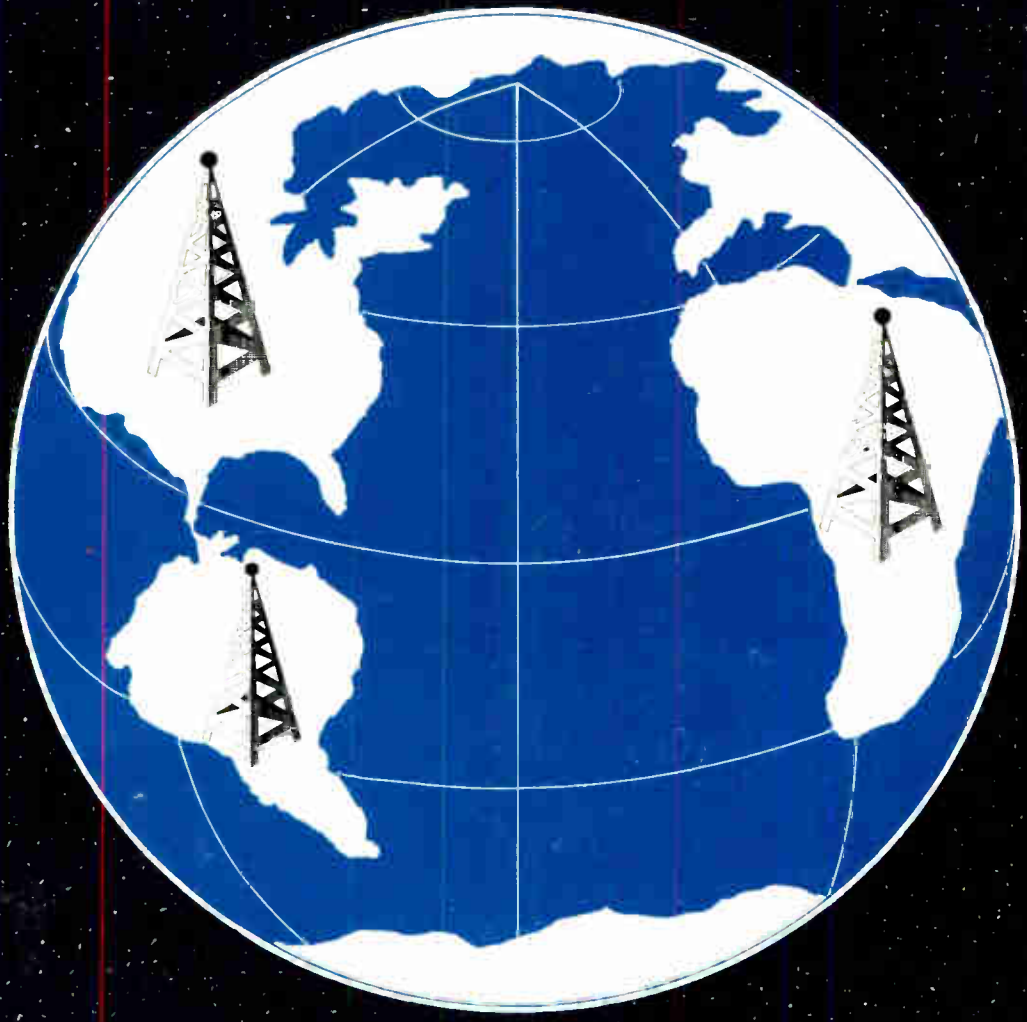
Radio World

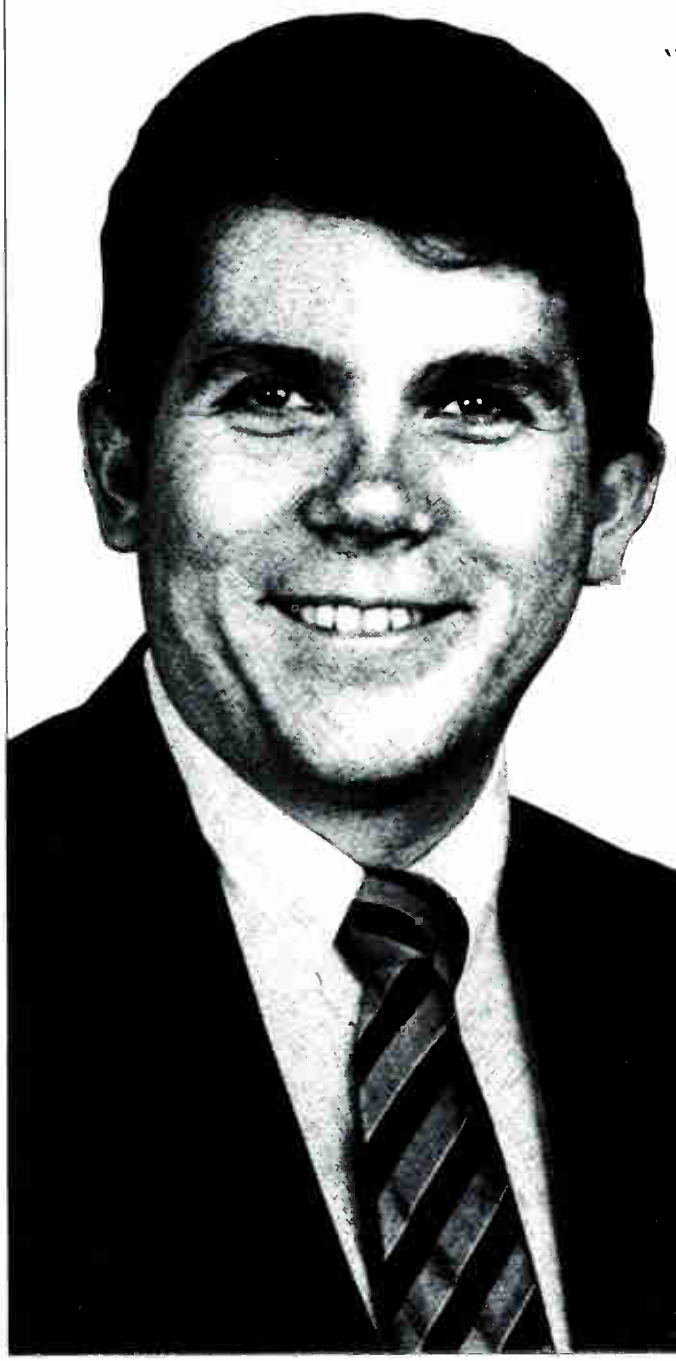


1990 ANNUAL

Supplement to *Radio World* February 21, 1990

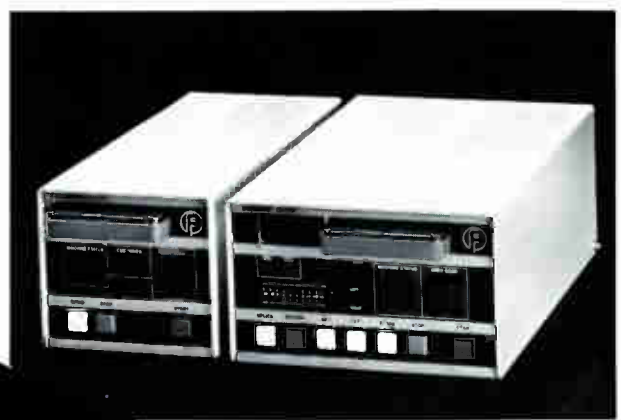
World Radio History

GO WITH THE WINNERS. DYNAMAX CTR100 SERIES



"The Chiefs at 14 of 16 Gannett Stations switched to DYNAMAX cartridge machines. Each Chief wants the best in performance reliability, and versatility."

Paul Donahue
Vice President of Engineering
Gannett Radio



DYNAMAX™
BROADCAST PRODUCTS BY FIDELIPAC®

Fidelipac Corporation
☐ P.O. Box 808
☐ Moorestown, NJ 08057
☐ U.S.A.
☐ 609-235-3900
☐ TELEX: 710-897-0254
☐ FAX: 609-235-7779

Circle 37 On Reader Service Card

World Radio History

Introducing Harris HT FM Transmitters...

WORLD-CLASS POWER AND PERFORMANCE FOR ANY SIZE FM MARKET

NEW! HT 7FM 7kW

Ronald C. Frillman
Manager — Domestic Radio Sales
Harris Corporation, Broadcast Division

No matter where you are or what your FM coverage requirements, Harris' new HT FM transmitters will provide the outstanding reliability and performance you want, at the power level you need.

HT transmitters come in 3.5, 5, 10*, 20, 25, 30 and 35 kW models, with dual configurations available. A perfect blend of rugged construction and proven technology, the HT FM transmitter family will deliver years of top performance and value.

At the heart of every HT transmitter is Harris' new solid-state 55 watt FM exciter. THE-I™. With two selectable RF power outputs, a low-profile slide-out design, ultra-linear voltage controlled oscillator and full stand-alone capability, THE-I provides a super-clean signal, maximum reliability and minimum maintenance.

For enhanced signal performance and low synchronous AM noise, HT transmitters use a high-efficiency single tube in a standard quarter-wave cavity. Other on-air features include RF Emergency Bypass or FlexPatch™, automatic VSWR foldback, automatic power control and convenient diagnostic systems.

For complete information on Harris HT FM Transmitters, write: Harris Radio Sales, P.O. Box 4290, Quincy, IL 62305-4290, or phone TOLL FREE:

1-800-4-HARRIS
Extension 3018

*Available in three or single phase models.

HARRIS

Circle 28 On Reader Service Card

FROM THE PUBLISHER

Welcome to the 1990 ***Radio World Annual****, radio's only comprehensive reference guide. Inside you'll find equipment and supplier information, phone listings and engineering data, as well as a review of the top news stories of 1989, both in pictures and print. Also featured is a directory of all the stories that ran in* ***Radio World*** *over the last year, a selection of Buyers Guide article reprints, and Earwaves' own Dubious Achievement Awards.*

We know you'll find this, our second year-end annual, a useful guide for all your radio reference needs. If there is anything we've missed here that you'd like to see included in future editions, let us know. We'd love to hear from you.

As we stand on the threshold of a new decade, we want to thank all of you for helping to make ***Radio World*** *the #1 radio industry publication in the US. We appreciate your support, and look forward to serving you throughout the '90s.*

World Radio History

Comtech's 3.8 Meter has the Extra Performance Margin Needed for Crystal-Clear Audio Reception.

Why Settle for Less?

Major network affiliates all over the country are specifying Comtech's 3.8 Meter Antenna. The reason is simple: No other antenna in its size category can deliver a gain of 42.9 db at 4 GHz.

This increased performance margin means outstanding audio reception on SCPC sub-carrier signals, and digital even in low EIRP areas.

Comtech's leadership in satellite antenna design is no accident. They pioneered the exclusive 3-piece "splice-strap" parabolic reflector with a superior surface tolerance unequalled by mesh or other home-type antennas. The result is higher efficiency, optimum side-lobe performance and increased gain. This is the extra margin of performance that only a Comtech Antenna can provide. That's why literally hundreds of Comtech 3.8 Meter Antennas are operating today at radio stations throughout the U.S.

So why settle for marginal performance when you can have a performance margin today and in tomorrow's 2° spacing environment.

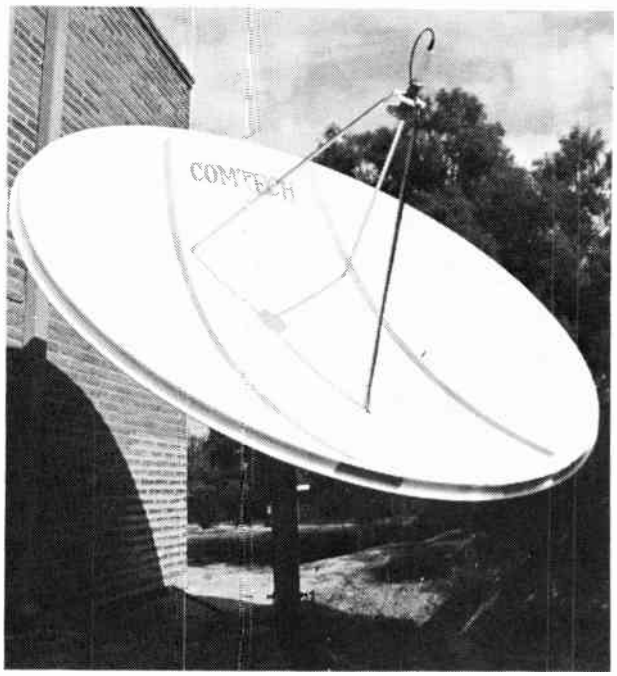
Allied Broadcast Equipment distributes Comtech Antenna systems to the radio industry nationwide. Call today for more information.

317-962-8596

ALLIED
Broadcast Equipment

3712 National Road West
P.O. Box 1487
Richmond, IN 47375

Comtech Antenna Corp.—Taking the lead in Satellite Antenna Systems



Radio Station KAIR/JOY, Inc.
Tucson, Arizona
3.8 Meter Antenna Installation

Circle 38 On Reader Service Card

RADIO WORLD 1990 ANNUAL

EDITORIAL
Editor: Alex Zavistovich
Associate Editor: Carmel King
Contributing Editor: Judith Gross

PRODUCTION
Director: Judith Chamberlain
Artists & Designers:
Ginger Bamford
Jim Gillgam
Kim Lowe
Jeanne Pearson
Bill Spencer
Cover Art: Jim Gillgam

CONTRIBUTORS
John Bisset
Alan Carter
Richard Farrell
Alex Felker
Ty Ford
Harold Hallikainen
Dee McVicker
Al Peterson

ADVERTISING
Art Constantine
Simone Leeser
Pat Macsata

Radio World

PUBLISHER
Stevan B. Dana

ASSOCIATE PUBLISHER
Art Constantine

CIRCULATION DIRECTOR
Tiana Hickman

COMPTROLLER
Anne Clark

The Year in Review
Earwaves 10
The Top Ten & The Year in Pictures 15
What's Up in AM 35
Radio's Tug-of-War 36

A Look Back/A Look Ahead 41

NAB & FCC Phone Listings 64

Directories & Profiles 67
Product Source Book 68
Supplier Source Book 84
Company Profiles 97

Indices & Reprints
Subject Index 114
Author Index 122
Buyers Guide Index 124
Buyers Guide Reprints 125

Advertisers Index 162

The Radio World Annual, ISSN: 0274-8541, supplement to Vol. 14, No. 4, is published by Industrial Marketing Advisory Services, Inc., 5827 Columbia Pike, Falls Church, VA 22041. Phone: 703-998-7600, FAX: 703-998-2966. Second class postage paid at Falls Church and additional mailing offices. Copyright 1990 by Industrial Marketing Advisory Services, Inc. All rights reserved.

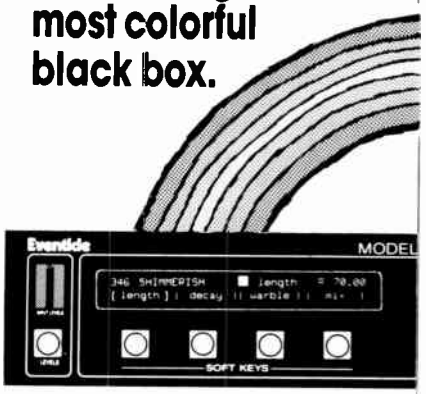
Postmaster: Send 3579 forms and address changes to Radio World, P.O. Box 1214, Falls Church, VA 22041.

World Radio History

Get the box that makes On-air Magic...

Eventide's H3000B Ultra-Harmonizer.

Introducing radio's most colorful black box.



Shimmerish Swept Reverb program—one of 70+ Eventide Broadcast Ultra-Harmonizer® digital audio effects you can use "right out of the box." Just turn the H3000B on, and it'll turn your listeners on.

RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

Morning zoo-in-a-box.

Java The Hun vocal shifter—one of 70+ Broadcast Ultra-Harmonizer® digital effects designed to let you dial up pre-programmed insanity. It's easy to afford the broadcast-engineered H3000B's power and flexibility: ask your Eventide distributor.

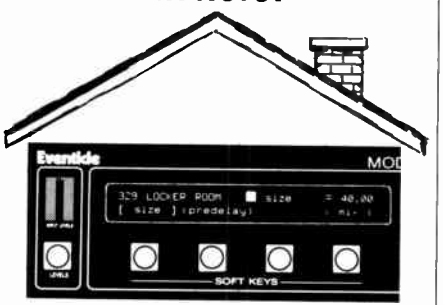
RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

Running out of room? Plenty of rooms in here.



Locker Room reverb/echo—one of 70+ broadcast-engineered H3000B audio effects you can use "right out of the box". The powerful and versatile Broadcast Ultra-Harmonizer® is also amazingly affordable—put it to work for you.

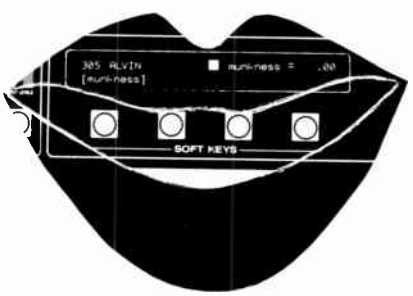
RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

The effects are all digital. The grins are only natural.



Alvin vocal shift program—one of 70+ Eventide Broadcast Ultra-Harmonizer® digital audio effects designed to stretch your imagination (and your smile). And when you have fun, so do your listeners.

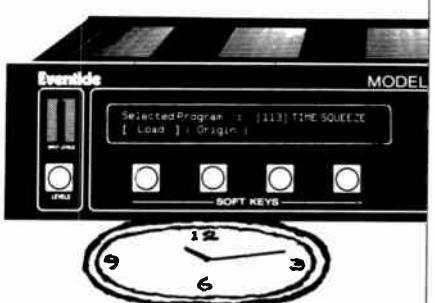
RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

Pressed for time? Press directly below.



TimeSqueeze™ automatic stereo time compression/expansion—one of 70+ Broadcast Ultra-Harmonizer® audio effects designed to make you more effective. The H3000B: never before has so little money done so much for your station's sound.

RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

Audio effects designed to make your staff more effective.

Traffic Report voice filter with 'copter effect—one of 70+ Broadcast Ultra-Harmonizer® digital audio effects. Put the "special effects department in a box" to work; call your Eventide distributor.

RADIO'S MOST COLORFUL BLACK BOX

EVENTIDE INC.
ONE ALSAN WAY
LITTLE FERRY, NJ 07643

Eventide the next step

TEL: 201-641-1200 • TWX: 710-991-8715 • FAX: 201-641-1640

World Radio History

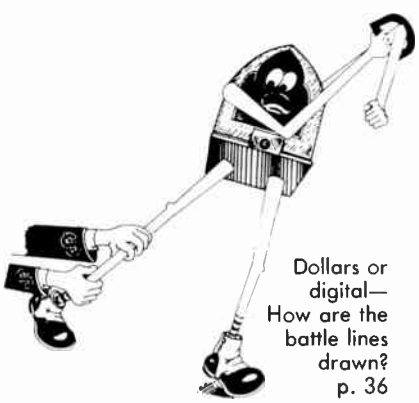
Circle 55 On Reader Service Card

1989 THE YEAR IN REVIEW

Who took top honors in last year's best of the worst?
p.10

THE TOP TEN

Which stories shaped the industry's direction for the coming year?
p. 16



Dollars or digital—How are the battle lines drawn?
p. 36

Earwaves' Dubious Achievements Awards 10

The Top Ten News Stories of 1989 & The Year in Pictures

Toasting AM's Milestones
FCC Adopts NRSC-2 16
Class A's Still Fight 18
BTP, Bose Go at It Over FMX System 20
The War to Be Loudest on the Dial 22
Musical Chairs at the FCC 24
Giving BEAR Facts to the FCC 27
Will the Go-Ahead Get DAT Going? 28
Defining Multipath 28
Prices Soar as Stations are Traded 31
The Digital Craze 32

What's Up in AM 35

Radio's Tug-of-War: Money Versus Gear 36

World Radio History

Dolby SR improves the medium for your message.

TAPE RECORDERS
Dolby SR provides the performance attributed to digital systems while maintaining such analog virtues as economy, editing ease, and tape interchange.

CARTS
Along with their familiar ruggedness and all-around utility, carts with Dolby SR capture the full dynamics of all your source material, digital or analog.

1-INCH VTR'S
With Dolby SR, video can sound as good as it looks. Signal purity is maintained through the multiple tape generations necessary in today's post-production techniques.

DISCRETE STL'S AND RPU'S
Dolby SR improves headroom and lowers noise, while suppressing the effects of interference and fade.

TV STL AUDIO SUB-CARRIERS
With Dolby SR, there's no need to re-allocate subcarrier frequencies or replace existing equipment in order to deliver high quality audio to the transmitter.

SATELLITE AUDIO
Dolby SR improves analog channels without audible side effects yielding performance rivaling digital systems.

Listeners today expect better sound wherever they go — at home, at the movies, in the car. To keep up with their expectations, you need Dolby SR. Two channels, with the compact, easy-to-operate Dolby Model 363 (shown). Or up to 24 channels, with Dolby Laboratories' multitrack products.

Dolby SR dramatically reduces noise, increases headroom, and lowers distortion from initial production to final transmission. That means you can deliver your message today with the clarity you've been expecting from the technology of tomorrow.

Dolby

Circle 2 World Radio History Ice Card

And Now, the '89 RW Dubie Awards

A Tribute to Dubious Achievements in Radio

by Judith Gross

The movies have their **Oscar**, TV has the **Emmy**, the music industry its **Grammy**. And, like every prestigious institution, *Earwaves* has its very own claim to fame: the **Dubie**.

Stolen fair and square from *Esquire*, here once again are **Radio's Dubious Achievement Awards**.

There's no panel of judges with two or three letters after their names; there's no long-ranging debate. There's just that **ludicrous feeling** in the pit of the stomach when an almost-momentous event in the industry prompts me to inquire (in my best Noo Yawk-ese) "So, that's supposed to **mean** something, huh?"

Then there are those events which spark an equally **awed reaction** along the lines of "That, and a dollar-fifteen will get you a ride on the subway."

