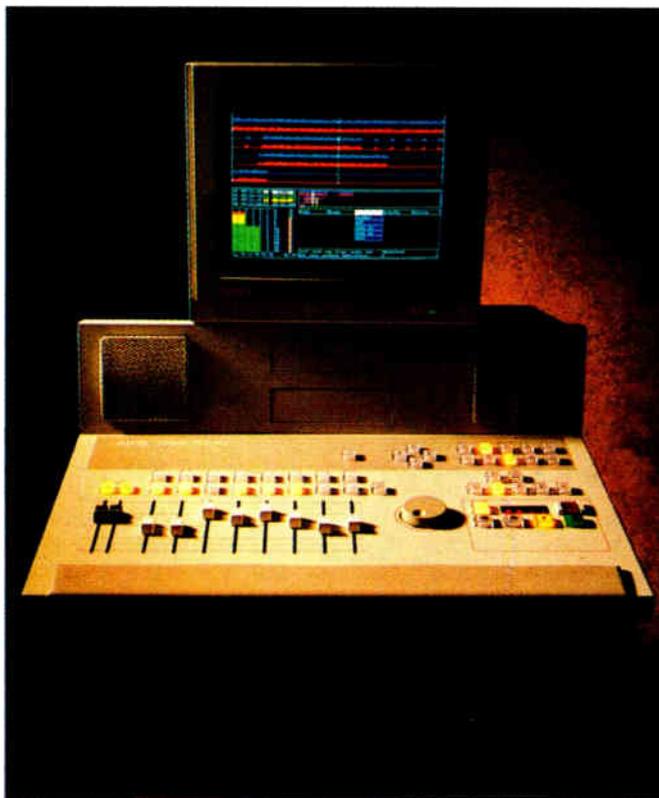
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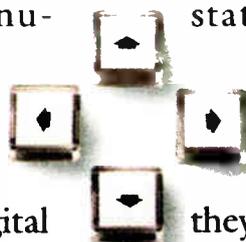
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about a company with over 40 years experience manufacturing professional audio products, who was already shipping a digital sound editor for radio production. Not coincidentally, this system had many of the same controls and functions they were used to.

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USER REPORT

LDL Panel Antenna Delivers for WQDR

by Gary Liebisch
Vice President, Engineering
Curtis Media Group

RALEIGH, N.C. The best FM antennas are those that don't require a great deal of attention or maintenance once they're installed and working properly. And that has been our experience in the two years since our LDL Alan Dick & Co. panel antenna was installed at WQDR(FM).

Early in 1990, joint plans were formed by then-WQDR owner Durham Life Broadcasting and WRAL-FM owners, Capitol Broadcasting, to build a "super tower" to support antennas of the two FM Class C stations and the companies' two TV stations.

... the antenna is the FM station's most important link.

Towers at three of these facilities recently had been destroyed in an ice storm. WQDR was to be the fourth facility, upgrading from a shorter tower several miles away.

Capitol Broadcasting's WRAL-FM and DLB's WQDR were especially challenged by the selection of FM antennas, because this new tower was to have a 12-foot face, making potential pattern distortion a very real issue.

Each FM station would have its own FM panel antenna, and both stations independently chose the Alan Dick & Co. panel array.

Rugged construction

I had the opportunity to view this antenna close up at the 1990 NAB Convention. It's an extremely rugged looking antenna. Manufactured in Cheltenham, England, the ADC elements are large diameter, galvanized steel, and aren't pressurized beyond the feedpoint flange. I like this feature, as it greatly reduces the incidents of lightning punctures and subsequent loss of line pressure.

Each dipole has a glass reinforced radome to protect the feedpoints from icing. The panel screen is made of heavy gauge 8mm (5/16-inch) galvanized steel wire, which easily can withstand the weight of riggers while maintaining good electrical integrity.

The galvanized or stainless steel hardware is metric, and any rigger bidding on installation should be aware of this.

Each antenna consists of eight bays of circularly polarized Spearhead dipole panels, with three panels in each bay. The Spearhead dipole is a pair of halfwave dipoles mounted at 90 degrees to each other.

To produce equal fields in both the vertically and horizontally polarized planes, the dipole arms are inclined at 45 degrees to the horizontal. To produce an optimum beam width of 120 degrees, the arms are angled back by 50 degrees towards the screen panel.

Three types of power dividers are used within the antenna system. One two-exit equal power divider feeds two four-exit

dividers, which in turn feed the six-exit equal dividers for each bay.

Easy reconfiguration

Unequal power division can be accomplished for directional applications, and shared antenna configurations are possible even if only one of the stations is directional. For easy reconfiguration of the antenna in an emergency, 50 ohm impedance is maintained.

There are two 7/8-inch EIA 50 ohm inputs on each panel, which are fed in phase quadrature by two half-inch

50 ohm cables.

Our stations, which elected not to use LDL Communications turnkey services for installation, chose Tower King to erect the tower. But LDL did provide on-site assistance for our rigger, and final proof of performance.

There are actually three ADC panel antennas on the tower. In addition to the two identical eight-bay panels for WQDR and WRAL-FM, Capitol Broadcasting took an unusual step in ordering a three-bay "standby" antenna, which combines both WRAL-FM and WRAL-TV.

These signals are almost 25 MHz apart, yet both stations can operate at full power with negligible VSWR.

The ice storm had no effect on operating VSWR. Next to the transmitter itself, the antenna is the FM station's most important link. The reliability and performance of our ADC antenna scores high in affording WQDR and WRAL-FM the best coverage possible.

□ □ □

For information, contact Jim Wilson in Maryland at 301-498-2200; fax: 301-498-7952; or circle Reader Service 129.



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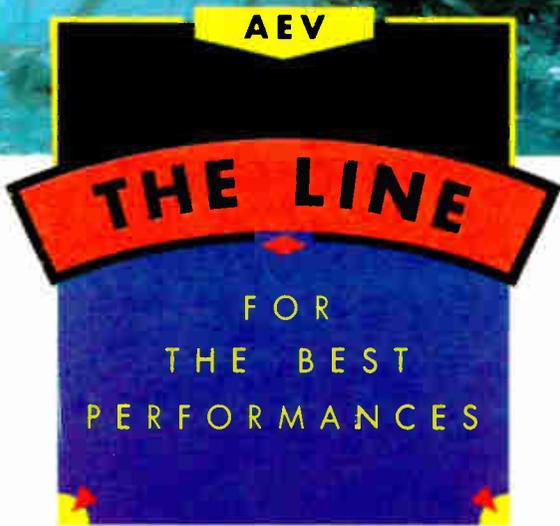
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USER REPORT

Stainless Meets Towering Demands

by John J. Heimerl
Project Engineer
Heimerl & Associates

YORKTOWN, Va. Broadcast engineers don't receive training as structural engineers too often. So when asked to choose the right tower for a new facility, I quickly became an expert on supporting structures—a task made easier when dealing with an experienced tower vendor.

For WRXL in Richmond, Va., the demand was high quality at the best price. The result was a G-7 tower by Stainless Inc. of North Wales, Pa. It was erected by L&R Tower of Suffolk, Va., and R.W. Harris of Largo, Fla., installed the caisson anchors.

The challenge

After exhausting other options, WRXL parent, Capitol Broadcasting, decided to upgrade its existing site. Complicated by co-location with sister AM station WRNL, the 140-kW grandfathered WRXL was upgraded from a 10-bay antenna at 260-feet AGL to a two-bay, 20 kW facility at 730 feet. The co-located 5 kW AM station was redesigned under new AM rules with two towers (rather than three) on the nighttime DA.

One of three 300-foot towers was removed, one was relocated, and a new 749-foot structure was installed for the revised FM antenna system. The rebuilt, original FM system on the non-directional AM tower was left as a backup.

An alliance of experienced company engineers, professional and structural engineers was formed. We also consulted with regional engineers who had faced similar challenges. Input narrowed the bid field to three contenders.

We felt the complexity of the project required an expe-

rienced company and additional independent review. Relatively detailed specification sheets were submitted to the final three fabricators, which still resulted in three distinctly different tower designs.

We chose the Stainless proposal because the company had a long history of dealing with unusual towers. Our structural engineers felt the company's proposal was the most cost-effective, while retaining a good margin of safety and remaining the closest to our original specs. Stainless provided 11 re-bids of the tower structure as the complicated design was finalized.

Tower specifications

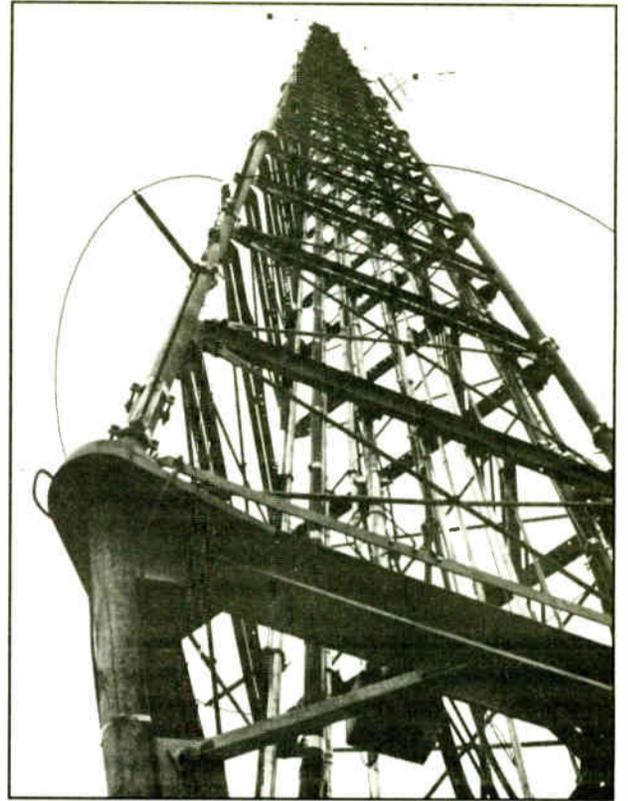
We needed a tower designed to fall within its inner anchors at a distance of 250 feet, yet able to survive the compressive strength of 40 percent guying. We wanted a grounded tower for easy rental installations, yet the guy wires had to be broken up with insulators every 100 feet due to the nearby AM directional array.

We specified a heavy tower, capable of supporting up to four FM antennas, over 40 communications antennas, and two detuning skirts covering almost the full length of the main face. We chose support conduits to efficiently manage bundling of lines.

The tower had to meet both RS-222 D and E standards, with the ability to upgrade if our planned loading was exceeded at any level. For this reason, a "knock-down" (bolt together) style tower was specified.

The insulated guy cables presented another challenge. Racal-Decca worked with Stainless to provide mil-spec CO27 compressive insulator assemblies heavy enough to handle the 1 1/4-inch top guy cables from Wire Rope Industries.

All cable was factory assembled at Wire Rope, pre-stressed and proof-loaded. This meant loops for "john-



The Stainless G-7 tower has paid off for WRXL in Richmond, Va.

ny-ball" insulators on smaller lower guys were factory made (rather than field assembled), so they could be stressed by machine to their required capacity.

When initial machine crimps on insulator loops were not to our liking, Stainless and Wire Rope returned the cables at their expense, re-crimping the ends as needed. This was a big step in customer satisfaction, considering the cost of shipping several tractor-trailer loads of cable from Virginia to Canada.

continued on page 60 ►

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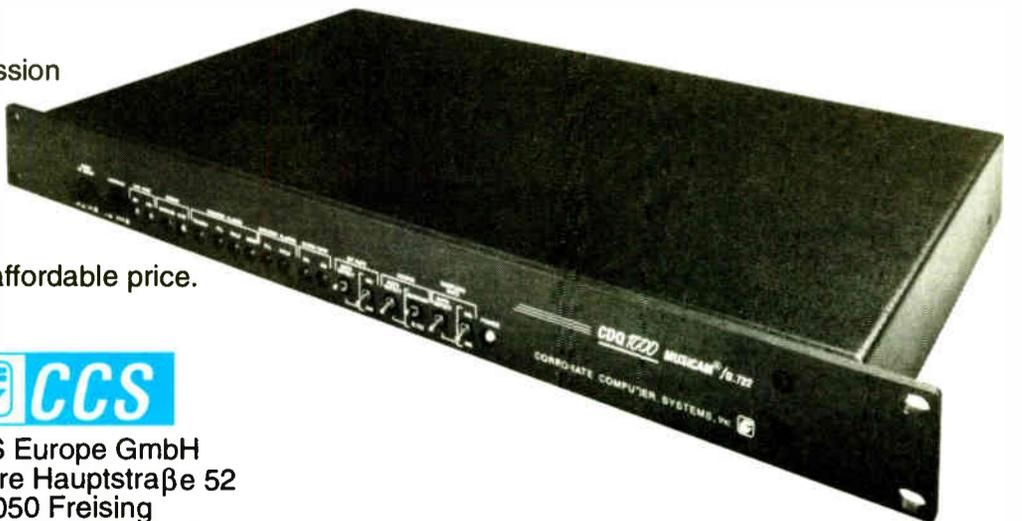
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Stainless Meets WRXL Tower Demands

► continued from page 59

Fargo Manufacturing Co. of Poughkeepsie, N.Y., provided damper assemblies to reduce cable high-frequency vibration or galloping. The dampers, designed for field installation, were clamped on the guys at a specified distance below each insulator.

Damper assemblies

We found installing the dampers to be the most challenging task, because the cables twisted when tensioned, making it hard to uniformly align the dampers. The dampers also formed "snag points" on the lower cables for tag lines. Eventually, we elected to ride the steep cables in an effort to get all the dampers to a final uniform set.

Erector LeBlanc and Royal sent managerial personnel from Canada to provide additional safety training. During this project, new safety climb devices were used by all riggers, including a safety cage and OSHA spec winch. Although increasing the time required to complete the project, the results were a completely accident-free installation.

Local regulations required a dual lighting system to minimize disruption of nearby single and multi-family housing. Modern Technical Service of Brentwood, Tenn., provided the custom lighting controller for the dual F-2 lighting, which was allowed because the main structure extended to only 697 feet, just below the 700-foot breakpoint for an F-3 kit. This Stainless suggestion saved the considerable expense of another tier of high-intensity strobes.

Lighting compatibility

It is always important to have the latest FAA lighting bulletin, and file any unique lighting changes with your 302 so the FCC can check for compatibility. Otherwise, you may find that FCC-issued lighting specs vary somewhat from FAA requirements when

using dual or strobe lighting configurations.

Our lighting includes dual red mid-beacons to comply with the latest rules and Flash Technology medium and high-intensity strobes with downward intensity-reducing blinders, operating at 480 volts to reduce wiring size.

It is also important to make sure all permanent light wiring is properly hung in junction box strain reliefs before powering the system up. It's much harder to go back and correct deficiencies after your

permanent lighting is running.

The tower has been up since June 1992, and Capitol is pleased with its serviceability and profitability. Well on the way to a five-figure monthly rental income and looking forward to a one-year anniversary, the decision to buy the Stainless G-7 has paid off in a big way.

□ □ □

For information, contact David Rodriguez in Pennsylvania at 215-699-4871; fax: 215-699-9597; or circle Reader Service 200.

USER REPORT

MCI's Multiplexer Answer

by Terry J. Dalton
Director of Engineering
Great Scott Broadcasting

GEORGETOWN, Del. When Great Scott Broadcasting received the green light to construct its new FM broadcast facility, WLQE-FM, the thought of finding an adequate transmitter site seemed trivial. But this was not the case.

Located in the southern end of the Jersey shore, WLQE-FM is faced with various geological restrictions such as wetlands, local zoning laws and the proximity of the local airport.

After some in-depth research, the decision was made to combine the transmitter with that of another local broadcaster, and conversely share a common antenna.

This gave birth to another dilemma, the acquisition of a reliable two-station combiner or diplexer. Great Scott's engineering staff had little practical experience with high power combining systems, and as a result, went with the recommendations of its Washington-based engineering consultants.

After corporate's review of the cost, it

was unanimous, Micro Communications Inc. would be building the WLQE-FM diplexer.

Purely a passive device, there is little, if any maintenance involved with Micro Communication's diplexing system.

Upon initial installation, and with aid of a reliable spectrum analyzer, the individual cavities were slightly adjusted to facilitate the lowest possible voltage standing wave ratio (VSWR) and resultant insertion loss. The end result is a VSWR of less than 1.09 on both transmitters and an insertion loss of less than 0.2 dB. The antenna port was also sampled for intermodulation products and proved negative beyond the ninth order. The modest size of the system is also to be commended.

In summation, if not for the yearly inventory list, no one would know this thing existed. It would be nice if we could forget about more of our equipment.