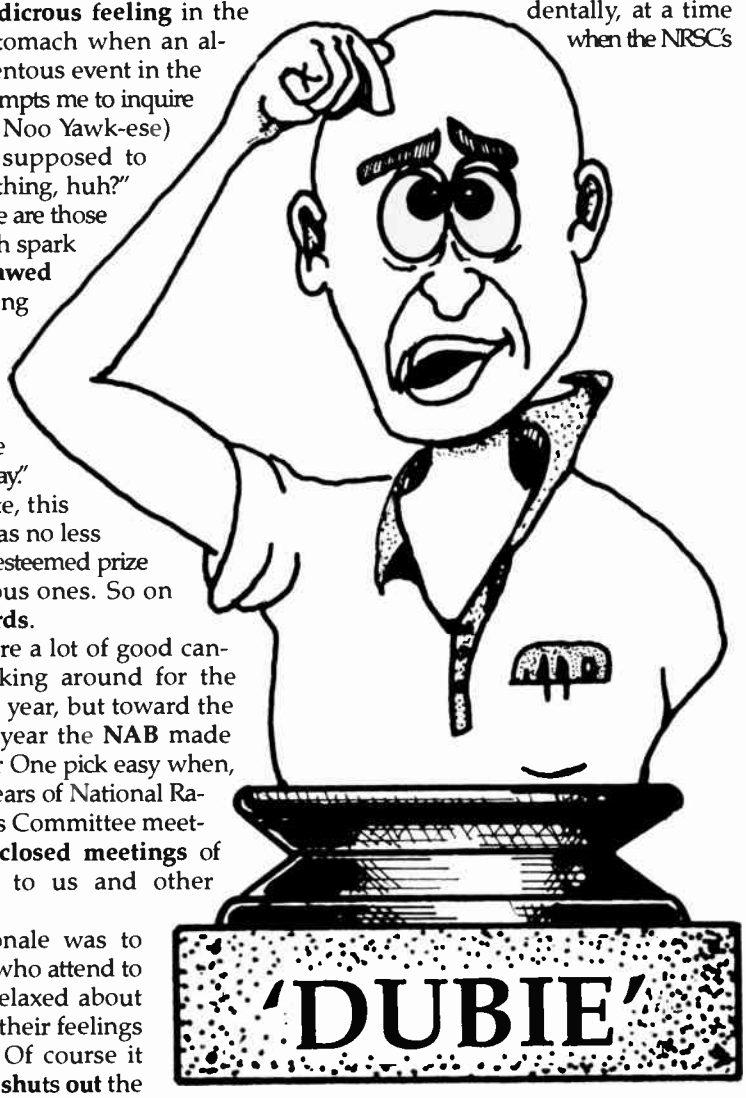
At any rate, this past year was no less ripe for the esteemed prize than previous ones. So on to the **awards**.

There were a lot of good candidates kicking around for the Dubies this year, but toward the end of the year the **NAB** made the Number One pick easy when, after four years of National Radio Systems Committee meetings, they **closed meetings** of the **NRSC** to us and other reporters.

The rationale was to allow folks who attend to feel more relaxed about expressing their feelings and ideas. Of course it **completely shuts out** the whole process to those who can't fly to the nation's capital (or some other such venue) but hey, nobody's perfect.

Never mind that **NRSC** became a household word in the radio industry primarily through the hard work of the press. And let's not worry about anything as trivial as the **First Amendment**.

We present NAB the first **Dubious Achievement Award of 1990** with enthusiasm because the **closed door policy** was put in place, maybe not so coincidentally, at a time when the NRSC's work is floundering on all fronts.



Which brings us to awards Two, Three and Four.

The **NRSC's AM subgroup** gets award Number Two for its work on the so-called **certification mark** for AM radios. Having failed to generate substantial interest in making higher fidelity AM radios among receiver manufacturers, the subgroup is now in the process of **making concessions** to this faceless mass of manufacturers who can't even spare the time to show up at its meetings.

AM stereo for the promised radios—that was the first to go. Then the 10 kHz to which stations had to cut their occupied bandwidth (down from 15 kHz) went **out the window**. The mark will only insist on 7.5 kHz frequency response and one manufacturer said AM will be lucky to even get that.

So a big **Dubie** to the certification mark effort.

Then there's FM. The **NRSC FM subgroup** thought it would be a good idea to look at processing. So a select group invited to a meeting—by fax exclusively—accepted a paper critical of **composite clipping** without bothering to seek input from those who make a living from the technology.

The whole affair has threatened to embroil the NRSC and its sponsors in a **sticky legal mess**. In addition the group has yet to decide whether it wants to **point the finger** at stations that don't adhere to modulation limits, **educate the industry** as to the "evils" of competitive processing or get a rule similar to the NRSC AM standard that would **clamp down** on a station's processing.

All these efforts show every sign of being greeted with a **gigantic yawn** by program directors and others tasked with getting high ratings for a station.

So a Dubie to youse guys, too.

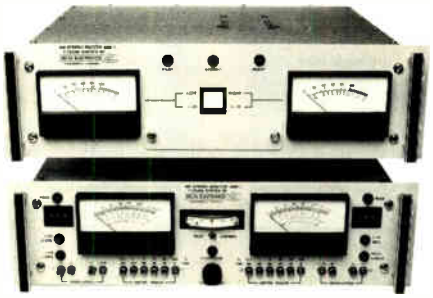
Then there's the **NRSC multipath subgroup**. It started out cheering on ➤

World Radio History

Adhere to Broadcast Standards.

Every day, all over the world. Delta's full line of products make sure the most important broadcasting standard of all is met—your total satisfaction.

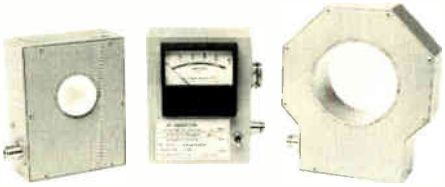
AM Splatter Monitor—Spectrum analyzer performance at a significantly reduced price! An inexpensive means of verifying FCC and NRSC spectral compliance. This frequency agile instrument tunes from 1700 kHz down to 450 kHz, with 9 or 10 kHz channel spacing. The monitor also measures incidental phase modulation (IPM). Designed to be rack-mounted or operated from a vehicle's 12 volt supply using an optional antenna.



C-QUAM® AM Stereo—The Above Standard Industry Standard is easy to install and maintain with its modular design and construction. Offers standard features other manufacturers charge as options. A sound value, built to last.

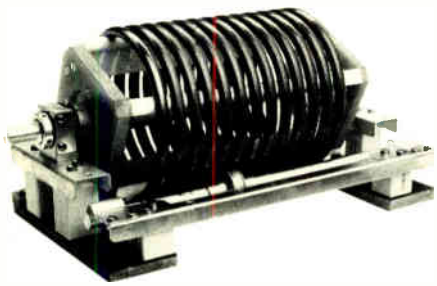
High Power Pulse Reflectometer—Strong interfering fields that would destroy time domain reflectometers are virtually ignored by the PRH-1. This instrument can handle up to 1,000 watts of induced power on an intermittent basis as it locates faults on transmission lines. Provides a visual representation of the transmission or sample line, STL coax, or antenna, using your oscilloscope.

Coaxial Transfer Switches—These 1⅝" and 3⅛" motorized four port switches are designed to switch between antennas, transmitters, or dummy loads both quickly and efficiently. The switches can also be operated manually and are fully interlocked.

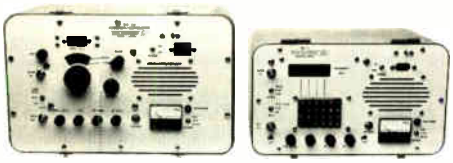


RF Ammeters and Sampling Toroids—Precision toroidal current transformers (TCTs) provide stable antenna monitor sampling while eliminating the problems associated with loops. TCTs also work well in supplying additional modulation monitor or test sample RF outputs. The transformer coupled ammeter (TCA) offers stable base or common point current readings, independent of modulation. The dual and single scale meters also provide remote DC outputs.

Low Power RF Ammeters—When every milliamp of current counts, depend on the accuracy of the TCA-Jr. This portable RF ammeter is designed to plug into either a Delta MJ-50 Meter Jack (pictured above), or a standard J-plug jack. Two current ranges are available: 0.2 to 1.0 Ampere, or 0.4 to 2.0 Amperes.



Rotary Variable Inductor—Where long life and high reliability are required, specify the RVI. Designed to provide long life, even under continuous rotation, the RVI is available in either 12 μH or 10 μH versions (maximum inductance). Other values by special order.



RF Receiver/Generator—A rugged, high output (2 watts) generator and correlation detector receiver virtually eliminate false nulls caused by interfering signals. The RG-3A operates from 0.5 to 1.65 MHz, and the expanded range of the RG-4 generates signals from 100 kHz to 30 MHz.

Transmitter Power Controller—Your insurance against over- and under-power citations. Continuously monitors transmitter power levels, compensating for AC power line sag by adjusting the transmitter to 100% power.

Digital Controlled Processor—This inexpensive, stereo tri-band processor boasts user-friendly controls and an aggressive sound. Mono stations can take a step toward AM Stereo, at a price that won't break the budget.

Impedance Bridges—At last, a means of measuring your impedance under full power. Both portable and in-line bridges are available, with a variety of features, for both AM broadcast and HF applications. The in-line Common Point Bridge can be supplied with a TCA RF Ammeter to permit precise current and impedance measurements.

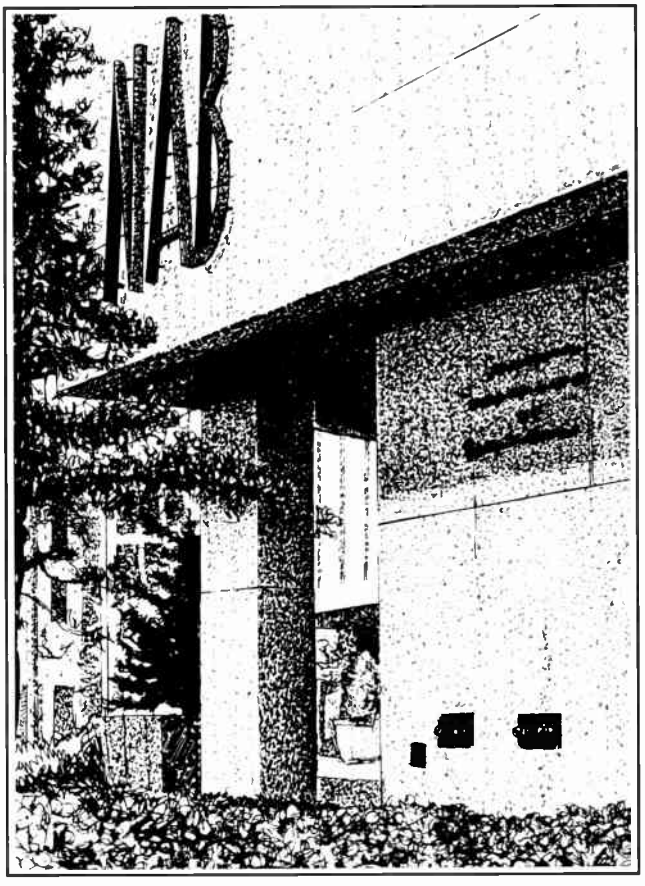
The Above Standard Industry Standards.

DELTA ELECTRONICS

Delta Electronics, Inc. • 5730 General Washington Dr.
P.O. Box 11268 • Alexandria, VA 22312 • U.S.A.
Telephone: 703-354-3350
FAX: 703-354-0216 • Telex: 90-1963

©1988—Delta Electronics, Inc. C-QUAM is a registered trademark of Motorola, Inc. Manufactured under license from Motorola, Inc.

AM Antenna Monitors—These are true ratio monitors which deliver a ratio reading without the need to continually reset the reference tower to 1.000. This simple operation reduces errors by non-technical personnel and makes tuning an array easier.



multipath tests at **WAEB**, Allentown, which had the support of many companies including receiver manufacturers. Then it decided the tests should be the station's project **alone**.

Then the group wanted to do its **own testing** in addition to WAEB's. At last glance, it was pretty tough to figure out who was in charge of what, how, why and where the whole thing was going.

So the NAB walks away with (count 'em) **four** Dubious Achievement Awards, thanks to its NRSC.

Now while processing with that **buzzsaw**, or (as **RW** columnist Ty Ford likes to say) "paint remover" subtlety is fresh in our minds, let's give award Number Five to our buddy **Scott Shannon**, the 15 million dollar man.

Having torn up the eardrums of New Yorkers and pulled in number one ratings on **Z-100** (WHTZ), he did an encore for Westwood One by bringing the same sound to the competitive Los Angeles market on **Pirate Radio** (KQLZ).

The imitation of an **illegal radio station** was on par with, oh say, punkers who wear army fatigues or teenyboppers in flak jackets. And that **sound**!

But hey, you got the attention of the media (including this one) so, you too, deserve one of our coveted awards.

Staying on the West Coast, let's give the next award to our pals at **KKBT** ("rock with a beat," or the place where "the big dogs eat"), the former KFAC.

Its new owners bought the only **commercial classical** station in the souped-up LA radio market, then decided classical music wouldn't **service the debt**. Solution? Go rock, distinguishing it from the other LA biggies about as much as dots in a domino game.

Our next award goes to the **SBE** for its contribution to the world of fashion. We're talking, of course about the **shop coats** given out to its convention attendees.

Here, in a time when all the **best advice** to radio engineers is to "put on a shirt and tie" and look more like management, comes their very own society encouraging that sterile, back room cubbyhole-with-all-the-wires-and-soldering-irons-don't-talk-to-me-I'm-the-nerd-engineer look.

Pockets bulging with chips, brownies and a sandwich, it was the superlative shade of **wall-spackle white**, making the entire convention resemble a coven of mad doctors or zombies, less than three weeks from Halloween.

And while we're being generous with the awards, I gotta give the **SBE** another one for the much-ballyhooed success of its **national convention**. Yes, it was better in Kansas City than in Denver.

And keeping exhibit hours **separate** from session times did work something short of a miracle.

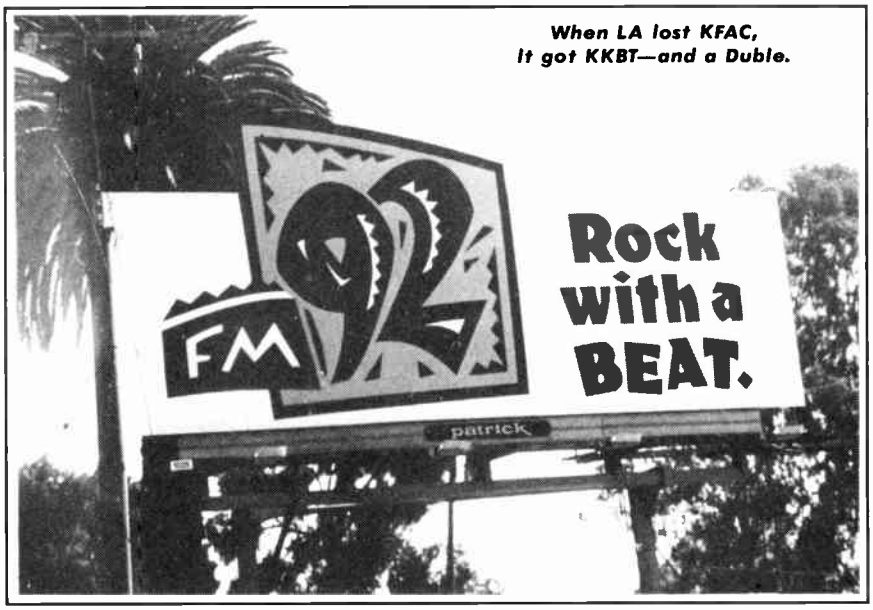
But in truth, the convention attracted **200 fewer attendees** this year, the second full day of exhibits fizzled to a trickle at the booths and it still does not seem to be attracting hordes of **SBE members** from around the country.

As a regional—it's a **smash**! As a national . . . a **Dubie**.

Before we get to the grand finale, I want to give my **penultimate** award to the **FCC**, which couldn't escape getting at least one this year.

While the **Commission** hasn't done a lot to ruffle industry feathers (mostly because it hasn't done a lot) it does deserve recognition for the aftermath of its **Class A upgrade** decision.

The decision itself was **OK**, allowing a portion of Class A FMs to go up to as much as **6 kW** of power right away and the rest on a case-by-case basis depending on interference protection. ➤



When LA lost KFAC, It got KKBT—and a Dubie.

World Radio History

But the report and order was **anything but clear** and in fact has left consultants and stations **shaking their heads** and muttering **expletives-deleted** under their breaths. And that's **before** the petition for reconsideration gets addressed.

In addition to the confusion the FCC has also increased its **own paper work** with the case-by-case solution. That, and dwindling resources, show all signs of making the Class A upgrade matter a **bottleneck of bureaucracy** with delays which may stretch on for 18 months, in some cases.

So a Dubie to you, too.

And finally, the **last** award goes to a particularly deserving **on-air promotion**. It's not as good as the breast implant operation of two years ago, or the DJ dipped in chocolate for Valentine's Day of last year.

But, deserving of its own (dubious) place in history is the NAB Futures Committee **"Radio. What Would Life Be Without It."** campaign, also known as 30 seconds of dead air.

The **catchy slogan** was designed to make listeners realize how beloved is their radio by taking it away for a full half minute. Where do we start with this one?

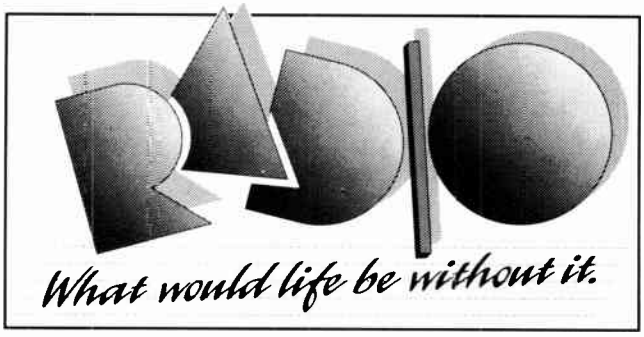
There was the **NAB Board member** who decided not to let his very own station give up a half-minute of precious drive time. There was that **hiss** as the station fell silent. There was the Peoria broadcaster who actually **sold the 30 seconds** to an advertiser.

There were the listeners who switched. And the folks still touting the success of the campaign. And the **barrels of money** that went to fund it. And then, how about that song?

You couldn't go anywhere at the trade shows without hearing it—although **we tried**. It was all just one more reason to switch on the TV, or the VCR, or the CD or the DAT.

So a Dubious Achievement Award to the promotion campaign which won the hearts of the **competition**. And we're done with this awesome task for yet another year. May all your **Dubies** be good **Dubies**.

OK. And all together now: "Radio, radio, what would life beeeee?"



Heard something interesting? Spill your guts to **Earwaves.** *Write PO Box 1214, Falls Church VA 22041, or call me at 703-998-7600. Best tidbit of the month wins a coveted* **Radio World** *mug.*

Are Your Quality Listeners Missing Your Quality Sound?

The new VAMP III delivers low cost, CD quality audio over a variety of STLs. VAMP III is a discrete, two channel, fully digital audio transmission system. No companding or pre-emphasis to degrade the signal.

Benefits:

- **Very Low Noise and Distortion**
- **No Significant Delay,** no delay echo to bug your DJ's
- **Low Crosstalk,** so low it's below the noise floor allowing you to use the two channels separately or as a stereo pair.

Several transmission methods to choose from:

- **T-1 data circuit,** far lower cost than 15 kHz analog telco lines plus you get a return path for remotes
- **Digital microwave,** a low cost radio link
- **Analog microwave,** it can use baseband of existing links for high quality, low cost remotes or multiple channels
- **Fiber optic link**

VAMP III is a proven system using all of the methods shown above.

If your transmitter isn't in the back room VAMP III will deliver the same high quality audio as if it were.

Give us a call for more information and an application note showing how each of the above transmission methods are used.

COMPLETE SYSTEM $4900.00

GRAHAM-PATTEN SYSTEMS, Inc.
P.O. Box 1960, Grass Valley, California 95945
800-547-2489 In California: **800-422-6662**

Circle 33 On Reader Service Card

World Radio History

CART MACHINES

Want to Sell

ATC PB-150 tube mdl, seems complete, gd for parts, etc, $100/BO. J Sigmon, WBZK, POB 398, York SC 29745. 803-684-4241.

ITC Omega Series (2) playback decks, program cards need minor repair, otherwise excel cond., $800 ea pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

BG Engineering BQE-1T new 10 minute digital up timer for retrofit into Spotmaster/ITC cart decks, BO; new semiconductors, IC's, lamps, motors, switches, rack ears, accessories for PDII, Delta, RP, SP, 3D, WP, Series 99 cart decks, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Telex MC-PR III RP audio, excel cond, $995. L Chatman, IVA, 424 Commerce Ln Ste 1, Berlin NJ 08009. 609-768-5006.

Automated Broadcast Controls w/(4) Otari ARS-1000DC reproducers, (2) 24 cart Carousels, 80 event sequence controller & audio controller, w/manuals, gd cond, $10,000 pls shpg. B Herrera, KCRT, 100 Fisher, Trinidad CO 81082. 719-846-3355.

Sentry complete automation system including (5) Revox PR-99 stereo PB machines; Instacart; (2) IGM Carousels; (2) Audicord stereo cart machines; PC compatible computer w/software & interfaces, excel cond. B Ferguson, WMMJ, 400 H St NE, Washington DC 20002. 202-675-4800.

BE 2000 R/P, 2 decks, one has new motor, manual, $700/both; (3) Ampex 602 R-R decks for parts, BO. B Oostenburg, KCKY, POB 6, Coolidge AZ 85228. 602-963-9290.

UMC Beaucart RP stereo record w/spare parts, manual, 3 tones, $1125. B Carr, WRED, 1201 Fremont Pk, Toledo OH 43469. 419-837-9896.

ATC Criterion Series mono R/P, gd cond, $300. B McKittrick, 331 Mulberry, Catashuqua PA 18032. 215-264-5295.

SMC 510 single cart player (2), $150 ea/BO. J McDonald, 303-669-3442.

Telex MC-PRIII R/P, like new, $950. L Chatman, IVA, 424 Commerce Ste 1, Berlin NJ 08009.

Rapid-Q ROM-2 R/P mono, fair cond, $200 or trade. D Kohn, KESM, 200 Radio La, Eldorado Springs MO 64744.

Fidelipac Zenith & height gages for head alignment, never used, $50. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

BE 5302B mono, triple decker, gd cond, $1300. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

3M/ITC Delta I stereo, gd cond, presently working. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

SMC 782 mono, gd cond, $900. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348, Fax 512-542-4108.

3M/ITC Delta I stereo, gd cond. E Trevino, KBOR, Box 3407, Brownsville TX 78523. 512-541-6348.

BE cart tape winder, almost new, w/timer, both in original packing, $425. G Cahill, Invisible Inc, POB 5786, Hudson FL 34674. 813-725-5003.

BE/Spotmaster TP-1A cart winder, without timer, $100, will throw in 100 plus carts for $150; (3) record amps, mono, for RCA RT-27/BA-27 series cart machines, $40 ea. F Vobbe, Great Northern Bdct Co, POB 5031, Lima OH 45802. FidoNet 1:234/16.

Want to Buy

ITC 3D mono w/WRA record amp, triple deck. C Waltman, KNEW, 66 Jack London Sq, Oakland CA 94607. 415-836-0910.

Parts & manuals for RCA 7 Series; record amp for RCA 7 Series; parts & record amp for Harris Criterion ATC Series. C Gill, POB 371, Indianapolis IN 46206. 317-923-2900.

Rapid cue R/P mono or stereo, any model, schematics & operative units, must work, need several, may be interested in units for parts. N Williams, WTJZ, 553 Michigan, Hampton VA 23669. 804-723-1270.

Eraser splice finder. KDKB, POB 6184, Kingman AZ 86402. 602-753-KDKB.

Tapecaster P & RP 700, any cond from junk to excel, call or write w/descriptions & lowest prices, complete or parts only. T Crockett, Hot Tracks, Box 10501, Blacksburg VA 24060. 703-953-0222.