□ □ □

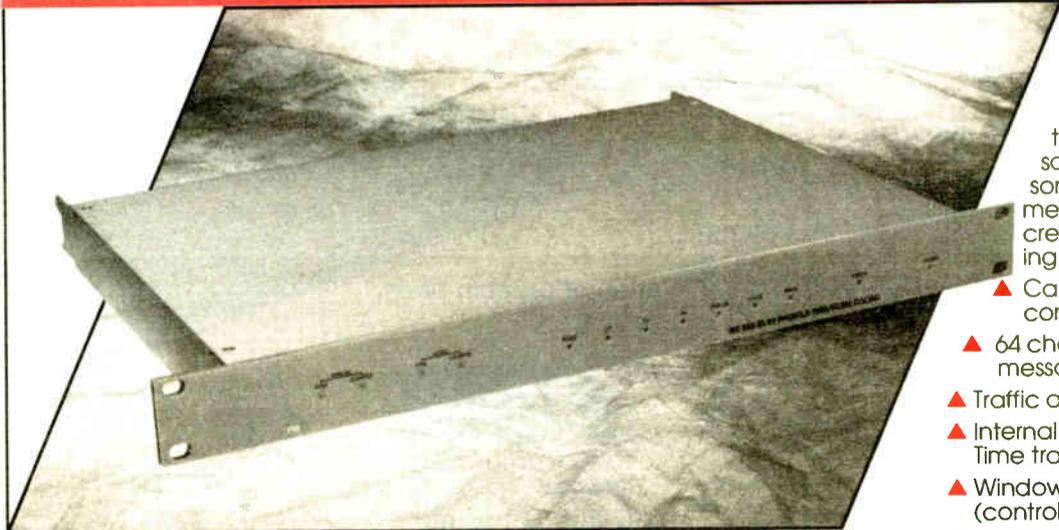
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USER REPORT

Cortana Helps Protect WGLF

by Bill Marriott
General Manager
WGLF-FM

TALLAHASSEE, Fla. When I started looking for lightning protection equipment for the 1,300-foot tower we were building, I had some specific features in mind.

The system had to be simple and reliable, so the average tower crew could install it properly and maintenance could be minimized. After all, any type of maintenance is expensive on a 1,000-foot plus tower when it costs a-dollar-a-foot.

The station also required a low windload so that it didn't force expensive tower design modifications or occupy space rental customers could otherwise use. And the system had to be inexpensive.

Last but not least, the system had to work.

Current protection

The Cortana system meets these requirements. It relies on a simple property of static electricity—that sharp points tend to leak or discharge an electric charge. If you have ever used a Van Der Graf generator at school, you know that it won't develop a good charge unless the surface of the top sphere is smooth.

A pin on the top buzzes as the leaking charge ionizes the air, which disables the generator from creating a big spark. In the real world, with enough well-grounded sharp points, a tower structure can leak enough current to a thunder cloud, keeping the potential difference small enough to prevent a lightning strike from occurring.

The Cortana Stati-Cat SC-1 devices are short aluminum bars covered with 120 sharp, stainless steel spikes attached to large, stainless allthread. You simply attach the other end of the allthread to the tower, using the nuts provided.

Bars are placed at intervals down the tower to maximize charge leakage. A CN-1 (Crow's Nest) is mounted at the top of the tower over the beacon.

The system's low windloading allowed us to ignore it in load calculations and tower engineering.

Safe installation

Installation was easy and safe with urethane foam packing covering the points, which are really sharp.

No system will work properly without a good ground, so we bonded the tower base at the center of a 100-foot ring of buried four-inch copper strap, silver soldered to 10 ground rods.

Does it work? It's very hard to prove. I can tell you that in the two years the tower has been standing, we've had no known lightning damage other than occasional, possibly unrelated, strobe failure.

In addition, I have seen trees split by lightning a quarter of a mile from the tower, which is the only tower of any size for miles. Lightning damage can be very expensive, that's why most stations get insurance. I believe that a prevention system such as Cortana's is just as important in saving downtime and money.

□ □ □

For information, contact David Stockmar in New Mexico at 505-325-5336; fax: 505-326-2337; or circle Reader Service 15.

USER REPORT

Jampro Antenna Serves Texas Outlet

by Bill Cordell
President
Spectrum Engineering Company

HOUSTON One of the remaining few Docket 80-90 FM allocations was completed with the help of Jampro Antennas, Central Tower, and Continental Electronics. The Class C1 facility signed on at the turn of the year.

The owner of Texas Classical Radio hired Spectrum Engineering Company as a general contractor to construct and make functional a 1,000-foot tower and antenna system for KRTK-FM, complete with a space diversity STL system and main studio facility in Cleveland, Texas.

The project went very smoothly, with the exception of the electrical power. It took the electrical co-op more than four

months to install less than four miles of three-phase circuits.

We wound up running the facility for over six weeks on the emergency generator, as we waited for commercial power. The Jampro JHPC-10 antenna was range tested, then placed on the cantilevered antenna spine on the topmost point of the tower.

Antenna aperture

The antenna aperture was free and clear of all items that could distort the pattern. This was one item the owner was adamant about, and as an engineer, I was pleased he would allow us to spend the extra money to keep the antenna aperture clear.

Central Tower of Newburgh, Ind., designed and constructed the antenna spine tower. The tower and crew were great.

continued on page 62 ▶

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USER REPORT

Dataworld Tracks AM Night Sky Signals

by **Timothy Z. Sawyer**
President
T.Z. Sawyer Technical
Consultants

CHEVY CHASE, Md. As a frequency allocation and antenna design consultant, I can appreciate the complexity of the skills needed to provide a computer program that's quick and cost-effective in determining the ability to add a new nighttime AM operation, or modify an existing one. **Dataworld's** new AM Nighttime Study program fulfills this need and more.

The program can be accessed remotely via a computer modem, or the staff of Dataworld can run it out for you and send the results overnight. All you need to run this program are the frequency of interest and the station's antenna location (geographical coordinates).

Quick retrieve

If you're examining an existing facility, the program can retrieve the present geographical location of the antenna system via its extensive databases of operating stations or pending applications.

Once you enter the information, the program will compute the maximum allowable radiation values for all stations requiring protection by the proposed operation. The program

computes these values for both domestic and international stations located in our hemisphere.

The present FCC Rules and Regulations require that we consider the impact of our proposed operation on co-channel stations, first adjacent domestic channels and, if applicable, co-channel international stations. This is a considerable amount of information to process and evaluate, so the computer program is a valuable resource to the engineer.

Night limits

One term mentioned a number of times in this article is RSS Nighttime Limit. RSS is simply the square root of the sum of the squares (root-sum-square) of each value added. For example, if we add 4 to 3 we get 7, while the same addition as a RSS value equals 5.

We use RSS to add the individual levels (contributions) of the interfering signal arriving from each station, and then calculate the various nighttime limits of each station under study. There are two values of interest to us: the 50 percent Exclusion RSS Nighttime Limit and the 25 percent Exclusion RSS Nighttime Limit.

The actual RSS is composed of all the interfering signals and is called the zero percent RSS

Exclusion value, because no signals are excluded from the calculations. Applying a 50 percent (or 25 percent) exclusion principle to the RSS calculation means that each succeeding signal is compared to the Running RSS (subtotal). If it is less than 50 percent (or 25 percent) of the Running RSS, the value is excluded from the RSS.

Station interference

As an example, we have four stations that contribute interference to a station. To determine the amount of signal we can add to a station's RSS

We first rank them in descending order of magnitude. In this example, the order is A, C, B, then D. We next add them in a RSS fashion:

Station	RSS	Percent
A 3.15	3.150	100
C 2.15	4.623	68.3
B 1.28	6.261	27.7
D 1.22	7.749	19.5

A station's nighttime interference free service is calculated by adding the squares of the values and extracting the square root of the sum, excluding those

between the United States and the foreign country.

Next step

Now that we have the 50 percent and 25 percent RSS Nighttime Limits for each station requiring study, it's time to compute the maximum allowable radiation for each station. The program now branches to three different calculations for each station requiring study.

The first task is to determine where our present operation ranks in the nighttime limit of each station. If our proposed operation is a new facility, there's no problem because we're not contributing to anyone's nighttime limit.

But if we wish to improve the facilities of an existing station, we must decide if we are above the 50 percent RSS Nighttime Limit or below the 25 percent RSS Nighttime Limit of the station. If we're already at the 50 percent RSS Nighttime Limit or greater of a domestic station, we must reduce the amount of radiation we presently radiate toward that station by 10 percent.

If it's a foreign station, we can remain at the same level of radiation. If we are somewhere between the two limits (50 percent and 25 percent), no increase in radiation is allowed, nor is a decrease required.

If the station is a foreign station, we can increase radiation toward that station up to half of the 50 percent RSS Nighttime Limit, or the value of the smallest contributor to the present RSS Nighttime Limit, whichever is less.

If we are below the 25 percent RSS Nighttime Limit of a domestic station, we can increase our level of radiation toward the distant station up to the 25 percent RSS Nighttime Limit of the station under study.

Dataworld's program handles this very nicely for you, flagging each station as to whether we must remain the same or reduce our radiation in the direction of the station being studied. If we can increase the radiation toward the station being studied, the program will compute the amount of skywave radiation that may be radiated by our proposed operation in the pertinent azimuth and vertical elevations.

The amount of information provided by this program could overwhelm the non-engineer, but it is presented in an orderly manner and should be understandable to those with a basic knowledge of AM nighttime allocation procedures.

□□□

For information, contact **John Neff** or **Bob Richards** in Maryland at 800-368-5754; fax: 301-656-5341; or circle **Reader Service 145**.

All you need to run this program are the frequency of interest and the station's antenna location.

Nighttime Limit, we must first find the 50 percent Exclusion RSS Nighttime Limit and the 25 percent Exclusion RSS Nighttime Limit of the distant station.

We've determined that the signal levels (after applying the appropriate protection ratios) from other stations to the station that we are interested in are as follows: Station A, 3.15 mV/m; Station B, 1.28 mV/m; Station C, 2.15 mV/m; Station D, 1.22 mV/m.

signals that are less than 50 percent of the RSS values of the higher signals already included.

We excluded the contributions from stations B and D to arrive at a 50 percent Exclusion Nighttime Limit for this station of 4.623 mV/m. This type of calculation is known as the Exclusion Method, and it's how we determine the Nighttime Interference Free (NIF) contour value for a station.

For the 25 percent Exclusion Nighttime Limit, we exclude those signals that are less than 25 percent of the RSS value of the higher signals already included for a value of 6.261 (station D is excluded).

The 25 percent Exclusion Nighttime Limit is now considered in all domestic studies as the value new stations cannot exceed as a contributor to the Nighttime Limit of existing domestic stations.

Further exploration

If you are interested in exploring this in more detail, Section 73.182 of the FCC Rules and Regulations and Mass Media Docket 87-267, Appendix C, provides examples of sample calculations.

Consider the following: to compute the maximum allowable radiation toward a distant station, we must first find the present 50 percent RSS Nighttime Limit, and the 25 percent RSS Nighttime Limit of the station.

That's not too bad, but if this is a domestic station, all the signals from both foreign and domestic first adjacent channels must be added in before you begin calculating.

If it's a foreign station, the nighttime limit of the station is calculated according to the pertinent international agreements

Jampro Antenna Completes System

► continued from page 61

Weather did not cause any major problems, so construction met all scheduled completion dates.

We placed a 27-1/2 kW Continental Electronics transmitter in a specially-built fiberglass shelter. The special shelter was outfitted with dual 15-ton air conditioners, all electrical pre-wired with a special overheating ventilation system.

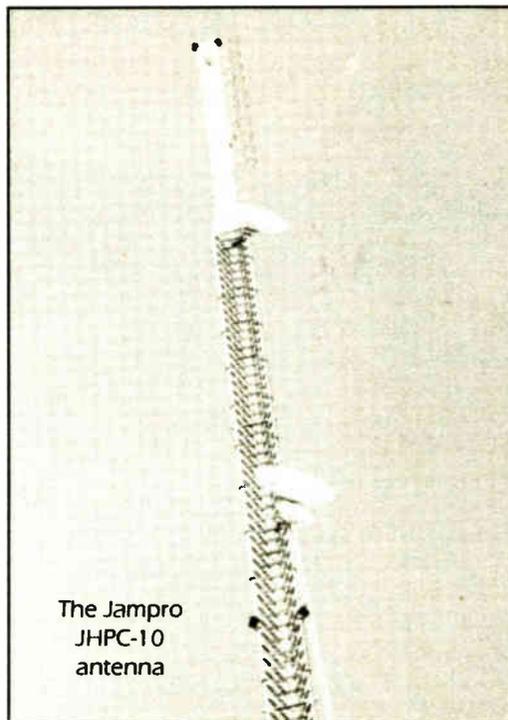
Smooth connections

The commissioning of the plant was a breeze. The Jampro antenna had VSWR of less than 100 watts reflected out of 26 kW forward

After aligning the special space diversity dual STL antennas, the plant was ready to go. We deliberated with the owner and agreed to fire up the plant on the 85 kW diesel emergency generator. The power company said it would only take a "couple of weeks" to complete the connection to commercial power.

Almost two months later (at four gallons of diesel fuel an hour) we received commercial power, and reconditioned and maintained the overworked "emergency" generator.

The system has been working flawlessly since its commission in December. The Jampro/Continental combination, the digital Moseley STL system and the 8200 Optimod provides quality classical programming to the northern part of Houston. Its sister station (KRTS-FM) provides the same programming to the southern part of Houston.



The Jampro
JHPC-10
antenna

Notwithstanding the delays by the power company, my compliments to all associated with this project. It was one of the smoothest installations with which we've been associated.

□□□

For information, contact **Marlene Young** in California at 916-383-1177; fax: 916-383-1182; or circle **Reader Service 111**.

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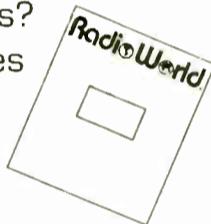
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INDUSTRY ROUNDUP

Audio Cable Gear: On the Heels of Change

by Mary Ann Dorsie

WASHINGTON As with almost all new and innovative products in the industry, audio cable companies have jumped on the digital bandwagon.

Although debate may continue as to how soon there will be a full digital takeover, the first steps are definitely recorded, according to audio cable manufacturers.

New choices

Cable has changed drastically just in the past couple years, said Benjamin

Nemser, President of Nemaal.

"Digital is really the wave of the future for digital equipment and for digital audio," Nemser said. "You do need cable with certain specifications, such as capacitance, impedance and others, to perform for the higher standard. We never had to deal with this before."

The old standard of buying one, and only one, type of cable is obsolete, he said. The choices with cable now are more numerous.

Since the electric code was changed a few years ago, a concern now is with more flame-resistant cable, Nemser said.

And coming up with materials to satisfy the many conditions surrounding cable is sometimes difficult. Cable must meet the required electrical standards, have greater flexibility, and—an important point for manufacturers—it must be easy to process.

All this while keeping costs at a reasonable rate is a feat, Nemser said.

Barry Brenner, general manager at CANARE, said his company is making products for the digital track. Its DA206, specified at 110 ohms, allows any AES/EBU input to output to shuttle digital signals.

"This is to facilitate out of the analog world, so everything can start being on a digital platform," Brenner said.

Fast movers

And CANARE's impedance transformer, which plugs into the same I/O, converts 110 ohm XLR balanced into 75 ohm BNC unbalanced. Brenner said this allows the cable to move through facilities at good distances.

"Audio engineers must think more along the lines of video engineers," Brenner said.

With the maximum analog bandwidth no more than 15 kHz, and a digital signal

between 6 and 10 MHz, "it's a whole new set of concerns when you're dealing with the digital world," he said.

Multi-conductor cable is setting the pace in the fast-moving cable industry, according to Jeff Culbertson, technical support representative for Belden Wire & Cable.

This Category 4 and 5 cable is in high demand. The copper cable can carry

Cable must meet the required electrical standards, have greater flexibility and... it must be easy to process.

high-speed data, and is less expensive than fiber optic cable, Culbertson said.

"With the technology and equipment today, you can attain high speed data cable," he said.

Belden Wire & Cable offers a wide range of cable products to keep up with a moving industry, including single wire, coaxial cable and fiber optic cable, he said.

Philip Cindrich, Myat's president, said he sees an increased interest in the rigid coaxial transmission cable the company offers.

Although cost for a rigid line, as opposed to semi-flexible cable, may be more expensive up front, it allows stations to use less power running their transmitters, which saves money in the long run.

"We see more FMs taking advantage of the rigid line's increased efficiency as compared to the semi-flexible," Cindrich said.

Another cost-saver for stations is combining signals, something Cindrich said he has seen of late. The 9 3/16-inch, 50 ohm line is one of the most popular sizes for this application.

There are three general radio applications for coaxial cable: AM, FM and shortwave radio, said Robert Leonard,

HELIX® product manager for Andrew Corporation.

Most of the action takes place in the FM realm, he said, with 7/8-inch to 2 1/4-inch coaxial cable. Coaxial cable is either air or foam dielectric, he said.

High power

Air dielectric cable is high-powered, but if it gets wet, the water can get inside

the cable, Leonard said. With foam dielectric cable, water will not leak inside the cable.