Stereo record in gd working cond, used carts 40 sec, 70 sec, 100 sec, 2.5 min. A Moll, KLXQ, 128 Memory Trail, San Antonio TX 78232. 512-496-0677.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Tandberg 74B 4 trk, 3 speed, portable case w/opt plastic lid, service & user's manuals, no mics, mint, BO pls shpg; VM 700 portable 1950's consumer unit, fair cond, BO pls shpg. S Delahoyde, Box 33083, Phoenix AZ 85067. 602-937-9088.

Tascam 38 1/2" 8 trk, low hrs, excel cond, $1675; Tascam 40-4 4 trk w/dbx, low hrs, $925. K Flory, The Production Co, Box 1027, Siloam Springs AR 72761. 501-524-4626.

Scully 280-14SR, mono 14", fair cond, $250; Kahn Symetra-peak SP 58-1A, gd cond, $50; SMC 282 time announce, gd cond, BO; CBS Audiomax 4450 stereo, gd cond, $200; CBS Volumax 4100, mono, excel cond, $200. J Thomas, WLEW, Bad Axe MI. 517-269-9931.

Scully 280B 2 trk stereo in factory roll-around cabinet, manuals, new heads, spare capstan motor & other parts, excel cond, $1000 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

Stancil Hoffman CRM-7 logge
Young, WJON, POB 220, St Clou

Crown motor, capstan, Dale HI
bi-directional, Crown player, nev
athon 702-7 & 702-10 portable t
bi-directional, auto reverse, call
prices. E Davison, 135 N Illinois,
IL 62702. 217-787-0800.

Ampex AG-440C 1/2" 4 trk in
around cabinet, manuals, heads l
tle wear, spare set of R/P electro
spare parts, vgc, $1000 pls shp
joy, WIDD, 610-1/2 Hattie, Eliza
37644. 615-543-5849.

Technics 1520 isolated loop R
control in fair cond, $500. R San
POB 83111, Lincoln NE 68501. 4

Scully 270-2 (2) 14" stere
reproducers, 3.75-7.5 ips; also (6
capstan motors, BO; Ampex 35
only w/Schafer electr, excel cond,
heads, parts, relays for 350 & 4
BO; PR&E Multisync MOA motor
ble speed amp for Ampex & Scull
B Royster, KQM, 1019 Cordova, S
92107. 619-223-3413.

Telefunken M15A 24/32 trk 15/
& variap, $25K; Telefunken M15/
$4K; Tascam 80-8 w/dbx rack
Nakamichi 550, BO. R Rhodes,
NYNY 10101. 212-245-5045.

Pioneer CT-F2121 stereo (2), lo
need minor repair, $60 ea or $10
mon, WBZK, POB 398, York SC
684-4241.

ITC 850 Series, gd cond, BO. D
901 E Pike Blvd, Weslaco TX 785
1548.

IBM System 34 computer w
drive, 6 yrs old, excel cond, use
bine traffic system, $3500 pls sh
WJKL, 3342 Perry, Carrollus NY

Otari 8 SD 1/2" 8 trk w/calibrati
tremely clean & reliable +4 or -
tions, $2500/BO. M Mantell, 1st I
15 Perkins, Brockton MA 0240
1844.

Revox B77 excel cond, $1000/BO
J-Con Ltd, 200 E Racquet Club,
Springs CA 92262. 619-323-436

Teac X-2000R 10.5" 1/4 trk, 7.5-3
bi-directional 6-head system, aut
motor transport, very low hrs,
$1000. G Curry, Int'l Ministr
Peachtree Corners Circle Ste 2
GA 30092. 404-449-6766.

Revox A-77 15/7.5 ips w/Dolby B
$450/BO; Revox B-77, 15/7.5 ips,
$1250/BO. B Henry, KLLK, 12 W
lits CA 95480. 707-459-1250.

Otari MX5050-4, 1/4" 4 trk,
lapped, $950. B Petruzzi, Rouse
E Old Hickory, Madison TN 371
8516.

Ampex 1200 24 trk matched
mods, great shape, heads have b
many spares, $30K/pr, will cons
breaking set. D Hewitt, Remote
334, Lahaska PA 18931. 215-79

Ampex 601 tape transport, as
$30; (3) Rotron 115 V Whisper fa
ment cooling, $10 ea or $25/al
Welch Media, POB 1455, Moncks
29461. 803-761-7585.

Recordex 330B cassette duplic
ter & 3 slaves, 16X duplication s
matic rewind, erase heads, long-li
ord heads, LED level meters, $70
ry, Int'l Ministries, 4725 Peachtr
Circle Ste 250, Norcross GA 300
6766.

Sony/MCI JH-110B-2 R-R consol
(2), light use, new heads & pinchr
capable, (2) technical manuals &
control, $2800/as. B Kohtz, KBAY
San Jose CA 95150. 408-370-7377.

Otari 5050B2 7.5 & 1.5 ips 2 trk, less than 1
yr old, excel cond w/manual, $950/firm. S Mahaffey, Mahaf Prod, 3592 N Delsea Ste 12,
Vineland NJ 08360. 609-692-3439.

Otari ARS-1000 in excel cond, (4), $700 ea.
C Knerr, KCNA, 139 SE J St, Grants Pass OR
97526. 503-474-7564.

Scully 1/2 trk tape heads (2B) play; (12) mono Magnacord Presto, play; (16) Magnacord stereo lapped Presto, play, sacrifice price. Call 616-782-9258.

Ampex AG 440B 2 trk, 7.5-15 ips in Ruslang console (2), $700; Ampex 351-2 2 trk 7.1-15 ips w/inovonics 360 electronics in Ruslang console (2), $400; Ampex 351 FT 7.5-15 ips in Ruslang console, $250; Ampex 351 electr (4), $100. B Reider, WGUC, 1223 Central Pkwy, Cincinnati OH 45214. 513-556-4444.

Scully 280B 4 trk 1/2" in factory roll-around cabinet, manuals, new heads, spare capstan motor & other parts, excel cond, $1200 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

Ampex 350 FT w/inovonics electr in roll around walnut floor cabinets (2), $800 ea; Scully 280B 4 trk 1/2" recorder, gd cond, in

Revox tape recorders, top-shape factory rebuilds. New heads, etc. Accesories. A77, $950; B77 (1/4 trk 7.5 ips), $1000; G36 (tube mdl) 1/4 trk 7.5 ips, $500. Send phone number & address to: JM Technical Arts, POB 6156, Hermitage TN 37076.

Ampex AG-440a-1-r, gd cond, $450; Ampex AG-602-2-p, new, $775; Ampex PR-10-2-p, very gd cond, $850; many others, call Martin at 219-322-7090.

Want to Buy

Sony TC 768-4 4 trk in gd cond & w/maintenance manual. C Fuller, Voices, POB 153, LaGrange IL 60525. 312-579-9578.

The hardest place to find our products.

Any time you care to scan the broadcast equipment classifieds, you can find most of the major names in our industry—with one notable exception. Products manufactured by Pacific Recorders & Engineering seldom if ever show up in these pages.

That should tell you two important things about our equipment. One, it has a very long life. Two, it's in such demand, even after years of use, that it's almost never advertised. Instead, the engineer who's replacing his BMX consoles (usually because his station or network is building new facilities with new PR&E equipment) simply calls a few friends. Once word gets around that some of our gear is available used, it's quickly sold.

Pacific Recorders & Engineering consoles and cart machines are never hard to find. Try any major market station, network studio or smaller facility where professionals demand tools that work as hard, as well, and as long as they do. But please, don't waste your time looking in the classifieds.

Of course, the enduring worth of PR&E equipment is another excellent reason most people buy it new, direct from the source. Just call us at (619) 438-3911 for complete information on BMX Series III consoles or any of our other products and services.

PACIFIC RECORDERS
& ENGINEERING CORPORATION
2070 Las Palmas Drive
Carlsbad, CA 92009
Tel (619) 438-3911 Fax (619) 438-9277
Circle 11 On Reader Service Card

CONSOLES

Want to Sell

Autogram AC-8/IC-10 spare parts, lamps, switches & bridging input transformers, BO. B Royster, KQM, 1019 Cordova, San Diego CA 92107. 619-223-3413.

Numark DM 1550 4 chnl DJ mixer, 2 phono inputs, 2 line inputs, 2 mic inputs, 6 band graphic EQ, always in road case, excel cond, $150. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

Autogram AC-8/IC-10 spare parts, lamps, idging input transformers, BO. M, 1019 Cordova, San Diego CA 3-3413.

1550 4 chnl DJ mixer, 2 phono inputs, 2 mic inputs, 6 band lways in road case, excel cond, r, KPOK, Box 477, Bowman ND 23-3883.

h Systems 8 16 input, 8 subs, effect sends, +4 or −10 level cond, $3000/BO. M Mantell, 1st 15 Perkins, Brockton MA 02401.

Executive 10 chnl stereo solid-in clean, vgc w/manuals, $1000 Mountjoy, WIDD, 610-1/2 Hattie, TN 37644. 615-543-5849.

d cond, BO; Cetec 2000 8 pot, r supply, gd cond, BO. D Wolfe, Pike Blvd, Weslaco TX 78596.

Grandeon 16 input console, eck 33X16 rodg console 3-band atch bay plus 24 tr harness, Freeman, Pranava Prod, 1227 ay, Los Angeles CA 90069. 213-

o 80 complete w/pwr supply, ders new, works fine, 3 mic in-t, includes book, $800. C Ben-40 Domino Ln, Philadelphia PA 3-8900.

10 chnl, all plug-in amps, digi-complete set of spare PC boards, wn , WPRS, POB 367, Paris IL 5-6336.

5 8 chnl stereo, excel cond, all tras, $5500. R Trumbo, KNLF, ncy CA 95971. 916-283-4144.

AC-8 6 chnl 23 input stereo, in includes ESE built-in timer, shpg. D Kelley, KISZ, POB 740, 321. 303-565-1212.

12x6x8, lots of extra features, t cond, $2900. K Flory, The o, Box 1027, Siloam Spring AR 4-4626.

ee A/B 20x16 w/(8) 9-band ull patch bay, producers desk, rich, Box 869, Greenville CA 4-6829.

:112, 12x4x2, $1500. C Green, rogramming. 800-937-2100.

12 in, stereo out & mono & mon-, $500. D Bailey, 3422 Beech, 5088. 214-475-9796.

), modified to 7 inputs, complete & manuals, gd cond, BO; Kel-emote broadcast console w/(2) proof speakers, gd cond, BO. J , POB 1070, Sunbury PA 17801.

7500 stereo console parts, P&G in preamps, etc. J.C. Aegerter, W Center, Milwaukee WI 53210.

w/4 pots; (2) Ramko solid state; -2 tube type w/6 pots; ATI 6 chnl supply, call for details. Adolph,

IL 16x8 monitor mix console, 9 EQ pads, solos, etc, $950. B se St Prod, 804 E Old Hickory, 37115. 615-868-8518.

20 20 chnls, mint cond, 6 mos Miller, Airborne Audio, 11647 W nexa KS 66214. 913-492-8822.

5000, 24 inputs, 4 outputs, 3 band, 5 frequency EQ, Duncan spare modules & case, $2300. louse St Prod, 804 E Old Hick-TN 37115. 615-868-8518.

Midas Pro Custom Recording, 16x8, Remix switch-over, (8) Pro 5, (8) Pro 3 modules, peak meter, clock/timer, flight case, $10,500. H Alrich, Box 869, Greenville CA 95947. 916-284-6929.

Harris Micromac 16 input mainframe, manuals, spare pwr supply, $10,000/BO. V Killion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

RCA BC8A dual mono console, clean shape, $500 plus crating & shipping. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

Allen & Heath Systems 8 16 input, 8 subs, 16 monitors, 3 effect sends, +4 or −10 level options, excel cond, $3000/BO. M Mantell, 1st Impressions, 15 Perkins, Brockton MA 02401. 508-580-1844.

Gates/Harris Executive 10 chnl stereo solid-state console in clean, vgc w/manuals, $1000 pls shpg. B Mountjoy, WIDD, 610-1/2 Hattie, Elizabethton TN 37644. 615-543-5849.

RCA 8 pot, gd cond, BO; Cetec 2000 6 pot, 16 input w/pwr supply, gd cond, BO. D Wolfe, KRIX, 901 E Pike Blvd, Weslaco TX 78596. 512-968-1548.

Auditronics Grandeon 16 input console, $3900/BO; Speck 33X16 rodg console 3-band sweep EQ, patch bay plus 24 tr harness, $3795/BO. G Freeman, Pranava Prod, 1227 Sierra Alta Way, Los Angeles CA 90069. 213-457-8390.

Gates Stereo 80 complete w/pwr supply, most rotary faders new, works fine, 3 mic input 4 line input, includes book, $800. C Benner, WUSL, 440 Domino Ln, Philadelphia PA 19128. 215-483-8900.

QRK Omega 10 chnl, all plug-in amps, digital switches, complete set of spare PC boards, $4500. B Brown , WPRS, POB 367, Paris IL 61944. 217-465-6336.

Ramko DC8M5 8 chnl stereo, excel cond, all manuals & extras, $5500. R Trumbo, KNLF, POB 117, Quincy CA 95971. 916-283-4144.

Autogram AC-8 6 chnl 23 input stereo, in excel cond, includes ESE built-in timer, $4200/BO pls shpg. D Kelley, KISZ, POB 740, Cortez CO 81321. 303-565-1212.

Tascam M-50 12x8x6, lots of extra features, low hrs, mint cond, $2900. K Flory, The Production Co, Box 1027, Siloam Spring AR 72761. 501-524-4626.

Sphere Eclipse A/B 20x16 w/(8) 9-band graphic EQ, full patch bay, producers desk, $8000. H Alrich, Box 869, Greenville CA 95947. 916-284-6929.

Ramsa WR 8112, 12x4x2, $1500. C Green, Century 21 Programming. 800-937-2100.

EV EVT 5212 12 in, stereo out & mono & monitor, mint cond, $500. D Bailey, 3422 Beech, Rowlett TX 75088. 214-475-9796.

RCA BC5A (2), modified to 7 inputs, complete w/spare parts & manuals, gd cond, BO; Keldon KD20A remote broadcast console w/(2) TTs, (2) waterproof speakers, gd cond, BO. J Keller, WKOK, POB 1070, Sunbury PA 17801. 717-286-5838.

McCurdy SS-7500 stereo console parts, P&G faders, plug in preamps, etc. J.C. Aegerter, Satcom, 5431 W Center, Milwaukee WI 53210. 414-445-2300.

BE 4BEM 50 w/4 pots; (2) Ramko solid state; Collins 212 F-2 tube type w/6 pots; ATI 6 chnl stereo w/pwr supply, call for details. Adolph, 915-949-2112.

Interface 104L 16x8 monitor mix console, 9 freq, 3 band EQ pads, solos, etc, $950. B Petruzzi, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-8518.

Tascam M-520 20 chnls, mint cond, 6 mos old, $4250. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66214. 913-492-8822.

Sunn Magna 5000, 24 inputs, 4 outputs, 3 aux sends, 3 band, 5 frequency EQ, Duncan faders & (2) spare modules & case, $2300. B Petruzzi, Rouse St Prod, 804 E Old Hickory, Madison TN 37115. 615-868-8518.

Midas Pro Custom Recording, 16x8, Remix switch-over, (8) Pro 5, (8) Pro 3 modules, peak meter, clock/timer, flight case, $10,500. H Alrich, Box 869, Greenville CA 95947. 916-284-6929.

Harris Micromac 16 input mainframe, manuals, spare pwr supply, $10,000/BO. V Killion, KRVN, POB 880, Lexington NE 68850. 308-324-6717.

RCA BC8A dual mono console, clean shape, $500 plus crating & shipping. J Kreines, DeMott/Kreines Films, 5330 Kennedy, Millbrook AL 36054. 205-285-6179.

MICROPHONES

Want to Sell

Neumann TLM-170, new, blk finish, $1250/trade; AKG D-1000E, vgc, $75. J Pines, 217-367-3530.

RCA 44, $750; Sony AC148A 2 mic pwr supply, BO. R Rhodes, POB 1550, NYNY 10101. 212-245-5045.

RCA BK-4B program velocity ribbon, new, $325. D Miller, Airborne Audio, 11647 W 83rd Terr, Lenexa KS 66214. 913-492-8822.

AKG C-60 tube condenser mic systems, mint, tube 451e w/AC701K w/cardioid capsules, pwr supply & cables (4), 2 pairs, will trade, $800/pr or $1525/all. J Pines, 217-367-3530.

Classifieds reprinted with permission from *Radio World*, © 1989.

RadioArchives.com

Radio World

THE TOP TEN

News Stories of 1989
and
The Year in Pictures

World Radio History

Toasting AM's Milestones

After years of committee meetings, subgroup meetings, working group meetings and who-knows-what other meetings, the National Radio Systems Committee in 1989 was finally able to break open the champagne and toast an AM milestone—adoption by the FCC of the so-called NRSC-2 RF emission limitation, effective 30 June of this year.

NRSC had split its proposed standard into two sections—NRSC-1, which defines a station's preemphasis and reduces occupied bandwidth to 10 kHz through the use of processing filters, and NRSC-2, which defines a complementary transmission standard, or "RF mask."

Some NRSC supporters had hoped the FCC would adopt NRSC-1 first, with NRSC-2 to follow, primarily because of difficulties in measuring NRSC-2 compliance.

But the Commission, in its 12 April 1989 action, said that in addition to transmission anomalies, NRSC-1 could be "readily circumvented and abused by adjustments" and that the preemphasis specification of NRSC-1 "restricts the flexibility of licensees" in adjusting processing.

The FCC also said that the presumption of compliance with NRSC-2 by using NRSC-1 processing would be dependent on the absence of any "technical evidence of non-compliance."

Presumptive compliance

Rather than requiring stations to embrace NRSC-2 immediately, the Commission has allowed a four-year grace period with a presumptive compliance provision if stations use the NRSC-1 preemphasis standard. After 30 June, 1994, stations must establish NRSC-2 compliance through measurements.

Presumptive compliance was a "compromise" endorsed by many broadcasters and the NAB, who supported NRSC-1 pending further evaluation of NRSC-2. But the FCC noted that NRSC-1 alone could not alleviate interference from overmodulation or transmission system anomalies.

Regardless of the inability to have NRSC-1 made mandatory, NRSC Chairman Charlie Morgan praised the FCC's ruling as accomplishing 90% of the committee's goal: "reduction of second adjacent interference," he said.

The action also put receiver manufacturers on notice to make wide band receivers, a key to the success of AM, Morgan said.

A call to action

In an NRSC meeting following the FCC action, Morgan toasted fellow broadcasters, saying, "We're celebrating the result of a long, diligent effort."

"And we'd also like to toast receiver manufacturers, to say that now that we've done our part and obtained a standard, it's up to them to give us better fidelity AM radios," he added.

To date, however, only one receiver manufacturer seems to be heeding the call. Denon America, Inc. announced during a session on AM engineering at the Radio '89 show in New Orleans, LA, that by March of this year, all of its AM receivers will be designed to the NRSC standard.

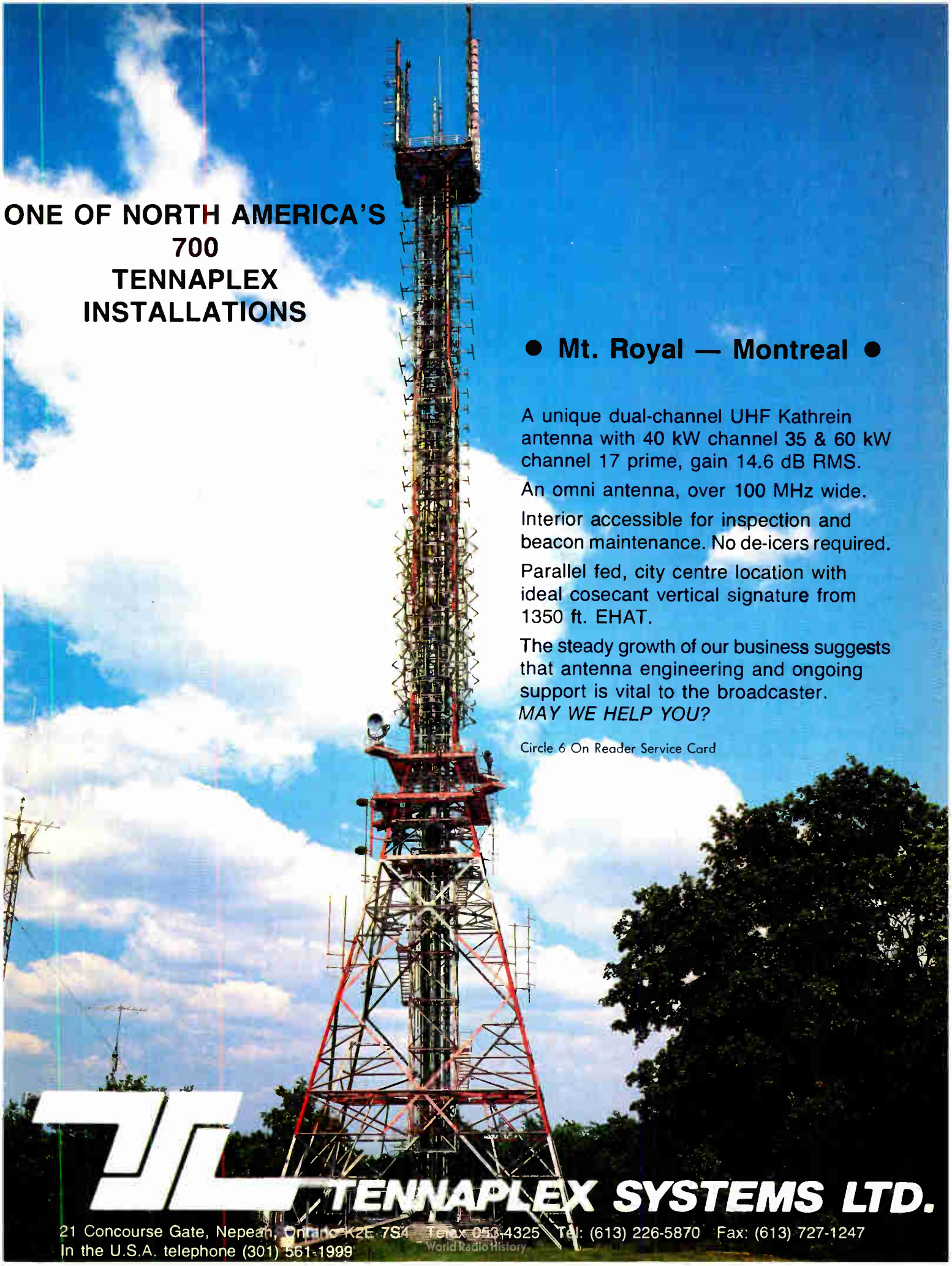
The announcement was made by Robert Heiblim, executive VP for Denon America, who said the company was "already selling" some NRSC receivers. Heiblim said Denon's timetable amounts to "twisting the arms of our fellow competitors" to do likewise and produce higher quality radios for AM.

The fly in the ointment which may spoil the NRSC's good feelings about its success with the RF mask, however, is the desire by some (including Denon) to see the creation of a certification mark for AM radios.

Although the NAB and the EIA have said they would aggressively promote such a mark, by year-end there was still disagreement over criteria to be met before a receiver could be certified—disagreement that extends to the bandwidth of such radios, which could undermine the committee's efforts to date.

NRSC Chairman Charlie Morgan (right) salutes the committee's efforts with a champagne toast.

World Radio History



ONE OF NORTH AMERICA'S 700 TENNAPLEX INSTALLATIONS

● Mt. Royal — Montreal ●

A unique dual-channel UHF Kathrein antenna with 40 kW channel 35 & 60 kW channel 17 prime, gain 14.6 dB RMS.

An omni antenna, over 100 MHz wide.

Interior accessible for inspection and beacon maintenance. No de-icers required.

Parallel fed, city centre location with ideal cosecant vertical signature from 1350 ft. EHAT.

The steady growth of our business suggests that antenna engineering and ongoing support is vital to the broadcaster. *MAY WE HELP YOU?*

Circle 6 On Reader Service Card

TENNAPLEX SYSTEMS LTD.

21 Concourse Gate, Nepean, Ontario K2E 7S4 Telex 053-4325 Tel: (613) 226-5870 Fax: (613) 727-1247
In the U.S.A. telephone (301) 561-1999

World Radio History

Class A's Still Fight

RW 2

Although the FCC in July granted a power increase to 500 Class A FMs, the ruling had one hitch in it, as far as a number of Class A broadcasters were concerned—it wasn't what they had been fighting for.

Nonetheless, the anxiously awaited FCC rule did selectively allow that limited number of stations judged fully spaced to boost their maximum effective radiated power from 3 kW to 6 kW after filing necessary FCC forms.

Another 1500 Class A's were qualified for the upgrade on a case-by-case basis after 1 December. That was to allow time for the upgrade of nearly 150 Class A stations affected by a March FCC ruling creating a new C3 class, according to the Commission.

Good news for some; for others, it missed the point. The New Jersey Class A Broadcasters Association had been the standard bearers for a blanket power increase for stations of their class and long had been petitioning the FCC for such an increase.

Rising from the ashes

Other Class A action from the Commission included the creation of Class C3 FMs. The stations would be appropriate, according to the FCC, where a larger coverage C2 station could not be assigned without interference and a smaller Class A facility might not be economically feasible.

Finding the FCC's resolution to the power hike issue unacceptable, the disaffected Class A's reorganized. Calling themselves the United Class A Broadcasters Association to give their cause a more comprehensive rallying name, the broadcasters again asked the FCC for a change in the rules.

"A variety of regulatory handicaps which unnecessarily handicap their (Class A's) ability to secure improved coverage (exist in the rule)," according to the United Class A Broadcasters Association petition filed with the FCC.

Among the obstacles cited by the new Class A association are the length and costs associated in completing FCC Form 302, the document a Class A station must file with the FCC if it wishes to increase its power. The FCC estimates that it will take between 12 and 18 months for it to respond to the filing of a Form 302.

The petition also said that the FCC was particularly remiss in not weighing the possible "marginal increased interference" against the much-improved community service a blanket upgrade would produce.

THE TOP TEN

Points of contention

Those in favor of the FCC's case-by-case approach, including the NAB, have argued and maintain that a blanket ruling by the Commission would have caused too much interference.

The Commission's logic in requiring a short-spaced Class A station to show availability of a full or less short-spaced alternative site was also challenged by the Class A petitioners. The alternative site provision is "irrelevant," according to the petition, because alternative site showings are required only when an applicant seeks a waiver to install a new transmitter at a new short-spaced site.

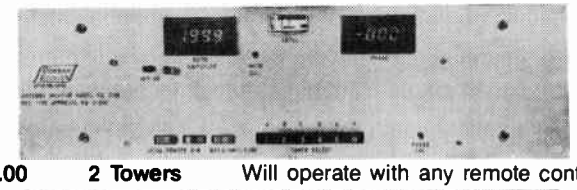
In the unlikely event that another site could be found, the cost would be way more than the "average mom-and-pop Class A station can afford," said William Keane, an attorney representing United Class A Broadcasters Association.

Another point of contention, according to the petition, is the FCC's requirement that Class A's get an agreement from short-spaced neighbors for the power upgrade. The United Class A Broadcasters Association contended that if a Class A station proves it will not increase its coverage, the agreement is not necessary.

The group also found fault with the FCC's decision to prohibit power increases in second and third adjacent channel directions. According to the petition, the FCC routinely allows grandfathered short-spaced stations to increase power in those directions.

DIGITAL ANTENNA MONITORS

In Stock — Available for Immediate Delivery



Price $2400.00 **2 Towers** Will operate with any remote control equipment.

Price $1780.00 2 Towers For AM directionals with studio located at transmitter site.

These monitors are state-of-the art instruments of unequalled accuracy (.5% or better on ratio and .5° or better on phase) and stability. With typical modulation the true ratio readout of these monitors is a factor of 10 more stable than instruments that measure normalized amplitude, and their phase readouts are rock solid. Phase sign is automatic, no extra operation. In addition to the analog DC outputs for remote control the Model CMR has a multiplexed BCD digital output which can be used to drive the Remote Indicator Model CMR-1. RF inputs have dual protection. Gas discharge tubes across the sample line terminations plus relay protection.

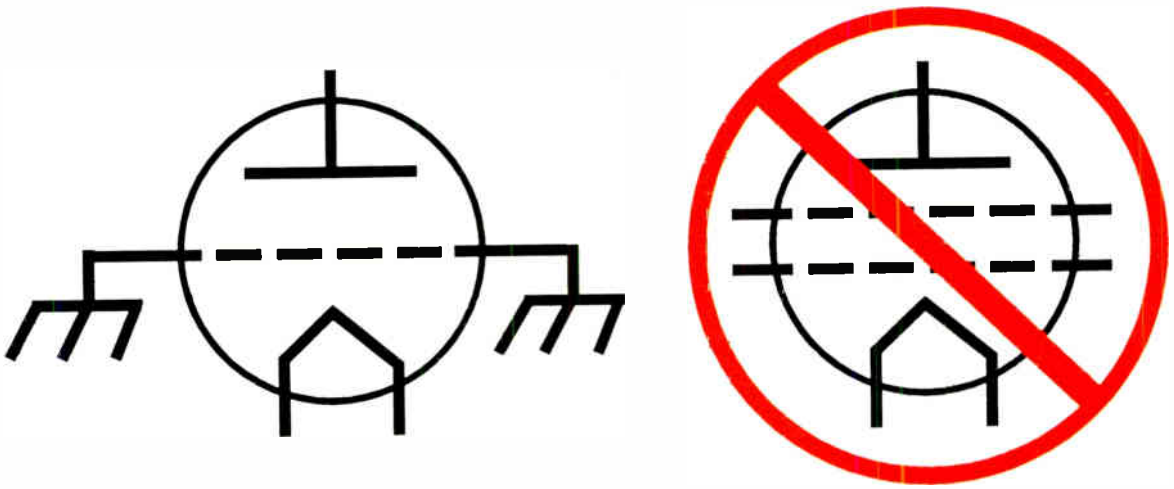
GORMAN REDLICH MFG. CO

257 W. Union St. • Athens OH 45701 • 614-593-3150

Circle 46 On Reader Service Card

World Radio History

FCC Mass Media Bureau Chief Lex Felker (3rd from left) won the Gold Medal for lifetime achievement in the last days of 1988. In 1989, he resigned his Commission post.



CCA ELECTRONICS, INC.

360 Bohannon Road/P.O.Box 426
Fairburn, Georgia 30213
Phone:(404) 964-3530 Fax:(404) 964-2222

Circle 17 On Reader Service Card

World Radio History

BTP, Bose Go at It Over FMX System

RW 3

It was a tough year for the FMX stereo extension system.

The technology, marketed by Broadcast Technology Partners (BTP) of Bloomfield Hills, MI, entered 1989 touted by many as the biggest single improvement in FM since stereo. CBS had endorsed the system for use at its FM stations, and many others were following suit. Two major receiver manufacturers were incorporating FMX circuitry into their lines, and several others were hinting they would follow. The future looked very bright. Then the bottom fell out.

At a 25 January 1989 press conference, Bose Corporation President and MIT Professor Amar Bose released a sharply critical report on FMX, claiming tests proved the technology did not perform as advertised.

According to the joint MIT/Bose study, FMX—a noise reduction system designed to allow listeners in the fringes of an FM's coverage area to receive a clean FM stereo signal without the hiss that normally accompanies distant stereo signals—actually adds noise and distortion under multipath conditions.

"The FMX system was a creative idea to patch up FM stereo, but it introduced more artifacts," said Bose. The researchers called the technology a "step backward" from FM stereo when operating under multipath conditions.

BTP and other supporters of FMX refuted the test results, claiming the mathematical models used for analysis were flawed.

"We graded the professor's math paper and it failed," said BTP President Emil Torick.

There were also whispers of doubt cast on the motivation of the testers. Some people theorized that the research study was undertaken to discredit FMX, clearing the way for a future commercial venture to compete with the technology.

However, Bose repeatedly denied these allegations, claiming the MIT/Bose research was nothing more than research.

"Nobody can understand that you can do something without commercial incentive," he said.

Whatever the motivation, the effect of the study has been to place a cloud of uncertainty over the FMX system.

FMX™

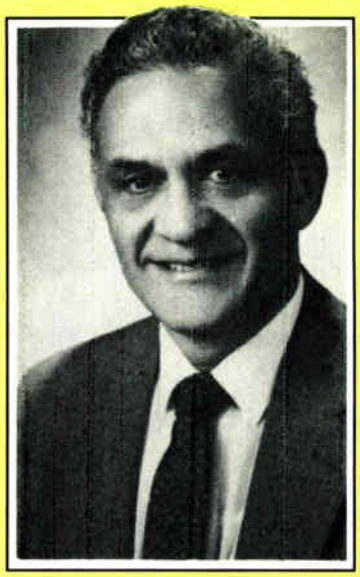
While, according to BTP estimates, slightly more than 100 stations are currently broadcasting in FMX stereo, only one company—Inovonics—is producing FMX generators and just two—JVC and Alpine—are manufacturing consumer receivers.

Many others, originally enthusiastic about FMX, are now taking a wait-and-see approach.

In spite of the negative publicity generated by the MIT/Bose study, BTP remains firmly behind FMX technology.

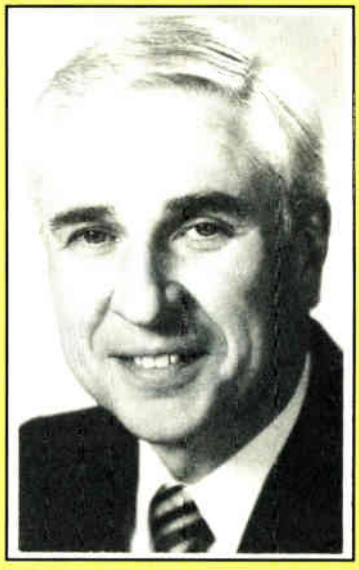
In the fall, the company consolidated its technical and marketing operations in new quarters in Bloomfield Hills, MI The move, from Greenwich, CT, is part of a shift toward more intense promotion of the FM stereo-enhancing technology, which will include exploration of foreign markets, according to Torick.

"You might say we are shifting from developing the technology to the marketing mode," he added.



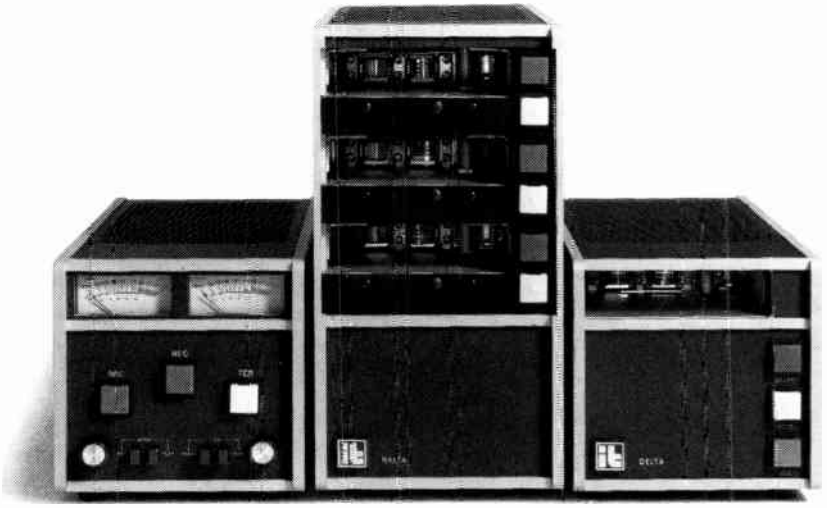
"The FMX system was a creative idea . . ., but it introduced more artifacts."

"We graded the professor's math paper and it failed."



World Radio History

Here's another reason we sell more cart machines than anyone else.



The Delta series. The world's most popular cart machine over the last five years.

And here are three more.

Authorized 3M Dealers

Allied Broadcast Equipment	Broadcast Services Company	Broadcast Supply West
800/622-0022	800/525-1037	800/426-8434

3M International Tapetronics — The World Leader In Cart Machines.

3M

©1989, 3M Company

Circle 22 On Reader Service Card

World Radio History

The FCC's 16 November comprehensive hearing on AM's ills included testimony from John Abel (left) and Lowry Mays, of the NAB.

The War to Be Loudest On the Dial

From Pirate Radio to Modulation Monitoring

RW 4

The trend to increased processing, particularly in CHR stations, escalated in 1989 to full-fledged combat with audio for ammunition. "Loudness wars" resulted from broadcasters searching for the most "aggressive" audio they could achieve, in a vicious cycle to remain competitive with other stations, who rode their processing knobs like Sherman tanks.

The leader of the sonic onslaught this year was almost certainly Los Angeles' Pirate Radio, under the command of Scott Shannon. Shannon first found fame and fortune at New York's WHTZ with a mix of heavy processing and fast-paced programming—in many observers' opinion, the opening salvos in the war. This year, he brought his bag of tricks to the West Coast and introduced the commercialized renegade radio concept to Westwood One's LA acquisition, KQLZ.

Shannon's self-described "neck-snapping" sound was achieved with the help of audio consultant and processor manufacturer Frank Foti, whose Cutting Edge Technologies provides Pirate Radio with the same heavy artillery Shannon used in his WHTZ campaign. The audio firepower was at least partially responsible for an impressive improvement in the station's position—from 13th to fourth in the ratings.

We got the Beat

On the other side of the front line, a latecomer to the fray—LA's KKBT, Beat 92—enlisted the help of Greg Ogonowski, a radio engineer and owner of Modulation Index design and consulting firm.

214-388-5800

Service 24 hours a day

This number is your link to the service experts at Continental Electronics where the number one priority is keeping you on the air. Our commitment includes:

- Telephone assistance 24 hours a day, 365 days a year;
- Field service engineers skilled at troubleshooting;
- Critical parts orders shipped the same day;
- Technical training for all Continental transmitters available;
- No charge for telephone assistance.

For parts orders call 214-388-3737. Our job is to keep you transmitting.

varian

continental electronics division

P.C. Box 270879 Dallas, Texas 75227
Telephone: 214-381-7161 Fax: 214-381-4949

Circle 52 On Reader Service Card

World Radio History

Ogonowski installed a customized multiband processor and his linear composite processor, which he said deals with STL overshoot, and does not involve clipping. KKBT's GM Jim De Castro said his station was striving for the "finest modulated sound" he could get in LA's aggressively competitive market.

Among engineering purists, however, an aggressive sound can be an annoying sound. A backlash ensued against the wars, centering on whether such heavy processing might be a tune-out factor. Supporters of hot processing, however, fired back that loudness is not employed on all stations, but only on those with a format for which time spent listening is not as important as snaring a listener with a sound that leaps off the dial.

With the wars raging in Los Angeles, the fire was lit for a full-scale national battle over modulation and processing issues.

The conflict erupted last spring following a meeting of an NRSC FM working group on composite spectrum occupancy. During the meeting a "proposal" was submitted by Chuck Adams of CRL to increase modulation limits to 110% with a composite baseband spectrum mask. A class for rules allowing different amounts of total modulation based on peak duration was discussed.

Adams' proposal advised that peaks greater than .5ms in length be held to 110% and that peaks shorter than .5ms be held to 130%. Composite clipping proponents were not present at the meeting when the proposal was presented.

While the NAB and EIA (co-sponsors of the NRSC) downplay the significance of the proposal, Modulation Sciences Engineering, Brooklyn, N.Y., charged that the NRSC discussion of it may have violated of anti-trust laws. Eric Small, VP of Engineering for MSI, has been considering legal action in the matter.

In the meantime, MSI marketed its new ModMinder. Installed at the transmitter, the ModMinder is a device that measures modulation peaks in transmission, allowing FM stations to cut back on limiting and other types of processing designed to increase loudness, while also increasing modulation.

KQLZ's Shannon led the frontal assault in the loudness wars.

Small said the ModMinder will more precisely measure modulation peaks based on the FCC's pre-1983 rule that required an FCC type-approved monitor.

Small noted ModMinder ignores the very brief peaks that last less than one millisecond. However, questions arose regarding whether the FCC considered ModMinder a valid way to monitor compliance with modulation rules.

The questions were answered late in 1989 in a letter to MSI from Dr. Thomas Stanley—the FCC's Chief Engineer—of the Commission's Office of Engineering and Technology. In the letter, Stanley noted, "If the equipment does indeed meet the pre-1983 technical requirements ... I expect it would produce valid readings of FM modulation."

Circle 41 On Reader Service Card

World Radio History

Musical Chairs

RW 5

FCC Chairman Al Sikes took the place of outgoing chair Dennis Patrick.

Andrew Barrett had been an Illinois commerce commissioner before his FCC selection.

Sherrie Marshall left private legal practice to return to the Commission.

You would practically need a scorecard to keep track of all the changes at the FCC's commissioners' table in 1989.

First, outgoing chairman Dennis Patrick vacated office 2 August with plans of opening his own communications consulting company.

Before his office had time to be scrubbed and whitewashed, newly appointed Chairman Al Sikes took oath and began making himself comfortable at 1919 M Street.

Later in the month, Sherrie Marshall and Andrew Barrett were sworn in as commissioners, filling posts vacant since 1987.

Then, in September, Commissioner Patricia Diaz Dennis left the FCC to return to private law practice.

Two months later, in November, Dennis' chair was earmarked by the White House for Washington communications consultant Ervin Duggan.

At press time late in 1989, a Senate confirmation hearing on Duggan's nomination was expected to be scheduled sometime in early 1990.

Patrick informed President Bush in April of his intention to leave the chairman's post, but held on to the gavel late into the summer until Sikes' appointment was confirmed.

The California lawyer served the Commission for six years, the last two as chairman. During his tenure, AM technical improvements were initiated, and local ownership rules relaxed. Detractors criticized him for his deregulatory stance, and his sometimes rocky relationship with Congress.

Before filling Patrick's slot, Sikes served as assistant secretary of Commerce and head of the National Telecommunications and Information Administration (NTIA). He was also involved in the management of radio stations in Missouri, and headed a Missouri broadcast and political consulting firm.

Marshall's appointment as commissioner was a homecoming for the lawyer, most recently a partner in the Washington DC law firm Wiley, Rein and Fielding. She was formerly director of the FCC's Office of Legislative Affairs. She was also an attorney with the White House Counsel's Office in the Office of the President-Elect for President Bush.

Barrett had been an Illinois commerce commissioner since 1980. Prior to that he was assistant director of the Illinois Department of Commerce and Community Affairs.

Dennis, a commissioner since 1986, asked President Bush not to consider her for reappointment after her term expired in June.

"Although I have enjoyed the rare privilege I have had to serve the public, it is time for me to return to the private practice of law," she said in a letter to Bush.

The nomination of her intended replacement, Duggan, came as a surprise to most, because he is not well known in broadcasting circles. However, reaction to his selection generally has been favorable.

World Radio History

It takes plenty of guts to back our products this solidly.

At QEI, we back our products — and our customers. Our power tubes, for example, carry the best warranty in the industry: 15,000 hours or 2 years. And only QEI includes a FREE comprehensive spare parts kit with every FMQ transmitter, exciter and remote control. Experience shows that you may never use more than 2 or 3 of these "guts". But since we can't be certain *which* 2 or 3, our kits include ICs, transistors, lamps, diodes, fuses — everything you're *un*likely to need.

24 HOUR SERVICE HOTLINE

Giving you the most complete spare parts kits in the industry is just the first step in a customer support program that lasts as long as your QEI transmitter. If you need expert advice on installing a spare whatever, call us any time at 609-728-2020, day or night. And if you ever need factory parts support, we can deliver — fast. We're just 1/2 hour from Philadelphia International Airport, not out in the middle of nowhere.

MAXIMUM EARNING POWER

You can count on it with every QEI transmitter, because we design them to stay on the air. And as a fully integrated company dedicated to RF and transmission products, we're able to build in quality and reliability — and still maintain our value advantage.

No wonder stations in both large and small markets have been using QEI products as long as we've been making them — since 1971. During that time we've put over 1300 exciters, more than 450 transmitters and over 1000 modulation monitors in service.

GET THE FACTS

When it comes to standing behind our products — and our stations — we're way ahead of the competition. That may make other manufacturers nervous, but it makes QEI customers very satisfied.

Call us at 800-334-9154, toll-free, for all the facts on the transmitters that deliver a solid return on your investment: the QEI "New Reliables."