Because air dielectric cable needs to be pressurized to keep moisture out, some FM antennas now require pressurization.

"Thus, the trend is toward air dielectric cable," Leonard said.

Leonard also said he sees a standardization with cable sizes and peak power requirements in the industry. The safety factor is now a two for peak power, something Andrew Corporation has changed for greater compatibility with other manufacturers.

Over at Cablewave Systems, Bill Meola, national sales manager, said he also sees this move to commonize cable.

"So we don't really have any real connector-compatibility problems," Meola said.

Meola also said the future with cable is toward digital audio and radio.

Marc Dimmitt, with technical sales and support at Clark Wire & Cable, said he still sees the 22-gauge twisted pair as the industry standard.

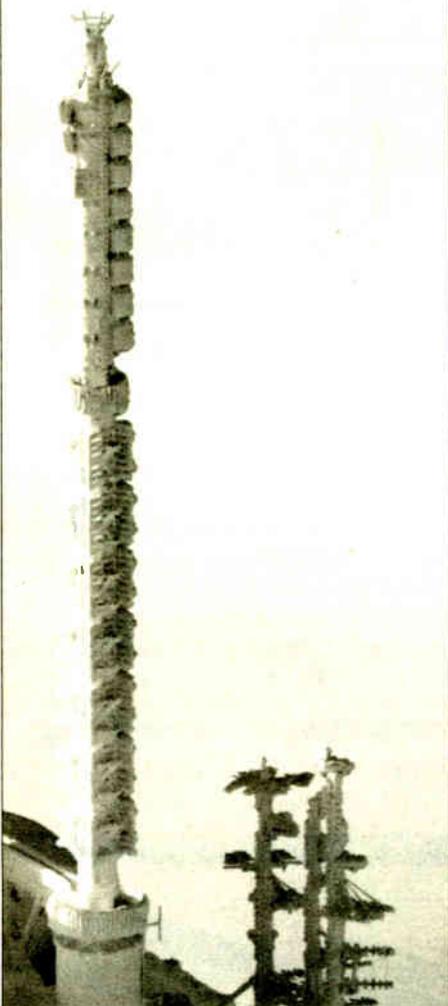
He said digital cable is not the rule of thumb yet.

"There's starting to be a little of the digital stuff creeping in around the edges," Dimmitt said. "It's probably five to 10 percent of what's actually out there now."

"Digital shows up more in production, not that much with transmission and radio—it's still analog twisted pair," he said.

He said even though digital is not fully integrated, digital signal transmission will be here soon. And when that happens, the engineers will have to learn the new technology.

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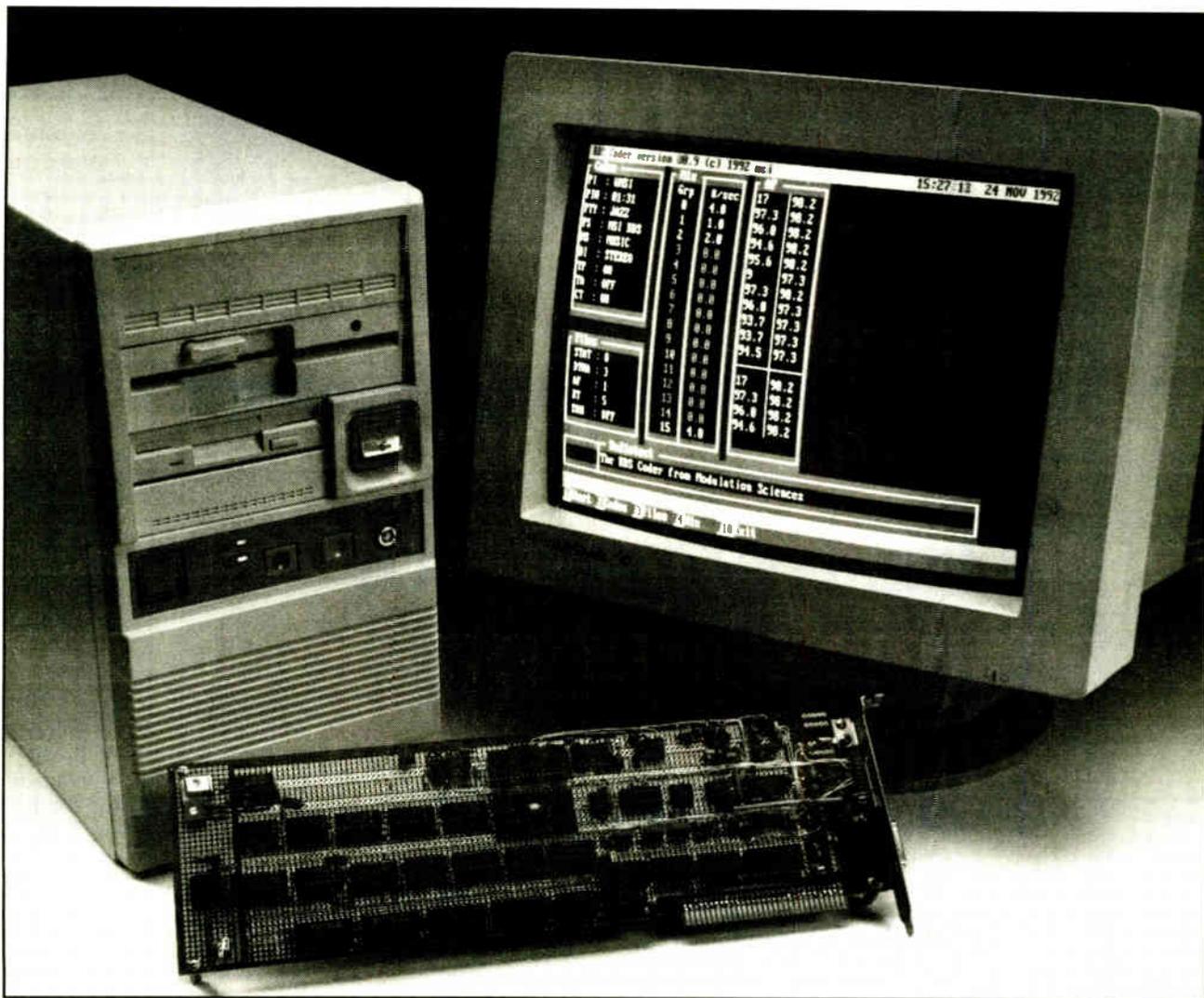
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Circle (26) On Reader Service Card

World Radio History

TECHNOLOGY UPDATES

LBA TECHNOLOGY INC.

Transmitter Combiners Help Increase AM Station Power While Providing Failsafe Operation

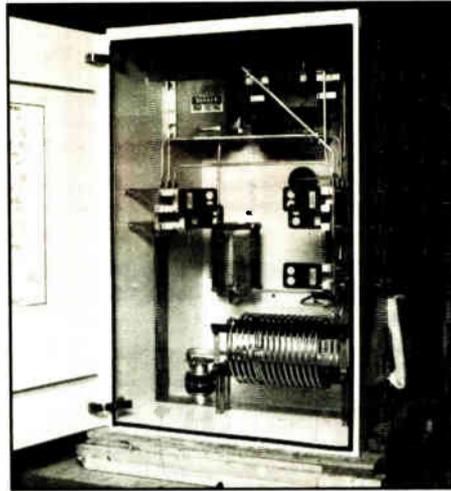
GREENVILLE, N.C. By permitting the operation of two or more AM broadcast transmitters at the same time, **LBA Technology Inc.** Type TCU Transmitter Combiners enable broadcasters to increase their power output while providing a failsafe operation.

For example, a station using a single 25 kW transmitter can increase power to 50 kW by retaining its old transmitter and adding a new 25 kW transmitter through an LBA TCU-50 Combiner. If either

transmitter fails, the LBA TCU Combiner automatically continues transmission at 25 percent power, making the TCU Combiner ideal for unattended locations.

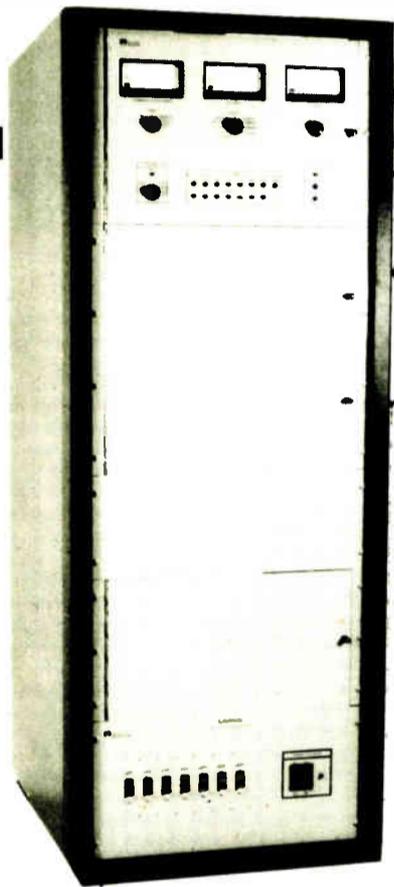
The combiners present stable load impedances to both transmitters, regardless of input port impedance, and they incorporate an artificial load to absorb power imbalances between the transmitters.

To maintain efficient phase and balance conditions, the TCU Combiners can be



supplied with an automatic common transmitter exciter and phase controller. Custom configurations of the TCU combiners are available at powers to 500 kW, including automatic switching, remote operations and VSWR monitoring.

For information on the LBA Type TCU Combiner, contact Susan Lalik in North Carolina at 919-757-0279; fax: 919-752-9155; or circle Reader Service 86.



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EG&G ELECTRO-OPTICS

FlashGuard Obstruction Warning Lighting System Offers Tower Protection

SALEM, Mass. EG&G Electro-Optics designs and manufactures aviation obstruction warning lighting systems for towers and other tall structures.

The product line includes FlashGuard™ 2000 white strobe, FlashGuard 2000-Red flashing red and Flashguard 3000 integrated dual red/white medium intensity beacons, StrobeGuard® OWL high intensity white strobes, and accessories such as cable and steady burning side lights necessary for lighting systems.

All products are FAA-approved, Transport Canada approved and ETL certified.

FlashGuard beacons rely on a trio of linear xenon flashlamps, each with an adjustable parabolic reflector for focusing and intensifying the light output. They typically cost 20 to 40 percent less to purchase, install, operate and maintain than conventional fresnel lens beacons.

Introduced in 1991, FlashGuard systems are now in use worldwide.

For information, contact Joe Farrell or Lew Wetzel in Massachusetts at 508-745-3200; fax: 508-745-0894; or circle Reader Service 139.

SHIVELY LABS

High Power Antenna Made For Mild Icing Conditions

BRIDGTON, Maine Shively Labs' new Model 6824 FM Antenna was designed to provide broadcasters with a high power antenna for mild icing environments.

The antenna's VSWR seldom exceeds 1.5:1. Each bay is rated at 40 kW for 3 1/8-inch lines, and one-bay arrays can handle 40 kW of input power. If high power handling is required, 4 1/16-inch arrays are available.

Options include center feeding, beam tilt and null fill.

Shively Labs also has available wireless cable antennas. Models 6950 (vertical only) to 6960 (horizontal only) can be configured with multiple bays to satisfy different applications and gain requirements.

The bays are configured as four-bay modules, and are housed inside a continuous radome.

Mounting brackets for non-tapering poles with diameters ranging from 3/4-inch to three inches are provided.

For information, contact Jon Clark in Maine at 207-647-3327; fax: 207-647-8273; or circle Reader Service 158.



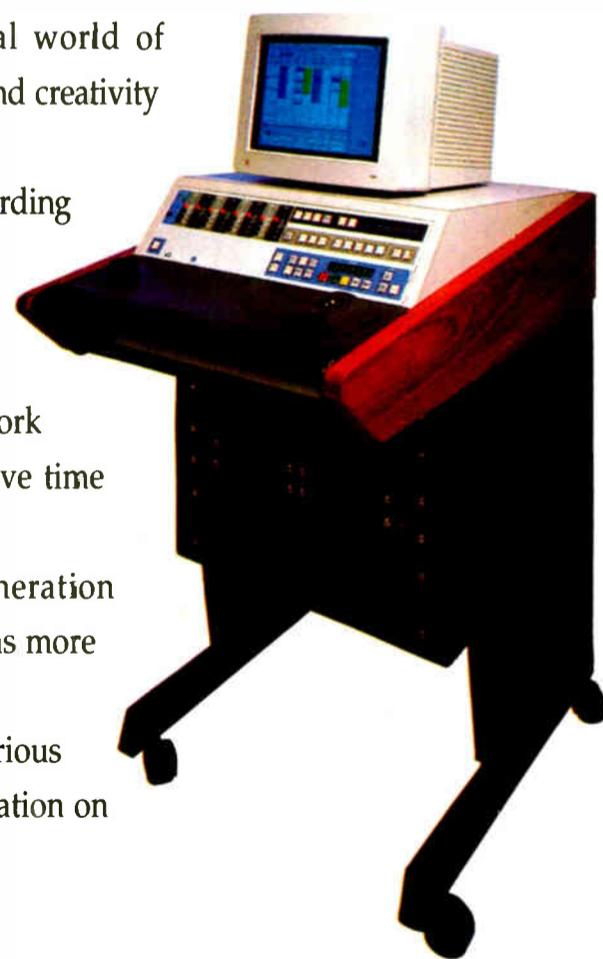
Introducing ADX, the first digital production system designed for the real world of broadcasting. A world where time is of the essence, change is the rule, last-minute is routine, and creativity is the competitive edge!

ADX is a fully integrated system which combines the creative flexibility of digital recording and editing with the speed and intuitiveness of a fully automated production mixer. Instead of simply storing audio elements and their edit decisions, ADX also recalls and recreates the mixing and processing talent of the producer.

Just imagine having the ability to precisely replay complex multitrack production work the way you mixed and equalized it yesterday, last week or last month! Think of the creative time saved when a change or update is requested in an otherwise perfect mix.

Plus, the ADX is unencumbered by the architectural limitations of first-generation workstations and is designed to grow and expand with your needs. Even the basic system has more standard features than anything before.

And like all PR&E products, ADX is a powerful tool optimized for the fast and furious demands of broadcasting and backed by world-famous PR&E support. Call today for information on ADX, the next generation of digital.



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DESIGNS THAT MAKE THE DIFFERENCE

GEPCO INTERNATIONAL INC.**Digital Audio 110 Ohm Compatible Cables**

CHICAGO GEPCO International Inc. designed additions to its line of digital audio 110 ohm AES/EBU compatible cables.

New from the company are four-pair and twelve-pair cable configurations of the GEPCO 5524. Also new is the GEPCO 5526, a flexible, oxygen-free copper patch cable that is 110 ohm AES/EBU compatible.

These products are available in bulk cable put ups or as pre-connected assemblies.

The GEPCO 5524SD is an AES/EBU com-

patible, solid conductor, 110 ohm, twisted pair, and it's available in bulk cable put ups.

Custom cut lengths to fit individual requirements are available for all the products.

For information, contact Greg Hansen at 312-733-9555; fax: 312-733-6416; or circle Reader Service 75.

**DIELECTRIC****Anechoic Chamber Built for Antenna Pattern Measurement**

RAYMOND, Maine Dielectric Communications recently completed a new anechoic chamber at the company's facility for FM antenna pattern measurement.

The chamber operates at 4.4 times FM carrier frequencies. At this frequency, the antenna, tower structure and transmission lines can be modeled to 1.4/4 scale.

The antenna/structure rotates 360 degrees while receiving a signal from a source antenna. The source is fed by an HP signal generator with directional coupler located at the antenna input.

A reference signal is obtained from this coupler and compared to the "receive" signal of the antenna under test.

An optical encoder, located at the antenna under test, sends signals to a computer CPU where custom software converts antenna orientation and signal information with each antenna rotation. Measurements are performed under several mounting configurations.

For information, contact Jay Martin in Maine at 800-341-9678; fax: 207-655-7120; or circle Reader Service 121.

Companies

QMI was appointed agent in the United States and internationally for **Studio Technologies** of Skokie, Ill. Studio Technologies manufactures the AN-2 Stereo Simulator and the Mic-PreEminence two channel microphone preamplifier.

AEQ-America Inc. has an office at 2211 South 48th St., Suite H, Tempe, Ariz., 85282; telephone: 602-431-0334; fax: 602-431-0497.

BEC Technologies was selected to supply digital fiber optic transmission, switching and routing equipment for a new audio system at the Gottlieb-Daimler Stadion, an outdoor sports stadium complex in Stuttgart, Germany.

ESE appointed **EAV Technology** as its exclusive Australian distributor.

ESE manufactures Master Clock Systems, Time Code Products, Desktop Video Accessories and Audio/Video Distribution Amplifiers. **EAV Technology** supplies products and service to the professional audio and video industry in Australia.