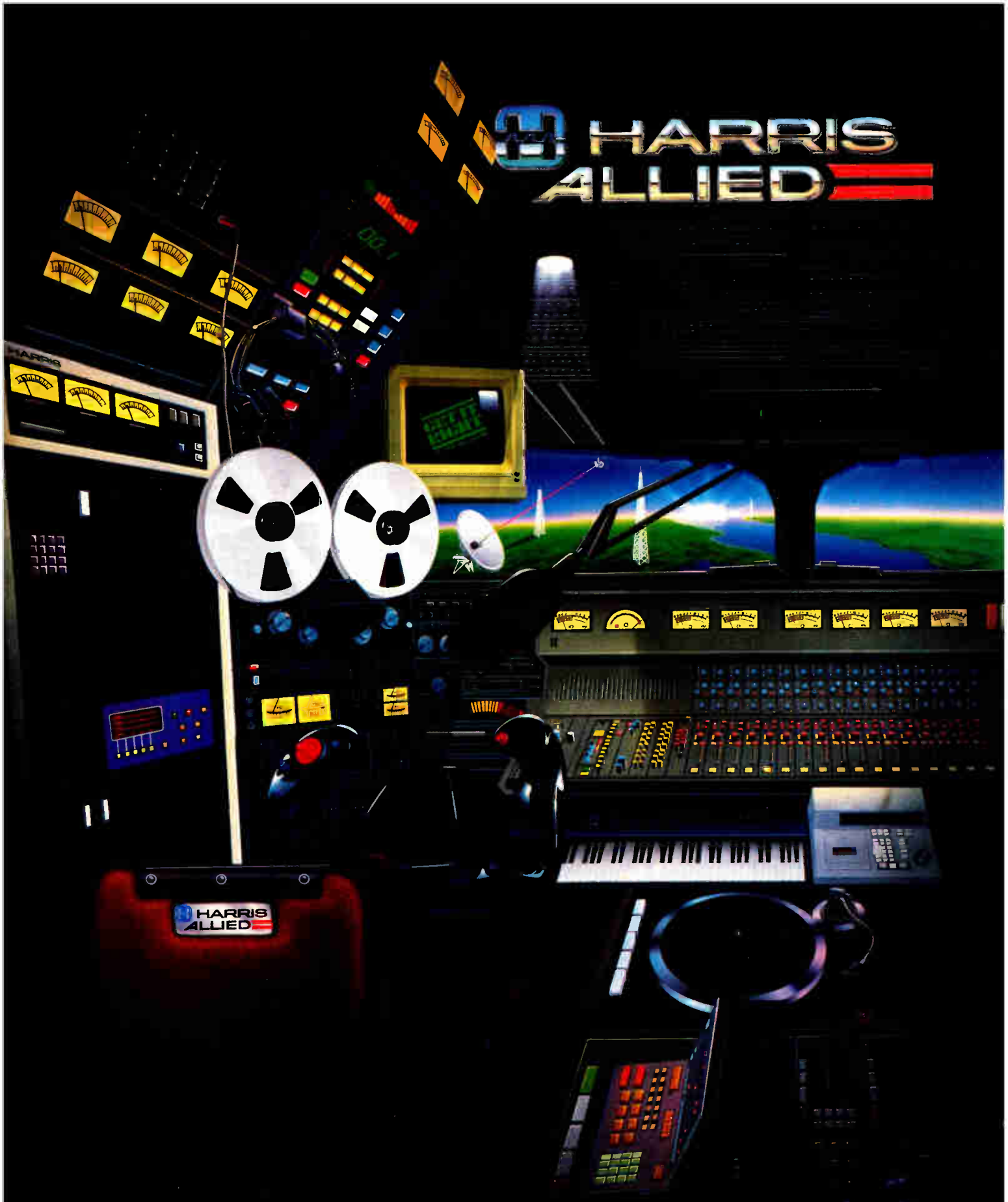
QEI

Quality • Engineering • Innovation

QEI Corporation • One Airport Drive, P.O. Box D
Williamstown, New Jersey 08094
Toll-free 800-334-9154 • Fax 609-629-1751

Circle 32 On Reader Service Card

World Radio History



THIS IS THE BOOK THAT WILL HELP YOU CHART YOUR STATION'S WAY TO SUCCESS IN THE 90s. IT'S THE HARRIS/ALLIED 1990 CATALOG — USE IT! CALL 800-622-0022 TOLL FREE.

Coming April, 1990

Circle 36 On Reader Service Card

Giving BEAR Facts to the FAA

RW 6

A bureaucratic power struggle in the nation's capital is making broadcasters mad as a BEAR.

Broadcasters for Equal Air Rights (BEAR), a coalition of broadcast interests, banded together in the fall to fight for broadcasters' rights in the face of increasing Federal Aviation Administration scrutiny regarding broadcast spectrum allocation.

Over the last several years, the FAA has shown increased interest in broadcast tower construction and frequency control, an area of jurisdiction reserved for the Federal Communications Commission.

The aviation agency originally was empowered to object to a tower if its physical presence could endanger air traffic. That power has since grown to include objections based on a station's potential signal interference with aircraft communications and control systems.

"In the business that the FCC serves—the broadcast industry—it is their job to be the guardian and to be sure they get a square deal. That's fine. Our job is to make sure aviation gets a square deal and certainly we're going to cross swords somewhere," commented FAA Spectrum Engineering Division Manager Jerry Markey.

Upgrades stalled

Those swords crossed this fall when the FAA objected to the upgrading of 149 Class A FMs to the new C3 status of 25 kW at present sites.

THE TOP TEN

The FAA contends that these power increases may interfere with aeronautical frequencies used for instrument landing systems and VHF omnidirectional range facilities.

The National Association of Broadcasters predicted that the FAA's action may be a precursor to the agency opposing all Class A upgrades, including those who want to go from 3 kW to 6 kW.

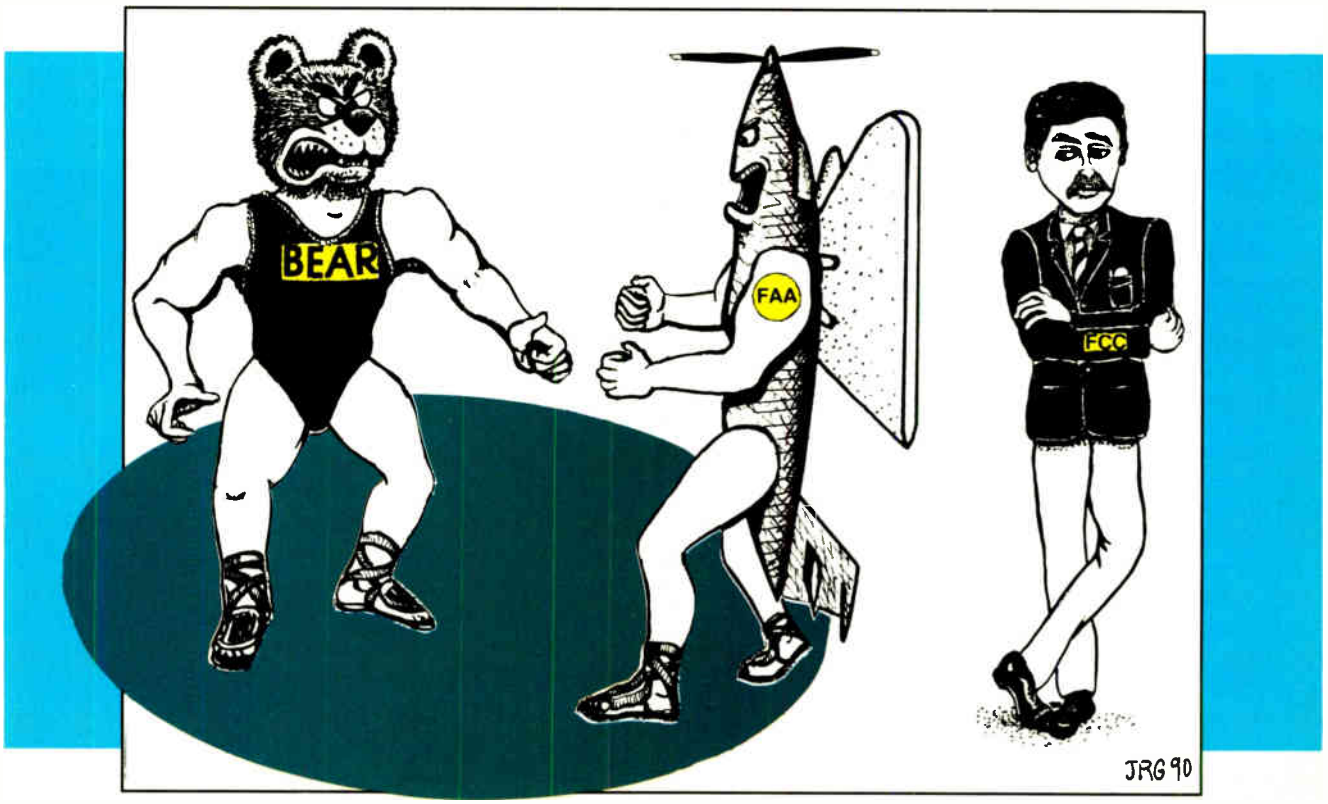
Some broadcasters have been critical of how the FCC has reacted to the FAA's actions. BEAR member Rob Bednarek, an engineering consultant, said it appeared the FCC was "hesitant to assert its rights," more or less giving in to the FAA.

Organized resistance

Broadcasters, however, don't plan to back down. Representatives from the NAB, the Association of Federal Communications Consulting Engineers, the Association of Broadcast Engineering Standards and the Federal Communications Bar Association met with FCC staff members in late October to discuss the urgency of resolving the dispute.

For its part, BEAR plans to petition the FCC to seek remedy of the problem.

"The FCC is very aware that hundreds of applications are being denied," said Ralph Justus, NAB director, engineering regulatory and international affairs. "Basically, we need to resolve this quickly. The public is being deprived of FM service because of this."



World Radio History

Will the Go-Ahead Get DAT Going?

RW 7

The road to implementation is clearer, but will DAT make a difference?

After two years of legal squabbling over Digital Audio Tape (DAT), the recording industry and audio equipment manufacturers agreed this summer to a compromise technology that allows limited digital-to-digital recording capability on consumer DAT machines.

The technology, developed by Philips and known as Serial Copy Management Systems (SCMS), allows consumer DAT players to make digital-to-digital recordings, but does not allow the copy to be copied. DAT recordings from analog sources can be copied once.

Professional DAT decks, which allow unlimited digital-to-digital copying, are not affected by the agreement.

The aim of SCMS is to prohibit the proliferation of pirated, exact copies of analog or digital sources, thus protecting copyrights held by recording artists.

Future unknown

DAT proponents hope that the agreement will pave the way for the technology to carve a niche in the consumer marketplace, thus driving prices down for all DAT equipment—professional and consumer.

But it remains unclear whether DAT will be widely accepted. For most broadcasters, questions on how the technology will integrate into on-air operations need to be resolved.

However some stations, including WMTR-FM in Toledo, OH, are willing to take the lead. WMTR went all DAT in January, 1989.

How does it sound? "You can hear Karen Carpenter's lips touch when she sings," said station owner Max Smith, Sr.

Smith said the Class A station spent about $200,000 in changing to a "pure DAT gold" hits format. It uses converted Sony DTC 1000 DAT machines adapted for professional use under the name RS-1000 by Radio Systems Inc. All the music is provided by First Com, a California company that remasters old hits to DAT.

Not ready for prime-time

Most stations' hesitation about using DAT is a result of questions about cueing. Unlike the single event, instant cue-capability of a cart machine, DAT cassettes hold a multitude of audio cuts and rely on index codes to cue to any one.

Several companies have managed to come up with interfaces which allow for instant cueing for automated stations, but the "Morning Zoo" team's use of the equipment places tougher demands on its capabilities.

However, DAT seems to have found a place in stations—especially classical and public stations—as a production tool for recording long-form music programming or on assignment overseas.

One additional concern about DAT is the lack of editing capabilities. Electronic editing similar to videotape editing would be ideal, but so far only one company—Matsushita—has shown an inclination in that direction, and then only in prototype form.

Now that copying questions have been settled, the broadcast industry may just have to sit and wait for consumer acceptance of the new technology before seeing which way the wind blows for DAT.

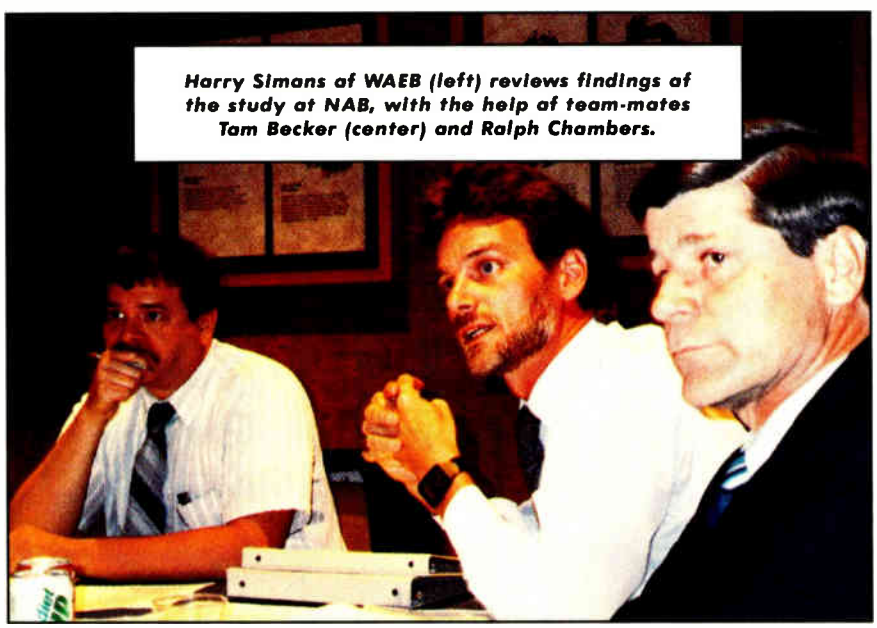
Defining Multipath

RW 8

Disparate groups within the broadcast industry joined forces in 1989 to define and remedy multipath interference. After all was said and done, however, the first round of tests revealed only one thing—the need for further testing.

Born in July as an independent offshoot of an NRSC technical subgroup, the multipath project included broadCasters, transmitter and car receiver manufactures, and a data collection team. The site of the tests, WAEB-FM in Allentown, PA, was selected for the rolling hills and mountainous terrain comprising its listening area.

Testing included studies of the effects of AM incidental noise on receivers, multipath versus stereo, multipath versus antenna tuning and matching, multipath effects on SCA and vice versa, and circular reception. ➤



Harry Simons of WAEB (left) reviews findings of the study at NAB, with the help of team-mates Tom Becker (center) and Ralph Chambers.

World Radio History

Preliminary report

Preliminary results from the first round of tests were reported back to the NRSC Working Group on FM Multipath Studies in November. Harry Simons, CE of WAEB and a leader of the multipath project, brought the NRSC group up to date.

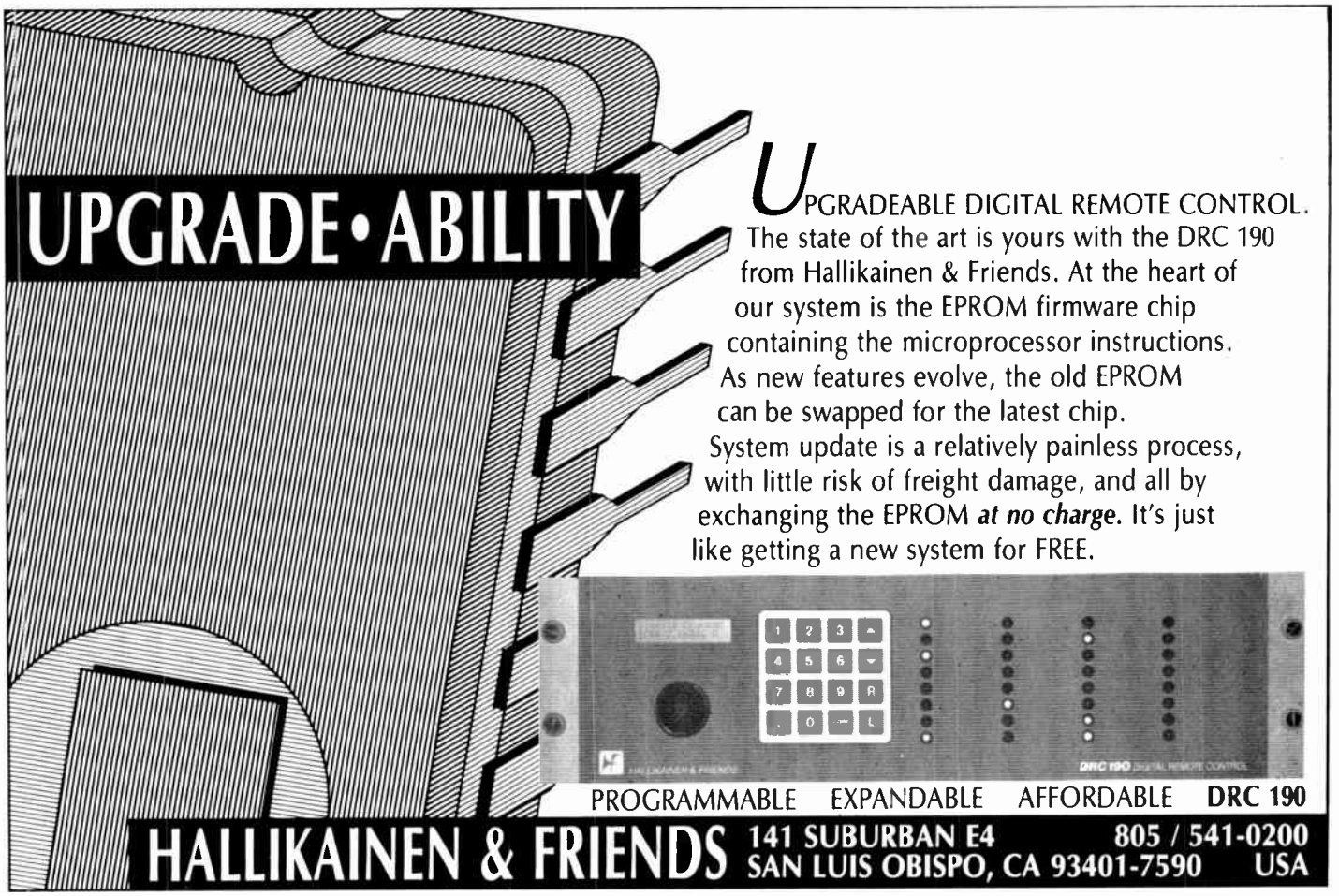
Simons reported that Round I tests had included characterizing multipath using transmitter pulsing with ground measurements taken in a specially equipped van provided by General Motors and Delco. Other tests included trying to determine the effect of ICAM—AM incidental modulation—through a series of listening tests.

Inconclusive results distributed to members of the NRSC working group showed that ICAM level changes under heavy or light multipath conditions were generally not perceived while level changes under multipath conditions which could be considered "moderate" were perceived.

Other multipath tests focused on antenna patterns. Two WAEB antennas, an ERI and Shively, were measured by Air System Technologies in a plane with wing-mounted equipment that calculates the signal in real time.

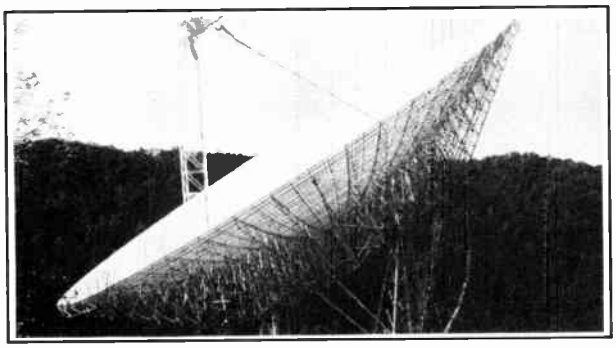
A wing-mounted antenna helped Air System Technologies collect test data from the air.

The readings were taken by flying three-mile radius loops around the antennas. Several consultants expressed the opinion that three miles is too wide a radius and the readings under such conditions would include ground reflections. A radius of a quarter mile was recommended for a second round of tests from the air.

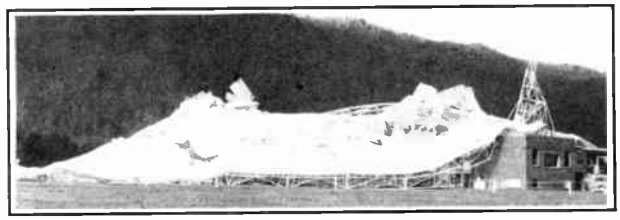


Circle 30 On Reader Service Card

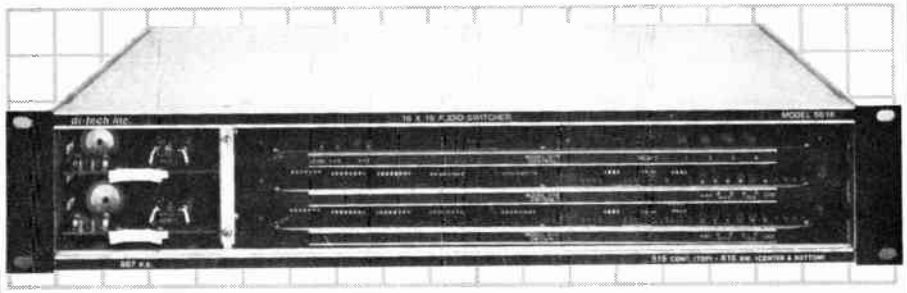
World Radio History



The National Radio Quiet Zone's 1988 telescope collapse (before, at left; after, below) paved the way for a petition to relocate the zone in 1989. The petition failed.



Make the Right Switch...



With The Compact (2 RU) Audio Only Routing Switcher from di-tech

MODEL 5616 STANDARD FEATURES

- 16 x 16 Stereo
- 16 x 32 Mono
- Plug-in P.C. Cards
- Serial Coax for External Control Panels
- Output Level +24 dBu @ 150 Ohm
- RS232 / RS422 Computer Control
- All I.C.'s are Socketed for easy maintenance

ALL FOR A COMPACT PRICE $5250

di-tech

48 Jefryn Boulevard, Deer Park, N.Y. 11729
Tel: (516) 667-6300 • Fax: (516) 595-1012

Circle 43 On Reader Service Card

More field work required

While several members of the NRSC multipath group were anxious to move ahead and begin conducting laboratory tests to verify field results, Simons cautioned that more field work was needed before lab tests could be done.

Although Simons maintained that the diverse backgrounds of those involved in the multipath project is an advantage, he recognized that the diversity may also have diffused the original purpose of the project.

...the first round of tests revealed only one thing—the need for further testing.

"We need to sit down and prioritize what we want to accomplish," Simons said. But he added that the multipath work will be somewhat easier from this point on because "we know how to do it now."

"Information from Round I will help us to decide how to go about Round II," he said. Round II testing is expected to be taken up as early as this summer.

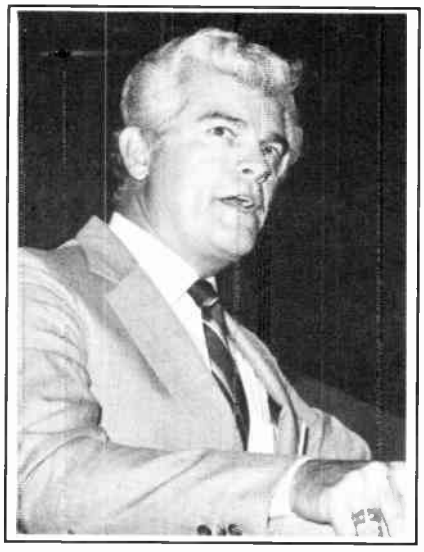
World Radio History

Prices Soar As Stations Are Traded

RW 9

The effects of deregulation came to fruition in 1989 as prices for radio stations reached new heights. The record was broken in Los Angeles when KJOI-FM was purchased by Viacom in December for an estimated $85 to $90 million. This was the second record sale of the KJOI property—it also topped the carts in 1988, at $79 million.

The 1989 KJOI purchase was the latest strategic move by Viacom in an "aggressive pursuit of properties in major radio markets around the country," said Henry S. Schleiff, chairman and CEO of the company's Broadcasting and Entertainment Groups. The KJOI purchase was part of a $101.5 million transaction that also included KSYY-FM and KHOW-AM, Denver.



Radio Ventures' Jerry Lyman

The LA market also generated another record-breaker, when Evergreen Media Corp., Dallas, paid $55 million for KFAC-FM—to date the highest price paid for a classical music station. The buyers then were faced, however, with having to service a $50 million debt on the station's classical format, no mean feat.

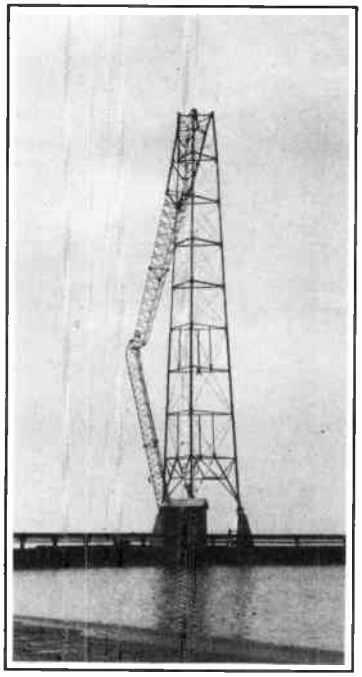
Evergreen thus wasted no time in transforming KFAC into "Rock with a Beat" KKBT. The station set the stage for the coming of its modern music format with words of warning to its competitors to "move over and let the big dogs eat."

But while the big dog of KKBT was taking a bite out of the LA market, another entry proved to be the wolf at the door.

Shiver me timbers

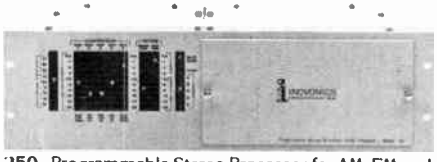
In an earlier, but no less significant LA purchase, Westwood One acquired KIQQ, for $56 million. Formerly a soft rock station, KIQQ got a facelift with a new format and aggressive audio processing. The fledgling high energy, high visibility rocker—KQLZ, "Pirate Radio"—rose nine places in the ratings after its bold change of image. ➤

Structural damage caused by an October '89 earthquake that rocked San Francisco forced some area broadcasters off the air. Others had to adopt emergency measures.



Since 1972, Inovonics has provided disarmingly affordable, top-quality equipment to broadcast and audio professionals worldwide. Our dedication to innovative, leading-edge technologies is demonstrated in the 1982 introduction of programmable audio processing, extensive use of pulse modulation and other digital techniques, and our pioneering work with the FMX™ system.

As we enter a new decade, Inovonics reaffirms its commitment to cost-effective excellence in professional audio.



250—Programmable Stereo Processor for AM, FM and TV. AGC, 5-band Compressor/EQ. Split-band FM or Matrix AM Peak Control. Five separate processing setups, or may be computer-controlled.

222—"NRSC" Mono Processor for AM to increase intelligibility and coverage. Exceeds NRSC-1 spec. Also available in European and Shortwave versions.

255—Triband/PWM Stereo Processor for aggressive FM-Rock formats. AGC, 3-band Compressor/Limiter.

705 and **706**—Stereo Generators with patented overshoot compensation and overmodulation protection. CBS/NAB FMX™ Coverage-Extension System available as a plug-in option.

Inovonics Inc.
1305 Fair Avenue
Santa Cruz, CA 95060

CALL: 1-800-733-0552
FAX: (408) 458-0554

Circle 18 On Reader Service Card

World Radio History

However, LA is not the only pot of gold at the end of the buying rainbow; the value of stations in less lucrative markets also is on the rise. In mid-August an AM/FM combo in Asheville, NC and an FM station in Richmond, VA were purchased for nearly double their former values.

Radio Ventures I, a station group formed by Jerry Lyman after the deconstruction of RKO early in 1989, bought the NC and VA properties with the intention "to build fine radio stations and as an investment," Jerry Lyman.

Expensive proposition

It's investment with a high price. Lyman's acquisitions, WWNC-AM and WKSF-FM combo in Asheville, NC, had been bought in 1986 by the Heritage Broadcast Group for $13.5 million. Three years later the duo fetched $25.5 million.

THE TOP TEN

As for Richmond's WMXB-FM, it went for $23 million. The adult contemporary station had been owned by Ragan Henry Communications Group, which paid $13 million for the station just over a year ago.

The reason for this land-office business? Some claim the inflated radio prices spring from the FCC's 1982 elimination of the three-year holding rule, which prevented buyers of a radio station from selling at a profit in less than three years.

"The three year old rule very decidedly had an impact," said Roy Rowan, Beverly Hills-based vice president of media broker Blackburn & Co. The rule change allows for quicker station turnover and increased speculation in the radio station markets, commented Rowan. "It's anybody's determination whether that's good or bad."

Others disagree. "Elimination of the three year rule was simply a business convenience," commented Ray Stanfield, chairman of Chapman Associates, a radio brokerage firm. "The fact is most people who buy stations don't plan to sell them in one or two years. The average station turnover is probably once every seven years."

"There are 10,000 stations out there," noted Stanfield. "The sale of one in two years instead of three is not going to change mankind."

The Digital Craze

RW 10

To a non-radio person, the term "digital" would probably bring to mind CD players. But that's only the tip of the iceberg in the digital craze that swept the broadcast industry in 1989.

In fact, CDs come off as somewhat dated technology, considering the proliferation of desktop audio systems, digital RF gear, studio products and digital recording media which tantalized radio engineers in the year gone by. After all, many stations in most markets have already had experience with the CD format. The other, more esoteric products are still only the stuff of wish lists for many broadcasters.

One of the most significant introductions of the year had to be the availability from Motorola of the first 16-bit analog-to-digital converter on a single microprocessor chip.

"This chip will lead to an explosion of applications in the radio world," Motorola spokesman Nick Sturiale said. "It is probably the most significant thing Motorola is doing right now."

The DSE 7000, from AKG

Concrete application

The degree of that significance became concrete when later in the year Ariel Corp. introduced a digital microphone, which employs the Motorola A-to-D chip. The device has a dynamic range of up to 92 dB with a total harmonic distortion of less than .005%.

The Ariel microphone, which lists for $595, was designed exclusively for use with the NeXT computer, a new desktop product introduced by former Apple Computer head Steve Jobs.

Jobs' NeXT system was only one of a number of desktop audio systems that were launched in 1989. At the NAB convention in Las Vegas, AKG Acoustics unveiled the DSE 7000 that, at under $30,000, broke new ground in price and performance.

The DSE 7000 is a RAM-based digital workstation incorporating the equivalent of an eight-track recorder, an editing system and a mixer. It is designed for the preparation of commercials, promos and other short duration recordings.

New England Digital (NED) unleashed new software enhancements for its existing systems and touted the recently introduced PostPro system. The Post Pro is an eight-track direct-to-disk workstation specially configured for broadcast applications.

Not to be left out of the workstation war, Integrated Media Systems (IMS) firmly staked claim to the low end of the market with enhancements to its Dyaxis system. Designed to work with an Apple Macintosh computer, the Dyaxis offers random access two-track recording and playback and multitrack offline sound file assembly. The Dyaxis is now a Studer product.

Ariel's digital mic, with NeXT mouse

World Radio History

Best Sellers.

Across the country and around the world, more broadcasters count on Audiopak tape carts than any others. That's because Audiopak carts are designed and manufactured for consistency, durability and exceptional audio performance — cart after cart after cart.

Whether you use carts as a "backup," for spots only or as your principal audio format, Audiopak has the right cart for you. The industry standard A-2 with 605 tape offers "workhorse" performance and outstanding longevity. With its revolutionary "neutral-design" casing and high-performance 613 tape, the AA-3 is perfect for stereo recording and playback. The AA-4's advanced 614 tape delivers sound that's so crisp and clean even professionals can't tell the difference between AA-4s and digital sources in blind listening tests.

Longevity, consistency, performance — whatever your needs, there's one way to be sure your carts will always meet them. Just do what thousands of broadcasters world-wide do. Insist on genuine Audiopak broadcast tape cartridges.

audiopak®
BROADCAST CARTRIDGES

audiopak inc.
P.O. Box 3100
Winchester, VA 22601
USA
Tel. (703) 667-8125
Fax: (703) 667-6379

Circle 8 On Reader Service Card

World Radio History

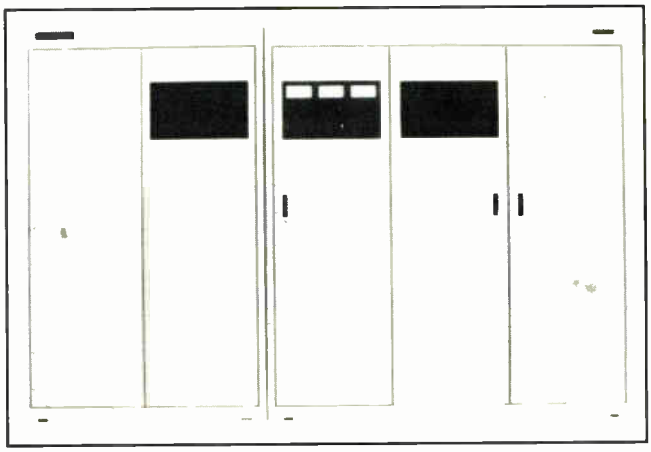
RF and DAT

In the way of RF products, Harris unveiled its DX-50, a 50 kW AM transmitter. The first station to have the unit grace its transmitter room was KFBK-AM in Sacramento, CA.

The DX-50 uses 128 plug-in output modules that are either "on" or "off" as needed to generate the required RF output power. Generally satisfied despite some minor problems in the installation of the device, KFBK's biggest surprise came when the station discovered a 29% reduction in kW hours for the entire plant over the same period a year earlier. The reduction amounted to a savings of over $1200 per month (at winter rates).

Digital audio tape (DAT) also got a boost this year when the recording industry reached a compromise with audio manufacturers. Formally announced 26 July, the compromise would require the so-called Serial Copy Management System to be included in DAT decks, which would allow DAT copies to be recorded from digital sources. That copy, however, could not itself be digitally copied.

Proponents of DAT technology expressed hope that the compromise would encourage more widespread acceptance of the recording medium, and allow DAT recorders to be brought into the country by means other than the gray market.



The DX-50, from Harris

Even before the compromise was reached, however, the technology was in place at some more adventurous stations. WMTR-FM in Toledo went on the air 12 January, declaring itself the first all-DAT radio station in the US. Installation was undertaken by Radio Systems, which converted the Sony DTC 1000 DAT machine to its own Rs-1000 designation, adding microprocessor control.

One repercussion from all this increasing interest in the digital domain was the realization that some type of interface standard for digital gear had to be accomplished. Work in that area began in earnest at the NAB convention, when the newly formed NAB Digital Interface Committee decided to assist the Audio Engineering Society in its standardization efforts.

For many, however, the work was begun somewhat behind the times—there was skepticism as to whether the committee could have any impact at this late stage of digital equipment development.

"I don't think a general interface will happen," said panel member Bart Locanthi, of BNL Research Associates.

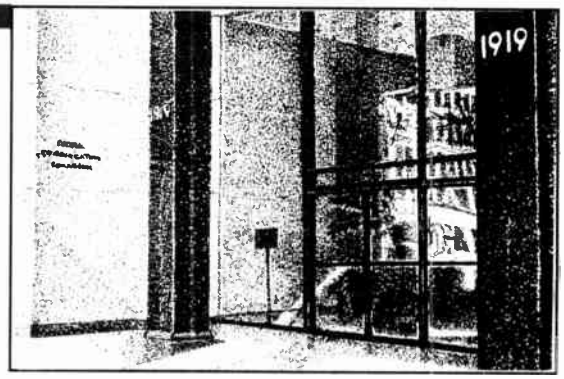
The SBE handed out snack-filled shopcoats to get attendees to stay on the show floor longer during the 1989 national convention.

A re-arranged SBE session schedule also allowed showgoers to spend more time at the exhibits, without missing any seminars.

World Radio History

What's Up in AM

by Alan Carter



While programmers program and general managers manage based on freely-chosen business practices, engineers engineer their stations in line with federal regulations under the control of the Federal Communications Commission. The agenda for 1990 promises to be an active year with a collection of technical issues well underway.

The new Commission under Chairman Alfred Sikes has given AM a priority position for broadcasting. The FCC set the stage when it concluded 1989 with a comprehensive public hearing on the difficulties of the struggling band.

Numerous proposals designed to correct technical problems with AM are on hold from the previous Commission, dockets that may be acted on this year. The dockets stemmed from the technical review initated in 1987, known as 87-267.

What's on tap for AM

Among the outstanding proposals is MM 88-376, which would amend the rules by reducing adjacent channel interference and by eliminating restrictions pertaining to the protected daytime contour.

The FCC also proposes to improve methods for calculating skywave field strength under MM 88-508. Nighttime operations for Class II-S and Class III-S are targeted in MM 88-509; improved methods for calculating groundwave field strength are at issue in MM 88-510, and a review of the methods for calculating nighttime protection is under MM 88-511.

The Commission also is taking a look at policy issues to encourage interference reduction between AM stations in docket MM 89-46.

While some issues are in the official notice process, the FCC promises other topics may be addressed in forthcoming proceedings.

On the list is protected contours and protection ratios; reclassification of AM stations; possible restrictions on permissible modifications of Class I stations; changes in the permissible power levels of AM stations; and regulations pertaining to the use of advanced AM station antenna technology.

(cont. on page 37)

EXTEND YOUR LEVEL OF SUCCESS

The ATS-100 Stereo (dual channel) Extended Range Audio Meter is a self-contained audio measuring system. Dual "VU" meters provide precision visual monitoring. Peak Program Meters offer simultaneous level and peak monitoring.

The ATS-100 input sensitivity allows for a wide range of levels, from -60 to +30 dBm, and a visual indicator is provided for accurate phase measurement. The reliable, fully solid state amplifier and power supply, coupled with advanced micro-processor control, is assembled in a compact 3½" rack mount frame.

ONLY $1,980

McCurdy

McCurdy Radio Industries

108 Carnforth Road, Toronto, Ontario
Canada M4A 2L4 Tel: (416) 751-6262
Telex: 06-963533 Telefax: (416) 751-6455
1051 Clinton Street, Buffalo, New York 14206
Tel: (212) 772-0719

Circle 58 On Reader Service Card

World Radio History

Radio's Tug-of-War: Money Versus Gear

by Richard Farrell

Falls Church VA As the last decade of this millenium gets under way, we at RW thought it would be interesting, as a sort of year end and year beginning collective *Industry Roundup*, to gather some thoughts on where radio has been, and where it is going—particularly over the past year.

Continental Electronics

Steve Claterbaugh, Advertising and Sales Promotion, Continental Electronics Division:

"From a manufacturing standpoint, technology is increasing rapidly in the area of production of solid state devices. There is a move toward these new items where efficiency is higher and operating characteristics are higher. Another trend we'll see a lot more of next year is automation—the control of a complete station."

COMREX

Lynn Distler, Vice President, Comrex:

"The major trend is still the leveraged buyout situations where radio stations are spending more money servicing their debt than they are investing in the capital equipment necessary to run the station. In the area of remote audio transmission, with AT&T effectively out of the business as of 1989, broadcasters are going to have to look at other means of getting audio from point A to point B."

orban

Bob Orban, Chief Engineer, Orban Associates:

"The positive is the FCC's involvement in AM improvement, which I think is important, although I don't know if it's going to be enough to save that segment of the industry. A negative is the continued trafficking in radio stations, which is sucking out capital budgets that should have gone for equipment upgrades instead of servicing debt."

CUTTING EDGE TECHNOLOGIES, INC.

Frank Foti, President, Cutting Edge Technologies:

"Interest by either the radio industry in Wall Street or vice versa has made an economic change. Radio is not being operated by radio enthusiasts but more by Wall Street. Because of that, radio is becoming like any other business—lean and mean with respect to the almighty dollar.

"The broadcaster now needs more justification to warrant adding equipment. In *some* cases, the economics appear to be more important than the technology."

3M

Bill Parfitt, Product Supervisor, ITC/3M:

"We see a lot of stations having smaller budgets than in the past, resulting from the buying and selling consolidation occurring within radio stations. Stations have not been spending as much on equiment. That is an industry-wide trend.

"As far as products are concerned, we've seen a lot more options available to stations today than a few years sgo, so there appears to be some confusion as to what our future products are going to be."

Moseley

Jamal Hamdani, Vice President, Moseley Associates:

"The trend is toward digitization in all regards. It is going to affect broadcasters in the short and long term. We think we are at a transition point where older technologies are gradually giving way to newer things.

"We see a greater demand for user friendly products that are programmable and require very little maintenance. The Japanese have 'spoiled' us to the point where there is a national expectation that everything should be inexpensive, do everything and require little maintenance."

SHURE

John Phelan, Director of Technical Markets, Shure Brothers:

"Probably the biggest trend concerns digital audio and where it fits into the overall scheme of radio. Nobody has really set a pace for the overall market. Right now it seems to be a product here, a product there. Sooner or later, somebody is going to ➤

World Radio History

have to sit down and define how digital is going to evolve as a marketplace. Until that happens, I don't think a digital market is going to evolve that looks serious and interesting."

DELTA ELECTRONICS

John Bisset, Broadcast Sales Manager, Delta Electronics:

"An area of concern is some (station) managements' attitude of 'we'll be sold next year, so can we put off this maintenance?' And in some cases these are things under the jurisdiction of the FCC, which hasn't the money to inspect as it used to. Who is going to be left holding the bag, as far as trouble with the FCC is concerned?

"Some groups are driven by the investment banker, and it seems their only goal is to make a profit. The CE is stuck in the middle wondering what's going on."

BE

Geoff Mendenhall, VP Engineering, Broadcast Electronics:

"Deregulation has had a major impact on the industry. The waiving of the three-year holding rule by the FCC has allowed broadcast licenses to be bought and sold on the same day. It has encouraged investors who don't know anything about broadcasting and has made radio a commodity to be bought and sold.

"This will probably continue until the 'paper' investors are tired of the industry, or until the FCC requires licensees to be committed to operating for a reasonable period of time. At least three years." ➤

WHAT'S UP IN AM

(cont. from page 35)

FM and DAs

While AM will receive additional attention in 1990 and the years ahead, the Commission carried over an FM issue of extreme importance to broadcasters: the use of directional antennas.

Broadcasters represented across the spectrum have asked the FCC to reconsider its approval of broadcasting in short-spaced locations with use of directional antennas.

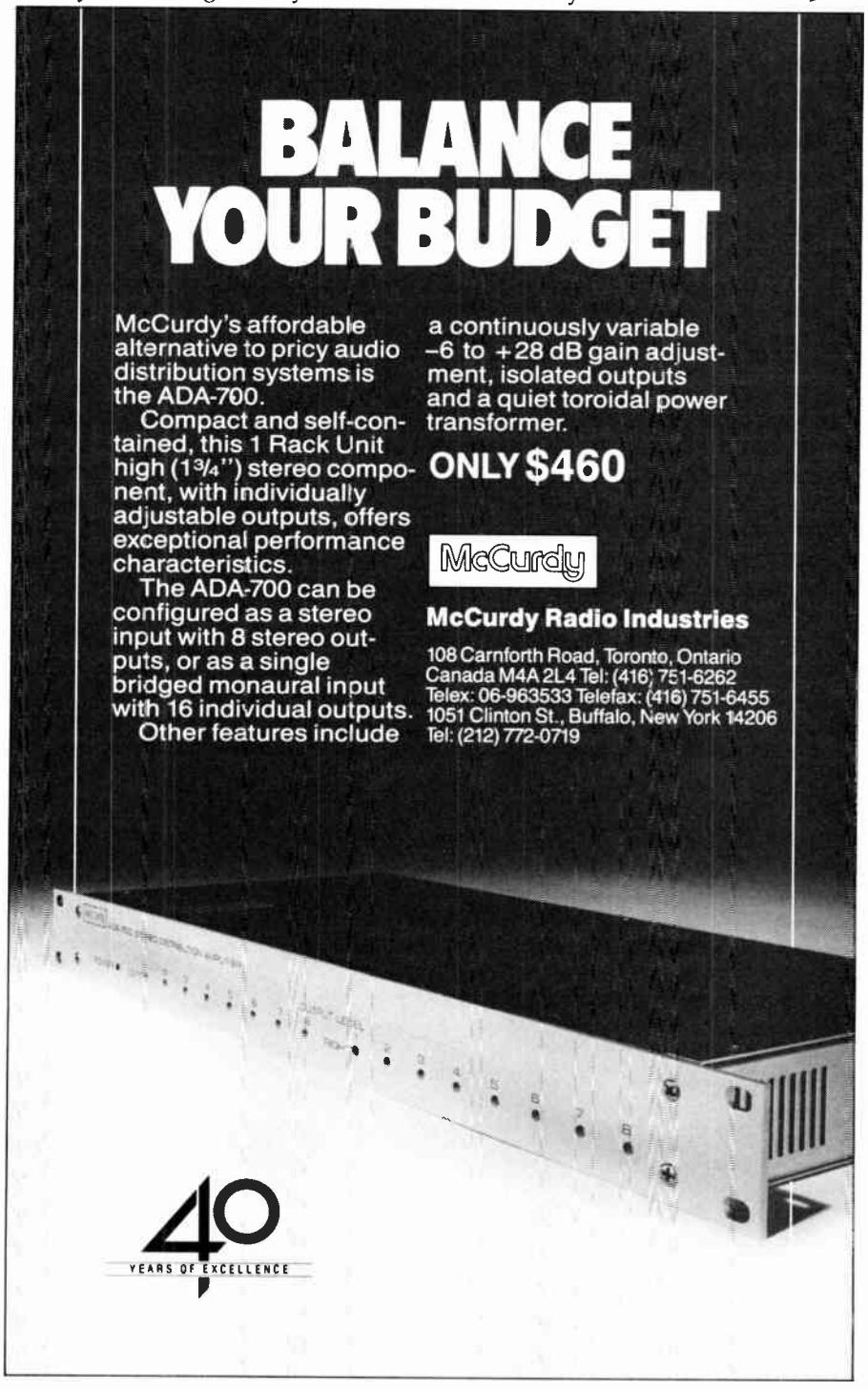
Previous rules required broadcasters to apply for a waiver. Authorization was granted generally to facilities of other co-channel or adjacent channel stations, provided these stations were protected from interference.

The then-sitting Commissioners were split on the issue, with Commissioner James Quello opposing the action. He agreed with broadcasters who argued that short-spacing could become an allotment tool for new FM stations. With only Quello left from the days of the previous vote, a new ruling could emerge.

In the appeal, petitioners cited complaints from limited applications to shortcomings for interference protection.

There are no cut and dried issues for the Commission. The agency is very aware of that, having commented that it doesn't want any unforeseen circumstances arising from it rulings.

The burden is on broadcasters to participate in the proceedings.