Harman International Industries, Inc. signed an agreement to acquire

Lexicon, Inc.

Lexicon is a Massachusetts-based manufacturer of digital audio signal processing equipment and disk-based audio production systems for the professional audio and high-end consumer electronics industries.

RF Industries, Ltd. completed its new facility in San Diego. The new address is 7620 Miramar Road, San Diego, Calif., 92126-4202;

telephone: 619-549-6340; fax: 619-549-6345.

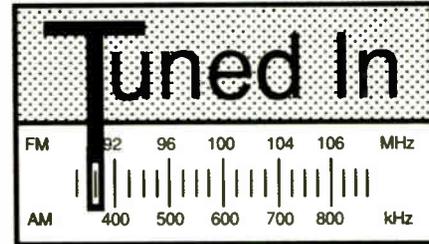
ViaSat Technology Corporation announced its expansion into a 35,000-square-foot facility at 55 Commerce Drive, Hauppauge, N.Y., 11788; telephone: 516-273-4455; fax: 516-273-4583.

The new location is about three times the size of the previous location.

People

Les Perlman was named Distributor Sales Manager for Domestic and International operations of **RF Industries, Ltd.**

Richard J. LaFay was appointed Representative and OEM Sales Manager for Domestic and International of **RF Industries.**

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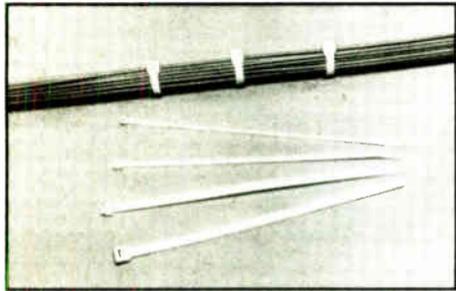
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MARKETPLACE

A compendium of new and recently introduced radio broadcast products



Cross Section Cable Tie

Panduit Corp., Electrical Group, introduced a heavy cross section cable tie for bundling wires, cables or hoses.

The 6.6 nylon tie has a flammability rating of UL 94V-2, and is available in natural and black weather resistant and black heat stabilized. It offers a minimum loop tensile strength of 120 pounds.

The tie provides low threading force for reduced operator fatigue, a low profile head for flexibility and fine pitched teeth for tight bundles.

For information, contact Hans A. Lustig in Illinois at 708-990-0220; fax: 708-990-2556; or circle **Reader Service 76**.

Signal Processing Amplifier

BGW Systems has introduced the SPA-2, the newest member of its Signal Processing Amplifier family.

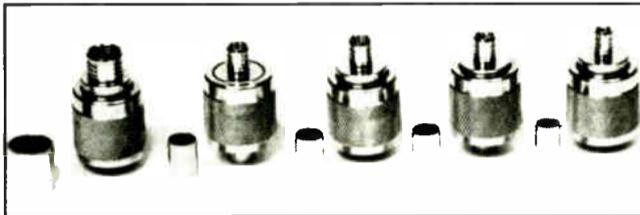
The SPA-2 contains two high power amplifier channels. The signal processing section includes a customer-specified, two-way crossover, one delay line, a sub-sonic filter, a compression-driver equalizer and a parametric equalizer.

Power output (per channel) is 500 W at four ohms, or 300 W at eight ohms.

For information, contact BGW Systems



in California at 800-468-AMPS; fax: 310-676-6713; or circle **Reader Service 189**.



UHF CRIMP Connectors

RF Industries Ltd. offers its Distributor Network of five new UHF CRIMP connectors to fit RG58/U, RG142/U,

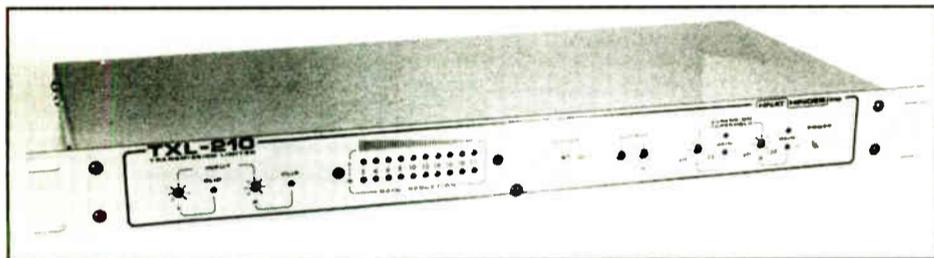
RG59/U, RG8X, PRO-FLEX, RG8/U, RG213, RG214 and Belden 9913 coaxial cables.

The connectors are machined from solid brass and then either nickel or silver plated.

Silver plated pins are included with both styles, and then anchored into either DAP or Teflon Dielectric.

Connectors are attached by crimping the center conductor to the pin and the shield to the ferrule stud. The finished connector can be attached in one quarter the time of solder connectors.

For information, contact RF Industries Ltd. in California at 619-549-6340; fax: 619-549-6345; or circle **Reader Service 52**.



TXL-210 Transmission Limiter

Hnat Hines has introduced the TXL-210 Transmission Limiter, designed to control any kind of energy, including complex wave forms in digital and synthesized audio.

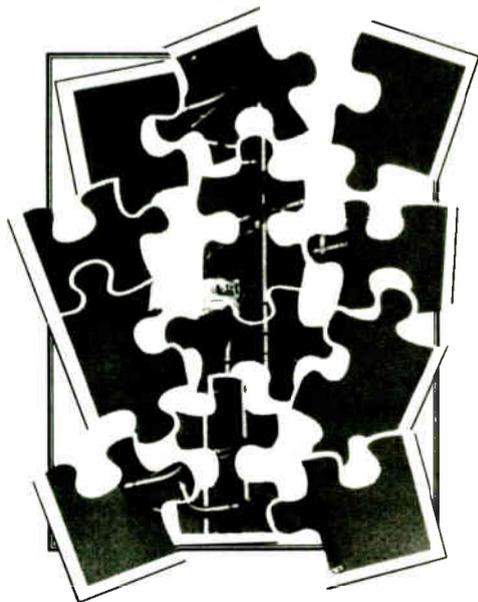
When installed in front of your processing chain, it helps to ensure that all subsequent processing will function in a safe, dynamic environment without going into overload.

The TXL-210 is available as a broadcast device, or with an optional plug-in Filter/Clipper Assembly for FM or NRSC applications.

Other features include a MONO output and phase rotation in the control circuits for optimum voice level control.

For information, contact Bonnie Hnat in Connecticut at 203-935-9066; fax: 203-935-9919; or circle **Reader Service 70**.

Let **ERI** piece together your Antenna System Puzzle



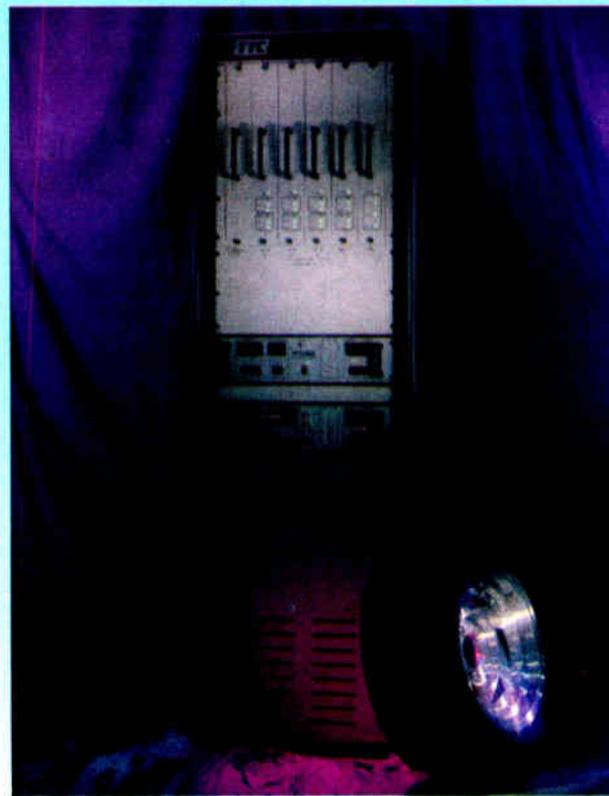
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ERI ELECTRONICS RESEARCH, INC.

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Tubeless.



If you thought Solid-State FM was something new... think again.

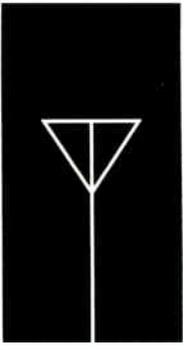
Why settle for old tube-type performance when field proven solid-state FM is here today? Since 1989, TTC has shipped over 80 solid-state FM transmitters to customers all over the world. Cost Savings? About \$3,000 per year over competitive designs. Lightning Protection? It's built in. Performance? Some specs are eight times better than our competitors.

Power Range? 100 watts to 16,000 watts. For more information on TTC's full line of Radio Products, please call or write Russ Erickson at TTC.

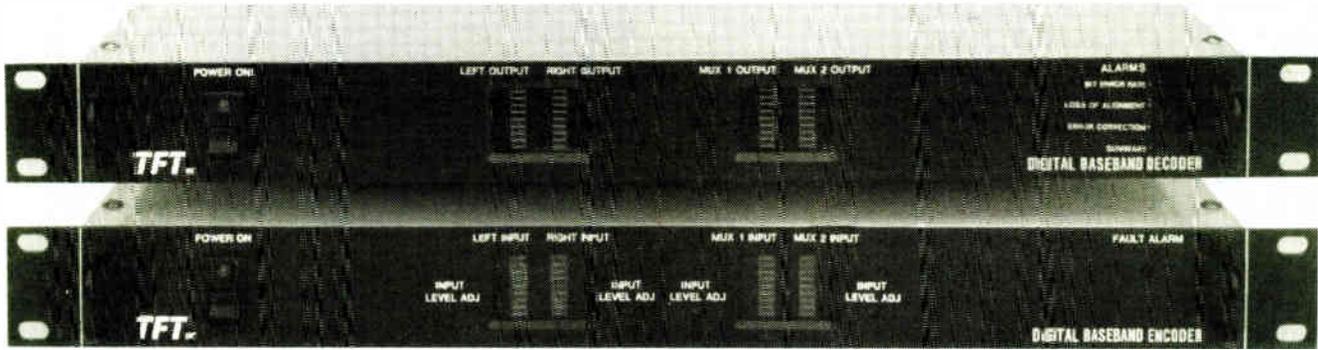
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DIGITAL STL BREAKTHROUGH

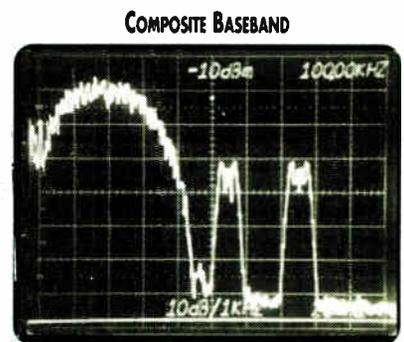


TFT DMM92 Digital STL Modems: The Spectrally Efficient Solution

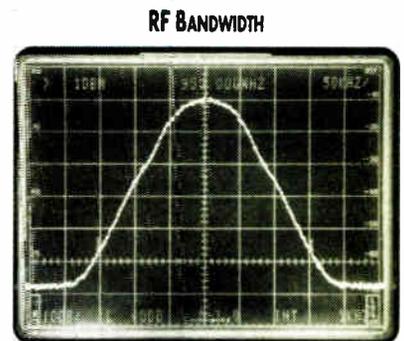
Would you like to improve the fade margin of your existing analog STL by 20 dB or more? Increase Signal-to-Noise Ratio by at least 10 dB? Extend STL distance by miles? You can—without buying expensive new transmission equipment, without modifying your existing STL. Just add TFT's advanced DMM92 Spectrally Efficient Digital STL Modem/Multiplexer. Along with vastly superior performance, you'll get:

- ◆ **More Channels** — Analog models accommodate up to four analog channels or two AES/EBU digital audio pairs, plus a 9600 baud RS232 channel—all in a 75 kHz baseband. MUX subcarriers at 110 kHz and 152 kHz can coexist with the DMM92 baseband signal plus additional channels.
- ◆ **More Flexibility** — Digital models accommodate codecs from apt-X, Musicam, Dolby, Intraplex... any 256 kbps codec with RS422 or V.35 interface. Plus two 7.5 kHz audio channels and two more SCA subcarriers or MUX channels.
- ◆ **More RF Power** —The DMM92 allows you to use the full power of your STL transmitter, not just 1 Watt.
- ◆ **More Usable RF Spectrum** — the DMM92 requires only ± 50 kHz carrier deviation for 451 kbps, allowing composite STLs to be operated on 250 kHz channel spacings.

The DMM92 is also compatible with video microwave links. A single composite subcarrier can contain four audio channels with 80 dB SNR and an RS232 data channel.



2 x 15 kHz, 2 x 7.5 kHz, 1 x 9600 baud RS232, 110 kHz and 152 kHz Subcarriers.

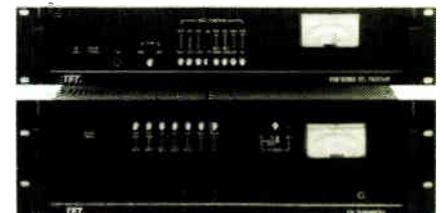


2 x 15 kHz, 2 x 7.5 kHz, 1 x 9600 baud RS232 in 250 kHz RF channel spacing.

also from TFT:

9100 Composite STL

- ◆ Frequency-synthesized, field-programmable Tx and Rx.
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ENVIRONMENTAL TECH

Ice Melting Control System Designed for Radio Antennas



SOUTH BEND, Ind. The Environmental Technology Inc. Antenna Ice Melting Control System includes a CIT-2TV Ice Sensor located adjacent to the transmitting antenna, and an APS-3A Control Panel.

The APS-3A is normally located in the transmitter shelter and within 2,000 feet of the sensor. Sensors and the control panel have special filters and circuit design techniques to help minimize susceptibility to RFI and lightning damage.

The CIT-2TV sensor operates heaters at temperatures below 40 F when there's moisture, and prevents heater operation at temperatures below 0 F. This helps save electrical energy and prevent partial ice melting.

As the temperature increases through the lock-out temperature, heaters operate if precipitation occurred during lockout.

In addition to supplying 24 VAC for sensor operation, the APS-3A control panel provides status indicators, an adjustable heater hold-on timer and a heater cycle switch. The APS-3A control panel operates from 120 VAC, 50/60 Hz, with 230 VAC, 50 Hz optional. The APS-3A control panel is UL listed and CSA certified.

For information, contact Steve Leykauf in Indiana at 219-233-1202; fax: 219-233-2152; or circle Reader Service 8.

CABLEWAVE SYSTEMS

Flexwell Air Dielectric Coaxial Cable Features Helical Insulators

NORTH HAVEN, Conn. Cablewave Systems offers a variety of Flexwell products. Flexwell air dielectric coaxial cable features the spiral vertebrae helical insulator for larger diameters of 1 5/8-inch to 9-inch, and extruded helix for 1/2-inch and 7/8-inch.

Flexwell foam dielectric is manufactured under the requirements of MIL-C-28830, featuring diameters of 3/8-inch, 1/2-inch, 7/8-inch and 1 5/8-inch.

In addition, a full line of rigid line and associated accessories are offered.

Cablewave systems also features circularly polarized FM antennas. They're designed to accommodate power requirements from 500 W educational-to 40 kW, high-power-commercial situations.

Low pass filters, directional couplers and manual patch panels are also available. Included in the company's accessory inventory are the required cable hoist, grounding kits, mounting hardware and several options for pressurization equipment.

For information, contact Bill Meola in Connecticut at 203-239-3311; fax: 203-234-7718; or circle Reader Service 66.

FWT

Turnkey Systems Designed For Various Configurations

FORT WORTH, Texas FWT designs and manufactures turnkey systems for the cellular, microwave, broadcast and cable TV markets.

FWT offers welded or bolted guyed and self-supporting towers constructed of solid bar, tubular or angular materials. FWT's tower services include custom specifications, tower engineering, custom manufacturing, foundation installation, shipping and delivery, tower erection and tower related products.

For information, contact Roy Moore in Texas at 817-429-3091; fax: 817-429-6010; or circle Reader Service 106.

FLASH TECHNOLOGY

ElectroFlash FTB 310: Obstruction Strobe Lighting For Facilities with a Minimum of Space



BRENTWOOD, Tenn. Flash Technology Corp. of America introduced the omni-directional Electro-Flash™ FTB 310 for obstruction strobe lighting.

This medium intensity strobe beacon has a small, lightweight power converter for facilities within minimum space. Its dual system interface capabilities help make connecting two independent systems easier, and it's programmed to automatically flash upon red beacon failure. The ElectroFlash™ is FAA approved.

For information, contact Cannon Connell at 615-377-0600; fax: 615-377-2383; or circle Reader Service 181.