Circle 44 On Reader Service Card

World Radio History

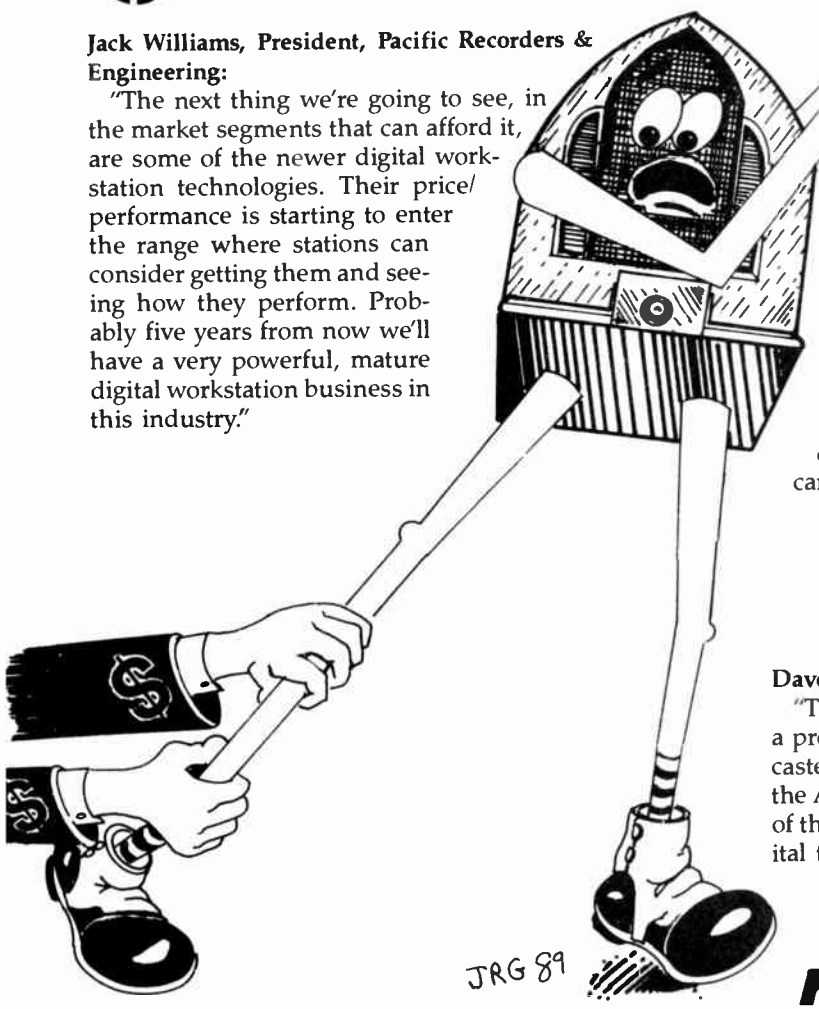
modulation sciences, inc.

Eric Small, VP Engineering, Modulation Sciences:
"For FM, the issue today is competition from other media. It is getting competition from CDs and the just-begun cable radio. DBS may be a threat, and also SAP. And also digital broadcasting, which will be a completely different service.

"The competition ground is going to be quality. All of these media are capable of delivering infinitely higher quality than broadcasters are delivering today. Broadcasters will have to start dealing directly with the quality issue."

PACIFIC RECORDERS & ENGINEERING CORPORATION

Jack Williams, President, Pacific Recorders & Engineering:
"The next thing we're going to see, in the market segments that can afford it, are some of the newer digital workstation technologies. Their price/performance is starting to enter the range where stations can consider getting them and seeing how they perform. Probably five years from now we'll have a very powerful, mature digital workstation business in this industry."



GENTNER™

Russell Gentner, President and CEO, Gentner Electronics Corp.:
"We're currently losing full-time engineers and gaining consultants. The number of qualified engineers is decreasing. This is causing us to develop products that require less field repair and installation, and is causing people like Allied and PR&E to do more turnkey installations.
"The equipment we're developing now is geared toward making equipment in radio stations like computers, which offer a lot of self-diagnostics and can be repaired by swapping boards back to the factory."

HARRIS

Dave Burns, National Marketing Director, Harris/Allied:
"The number one influence in radio now is digital. If a product has digital associated with it, then the broadcaster is at least interested, if not buying it. For instance, the AKG Acoustics DSE-7000 digital workstation is the talk of the industry right now. And the Harris DX-10 true digital transmitter is a runaway success.

RADIO SYSTEMS INC.

Bill Wohl, Custom Projects Manager, Radio Systems:
"There is some uncertainty about the proper way to deliver programming. This year more than ever we've seen debate over whether traditional analog sources like cart, reel-to-reel and records are still acceptable or whether we should give consideration to DAT and CD. People are still uneasy about the CD experience, and the DAT technology is still relatively new, although we've seen a recent surge of interest in it."

While this small sampling of commentary does not pretend to be a conclusive analysis of the industry, it does highlight some common concerns. Nearly all respondents in one way or another expressed worry over the financial fate of radio stations. Radio as investment clearly has many wondering just where it will all lead.

Couple this with an engineer's natural inclination toward the best that technology has to offer, and an unfortunate tug-of-war arises, leaving engineers caught between their own desire to put out a quality sound and the tightened purse strings with which they must deal. Perhaps that will change in the Nineties. And, then again, perhaps not.

World Radio History

Useful Engineering Formulas

REACTANCE FORMULAS

$$C = \frac{1}{2\pi f X_C} \qquad X_C = \frac{1}{2\pi f C}$$

$$L = \frac{X_L}{2\pi f} \qquad X_L = 2\pi f L$$

RESONANT FREQUENCY FORMULAS

$$F = \frac{1}{2\pi\sqrt{LC}} \qquad f_{kHz} = \frac{159.2}{\sqrt{LC}}$$

$$L = \frac{1}{4\pi^2 f^2 C} \qquad L_{\mu HY} = \frac{25{,}330}{f^2 C}$$

$$C = \frac{1}{4\pi^2 f^2 L} \qquad C_{\mu FD} = \frac{25{,}330}{f^2 L}$$

Where f is in kHz
L is in microhenries
C is in microfarads

CONVERSION FACTORS

$\pi = 3.14$ $\qquad 2\pi = 6.28$

$\pi^2 = 9.87$ $\qquad \log\pi = 0.497$

1 meter = 3.28 feet
1 inch = 2.54 centimeters
1 radian = 57.3°

FREQUENCY AND WAVELENGTH FORMULAS

$$f_{kHz} = \frac{3 \times 10^5}{\lambda_{METERS}} \qquad \lambda_{METERS} = \frac{3 \times 10^5}{f_{kHz}}$$

$$f_{MHz} = \frac{984}{\lambda_{FEET}} \qquad \lambda_{FEET} = \frac{984}{f_{MHz}}$$

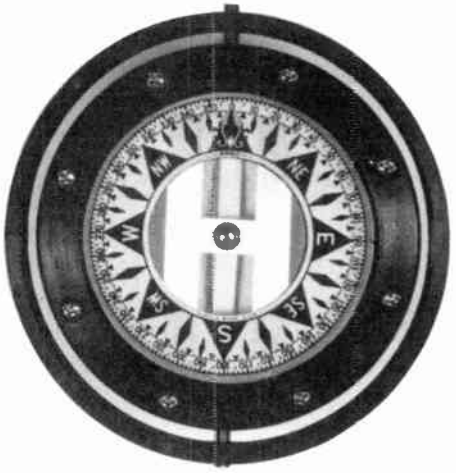
0.625λ = 225° = 5/8 WAVE
0.5λ = 180° = HALF WAVE
0.311λ = 112°
0.25λ = 90° = QUARTER WAVE

RESISTORS IN SERIES

$$R_{TOTAL} = R_1 + R_2 + R_3 + \cdots$$

Courtesy of Delta Electronics

Broadcast Supply West,



East, North & South

As a company that serves the nation's broadcasters, we have often considered opening regional offices to improve our service or expand our sales. In the final analysis, we determined that regional offices would only serve to retard service and drive our overhead sky high. So here we are in the west, maintaining the most efficient and economical distribution system in the broadcast industry. Regardless of your location, you benefit by saving money, enjoying quick delivery, and receiving exceptional service. We are open 12 hours daily, 9 a.m. to 9 p.m. east, 6 a.m. to 6 p.m. west, so you can call us at your convenience for all your audio equipment needs.

From any point on the compass, BSW is as close as your telephone.

BSW®

BROADCAST SUPPLY WEST

America's Full-Time Broadcast Supplier

1-800-426-8434

ORDERS • INFORMATION • SPECIFICATIONS

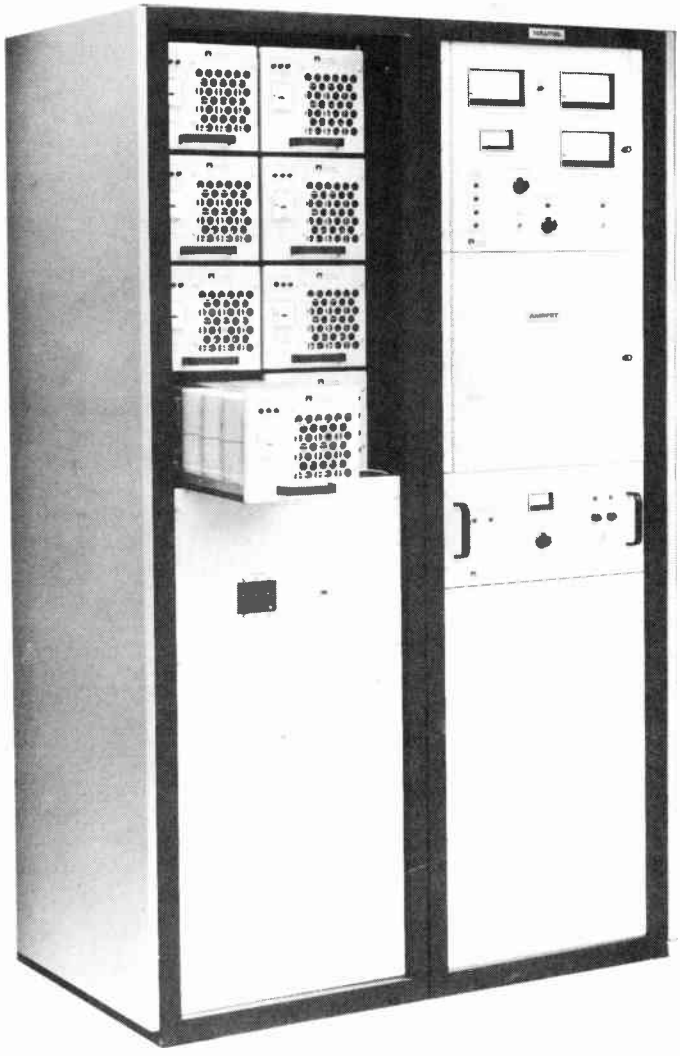
BSW • 7012 27th Street W • Tacoma, WA 98466 • FAX 206-565-8114

Circle 14 On Reader Service Card

World Radio History

nautel

The World Prefers Nautel Transmitters



All Solid State AMPFET series AM Medium Wave Transmitters. The choice of Broadcasters around the world.

Proven solid state design, modular configuration and On-Air serviceability are reasons why broadcast professionals choose Nautel transmitters.

Other features include
- 75% overall efficiency
- Built in redundancy
- Power Reserve

Power Range up to 100 kw.

ALL SOLID STATE

Contact Jorgen Jensen for more information about the Nautel AMPFET series transmitters:

Phone: (902) 823-2233 Canada • **Fax:** (902) 823-3183 • **Telex:** 019-22552

Nautel
(Nautel Electronic Laboratories Limited)
R.R. #1, Tantallon, Halifax County,
Nova Scotia, Canada B0J 3J0

Nautel Maine Inc.
201 Target Industrial Circle
Bangor, Maine 04401 U.S.A.

nautel

Circle 4 On Reader Service Card

World Radio History

A LOOK BACK/ A LOOK AHEAD

Predicting the Future
Tracking the Trends in '90 and Beyond
by Ty Ford 42

Making Man from Machine
by Al Peterson 45

A Modern Parable for Today's Hi-Tech Studios
by Dee McVicker 48

How to Ready Your Stations for NRSC-2
by Harold Hallikainen 53

AM Stereo How-To's: A Systems Checkup
by John Bisset 56

Changes on Radio's Horizon
by Alex Felker 60

Broadcast in the Digital Era
by Stan Salek 62

World Radio History

Predicting the Future

Tracking the Trends in '90 And Beyond

by Ty Ford

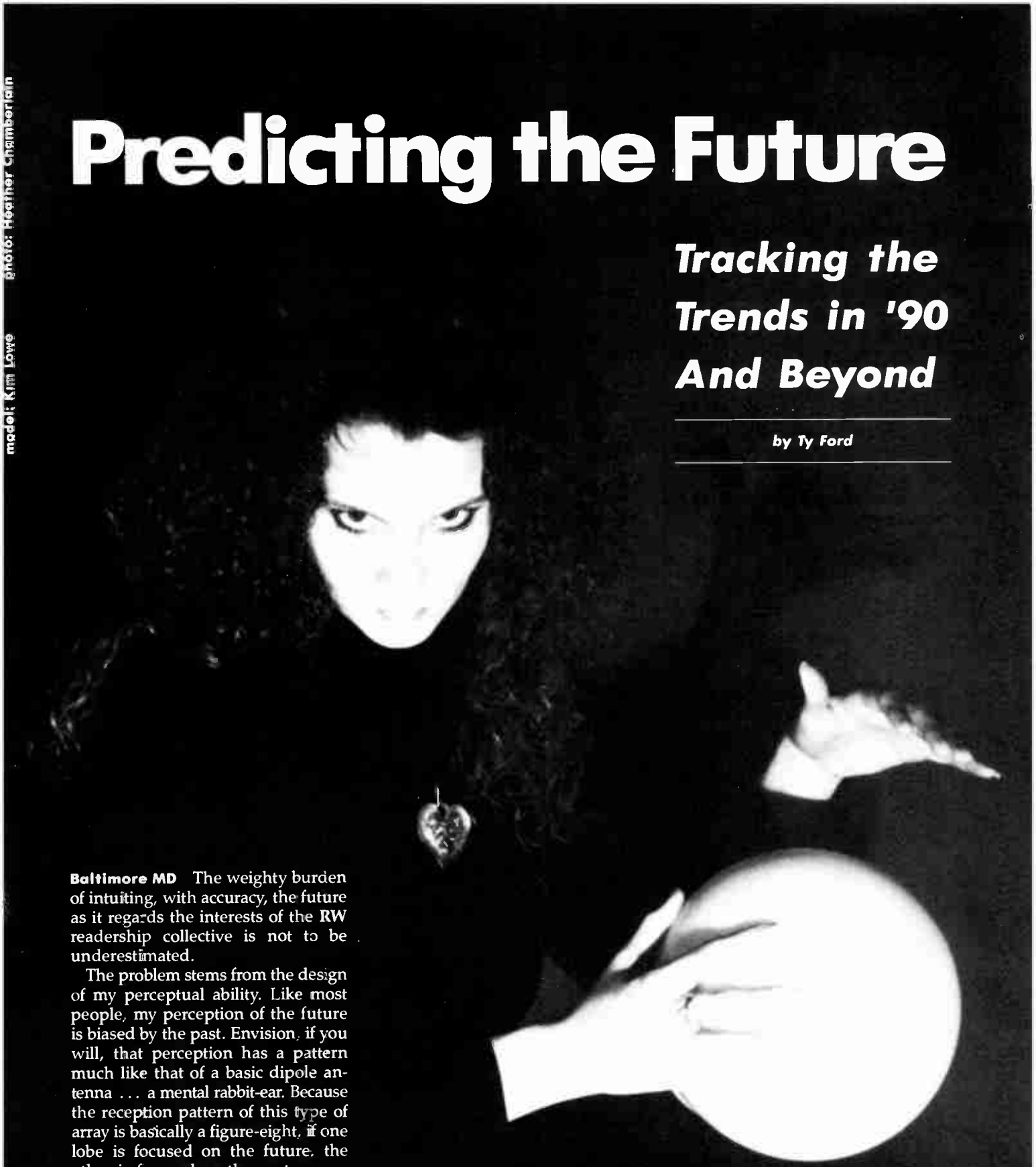


photo: Heather Chamberlain
model: Kim Lowe

Baltimore MD The weighty burden of intuiting, with accuracy, the future as it regards the interests of the RW readership collective is not to be underestimated.

The problem stems from the design of my perceptual ability. Like most people, my perception of the future is biased by the past. Envision, if you will, that perception has a pattern much like that of a basic dipole antenna . . . a mental rabbit-ear. Because the reception pattern of this type of array is basically a figure-eight, if one lobe is focused on the future, the other is focused on the past.

Attempts to redirect rear-oriented sensitivity to the front, for a deeper or more accurate look into the future, require extra elements of concentration. At some point this redirection effort creates splattering of the side lobes (present tense), which results in reality saturation . . . and a nasty headache.

The conclusion I have become most comfortable with is that, without referencing the past, attempts at predicting the future are often too heavily influenced by the present. For example, if you had a bad pizza for lunch, the resultant heartburn will compromise the accuracy of your vision. ➤

World Radio History

Proof of this sort of mishap is abundant in our industry. Were it not for my esteem for discretion, and the fact that I had a good lunch, I would share a few of my favorites with you.

Fortunately (for all of us), I'll remain focused on the future. I wish I could report that the future will be kinder and gentler for everyone. It won't be.

"Play-it-safe"

The business of broadcasting won't change much, which is to say it will become more boring. In the near future, increased competition will continue to create a "play-it-safe" conservative atmosphere.

Even though many economists claim we are "not experiencing a recession," most will grudgingly agree that business is sluggish, soft or just a little off. This will increase the pressure on more marginally capitalized and highly leveraged broadcast properties. Some of them will hit the wall.

A few more "old-timers" will get out of the business, selling their holdings to new owners, who don't know beans about radio. Their fascination will lie not in how the tea leaves of an Arbitron ratings book are interpreted, but in how the station looks on a profit and loss sheet. In that sense, radio will remain a "numbers game."

FM powerhouses

The *really* smart investors will buy up FM properties that they can upgrade into regional powerhouses. These suburban facilities now lie between or among several larger markets. With the proper upgrade, they will cover more than one market. The key to their success will be that they will provide a more efficient time buy for advertisers who now buy markets separately.

Stations within a market, with signals strong enough to effectively penetrate tangential markets, will also do well.

In the Baltimore-Washington area, for example, expect WHFS-FM to emerge as a regional powerhouse, even if its format does not remain intact. Also expect DC stations like WPGC, WASH, and possibly WWDC and WAVA to increase

"Our ratings are powerful...and so are the demands of our equipment."

Beaven Els, Chief Engineer, WFAA-TV Dallas

A television signal going to millions of homes can be a very complicated process. In Dallas, WFAA-TV has been THE dominant force for decades. This success is due, in large part, to the technical expertise BEHIND the camera.

As Beaven Els will attest, WFAA-TV is committed to investing in the finest equipment. From the most sensitive recording instruments to the electric clock in the lobby, WFAA-TV must have a reliable source of power. That's why Chief Engineer Els chose to have *everything* protected by the POWER SIFTOR® from Current Technology.

UL The effects of unfiltered power can wreak havoc in a television station. Digital equipment and computers can be destroyed by "dirty power", and the POWER SIFTOR typically eliminates these effects. And, Underwriter's Laboratories has made the picture even more clear by giving the POWER SIFTOR outstanding marks in the 1449 testing program.

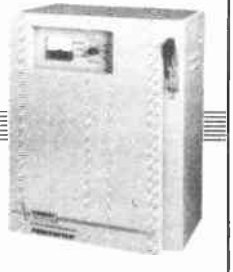
Beaven Els is right. WFAA-TV's investment in programming and equipment are two reasons for the station's success. But without power protection, the station's "sign off" might occur earlier than scheduled.

Don't wait. Failure to act can result in permanent damage to your equuipment! Our analysis of your power protection needs is free...and so is the call. ***800 238 5000*** *ask for Peter Diamond, ext. 480*

CURRENT Technology

MP Series

The Power To Succeed ™



1400 South Sherman • Richardson, TX 75081
(214) 238-5300
Power Siftor and The Power To Succeed are registered trademarks of Current Technology, Inc.

Circle 50 On Reader Service Card

World Radio History

marketing efforts in Baltimore. Broadcasting from Baltimore, WTYY's footprint over Washington also gives them an edge.

Successes will be modified by how well the stations market themselves, by their formats, and by the inroads made by the emerging competition.

Under the heading of "emerging competition," look for cable FM stations in markets that are particularly well wired for cable. Here, unfettered by many FCC "broadcast" regulations, a forest of formats will develop.

While it's true that you can't get cable in cars (yet), in-home or at-work locations wired to a cable system's FM spectrum are the tip of an iceberg that will continue to rip away at the soft white underbelly of broadcast radio.

The grossly over-inflated price of broadcast properties will continue to force owners to find new and inventive ways to meet their loan payments. Subcarriers and tower space will be reconsidered as ways of replacing revenue lost to the increasing number of programming sources.

Stations who can't figure out how to increase revenue will respond by cutting operating costs. Many ex-chief engineers have already "met the future." They have either become contract engineers for a number of stations, or have moved on to allied fields. On-air people should prepare for an even bigger problem.

Ten years ago, trade schools were the main source for most announcers. Now, colleges and universities have inflated the work force by turning out thousands of new "on-air hopefuls." Even though many graduates are going into TV and video, the glut of humanity in the workforce will continue to drive entry level salaries for radio down. That big paying job simply won't be there.

For a comparison, consider the airline industry. The "glamour" that was attached to stewardesses in the '50s and '60s faded through the '70s and '80s. Increased competition among the carriers and rising operating costs reduced profits.

Because the workforce was unionized, strikes were inevitable. Younger men and women who were then entering the workforce happily took smaller salaries, just to get the job.

In addition to competition from other individuals for on-air jobs, announcers will also be competing against network programming via satellite. Satellite-fed formats have already found a niche in the market with station management who have judged that the cost of on-air personnel is too high.

Although it's a little too early to start planning the radio format for the children of the Baby Boom, expect it to be tried by stations who have nothing to lose. When the time is right for this format, it will undoubtedly consist of music and attitudes parents will hate.

There will be many opportunities for success. Take heart in knowing that, in this country, just showing up is more than the average person can handle. Winners—be they good people or jerks—not only show up, they get the job done. It's that simple.

Ty Ford, audio production consultant and voice talent, can be reached at 301-889-6201 or by MCI mail #347-6635.

Clean up dirty talk dirt cheap.

For some listeners, waiting for things "you can't say on the radio" is part of the fun. But with today's free-wheeling talk radio formats, controlling what actually goes out on the air is more essential than ever. Now Eventide's BD941 and 942 Broadcast Audio Delays are here to make effective obscenity protection more affordable than ever.

The stereo BD942 and mono BD941 give you six seconds of delay protection (or optionally, three, or even twelve). Yet they cost thousands less than Eventide's industry-standard BD980. You don't get the BD980's elegant *Catch Up* function or its other sophisticated features. But the BD941 and 942 have an easy, convenient and totally reliable system of their own.

OK, you're on the air, and someone's just opened his or her mouth a little too wide. Just hit the *Delete* button to delete an obscenity, and you're instantly back in real time. The BD941 and 942 delays also have a set of relay contacts that close automatically when *Delete* is pressed. You can use the relay to start a cart or other device to fill the delay period. Then, after the delay period expires, the unit automatically switches back online for full delay protection. What could be simpler?

The full bandwidth audio performance of the BD941 and 942 is everything you'd expect from Eventide, the world leader in talk show delays. All at a price that makes talk cheaper than ever. How much cheaper? Talk to your broadcast distributor, or call Eventide for the good news.

Eventide
the next step

ONE ALSAN WAY • LITTLE FERRY, NJ 07643 • TEL: 201-641-1200 • FAX: 201-641-1640

Circle 40 On Reader Service Card

World Radio History

FROM THE TRENCHES

by Alan Peterson

Making Man from Machine

Dear *JG*,

I'm dropping you this line after recently having learned yet another new language to communicate with a state-of-the-art, modern, sophistikatydid automation system.