ANTENNA TECHNOLOGY

PROFLine Delivers Music, Programs through Network

MESA, Ariz. Antenna Technology's PROFLine satellite digital audio network delivers music, syndicated programming, advertising inserts and other spot distribution through virtually any satellite antenna, including the simul-sat.

Music programming can be broadcast and received point to point, or point to multi-point, while maintaining studio CD quality.

The PROFLine network was designed for CD quality music, news, sports, announcer feeds, instantaneous broadcasts and concerts.

Antenna Technology offers a history in the industry as a manufacturer of satellite earth station antennas and satellite headend electronics. In recent years, the company has expanded its product line to include a broad range of satellite communications and test equipment.

For information, contact Tim Peyla in Arizona at 602-264-7275; fax: 602-898-7667; or circle Reader Service 164.

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- C. Educational FM station
- E. Network/group owner
- F. Recording Studio
- G. TV station/teleprod facility
- H. Consultant/ind engineer
- I. Mfg, distributor or dealer
- J. Other _____

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- A. Ownership
- B. General management
- C. Engineering
- D. Programming/production
- G. Sales manager
- E. News operations
- F. Other (specify) _____

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May 26, 1993 Issue Use Until August 26, 1993

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AMPLIFIERS

Want To Sell

Dynaco ST120 fact built, gd cond, BO. R Robinson, TNA Rcdg, 10 George St, Wallingford CT 06492. 203-269-4465.

McMartin Prog/IFB, BO, several additional items also available. A Croft, Mutual Bdcg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

McCurdy DA504 (6) dist & pwr sply, 1x12, \$300. B Kuhar, 215-434-7921.

Altec 1568A w/bal inputs, matched pr, \$950/BO; Marantz 8, \$1450; McIntosh MC240, \$1200; MC225, \$750; MC40, \$600; Krell Altair, \$2750; KBL, \$2750; NRG PA1/MC, \$4500/BO/trade. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

LPB DA 1 16 distribution amp, new. J Gelo, J&H Music Programming, POB 1697, Marco Island FL 33969.

Straight Wire Audio (2) DAs, \$150 ea; (2) Lauderdale Elects LEL DA-8 DAs, \$100 ea; (2) Ramko DA-6 BR/Es, \$125 ea. M Guthrie, 813-855-5642.

BGW Pro 6000 stereo power amp, 100 watts per chnl, gd cond, \$225. A Gregory, 3003 20th St, San Francisco CA 94110. 415-285-1953.

Crown D-75 amp, gd cond, \$300. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

RCA, Altec, Dynaco tube amps, sell of trade. Tracy Eaves, 615-821-6099 (evenings before 10PM EST).

Want To Buy

Sansul B2301, B2302, C2301, C2302; Denon POA8000; Fisher SA(K)1000; Peploe; ARC M360, D150, D79, D75, D76; B&W MPA810; Crown Macro Ref; Marantz 1-10; McIntosh; JBL Hartsfield; Paragon; Cascade. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

ANTENNAS & TOWERS

Want To Sell

Shively 6813 2-bay w/radomes on 96.1, BO. D Magnum, WBOG, 1021 N Superior Ave, Tomah WI 54660. 800-736-WBOG.

Shively Labs 6813 4-bay, med pwr, FM w/radomes on 98.9, less than 3 yrs old, \$5500. R Ruff, WKHJ, POB 2337, Mt Lake Park MD 21550. 301-334-4272.

FM - ANTENNAS

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ERI Roto-tiller 1-bay on 91.3, \$1200/BO. M Friend, WTJU, 711 Newcomb Stat, Charlottesville VA 22904.

Anixter 8' Mark, 210-875-2555.

Continental 37-CP-3 3-bay FM on 105.5 MHz, \$1800/BO; Cablewave CP 1000-1 single-bay on 105.5 MHz, \$750. C Fletcher, WLJE, 2755 Sager Rd, Valpario IN 46383. 219-462-8125.

Rohn 65 447' AM, great cond w/insulator, lights, guys, \$6000/BO. L Walker, WIOZ, POB 1677, S Pines NC 28388. 919-692-2107.

Andrew HJ9-50 5" air line, 15' conns free. Henry, KSKB, 110 Jackson St, Brooklyn IA 52211. 800-326-8890.

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Phelps Dodge 3 1/8" rigid coax line, 9-20' lengths; ERI FMH 12AC ant parts. T Worthmann, WJAG, 309 Braasch, Norfolk NE 68701. 402-371-0780.

Andrew 3-1/8" rigid coax, 380', 13 yrs old, on tower & pressurized, \$200/20' section, you pay rigging & shipping. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

ERI CP-FM antenna, 2-bay tuned to 101.7 MHz, disco style, BO. K Block, KMAN, POB 1850, Manhattan KS 66500. 913-776-1850.

Phasetek P600-204 current transformers, toroidal pickup units for antenna sampling system, brand new, \$450. T Newcomb, KAPY, Box 1290, Port Angeles WA 98362. 206-452-9228.

ERI 37CP8 8 bay in storage, tuned to 107.3 FM, negotiable at around \$6000. K Reising, WRZQ, 825 Washington St, Columbus IN 47201. 812-379-1077.

Want To Buy

Used 30'-58" pneumatic telescoping mast. Mr King, 703-684-0373.

3-tower array phasor, 1290 kHz w/5000 W day/night pwr rating. D Wolfe, KMEN, 2001 Iowa Ave #200, Riverside CA 92507. 909-684-1991.

FM 103.3 any number bay, pref ERI, 140' cable w/conns & access; 100+' free-standing tower. 305-292-5009.

AUDIO PRODUCTION

Want To Sell

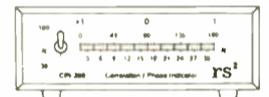
Neve 1066 EQ mods, \$1250. J Wells, SoundArts, 8377 Westview, Houston TX 77055. 713-464-4653.

Studio Sound S305 vintage passive filter sets, Studio Sound S305, matched pr, consec #, rackmount, rare, BO. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

UREI 533 EQ, BO. Several additional items also available. A Croft, Mutual Bdcg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

Lexicon RCM 60 dig reverb, \$500+s/h. D Glasser, Airshow, 7021 Woodland Dr, Springfield VA 22151. 703-642-9035.

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Digidesign SoundTools 1 w/DAT I/O; Mac dig edit hardware & software, \$1475; Lexicon 224 dig reverb, \$1995/BO. R McMillen, Super Duper, 1634 SW Alder St, Portland OR 97205. 503-228-2222.

dbx 150 2 chnl NR unit, gd cond, \$100. A Gregory, 3003 20th St, San Francisco CA 94110. 415-285-1953.

Prophet 600 synthesizer, \$450; **Spectro Acoustics** rack mount 200 W amp, \$150; **Crown VFX2** electronic crossover, \$125. W Gunn, 619-320-0728.

AKG 414 P48 like new, \$675; **Dynaco 410**, 400 W amp, \$400; **dbx 1BX** expander, \$135. W Gunn, 619-320-0728.

Roland SPH323 phaser, \$75; **Rockmann** sustainer & stereo chorus/delay, \$350/both. W Gunn, 619-320-0728.

TT (Bantam) ADC patchbays, 144 pts, 1 rack sp, \$129; **Tannoy HPB385A** 15" coaxial monitor pair in cabinet, \$1750; **Altec 436A** tube compressors, Daven attn, both \$700. W Gunn, 619-320-0728.

SKL H/LO variable filter (pair), \$200. W Gunn, 619-320-0728.

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Fairchild 600 conac or 602 Conex high freq limiters. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

AUTOMATION EQUIP

Want To Sell

BE-16 w/(3) single plays, (1) Carousel, (1) 48-tray Instacart, (1) 42-tray Go-Cart, nds work, (3) Scully R-R PB, clean, sat interface. BO. E DeLa Hunt, KPRM, Hwy 34 E, Park Rapid MN 56470. 218-732-3306.

Sentry FS-12C auto controller, new, BO. O Booth, 601-323-4980.

SMC ESP-1 prog display & keypad, PDC-5 clock, DS-20 switcher, (3) 350 Carousels, (1) 450 Carousel, (4) racks, \$2000/BO. M Bristol, WABJ, 121 W Maumee, Adrian MI 49221. 517-265-9500.

IGM automation w/2K memory, monitor panel, clock, (3) 24 tray random select Carousels, wiring harness for 4 R-R's, spare parts, manuals, working when removed.

\$1700 plus crating/shipping. M Filtzner, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

SMC 350's (6) in gd cond, sell all or individually, \$350 ea. P Swint, KFSB, 2620 Dogwood Rd, Joplin MO 64801. 417-624-1310.

Revox PR99's (4) PB units, like new w/rackmounts, \$1100 ea. E Gross, KEYZ, 410 E 6th St, Williston ND 58801. 701-572-5371.

MW Persons 3A prog for up to 4 sources, unlt sequential rotation w/manual, \$200. R Chambers, Sierra Bdcg Corp, 3015 Old Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Schafer 903 w/5 Carousels, 4 racks & documentation, \$500. S Horner, KBBY, 6150 Olivias Pk Dr, Ventura CA 93002. 805-654-0577.3

Systemation dig audio syst & traffic comp w/Darts software, \$9750. D Miller, WINA, POB 498, Charlottesville VA 22902. 804-977-3030.

Systemation On-Air & production brain(s), monitors, commadore 64 keyboards, cassette decks, currently running FM station, \$2500. S Greeley, Mad Dog Wireless, PO Box 1866, Lake Havasu City AZ 86405. 602-855-1051.

Want To Buy

Schematic for Control Design Corp CD25G tone gener. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

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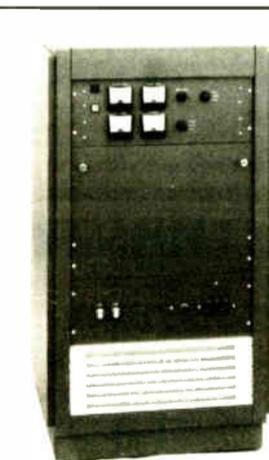
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Want To Sell

ITC (2), play, mono & (1) ITC R/P, mono, exc cond, \$1000 all. J Hart, Radio Genesis Intl, 13701 W Jewell Ave #111, Lakewood CO 80228. 303-987-9442.

Dynamax CTR 10 R/P, \$1000; CTR 10 play only, \$700, ESD-10 eraser, \$700/BO, all exc cond. B Whittington, KHNS, POB 1109, Haines AK 99827.

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ITC Delta 22053, (2) stereo, play, low hrs, exc cond, \$2000 ea/BO; (2) BG Engrg BGE-T1 dig count up timer for cart machs, exc cond, \$150 ea/BO; BE 2100 CPS stereo, play, low hrs, exc cond, \$1200/BO; BE 2100 CRPS stereo, R/P, low hrs, exc cond, \$2000/BO. Kerry, Emerald Sound, 1033 16th Ave S, Nashville TN 37212. 615-327-9544.

Tapecaster 700P stereo, play, exc cond, \$350; ITC RP 329-0003, mono w/triple cue, exc cond, \$400. A Wes, KZPX, HCR 1 Box 286-D, Merrifield MN 56465. 218-765-3333.

Spotmaster 2000 mono R/P cart machine, fair cond, \$400. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

Tapecaster RP-700 R/P, \$200; BE Tri deck, play only, \$950. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Harris CC II mono R/P w/all tones refurbished, \$695. P Willey, WNAW, 466 Curran Hwy, N Adams MA 01247. 413-663-6567.

ITC PD II R/P, mono, excel cond, \$500. D Johnson, MetroCities 381 Mansfield Ave Ste 500, Pittsburgh PA 15220. 412-928-0707.

Spartmatic 800C R/P's (2), working cond w/manual, \$200 ea; Tapecaster 700 R/P w/bad motor w/manual, \$100/BO. M Fitzer, WKCX, POB 1546, Rome GA 30162. 703-291-9770.

BE 5300C tripledeck, stereo, PB, mint less than 50 hrs, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

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ances, credible, reliable, dependable, thorough knowledge of the business. Jack Reynolds, 414-242-4357.

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General Manager for Southeast Iowa market AM/FM combo. Attention to bottom line, sales promotional experience and involvement in the community a must. Salary with excellent benefit package. Fax resume to Rick Lambert 314-651-4100, or mail to: POB 558, Cape Girardeau, MO 63701. All resumes kept confidential. EOE.

Salesman, for very small market radio in southwest Arizona, retired or semi retired for Winter Visitor season. Would need to work out of a Motor Home. KBUX, POB 1, Quartzsite AZ 85346.

Broadcast Engineer Maintain current plant and add new facilities. Knowledge of AM/FM RF, state-of-the-art audio, digital software, computer hardware. Full service, active stations in great town! Competitive salary plus good benefits. Start 6/1/93. Send Resume to: General Manager, WFVA/WBQB, POB 269, Fredericksburg VA 22404. EOE/M-F.

Engineer Wanted, Western Nebraska AM/AM/FM. Minimum 5 years experience RF, Audio, Computer. Knowledge of FCC Rules and regs. Competitive salary, benefits. Send Resume to: Michael Tracy, POB 532, Scottsbluff, Nebraska 69363-0532

Want To Sell

Ampex ATR 700, gd cond, \$500. B Kidd, Airwaves Co, 510 W 2nd, Rayville LA 71269. 318-728-4574.

Audio Technica RMX64 4-trk R/P, 6-chnl mixer/rec, 6 in 4 out, 2 cue sends, panthom pwr, low & hi spd R/P, para EQ, shelving, manuals, \$995. G Fitzgerald, Fitz Music, 37-75 63rd St #B29, Woodside NY 11377. 718-446-3857.

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MCI 110B boards, hds, motors, used, working, 1/2 wholesale price. M Shea, Precision, POB 723, NY NY 10276.

Otari MX5050 8-trk in custom console, demo, 1/2", \$2000; 8-trk in Ruslang console, new, 1/2", \$3000; (3) Technics RSM-65, new, \$250 ea/BO; Sony TC-228 8-trk R/P, new, \$150/BO; Sony TC-777-4 1/4-trk, 1/4", mint cond, \$250. J Diamond, Blue Diamond, Box 102C Chubbic Rd RD 1, Canonsburg PA 15317. 412-746-3455.

Studer C270 2-trk analog mastering, \$2950/BO; Studer HS77 MK IV full-trk, mono, 10 hrs, \$875/BO/trade; port case for A77 w/mon spkrs & pwr amps, exc cond, \$375. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

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Tascam 32, 2-trk w/rack ears, new in perfect cond, \$980. R Payne 313-786-1767.

Scully hds, 2-trk, stereo, new, \$225/BO; Ampex hds, full-trk, \$150/BO, both E/R/P. L Snyder, 718-347-2940.

Ampex 600 (3), mono, BO; 1 stereo, BO. Several additional items also available. A Croft, Mutual Bdctg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

3M M-79 24-trk, 2", alternate bias, Selectake II, remote, spares, \$800/BO. R Friedman, 1137 Rec, 1137 Fillmore St, Baltimore MD 21218. 410-889-4228.

Scully 280 (8) w/roll around cabs, 4 stereo, \$475; 4 mono, \$275, all exc cond. S Homer, KMRO, 2310 Ponderosa, Camarillo CA 93010. 805-654-0577.

Alwa stereo, exc cond, \$75+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

Tascam 58 8-trk, 1/2", very gd cond, low hrs, XLR in/out, conns for SMPTE lockup w/video, manual, 10 1/2" take-up, \$2000. T Carroll, In-House Prod, 456 9th St #20, Hoboken NJ 07030.

ITC 750 (4) P/B, very gd cond, \$400 ea. R Mason, 703-962-1133.

MCI JH-110B 2-trk w/o cabs, BO; (10) Ampex 440 xports, BO; (2) Ampex 444 elects, BO; (9) Ampex 440 roll-around; (6) Harris/Gates R/P, BO. Several additional items also available. A Croft, Mutual Bdctg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

Scully 280 14" stereo & elects in console. K Kenze, KFXE, 13 E 11th, Washington MO 63090. 314-239-0209.

Studer A80 8-trk, 1", \$1900. B Kuhar, 215-434-7921.

Pioneer RT-707 1/4-trk, gd cond, \$150; (4) Otari ARS1000 PB w/25 Hz detectors, gd cond, \$850; (2) Harris mono, single play, gd cond, \$100; (2) BE 3200 RP, mono, gd cond, \$800; (7) Scully play only, gd cond, \$50; (5) Audi-cord 200, stereo, gd cond, \$100; ReVox A-77 stereo, fair, \$100; (5) Sono-Mag 24-tray Carousel, parts, \$50. O Booth, 601-323-4980.

Crown SX-722 1/2-trk, stereo, clean, \$300. G Hultman, Hultman Media Svcs, 300 Limp Creek Rd, Grants Pass OR 97527. 503-474-6466.

Otari MX5050 B2-II immac, \$1610; MK3, gd cond, \$1000. R McMillen, Super Duper, 1634 SW Alder St, Portland OR 97205. 503-228-2222.

Otari ARS 1000 (4) interfaced to SMC automation equip, \$500 ea. P Swint, KFSB, 2620 Dogwood Rd, Joplin MO 64801. 417-624-1310.

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Uher 5000 R-R recorder, \$90. J Baltar, Maine Reel, 67 Green, Augusta ME 04330.

Magnecorder PTH6 vintage recorder in working cond w/case, free, you pay shipping. A Mitchell, A Mitchell Productions, 8107 Yorktown Dr, Alexandria VA 22308. 703-768-6186.

ITC R-R (2) 7.5 ips w/tone detector, \$250 ea, clean/gd cond. F Willis, WKXH, POB K, Alma GA 31510. 912-632-0104.

Otari MK III-5050 8 trk, mint cond, low hrs, 1/2" tape, 7.5 & 15 ips, \$2200. C Lallo Jr, 465 W Anderson St, Hackensack NJ 07601.

Ampex 351 & 354 transport head assembly, several amps, need work or for parts. D Johnson, MetroCities, 381 Mansfield Ave, Ste 500, Pittsburgh PA 15220. 412-928-0707.

Telex Magnecord 1022 2-trk R/P & 4-trk play w/rack, gd cond, \$250+s/h. A Wes, KZPX, HCR 1 Box 286-D, Merrifield MN 56465. 218-765-3333.

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Revox PR99 (4) to use w/automation or live music on reel, 25 Hz detectors, excel cond, \$600/ea or BO. P Delaney, KQYB, Box 308, Spring Grove MN 55974. 507-498-5720.

Technics RS1500 2 track, excel cond. J Gelo, J&H Music Programming, POB 1697, Marco Island FL 33969.

Viking 78 tape decks, \$100 ea/BO; (1) Ampex 600 w/manual, \$200/BO; (2) ITC 750 tape decks in vgc, \$550 plus shipping. M Fitzer, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

Teac 330-S, 2-trk; Teac A-3440, 4-trk; Teac A-4010, 2-trk. D Low, WUJM, 1 Carriage Ln Ste B-100, Charleston SC 29407.

Sony TC 650 R-R 7.5" 2-trk master, new heads/belts, very clean, \$300/BO; Scott DA 688 cass dubbing deck, excel cond, \$65. M Stewart, M&M Studios, 5712 Parker Rd, Modesto CA 95357. 209-523-0956.

Ampex 354 elects (2), fair cond, BO. R Meyers, Benchmark Comms, 4700 SW 75th Ave, Miami FL 33155. 305-264-5963.

Ampex AG440C mono R/P, like new cond, \$750. D Johnson, MetroCities, 381 Mansfield Ave, Ste 500, Pittsburgh PA 15220. 412-928-0707.

Ampex 440-C/7 (2), 5-15 ips 1/4" w/Ampex roll around cabinets & remote controls, new erase, record & playback heads, excel cond, \$1395 ea. Bill 313-242-2319, 8-4 in MI.

Crown CX824 w/variable speed, sync, remote, never used, mint cond, \$1000; Scully 280B stereo mounted 1/4" head assembly w/cables, new, \$250. D Kocher, Digital Sound Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Ampex 351 (3) full-trk, unmounted w/book, \$200 ea/BO; Magnecord PT-6 w/7 1/2 & 15 capstans, book, BO; ext arm for 10 1/2" reels on PT-6, BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628.

Otari ARS 1000 (4), exc cond w/25 Hz tone sensor & cue tone relays, \$300 ea. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Otari Mark II-V 1/2" 4-trk, multi-trk, mint, less than 50 hrs, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

Scully 270 14" PB, 1 stereo plus 1 mono for parts, \$200/both; Ferrograph Super 7, 10", 3-7-15 ips, 2 trk, \$300. W Gunn. 619-320-0728.

Tascam 32 2-trk & 38 8-trk, like new, \$2000/both; Teac 3340 4-trk, 1/4" deck, \$375; Tascam 80-8 8-trk never really used/perfect, \$1600. W Gunn. 619-320-0728.

Ampex ATR800 mono, like new, \$1200 & AG440-8 1" 8-trk; Otari 7800 1" 8-trk, \$2900. W Gunn. 619-320-0728.

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Want To Buy

Nagra 3S/4S w/NAB hds; Sony TC880/8750; ReVox B215S cass deck. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

Otari MK III 8-hd bridge w/o hds. R Robinson, TNA Rcdg, 10 George St, Wallingford CT 06492. 203-269-4465.

Audio & stop delay card for an Otari ARS 1000 recorder, card #ASB-2. D Carr, WTHL, 2034 N Hwy 39, Somerset KY 42501. 606-679-6300.

Ampex ATR102 15-30 ips 1/4" or 1/2", possible trade w/some cash. Bill, 313-242-2319, 8-4 in MI.

Scully '100' recorders, record/play amplifiers, 8, 16, 24 track heads. Sequoia Electronics, 4646 Houndshaven Way, San Jose CA 95111. 408-363-1646.

Ampex ATR100 taperecorders for parts. Circuit cards, heads, motors, machine parts, or electronic parts. Call 818-907-5161.

CD's/PLAYERS

Want To Sell

TEAC PD 325 plyr & rem, exc cond, \$75+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

Nikko NCD-600, 60 disc player, will interface to IBM computer, new w/8 yr warranty, never used, will ship via UPS, \$850. Keith, ALI, 9 Roxbury St, Keene NH 03431. 603-352-8460.

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Tandy 2000 w/software, \$375; Kaypro port, \$200; Texas Instr 810 printer, \$450. R Robinson, TNA Rcdg, 10 George St, Wallingford CT 06492. 203-269-4465.

NEC 8088 version for XT, plug in replacement, \$15/BO; Intel 8087 w/match co-processor for XT, \$75/BO; Autosketch drafting prog w/manual, \$50/BO. L Snyder, 718-347-2940.

CONSOLES

Want To Sell

BE 8M250 in excel cond, \$3500/BO; Sparta A16R in excel cond, \$1000/BO. Call Mark at 619-598-3311.

Ward Beck custom console w/9 inputs, BO; Spotmaster 4-input, BO. Several additional items also available. A Croft, Mutual Bdcg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

Arrakis 150SCT (2) 6-chnl, mono, rotary pots, exc bds, used 4 mos, \$2800 both. J Hart, Radio Genesis Intl, 13701 W Jewell Ave #111, Lakewood CO 80228. 303-987-9442.

Alesis 1622, exc cond, \$500+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

McCurdy 7000/8000 Series parts & manuals. B Kuhar, 215-434-7921.

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Russco 505 5-chnl rack mount, mono, \$50. C Hicks, WEAX, W Park Ave, Angola IN 46703.

McMartin B502 5-pot stereo, \$350/BO; Gates pwr sply/audio amp, unit only, \$30/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Peavey MK3-16-FC 16-input, phantom pwr, 4-band EQ, stereo mix buss, 2 cue outputs, 2 mon outputs, in-flight case, very gd cond, \$800+s/h/BO. Kerry, Emerald Sound, 1033 16th Ave S, Nashville TN 37212. 615-327-9544.

Ramko DE 12-SR 12-chnl stereo, gd cond w/manual, \$1200. M Benson, 916-893-8737.

PR&E CI-2/TI-2/TT-3 interface units; (2) stereo cart w/3 inputs ea; (2) R-R w/1 input ea; turntable w/2 inputs, \$150 ea/\$600 all. C Guglielmetti, Edgewater Co, 232 C St, San Fran CA 94080. 415-589-3313.

Audiotronics 200 series blue face mods, 1 mono line output, gd cond, \$125; (3) stereo line output, \$150 ea/\$475 all. M Guthrie, 813-855-5642.

Gates SA-40 9 chnl tube type mono board, worked fine when removed from service, complete w/manual, BO. D Burgeson, WDND, Box 119, Wilmington IL 60481. 815-458-2141.

Tascam M216 16.4.2 bal/unb recording/PA console, new cond w/blk nylon heavy padded case, \$875/BO. M Stewart, M&M Studios, 5712 Parker Rd, Modesto CA 95357. 209-523-0956.

BE 5 chnl mono, \$450; Shure M688 mic mixer, stereo, \$125; Shure M68RM reverb mic mixer, \$125. B Elliott, WRFX, 915 E 4th St, Charlotte NC 28204. 704-338-9970.

Shure M675 production master add-on mixer for the M-67, \$100; Shure M-67 mixer, fair cond, \$150. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

Spotmaster 5 BM 100 5 chnl dual mono, vgc, \$700. J Arzuaga, WREI, Rd 2 KM 102.5, Quebradillas PR 00678. 809-825-2725.

McCurdy SS8600 free standing custom stereo 12 chnl, real time clock, digital timers, slide attenuators, echo foldback, etc, \$5900. P Willey, WJW, Church St, N Adams MA 01247. 413-663-3419.

Gates Yard Board, painted white, \$300; Bogen CSM remote mixer, \$125. W Gunn, 619-320-0728.

Want To Buy

Cetec 001-2003 schematic. R Mize, KZML, 3514 Kings Ct Way, Sierra Vista AZ 85635. 602-458-9631.

Gates Stereo Yard wanted for parts, need not be working. D Hallow, KSTN, 2171 Ralph Ave, Stockton CA 95206. 209-948-5786.

DISCO & SOUND EQUIPMENT

Want To Sell

Sony C-37a mic, \$1250; (2) API 550a modules w/P.S., \$1500; EMT 140 ST reverb, \$3000; 2 ch Massenberg pre-amp, \$2000. Tony Campana. 313-553-4044.

EV SH 1502-ER 2-way mobile w/15" woofer & titanium driver/horn in carpeted cab w/handles, steel corners & grill, new cond. B Fisher, KPOK, POB 829, Bowman ND 58623. 701-523-3883.

Sony C-37a mic, \$1250; (2) API 550a modules w/P.S., \$1500; EMT 140 ST reverb, \$3000; 2 ch Massenberg pre-amp, \$2000. Tony Campana. 313-553-4044.

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dbx 222 noise reduc syst, gd cond, \$50+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

DOD crossover 2-way stereo, 3-way mono w/1/4" jacks, \$125. J Gardner, 816-644-5547.

Synthesizers: Korg DW8000 w/heavy duty case, \$500; Arp Omni 2, \$450; Roland TR707 drum mach, \$250; Casio C2101, \$175. G Fitzgerald, Fitz Music, 37-75 63rd St #B29, Woodside NY 11377. 718-446-3857.

Tad/Pioneer TL-1601A (4) 16" 300 W, low freq, 8 ohm, gd cond, \$125 ea/BO; (14) 4" dia beryllium diaphragm for Mdl TD-4001 high freq driver, 16 ohm, gd cond, \$125 ea/BO. Kerry, Emerald Sound, 1033 16th Ave S, Nashville TN 37212. 615-327-9544.

Tannoy PBM 6.5 near field ref monitor, exc cond, \$250+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

Snake, 16 phantom-pwr inputs w/ext ps; 250' Belden 19-pr cable, mil conns, ss strain reliefs, 10' Neumann XLR snake mats w/box or Belden snake, exc cond, \$750/BO/trade. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

DOD crossover, 2-way stereo, 3-way mono, \$125. J Gardner, KZBK, 107 S Main, Brookfield MO 64628.

Yamaha QX5 MDF-1 MIDI sequencer & disk drive, \$200 both/\$125 ea. P Cibley, Cibley Music, 138 E 38th St, NY NY 10016. 212-986-2219.

Dolby 301 A-type stereo, discrete, \$500. W Gunn, 619-320-0728.

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Gates Solid Statesman (2), exc cond & BL-40 Modulimeter, BO. E DeLa Hunt, KPRM, Hwy 34 E, Park Rapid MN 56470. 218-732-3306.

RCA BA43/45 (2) ABC/limiter on rack tray, \$200. B Kuhar, 215-434-7921.

dbx 160s, \$950 pair. J Wells, SoundArts, 8377 Westview, Houston TX 77055. 713-464-4653.

CBS Volumax 400 (2) auto peak, BO. L Smith, WIOZ, POB 1677, S Pines NC 28388. 919-692-2107.

CRL SMP 900 AM stereo matrix proc. M Young, WJON, Box 220, St Cloud MN 56302. 612-251-4422.

CRL PMC 300A (2), \$250/BO. C Hicks, WEAX, W Park Ave, Angola IN 46703.

Orban 8000A exc cond, \$1675/BO. M Friend, WTJU, 711 Newcomb Stat, Charlottesville VA 22904.

Inovonics MAP-230 multi band proc, fair cond, \$300; Univ Audio BL-40 audio proc, gd cond, \$300; Harris Mono-80, 8-chnl board. O Booth, 601-323-4980.

Gregg Labs Series 2530 tri-band audio processing amp (2), \$400/ea. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

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Alesis Micro limiter, Micro gate, Micro enhancer & rack attach, \$220/BO. M Stewart, M&M Studios, 5712 Parker Rd, Modesto CA 95357. 209-523-0956.

Inovonics 222 audio proc for AM w/NRSC std, 2 yrs, \$500/BO. S Buchanan, WPRZ, POB 3220, Warrenton VA 22186. 703-349-1250.

Want To Buy

Optimod-9100A, gd cond. H Cambero, 305-380-6001.

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Orban 8100A/8200/Unity 2000, Mark, 210-875-2555.

MICROPHONES

Want To Sell

Telefunken/Schoeps CM61 tube, rare, mint cond, \$3475/BO. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

Deumann D-67, \$2350. J Wells, SoundArts, 8377 Westview, Houston TX 77055. 713-464-4653.

AKG C535, exc cond, \$175+s/h; AKG stand/boom, \$25+s/h; Symetrix phantom pwr, exc cond \$150+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

Sennheiser 421U (3), used 4 mos, \$500 all. J Hart, Radio Genesis Intl, 13701 W Jewell Ave #111, Lakewood CO 80228. 303-987-9442.

Sennheiser 405 mkh, cardioid condenser, capsules cleaned, preamps aligned 10/92, exc cond, \$500. J Newman, 401-847-0455.

Sennheiser 441 (matte), new w/all papers & response curves, \$450. R Payne 313-786-1767.

Sony ECU 22 condenser mics (2), excel cond, \$350/pr. M Stewart, M&M Studios, 5712 Parker Rd, Modesto CA 95357. 209-523-0956.

Starbird 180 studio boom extends 146", \$200. D Kochoer, Digital Sound Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Altec 639 (2), gd cond, \$450 ea; (2) RCA 77, gd cond, in use, \$900 ea. L Berel, On-Cue Recdg, POB 85042, Hollywood CA 90072. 800-726-9813.

AKG 202E two element mic, excel cond, \$120. D Kochoer, Digital Sound Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

EV RE 27 (3), N/D, never used, still in cases, \$425 ea or all for \$1175. W Harris, WNPC, POB 189, Newport TN 37821. 615-623-8743.

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Telefunken M921 dual (2-way, not front/back) nickel capsules, cardoid only, classic tube mic; Neumann KM84 pair, mint, \$1100. W Gunn. 619-320-0728.

EV 676 supercardioid mics 3/\$200; EV RE10 mic, \$125. W Gunn, 619-320-0728.

Want To Buy

AKG C24. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

RCA 77-DX not working OK, silver/gray. M Miller, WSDM, POB 650, Brazil IN 47834. 812-446-2507.

RCA BK-6B lavalier mic. D Dintenfass, 7549 27th Ave NW, Seattle WA 98117. 206-784-4803.

RCA 77DXs/44BXs ribbon, chrome/TV grey, gd cond, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

77-DX's, 44-BX's, KU-3A's On-Air lights. Top price paid. Fast response. Bill Bryant Mgmt, 2601 Hillsboro Rd, G12, Nashville TN 37212. 615-269-6131.

MISCELLANEOUS

Want To Sell

Audiolab TD-3 in excel cond, \$325/BO. Call Mark at 619-598-3311.

Mic stand, fair cond, \$20+s/h; 7" reel tap, gd cond, \$25+s/h; cables, exc cond, \$25+s/h. R Clark, Northern Aire Audio, 3 NE 63 Terr, Kansas City MO 64118. 816-454-8067.

Anvil briefcases, new/used, \$50/BO+s/h. L Snyder, 718-347-2940.

Viking DVA 1000 (2) dig phone answer/rcvr, great cond, \$200 ea. L Walker, WIOZ, POB 1677, S Pines NC 28388. 919-692-2107.

78 rpm library w/6000 10" singles, gd cond, various formats, BO. B Kuhar, 215-434-7921.

CHS-52 (2) intercom headset, carbon mic, coiled cord, new cond, \$20 ea+s/h. G Kirby, Gray Fox Video, 13613 US 36, Marysville OH 43040. 614-261-8871.

Radio sales training tapes on 16 VHS tapes, 30 topics, \$2000. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4145.

Square D 60 amp, 3-pole, double throw, enclosed, gd cond, \$75/BO; 240/480 V, hi voltage; 120/240, low volt, indoor, dry, \$50/BO; 120/240 V primary, 16/32 V secondary, 0.750 KVA, NEMA raintight enclosure, \$40/BO; relay (2) P&B KRP14AG, 3PDT, 10 amp, 120 VAC coil, 11-pin octal style plug in, unused, \$3 ea; home brew relay panel, 6 DPDT w/onboard pwr sply, \$25/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Bulk tape eraser, heavy duty, 220 V, BO. Several additional items also available. A Croft, Mutual Bdctg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

New 8 space grey carpet rack box w/front/rear panels, \$75. M Stewart, M&M Studios, 5712 Parker Rd, Modesto CA 95357. 209-523-0956.

Mod-Tap, six 24-corrector tele-sharp patch fields for 19-inch rack mount, removed from service, \$100/BO. M Starin, WGOT-TV, 457 Varney, Manchester NH 03102. 603-625-1165.

CSI Technologies 13F38405 5.2 microfarad, 15 KVDC oil capacitors, no PCB's, new, \$150. J Alexander, KMCL, POB 24, Notus ID 83656. 208-459-9047.

Powerstat 240 volt, 0-280 volt variable autotransformer, excel cond, \$400/BO. M Fitzner, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

Rack System, 12 VDC, 25 amp, regulated, adjustable from 10-14 VDC, \$125. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

Want To Buy

RCA BC7B mods; phone hybrid syst; A/C & gold reels w/25 Hz tones. K Haight, KCMX, 820 Crater Lake Ave #213, Medford OR 97504. 503-482-2614.

Old Broadcasting Yearbooks wanted for research, the older the better. R Massey, WKYX, 360 Interstate N, Atlanta GA 30339.

Radio transformers by Chicago, UTC, Triad, Peerless, Freed, Sola, send list. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

Jazz record collections, 10" LP/12" LP be-bop, swing, dixie, highest prices paid. B Rose, Program Recdgs, 228 East 10th, NYNY 10003. 212-674-3060.

MONITORS

Want To Sell

McMartin EBS AM rcvr; 1979 Triad pwr sply; 6" rack, Sorensen volt reg; 1979 LPB lim/comp. J Wilsbach, WMSS, 214 Race St, Middletown PA 17057. 717-948-9136.

QEI 691-02 w/67 & 92 SCA, gd cond w/book, \$3500/BO; HP 335B FM mod, nds work w/book, \$75/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Belar AMM-2A AM mod mon, gd cond, \$500; RFA-1 AM RF amp, gd cond, \$300; Belar SCA mod mon, gd cond, \$300; Fluke 8840 5 1/2 digits, true RMS meter, gd cond, \$600; Phelps CFM-HP10 10-bay FM, hi pwr on 99.5 MHz, BO; Harris FM-20H 20 kW on 99.5 MHz, gd cond, \$15K; QEI 6 W exciter on 99.5; 400' of Andrews 3 1/2" line, gd cond, BO. O Booth, 601-323-4980.

Potomac Instruments AM-19 2 tower phase monitor, works but needs minor repair, clean, \$350 plus shipping; Gates/Harris AM mod mon, solid state, clean, \$200 plus shipping. B Elliott, WRFX, 915 E 4th St, Charlotte NC 28204. 704-338-9970.

Want To Buy

McMartin (buy & sell) any model. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886 or fax 402-493-6821.

MOVIE PROD EQUIP

Want To Sell

Technicolor w/zoom lens & mic, 8mm, port, rec, pwr sply, cables & cases, \$200+s/h. G Kirby, Gray Fox Video, 13613 US 36, Marysville OH 43040. 614-261-8871.

RECEIVERS & TRANSCEIVERS

Want To Sell

McMartin (2), gd cond, \$75 ea/BO; (2) Johnson, \$110 ea/BO, both 67 kHz, Xtai, tuned; Sony STJ-75 FM, mon quality, 75/300 ohm input, new, 8 push-button, seek, scan, \$1150/BO. L Snyder, 718-347-2940.

AM STEREO RECEIVERS
From \$34.95 Portable, Home, Auto
RRADCO GROUP
Phone/FAX 708-513-1386

Sony SRF-A1 AM Walkman, new, many, \$89 ea. C Fox, WOLF, 4853 Manor Hill Dr, Syracuse NY 13215. 315-468-0908.

GE MPI hand-held 2-chnl, 2-way, exc cond, 1st freq, 467.350 MHz. J Newman, 401-847-0455.

DB 264 on 155.625 MHz, \$250+s/h; Motorola TDD6073A w/5.25 dB gain, 150-159 MHz freq, \$250+s/h; Cushcraft BR-4, 42-50 MHz, \$60+s/h, all base stations. A Wes, KZPX, HCR 1 Box 286-D, Merrifield MN 56465. 218-765-3333.

RECORDING SERVICES

CD 1-off copies from your DAT master. 48 hour turnaround. Integrated Digital Systems 310-478-4264 fax: 310-444-9224

REMOTE & MICROWAVE EQUIP

Want To Sell

Wescam 2- or 4-wires hybrids; 200 Hz-5 kHz audio quality, \$100 ea w/prints. R Weaver, WIH EV, 413 S Fuquay Ave, Fuquay Varina NC 27526. 919-552-8036.

COMREX RENTALS

1, 2 and 3-Line Extenders Switched 56 Systems
Call Steve Kirsch for details
Silver Lake Audio
(516) 623-6114 FAX: 377-4423

Marti RMC15 16-chnl, gd cond, \$900; (2) Mark 4' STL dish, gd cond, \$500; (2) Marti STL-8 trx & rec STLs, gd cond, \$800. O Booth, 601-323-4980.

Moseley 303 2-trx, 2-receive. K Kenze, KFEX, 13 E 11th, Washington MO 63090. 314-239-0209.

Comrex LXR single-line rcvr, exc cond, BO. B Clain, Music Dir, Box 51978, Indian Orchard MA 01151. 413-783-4626.

PHONE: 703-998-7600 FAX: 703-998-2966



Call Simone Mullins, Classified Ad Manager, to reserve space in the next issue. Use your credit card to pay, we now accept VISA and MASTERCARD.

RadioWorld

5827 Columbia Pike, Ste 310
Falls Church, VA 22041

Select from these categories for best ad positioning:

- | | | |
|----------------------------|---------------------------|-------------------------|
| Acoustics | Consoles | Stereo Generators |
| Amplifiers | Disco-Pro Sound Equip. | Switchers (Video) |
| Antennas & Towers & Cables | Financial Services | Tapes, Carts & Reels |
| Audio Production (Other) | Limiters | Tax Deductible Equip |
| Automation Equip. | Microphones | Test Equipment |
| Brokers | Miscellaneous | Transmitters/Exciters |
| Cameras (Video) | Monitors | Tubes |
| Cart Machines | Movie Production Equip. | Turntables |
| Cassette & R-R Recorders | Receivers & Transceivers | TV Film Equip. |
| CATV-MATV Equip. | Remote & Microwave Equip. | Video Production Equip. |
| CD's | Satellite | Video Tape Recorders |
| CD Players | Software | Positions Wanted |
| Computers | Stations | Help Wanted |

Display Rates for Classified Advertising Effective January 1, 1991

	1x	3x	6x	12x
1-9 col inch (per inch)	\$55	53	50	45
10-19 col inch (per inch)	50	48	45	40
Distributor Directory	90	85	80	75
Professional Card	60	55	50	45
Classified Line Ad		\$1.50 per word		
Blind Box Ad		\$10 additional		

To compute ad costs: Multiply the number of ad inches (columns x inches) by the desired rate schedule for your per unit cost. Example: a 3" ad at the 1x rate is \$165, at the 3x rate \$159, at the 6x rate \$150, at the 12x rate \$147, etc.

DISTRIBUTOR DIRECTORY
The following distributors serving the broadcast industry would be glad to help you with any of your requirements.

CORNELL-DUBILIER MICA CAPACITORS

FROM STOCK

JENNINGS VACUUM CAPACITORS

FROM STOCK

JENNINGS VACUUM RELAYS

SURCOM ASSOCIATES

2215 Faraday Ave., Suite A
Carlsbad, California 92008
(619) 438-4420

... getting tired of the price/quality/performance puzzle?

... That's our game.

RADIO! The beat goes on!

CROUSE-KIMZEY OF ANNAPOLIS

tops in broadcast equipment

1-800-955-6800

ask for Kathleen

This Space Available

Call Simone for details

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SPENCER BROADCAST

Where Service doesn't End With the Sale!

Fax: (602) 843-2860

Call (602) 242-2211

Serving Broadcasters Since 1979!

REMOTE & MICROWAVE EQUIP... WTS

Moseley PCL-505 comp on 948 MHz, \$1500. K Freeman, WBBQ, 1305 Ga Ave, N Augusta SC 29841. 803-279-6610.

TFT 7610, studio OK, xmtr nds work, \$300/BO; Marti DRT-24 dig xponder, xmtr end only, \$100/BO; RCA: (3) MI-27566 meter alarm panels, MI-27562 rem control/metering unit, (2) MI-27571 metering units, 1 motor-driven metering commutator & 1 w/extra relays on panel. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

RENTALS
RENTALS
RENTALS

COMREX
3-line extender

Frank Grundstein 215-642-0978
Audio/Video Consultants

RCA BTR-11B remote control w/manual, working when removed, \$150/BO; (2) Marti M-30 BT remote pickup xmtrs, both on 161.76 w/manuals, \$450 ea; Raytheon RR-30 3-chnl remote amp w/manual, working, BO; RCA remote console, type BC-10A w/manual, gd cond, BO, prices do not include shipping. M Fitzner, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

Gates RDC-10 (3), 1 gd cond, 2 OK, 1 w/book, \$100/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628.

Moseley TRC15 remote terminal & TR55A telemetry rcvr for STL system w/manuals & shipping, \$600. G Wise, WEKU, 102 Perkins Bldg, Richmond KY 40475. 606-622-1672.

Moseley PCL-303C STL system in gd cond, \$500. P Christensen, WIVY, 3101 University South, Jacksonville FL 32216. 904-646-0129.

Marti STL 10, 1991 system control w/4' dish & approx 700' coax, on 951.5. C Ratliffe, Rt 2, Box 178, Wadesboro NC 28170. 704-694-5040.

Want To Buy

TFT 7601/7610 xmtr end only; Moseley MRC-1 studio end only. T McGinley, WPGC, POB 10239, Washington DC 20018. 301-441-3332.

Composite STL xmtr & rcvr. Mark, 210-875-2555.

Scala 960 mini-flectors, STL ant. K Kenze, KFEX, 13 E 11th, Washington MO 63090. 314-239-0209.

TFT 7707 stereo rcvr. Mark, 210-875-2555.

Marti RPT-15/similar 455 MHz. C Crouse, 814-837-9711.

SATELLITE EQUIPMENT

Want To Sell

Avcom SCPC 2000E for Tribune & Chicago Cubs baseball, \$950. R Jacobson, Jacobson Bdctg, POB 453, Estherville IA 51334. 712-362-2644.

TCS 9000 Telesyst Inmar SAT xportable, sat tele, BO. Several additional items also available. A Croft, Mutual Bdctg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.

Marcom/Prodelin 161-6 10' fiber-glass dish, 8 bolt together sections, hand crank, \$350. B Dickerson, WEAG, 1421 S Water St, Starke FL. 904-964-5001.

LOOKING FOR A SCPC RECEIVER?

The fully-agile Universal SCPC 300-C Commercial Broadcast Receiver can be purchased for the price of older, used fixed frequency, non-agile receivers. Why settle for a used SCPC receiver. The Universal SCPC 300-C is frequency and transponder agile, all compensating is built-in and selectable, microprocessor controlled, memory bank and all modern features — move to any satellite or any transponder in a minute. A full-featured, stand-alone SCPC receiver.

For full details and prices, SEE OUR AD IN THIS ISSUE and Call Universal Electronics, Inc. at 614-866-4605.

Wegener 1806 Ku Band rcvr, 2 yrs old, excel cond, BO. J Hansen, WYRQ, 70 SE 1st Ave, Little Falls MN 56345. 612-632-2992.

Fairchild DCC card; McCurdy DIC-1; CO Magnetics time switch for Unistar hot country/adult rock, \$950. B Christie, Grande Radio Grp, POB 907, La Grande OR 97850.

STATIONS

Want To Sell

Bdct facility for talk/news/music, late high qual equip, 14'x30', 2-axle mobile, less than 5 yrs old w/AC & restroom. 503-774-0459.

Profitable in sml mkt in NM, great hunting & fishing, growing community, \$100K building, \$290K 1/2 down, balance @ 8 percent. J Conner, 6 E Linda Ln, Gilbert AZ 85234.

25 kW CP in Susanville CA, exc site; 25 kW CP in Laramie WY, \$18K. D Ganske, KIKR, 5546-3 Century Ave, Middleton WI 53562. 608-831-8708.

Class C FM in ND, covers major metro, new bldg & equip, assumable financing, \$100K down, \$485K. E Stanley, Standef Bdctg, Hwy 5 W, Bottineau ND 58318. 701-228-2483.

Mid-South Class A FM w/pend-ing C2 (50 kW) upgrade, fully computerized digital automation system, on air one yr, great market acceptance, needs sales oriented owner-operator, \$250M, terms negotiable. 404-767-1840.

WFIC AM, Collinsville-Martinsville VA, 1000 watt Day, with/without real estate, will finance but prefer cash. Write or call Les Williams, 703-647-1530.

MUST SELL

AM 500 Watt full time in central Ohio. Some terms, offers considered.

For info write to: Chamberlain, PO Box 69 Bellefontaine, OH 43311

5kW day/29W nite w/new tower/ground system, w/4 acres in Jacksonville, FL metro market. Beautiful historic beach town. Best cash offer over \$200,000. Bill, 205-238-0281 or Mark, 205-236-6484.

Want To Buy

Small mkt AM on air in GA/FL w/sml amt down, \$15K-\$18K. B Rachels, 516 Colton, Thomasville GA 31792.

AM/FM combo 1000+ W AM/25000+ W FM or 50+ kW FM, pref South. J Wert, 717-423-6200.

Qualified & exper announcer, mgr, engineer, salesman seeks AM or FM to buy with no money down, owner financing, will consider GM also, if buy out possible in future. E Smith, POB 1341, Florence MS 39073-1341. 601-845-1920.

AM/FM/combo/CP, small/med mkt, pref southwest, off air/troubled OK, exper owner w/cash & equip. D Carver, KZBK, 107 S Main, Brookfield MO 64628.

New group seeks AM or FM or non-commercial FM, dark or on anywhere, will consider lease, send or call terms and price to: Radio World, POB 1214, Falls Church VA 22041. Attn Box #04-14-01RW.

STEREO GENERATORS

Want To Sell

Catel 2000 Series in excel cond, \$1500/BO. Call Mark at 619-598-3311.

SWITCHERS (VIDEO)

Want To Sell

3M Brand bridging video switcher, \$500/BO. Call Mark at 619-598-3311.

Tascam 42B (5); (6) Dynamax CTR-10; Otari MX5050; other equip. R Russ, KBLA, 1700 N Alvarado St, Los Angeles CA 90026.

TAPES/CARTS & REELS

Want To Sell

3M 203 on 10" reels, \$8 ea/BO; 4A Audiopak, various lengths, gd cond, \$1.75 ea/BO. L Snyder, 718-347-2940.

Airchecks from 50s/60s/70s. B Eckart, OK Classics, Box 803, Mustang OK 73064.

1000 Aristocarts, BO. Several additional items also available. A Croft, Mutual Bdctg Syst, 1755 Jeff Davis Hwy, Arlington VA 22202. 703-685-2000.



Airchecks of the 50's-60's-70's-80's, also some video airchecks of KOMA. B Eckart, Box 803, Mustang OK 73064.

100 7" w/1200' tape in mailers, \$1 ea/BO; (30) 5" w/600' tape in mailers, \$.75 ea/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628.

Pams Jingles ref tapes, 1951-1976, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625.

Want To Buy

16" radio transcriptions from 1930-1950 for cash. J Salerno, Indus Video Svcs, POB 1487, Bellaire TX 77402. 713-981-9803.

Gold Discs 1/all; radio CDs, all kinds. K Kenze, KFEX, 13 E 11th, Washington MO 63090. 314-239-0209.

Advertise in
Radio World
For Space Availability
Call: 1-800-336-3045

ACTION-GRAM

Equipment Listings

Radio World's Broadcast Equipment Exchange provides a FREE listing service for all broadcast and pro-sound end users. 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
 A. Commercial AM station
 B. Commercial FM station
 C. Educational FM station
 D. Combination AM/FM station
 E. Network/group owner
 F. Recording studio
 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
 E. News operations
 F. Other (specify) _____

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: _____

WTS WTB Category: _____
 Make: _____ Model: _____
 Brief Description: _____

 Price: _____

WTS WTB Category: _____
 Make: _____ Model: _____
 Brief Description: _____

 Price: _____

WTS WTB Category: _____
 Make: _____ Model: _____
 Brief Description: _____

 Price: _____

WTS WTB Category: _____
 Make: _____ Model: _____
 Brief Description: _____

 Price: _____

*Closing for listings is the first and third Fridays for the next month's issue. All listings are run for 2 issues unless pressed for space or otherwise notified by listee.

Broadcast Equipment Exchange

Phone: 703-998-7600 PO Box 1214, Falls Church, VA USA 22041 FAX: 703-998-2966

TAX DEDUCT EQUIP

Educ FM nds any equip. C Hicks, WEAX, W Park Ave, Angola IN 46703.

FM station set up. E Kischiugs, WPWB, 613 Will Scarlet Way, Macon GA 31210.

Destitute high school radio station requires tax-deductible donation of 1 kW transmitter or amplifier or working exciter. B Long, WSTB Streetsboro High School, 1900 Annalane Dr, Streetsboro OH 44241. 216-626-4906.

Non comm educ FM station for blind & handicapped nds equip from mic to tower. Fred, Aaron Svcs, POB 181, Collinsville MS 39325. 601-626-7061.

TEST EQUIPMENT

Want To Sell

Heathkit IG-52 TV alignment gener w/book & cables, \$35+s/h. G Kirby, Gray Fox Video, 13613 US 36, Marysville OH 43040. 614-261-8871.

Anaconda 9300 sweep spec analyzer, \$2500/BO/trade; Philips PM6507 curve tracer, \$1450/BO/trade. R Katz, Allegro Sound, 15004 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

We Have RENTAL EQUIPMENT available to SAVE YOU MONEY

Spectrum Analyzer
Potomac Field Strength Meters
Impedance Bridges
Receiver/Generator
Audio Test Set

ALSO

Other Equipment Available
RADIO RESOURCES
Ask for STEVE, BILL or Chuck
1-800-54-RADIO

Kay Markasweep 154-C sweep gener w/o markers, solid state, 110 MHz, working, \$50. J Cunningham, KEOR, Rt 2 Box 113 B, Stonewall OK 74871.

HP 400D AC VTV, gd cond, \$75/BO; AC VTVM Ballantine 300E, gd cond, \$75/BO; Sine square gener, Heath G-2, \$15; GR unit oscillator 1214-A, 400 & 1000 Hz, exceeds specs, \$30/BO; Heath low dist audio gener, fact wired w/book, \$50/BO. D Carver, KZBK, 107 S Main, Brookfield MO 64628. 816-258-7458.

Heathkit IM-2420 freq counter, gd cond, w/manual, \$150/BO; HP 200C audio oscillator, gd cond, \$200/BO; RCA WO-91B scope w/manual, \$100/BO plus shipping; B&W 210 audio oscilator in vgc w/manual, \$100 plus shipping. M Fitzner, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

Potomac AT-51 test set, excel cond w/transformers, \$2995. J McPhearson, Blue Ridge Bdct, 14926 Ampstead Ct, Centreville VA 22020. 703-968-7492.

General Radio 916 impedance bridge, \$300. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

Want To Buy

Grid dip meter, old, uses 955 Acom tube. F Hollon, WAHI, Rt 1 Box 72, Plymouth IL 62367. 217-392-2340.

TRANSMITTERS

Want To Sell

Gates FM 5-C w/SS TE-3 exciter & manual, gd cond, \$6000. J Cunningham, KEOR, Rt 2 Box 113 B, Stonewall OK 74871.

NEW 3 kW FM transmitters
for under \$14,000.
Call for details
Bill Hoffman
518-583-9490

LPB RC-25B 20 W AM, \$150/BO. R Schaedel, CWMCR, 6630 Monclova, Maumee OH 45357. 419-893-7968.

Audiosine 10 W AM TIS on 1610, 24 VDC pwr sply, weather-proof cab, pole mounted w/o ant, w/book, \$150+s/h. G Kirby, Gray Fox Video, 13613 US 36, Marysville OH 43040. 614-261-8871.
Harris MW-1A access ext control panel. P Salois, KPCR, POB 1 Hwy 54E, Bowling Gree MO 63334.

FM - TRANSMITTERS

Factory new not used. Why buy a used Transmitter when you can own a new FM Transmitter for about the same cost? Call JIMMIE JOYNT at 214-335-3425.

Collins/Rockwell 310Z-2 FM w/stereo gener, comp input card, manual, unused, \$1250. B Watson, KSAK, 3352 Honeybrook Way #7, Ontario CA 91762. 909-947-8440.

Collins 830-D1 1 kW FM, gd cond, manuals, spare tube, rem interface w/o exciter, \$2200/BO, Cablewave FL-50J 7/8" foam line, 75", new, BO. M Friend, WTJU, 711 Newcomb Stat, Charlottesville VA 22904.

Collins 30K-4 high freq, A1 & A3 svc, (2) 30 MHz, 250 W, \$400 or trade/video camera; Bendix TDD-5 AM plate modulated, tube-type, 25-50 W, \$350+s/h. J Cunningham, KEOR, Rt 2 Box 113 B, Stonewall OK 74871.

DEMOED EQUIPMENT

BEXT Inc. has a few demoed exciters, amplifiers and STL's for sale. All demoed systems are sold first come first served and have the same 2-year warranty as BEXT's new equipment. For information: **619-239-8462**

Harris IG 1 kW AM, gd cond, \$4500; Harris Vanguard I, 1 kW AM, gd cond, \$2900; Robert Jones J-318 FM booster, 10 watts, \$2500; CSI exciter FM synthesized tuned from 88 to 108, 10/W gd cond same QEI 675 a few spare boards, \$550. J Arzuaga, WREI, Rd 2 KM 102.5, Quebradillas PR 00678. 809-825-2725.

ITA FM 10,000C, 10 kW, rebuilt, new tubes & sockets w/spares, ready to run. T Mohr, WCLS, POB 296, Oscoda MI 48750. 517-739-8180.

Bauer 1 kW minor repair, \$2500. F Willis, WKXH, POB K, Alma GA 31510. 912-632-0104.

Emcee HTU-100 TV tube-type translator, chnl 70 in/78 out, gd cond, \$800+s/h. A Wes, KZPX, HCR 1 Box 286-D, Merrifield MN 56465. 218-765-3333.

Kintronics PS-1 AM low pwr w/2 pwr levels, pwr reduc for nighttime, \$1000. S Buchanan, WPRZ, POB 3220, Warrenton VA 22186. 703-349-1250.

Sparta 610 250 W FM, \$500. S Homer, KBBY, 6150 Olivias Pk Dr, Ventura CA 93002. 805-654-0577.

Collins 830H 1A 20 kW, 1967, 2 10 kW driver halves driven by IPA ctr cabinet, some spare parts, \$12,000 FOB our xmtr bldg. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

Gates 20H, exc cond, \$15K. S Wodlinger, WIXI, 3337 Tamiami Trl N, Naples FL 33940. 813-262-1000.

Gates BC1G 1kW AM, needs mod transformer, \$750 plus shipping; (2) tower phasing units, full of inductors & caps, \$750 plus shipping, willing to part out phasor cabinet. B Elliott, WRFK, 915 E 4th St, Charlotte NC 28204. 704-338-9970.

Harris HT-5, FM20H and CSI 3000 FM transmitters. Excellent condition. Call Steve or Howard at CCA Electronics at (404) 964-3530.

Used & New Transmission Line, many sizes & lengths, many like new. 816-635-5959.

Want To Buy

WE 1000 W 1935 era. R Steinberg, RC Comms, 3900 N River Rd, Schiller Park IL 60176. 708-678-7000.

Wanted Dead or Alive FM Transmitters Any Age or Power
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Natl 4CX1000A/8168, new, unused, \$200. T Peterson, Peterson Eng, POB 22, Big Rapids MI 49307. 616-796-7776.

Russco CueMaster TTs (2) in gd cond, \$100 ea; Russco TT w/no motor, \$50; Russco Studio Pro TT, \$100; (2) Russco Studio Pro TTs w/tonearms, excel cond, 10 hrs, \$200 ea, prices do not include shipping. M Fitzner, WKCX, POB 1546, Rome GA 30162. 706-291-9770.

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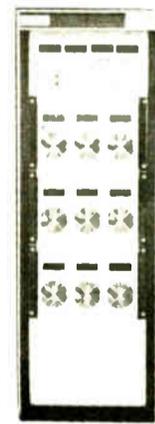
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STL, EBS Gear on Time

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the third provides the function of a set of four independent voltage controlled amplifiers. All are available for delivery now.

Henry Engineering showed its Digicord for storing news delay or EBS alert loggings, and introduced a new telephone information system, which is available now for a list price of \$895.

ComStream arrived at the show with enhancements to its digital audio distribution network. Its ABR200, with ISO/MPEG codec, now provides 64 Kbps QPSK operation and a higher speed in-band data channel, supporting up to 4800 baud.

At **Radio Systems'** booth, the TI-101 telephone interface was featured. At the **AEQ** booth, a new portable telephone hybrid was introduced, which will be available mid-summer for a list price of \$995.

At the **Burk Technology** booth, the ARC-16 remote control system was on prominent display with a new enhanced speech interface. Burk is offering the new option for \$350 list price.

Gentner showed its VRC2000 remote control, and debuted several teleconferencing systems. The T17200 system, with 7 kHz frequency response and up to 12 positions—including multiple locations—is listed at \$4,995. The GT700 system, with 7 kHz frequency response and built-in mic mixer and power amplifier, is listed at \$2,995.

The GT300 system, with 3.3 kHz frequency response and built-in mic mixer and power amplifier, is listed at \$1,995. All three systems digitally eliminate acoustic echo for high intelligibility and will be available in May. Gentner also had

on display its line of telephone hybrids.

360 Systems announced its new Series 1000 Message Player featuring 10 kHz bandwidth audio and storage of four messages for a total of three minutes play time. **Broadcast Microwave Services** featured its line of STLs, ENG systems and other microwave products.

Broadcast Software Ltd. featured a new modem PC board for its SVS computer interface remote control system, and showed the BSL Guardian software.

Harris Allied introduced a new transmitter remote control system, which includes 16 analog telemetry channels and can be expanded to 128 analog inputs. The new PC-based DC-128 is available now starting at \$14,000 and can be interfaced to Harris Allied's new System Manager.

IDB Broadcast announced its new KU-Band FM Squared distribution service, which reaches virtually all of North America. The company also introduced its IDAT (International Digital Audio Transmission) duplex service to and from France, and announced its LANDCO service will be converting to digital for direct dial-up on ISDN/Switched 56.

Digital was also heralded at **NPR Satellite Services**, which announced at the show that it is now able to cut SCPC C-band transmission costs considerably due to new digital technology.

Cost savings were likewise discussed at the **Scientific Atlanta** booth, which showed the new Encore DSR-3610 digital satellite receiver listed at a starting price of \$3,195. The receiver, is compatible with existing DATS and SEDAT formats and compares with similar products selling for around \$9,000.

Variety Key to Services

► continued from page 48

The "Rock 'N' Roll Graffiti" CD library consists of 1,229 songs on 50 CDs, with music from 1954 to 1969. And "Halland's Country," due out this summer, contains over 800 songs from 1985 to the present.

Sounding off

The **Valentino Sound Effects Library** includes over 300 different sound effects and a sound studio.

The disc includes over 300 files in .WAV format at two different resolutions: high-quality 16-bit, and eight-bits for compatibility with any Windows-compatible sound card.

The **Digivox Multimedia Sound Studio** includes a jukebox controller/player for audio with CD Audio, MIDI and Wave files. Features include fade-in and fade-out, zooming down to one sample and mixing wave files.

Omnimusic presented its 82-CD library, which includes 12 new releases each year and over 50 composers in its broad-based collection.

Most discs are organized by application, including technology, sports, drama, classical, rock, country, industrial and new age.

The **Professional Broadcast Series** contains 30 to 60 second music beds designed for radio, television and cable producers. The library includes the stingers, zappers, logos and bumpers used in broadcasts today.

The **Omni-FX** library is a collection of digitally recorded sound effects. It covers

all the basic production requirements of a small studio or video department. Effect sounds include jet planes, car crashes and suburban water sprinklers. Each disc contains pre-produced "environments" to layer sounds together for seamless backgrounds.

International E-Z UP Inc. displayed its instant shelters, used for portable shade during outdoor events or indoor trade shows.

A minute or less

The E-Z UP Instant Shelter can be set up in less than 60 seconds, and is designed for on-site remotes, promotions and other outdoor events requiring call letters and station colors.

E-Z UPs range in size from 8 x 8 to 10 x 20 feet. When folded down, they fit in their own storage bags.

New from **GE American Communications** is its GE-1 satellite with 36 MHz Ku-band. It's set for introduction in 1996.

Other features include 24 C-band transponders, 24 Ku-band transponders and 12-18 watt SSPA channels.

NPR Satellite Services, which also had a booth at this year's NAB, uses satellite space on Galaxy VI (followed by Galaxy IV) on an occasional or full-time basis.

Its C-band uplink service is in cities across the country. Features include transportable uplinks (both C and Ku-band) for remotes, connections via SATCOM C-5 to digital receivers and switched 56 backhaul for satellite broadcast distribution.

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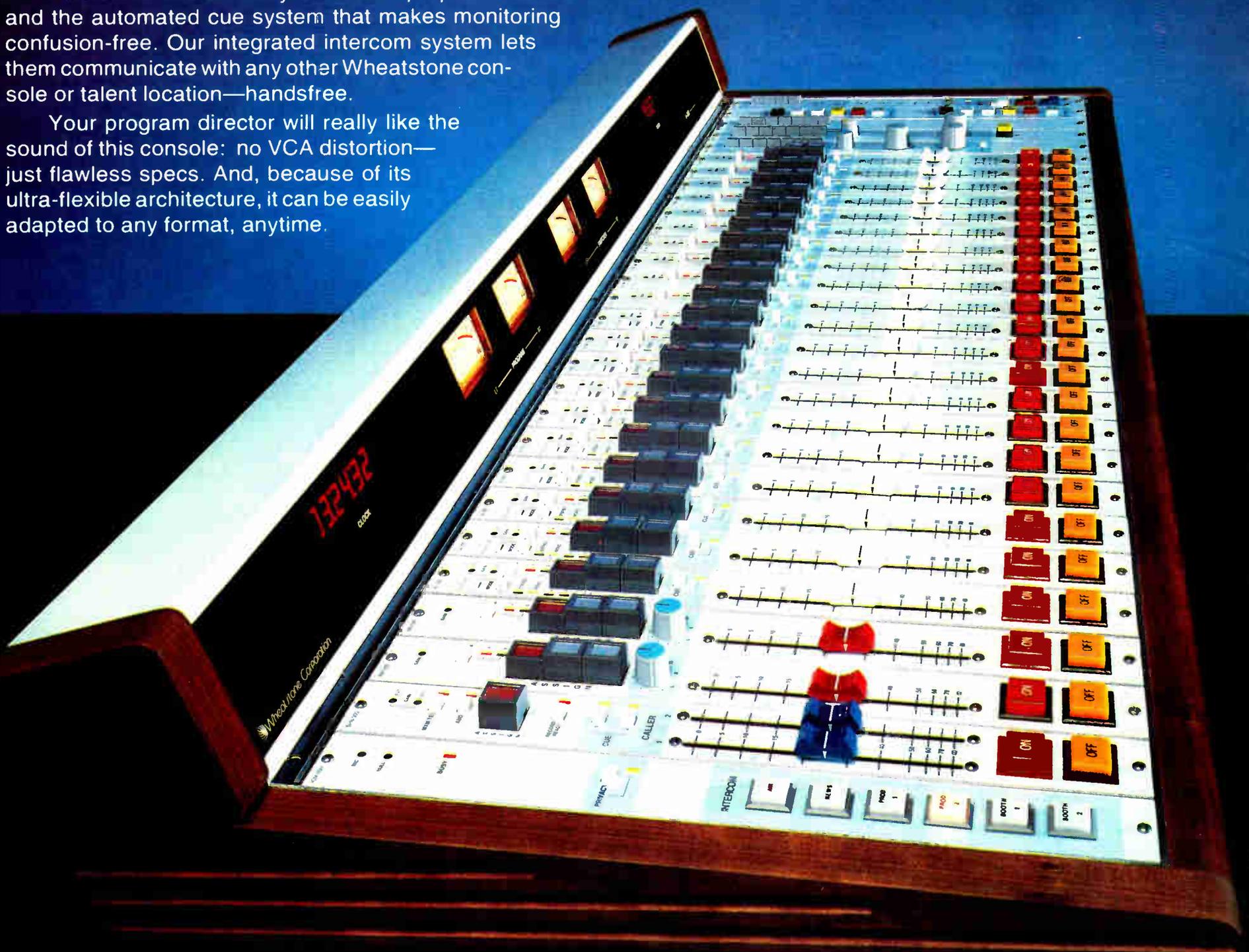
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