You wanna see a crowded trench? I'm sharing this one with *thousands*! These are folks who, like me, have witnessed a day's programming disappear in a blink, or have heard two or more sources on-air simultaneously, or have experienced that "sunken stomach" feeling when the Time Announce cart gets swallowed in an agonizing *mrrrupp* of the monitor speakers. All of us who still have a love/hate/fascination complex with radio automation.

By the way Jude, by "automation" I am referring to the classic self-contained reel/carousel/computer-sequencer system (or variations of CD or DAT therein) capable of broadcasting all by its little lonesome. To me, the satellite integrated live-assist subsystems just ain't da same. But boy, when I think of where I was when I first had to deal with it ...

Let's do the Time Warp

In mid-1979 I met the enemy and he was tin. While I was toiling at Oswego NY's WSGO, Frankenstein Jr. was crosstown at WKFM Fulton making them reels go 'round and 'round (WKFM is now licensed to Syracuse and the former site is now WZZZ-AM, Peter Hunn's very latest success story). I was somewhat peeved at losing Arbs to a box of Nixie tubes, RS5D relays and thumbwheels, but I was also gaining a respect for this strange technology.

Cousin Brucie Morrow made me PD/OM of Northampton, MA's WHMP-FM in 1984, and it became sink or swim with a Shafer 903 rack. The traffic folks referred to FM as "Arnie," so we gave the sucker *his own* airshift!

With the help of a Sillerman Morrow cohort, we reprogrammed the 903 and loaded the audiofiles with jokes and liners ... welcome "Arnie Shafer," our new overnight personality. This doesn't sound like much now, but in 1984 this was fairly heady; giving a machine a personality sure ticked off our consultant—"that's a tune-out factor." (Shaddap.)

Since then, I've been finding other folks who have personalized their systems as well. I'm amazed to see so many automation racks anthropomorphized with human names.

That human touch

Whether it's done to humanize the mechanism and soften its strangeness, or to give the thing an emotional label to hang blame on ("Don't yell at me ... *Fred* screwed up the rotation"), it has been amusing to conduct this research. What follows are some great examples of monikers bestowed upon these deified player pianos—I've deliberately left out HAL and Fred to present these little lovelies:

Don Richardson of T93 Watertown, NY tells me his Broadcast Electronics 16X system is MAX ... no doubt of Headroom fame. Their way of humanizing Max is to announce "the baby's crying" when the error alarm fires.

WNEZ in New Britain, CT christened their system as BUD. Near as I can figure, it's in honor of Bud Stone; local radio legend and big wheel at Connecticut School of Broadcasting.

BEXT Inc.

HIGH PERFORMANCE AT AFFORDABLE PRICES

- New front panel programmable composite STL's
- New directly programmable FM composite receivers
- New options for syncronous boosters and translators
- New FM power levels: 2, 10, 20, 30, 80, 100, 200, 250, 500, 800, 1000, 1500, 1800 2000, 3000, 3500, and 15000 W

BEXT INC. 619-239-8462
739 Fifth Ave. San Diego CA 92101
TLX 229882 FAX 619-239-8474

Circle 56 On Reader Service Card

World Radio History

Mark Simonson, arguably one of Binghamton's finest newscasters, tells me of Norwich, NY's WCHN-WKXZ, and their system IVAN (. . . the Terrible . . . need I have told you that?). He also tells me they once had a second rack as well named Otto. I'm presuming "Otto Mattick."

Credit goes to WNNZ, Springfield's 50 kW clear channel AM for WINNZ-TON. While not an automation system, it is one of those dial-up transmitter remote control jobbies with a speech synthesizer. Winnz-ton is occasionally temperamental and calls up whenever he bloody well pleases and gives the right numbers whenever he feels like it. Because of this very human quirk I have included Winnz-ton.

R-E-S-P-E-C-T

WTVR AM/FM Richmond and WSRK Oneonta in Virginia have a common condition: both their automation systems lack a name but have had similar treatment. Both have been on the receiving end of some pretty devastating kicks in the ribs over the years by some less-than-tolerant programmers. To this end, I offer the charming, somewhat feminine name "Dimples." And fellas, that ain't no way to treat a lady . . .

Here now is the name that will most likely be in use nationwide by tomorrow morning. Coined by Bob O'Keefe for our very reliable automation system here at WBBS, Judith, may I present SYBIL. As Bob explained it to me, Sybil "has thirty distinctly different personalities, seventeen of which are out to kill you."

"The traffic folks referred to FM as 'Arnie,' so we gave the sucker his own airshift!

Automation technology may have reached as far as it can now in creating a clean, well-paced air product. Faster computers, CD or DAT storage and fairly clear programming language—plus the ability to live-assist—have made automation a respectable word again around the station.

In the end, it's going to be clever programming and attention to detail at the user end that will make any station—Sybillized or UnSybillized—successful. But Judith, could it be the next evolutionary step in extending the user friendliness?

I mean, can you imagine replacing the "Error" Sonalert or strobe light with a digitized speech EPROM? Instead of beep-beep-blink-blink, PDs would hear, "Yo Bubba, we got us a train wreck over here!" How about digitizing "Warning! Warning, Will Robinson!!" or Scotty's "Captain, the engines are gonna blow any minute!"

Betcha Sam Kineson's "Augh! Aaauuggh!!" stuffed into an ROM would attract a little attention, eh? (T93's Don Richardson tells me his brother retrofit his office PC with Pee Wee Herman's "Aaack," replacing the beeper that signals a program's completion. In an otherwise serious office environment this must be a sidesplitter.)

I wonder if anybody wants to take a crack at using MIDI to run an automation system? It'd be pretty amazing to wire up a whole automation frame with MIDI INs and OUTs. Pretty weird too, to think an inexpensive Alesis MMT-8 sequencer could handle a whole airshift and have some tracks left over to do production on.

And in defense of Dimples, could somebody wire up a seltzer bottle to a mercury motion switch to zap the next clown that kicks a piece of broadcasting equipment?

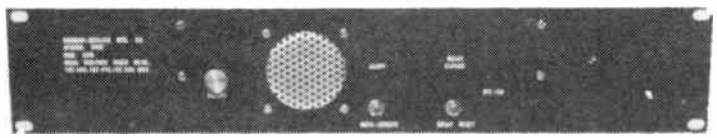
Finally, I'd like to doff my helmet to those companies and stations that are now automating with CD playback systems and DAT decks, and especially to those visionaries with the room and the bucks for the Touchstone archives or the big Synclavier racks.

Time to change the reels,

—Al

Al Peterson is an air personality at WSBS/WBBS, Great Barrington, MA. He wants to know about the automation system at your station. Write him c/o Radio World, Box 1214, Falls Church, VA 22041.

WEATHER RADIO
Model CRW



Price $540.00

Sensitivity .28 microvolts for 12 dB quieting. All 3 frequencies. Alert tone demutes receiver, closes relay and gates audio to 600 ohm rear terminals. Another set of rear terminals has continuous 600 ohm audio output. Double conversion crystal controlled, crystal filter in first I.F., ceramic filter in second I.F. Dual gate MOS FET front end. 50 ohm coaxial input. Adjacent channel (j25 kHz) down to 70 dB. 19" rack mount, 3½" H, all metal enclosure. In stock—available for immediate delivery.

GORMAN REDLICH MFG. CO

257 W. Union St. • Athens OH 45701 • 614-593-3150

Circle 16 On Reader Service Card

World Radio History

GET IT IN STEREO.

In the field or on the run, the AKG C 522 ENG, mics it just like you hear it — in stereo. Wherever you are, whatever you're recording, from courthouse interview, press conference, rock concert, to forest fire, the C 522's clarity, rugged performance, and convenience are exactly what you need to add a true-life dimension.

Inside its sturdy housing are two matched cardioid condenser capsules, elastic-mounted for low noise and pre-configured to give you a smooth, one-handed XY-stereo field. It's a workhorse mic, with the little extras a working pro needs, like a built-in rechargeable battery, low-power warning LED, integrated on/off switch and boom mount shock suspension.

Get it live in stereo with the AKG C 522.

AKG acoustics

77 Selleck Street
Stamford, CT 06902

Reporter: Denise O'Brien.
With permission of Colony Communications, Inc.

© AKG 1987 ®Akustische und Kino-Geräte GmbH, Austria

World Radio History

A Modern Parable for Today's Hi-Tech Studios

by Dee McVicker

In the beginning, technology created CD and R-DAT. Soon there were DATs and Robojocks—and then large brains to control the DATs, Robojocks, and the other wares that technology had created . . .

The above might read like broadcasting folklore, but all this happened during the last decade. Robojocks are not metal DJs transported out of a fable; they are large, multiple-disc CD players and they are usually transported by UPS.

If there is a parable here, perhaps it is in where technology is headed. The Robojocks, DATs and large brains of the coming paperless and tapeless era are not just headed for top ten markets. Surprisingly, they are also headed for what Arbitron's top ten might consider to be rural radio.

WMLS-AM in Monroe, GA, was one such station within the path of new age technology. Last year, this small AM acquired two Sony CDK 006 60-slot CD players, a full compact disc library and a Media Touch automation brain.

General Manager Ron Reeves considers these buys to be a sign of the times. "When you have an AM," he says, "you better make it sound as good as you can." In the outbacks of radio, this advice for AM broadcasters takes on double meaning. For Reeves, it meant setting aside some of the myths of AM radio as well as breaking the mold of conventional small market thinking.

Not that Reeves hasn't thought about staying within the small market comfort zone. He admits to "seriously considering" an automation carousel machine because it was tried and proven, and to at least browsing through satellite format listings.

But what Reeves couldn't convince himself of was how well program vending translated into everyday small market radio. In short, Reeves wanted his station to identify with the 15,000 potential listeners in Monroe, GA. And this, he reasoned, wasn't indigenous to satellite programming or even cut-from-the-mold analog—in any vending form.

From sea to shining sea

Andy Castiglione, chief engineer for KBET-AM in Canyon Country, CA, would probably agree. KBET is totally digital with three 800 megabyte hard disk drives, four Sony CDK 006s, two DAT machines and enough computer software to keep a radio station on the air long after the air is unsuitable for humans.

John Connell with Media Touch Systems, Inc. rates KBET, a 1 kW stereo AM, to be one of the more progressive radio stations of 1989. What is amazing, says Connell, is that "it's light years ahead of everything, and here it's this little radio station."

WESO-AM and sister WQVR-FM, on the fringes of Worcester County in Southbridge, MA meanwhile, have shed a different light on where technology is headed. In 1989, WESO/WQVR ended a beta test of the Astre system, a fully functional brain that handles total radio station operation.

Astre, the brainchild of the stations' engineer Richard LaVallee, is a departure from the new PC-based systems, with a UNIX disk operating system on mainframe computer. And it is, according to DJ Steve Mantle, "40 minutes into the future."

Considering the source

In a 1988 survey conducted by the National Association of Broadcasters, radio stations in markets with populations of less than 100,000 lagged only seven percent behind the 29 percent of all stations using compact discs to air programming.

If these numbers indicate anything, it is that even in the heart of Rural Radio USA, stations are considering the source. Whether this is the case because of heated pressure by listeners, or the result of technology trimming prices down to a more palatable size, no one knows for sure.

Dave Scott of Century 21 Programming, Inc. suspects it is a little of both. All stations, he says, are more quality conscious and more attuned to the type of product they air. "Quality has gone way, way up and the price has held the same or gone down," he maintains, citing these examples: "The worst DAT is going to sound terrifically better than the best cartridge. And the worst CD ever made sounds better than the best vinyl album."

KBET-AM's Castiglione would be the first to agree. As the engineer behind an AM stereo station, he is all for the quality of this new age broadcasting. "Even my transmitter is totally solid state," he boasts. "I have only one vacuum tube in the whole place."

➤

World Radio History

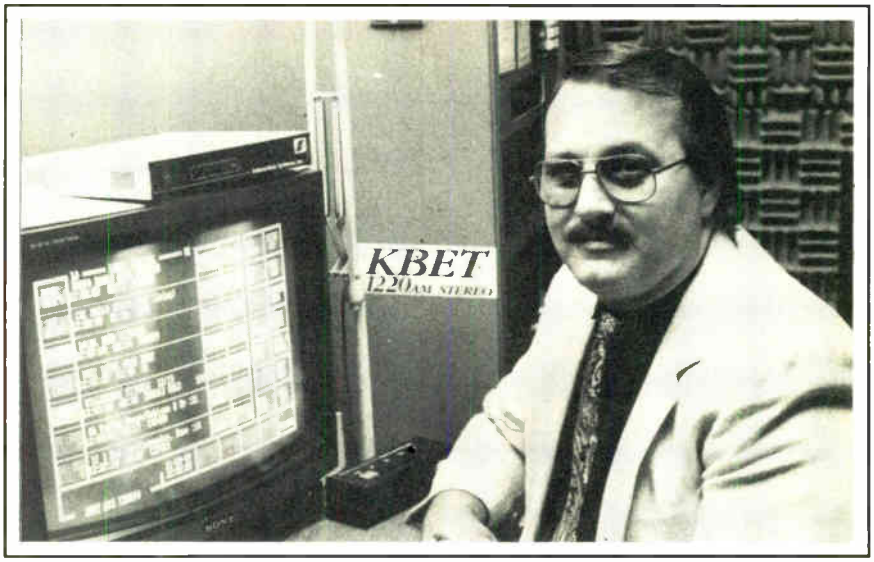
KBET entered the tapeless, paperless era in a clean sweep. The evidence? Nowhere in the station can one find a cart machine—or console, for that matter. The thought of doing without either of these broadcasting staples might be unsettling for some, but to Castiglione, it's all part of the digital package.

Disks and D.A.M.S.

Three hard disk drives, at 800 megabytes each, now hold what used to require numerous cartridge tapes to contain. Six hours of audio, at 15 kHz bandwidth for stereo, are stored on these three, relatively small devices for commercial, jingle, and sound effect rotation. The component behind digital retrieval and conversion to on-air broadcast is the D.A.M.S., or Digital Audio Mass Storage system developed by Southern Broadcasting Systems in Australia.

Four Sony CDK 006 CD players rotate the station's music load, which is supplied by Century 21 Programming and scheduled by KBET personnel with Century 21's Super Scheduler software program. Adding to this already large inventory of digital mass storage is a relatively new arrival to broadcasting.

The McKenzie Digimac is typically



KBET's Andy Castiglione, shown with just a sampling of the station's automation gear.

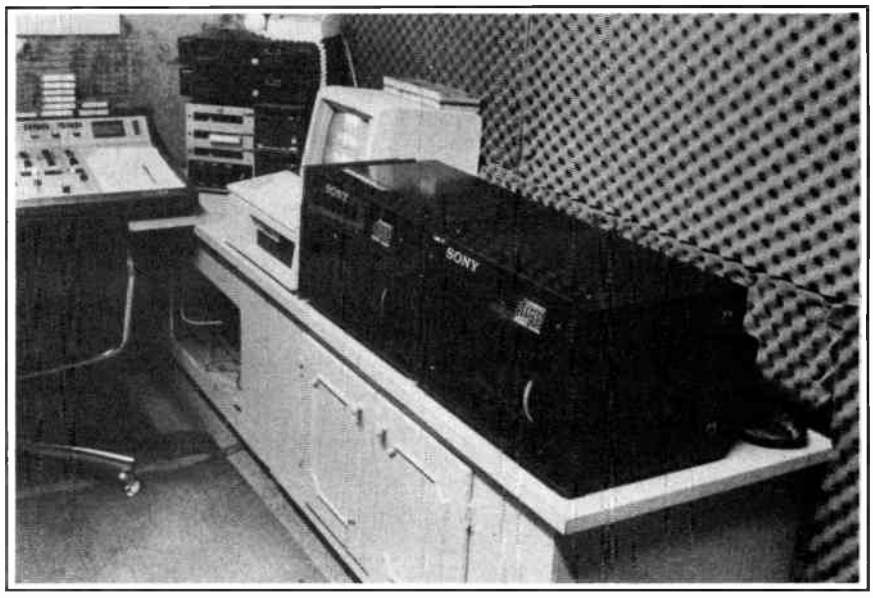
Circle 45 On Reader Service Card

World Radio History

found in television studios for live game shows, or in airports to direct passengers. But Castiglione, with 16 years in the television market and no stranger to digital mass storage, decided to try the device for the station's network tap.

Castiglione compares the Digimac to a DAT recorder, only with 4k bandwidth instead of a full spectrum. To use the DAT for the station's CBS news feed, he claims, would be "a waste of technology," because the audio pass from the satellite receiver is only 3.5k bandwidth.

That's not to say, however, that Castiglione doesn't take advantage of DAT technology. He does, in fact, and has two DAT machines for commercial load. "So if we wanted to sell a one-commercial load package, we can put all our commercials on DAT and also have them on D.A.M.S.," says Castiglione.



The WMLS CD library is housed in two Sony CD players.

Media Touch does the driving

The automation engine behind KBET's tapeless and paperless station is the Media Touch system. With touchscreen control at workstations in virtually every room in the facility, and with modem access to boot, just about any event—automation, programming, or otherwise—can take place without so much as turning a pot, sliding a fader or lifting a finger to other than the touchscreen.

WMLS-AM is also hooked up to a Media Touch brain for its digital automation. GM Reeves likes the idea that they can theoretically walk away from the station for 168 hours, providing enough events are pre-programmed into the chain.

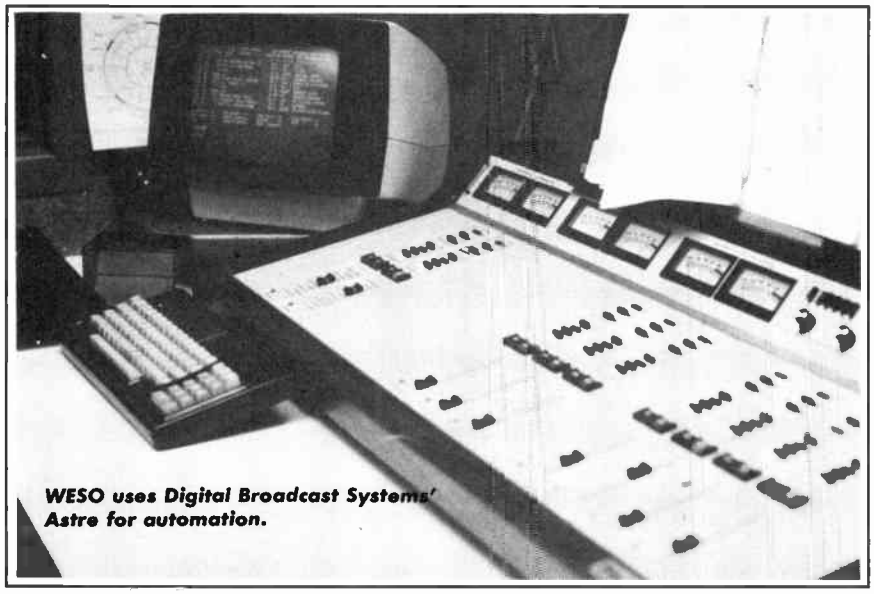
Robojocks, DATs and large brains...are not just headed for top ten markets.

So far, Reeves hasn't tested this theory, but he does leave the station unattended for four to five hours at a time. Reports Reeves, "The only time we automate is during non-drive times, when it's fairly music intensive—and overnight."

Unlike KBET-AM, WMLS mixes new technology with more conventional technology to feed its signal to a small market. Commercials are recorded on cart, and later transferred to reel tape for semi-automation by the system. Each standard spot set begins with a station promo, and when completed, signals control back to music rotation with a 25 Hz tone.

The CD library, housed in two Sony CD players, was—much to Reeves' regret—all timed and keyed into the computer by personnel at the station. Reflects Reeves, "We had to literally time every record, all the intros, all the tone endings and physically type out all the songs—tallying about 1800 songs." His advice to CD enthusiasts? Purchase a pre-automated CD library from a programming company.

Despite the long hours it took to get the library into the system, it has been well worth the time. Reeves estimates that for every hour of automation, the station gains 45 minutes over a manual system. Speculates Reeves, "The time it takes to do one hour (of automation) is about 15 minutes. So you spend 15 minutes of the jock actually sitting behind a control board, and you've freed him up for 45 minutes."



WESO uses Digital Broadcast Systems' Astre for automation.

Idle time

DJ Steve Mantle of WESO-AM/WQVR-FM concurs with Reeves' findings. He has noticed a bit more idle time in his workday since the stations put the Astre automation system on line.

➤

World Radio History

Astre, on the other hand, is anything but idle. If it is not scanning for a 5 volt pulse at 80 cycles per second, it's running a trim program to keep commercial production within, say, a 60 second time increment. The system is, in fact, on line 24 hours a day with a good part of the day as the central brain for *two* radio stations.

... for every hour of automation, the station gains 45 minutes over a manual system.

Digital Broadcast Systems' new system, which will begin its marketing life this year, is intended for large-market stations. However, said Digital Broadcast Systems' Director of Software Matthew Martin, it ended up at WESO/WQVR because of Christmas, among other reasons.

The FM especially was hard pressed to make Christmas on what Martin describes as "a single instacart," and Digital Broadcast Systems was hard pressed to turn down what is probably the hardest test for an automation system to pass: a one-operator AM/FM combination in the evening, with separate AM and FM programming.

That was two Christmases ago. The station combo has since purchased the system, and Digital Broadcast Systems' Astre has since met many challenging situations.

While the FM is for the most part fully automated, the AM is generally set up for manual or live assist operation. Both stations air separate Drake Chenault formats, the FM airing Country from four reel-to-reel machines and the AM airing hits from the '60s, '70s and '80s from six reel-to-reels. All of this is rotated by Astre.

The stations' music rotation databases are listings of reels, not songs. The sequence of music events takes place in the system's sequencing module, which switches back and forth between reels to air the next song in line for playback.

For commercials, liners and buffers, both stations use the Astre brain to call up events from an 800 megabyte or 328 megabyte hard disk drive. The rule of thumb for storage space, according to Martin, is that one minute of single channel audio at 15 kHz bandwidth takes up approximately four megabytes.

Automating advertisements

Mass storage is dynamically allocated onto the disk drives. Says Martin, "There's no compression done at any time, no unwanted artifacts due to compression and decompression." This not only benefits the quality of audio, but it also allows production personnel to utilize Astre's trim feature.

The trim feature, part of the system's production module, eliminates the need to tight cue a spot. Informs Martin, "When the system is told to record a 60 second spot, it allocates ➤

The engineers who know RF best already know us very well.

MYAT, INC.

If you're looking for superior rigid coaxial transmission line and RF components, your transmitter or tower might be a good place to start. Take a look around — you'll probably find the bright blue Myat logo. TV and radio RF engineers at Harris, Acrodyne, QEI, Micro Communications, and Broadcast Electronics all routinely specify our products. And so do the antenna experts at Jampro and the engineers for the Navy's top airborne radar system.

All of these manufacturers demand long life and superior efficiency. They expect the highest quality materials, the toughest construction techniques, plus the most effective expansion compensation designs. And, like you, they have budgets and schedules to meet. All of them demand Myat, because they know Myat delivers.

Next time you need rigid transmission line or RF components, call your favorite RF equipment distributor or phone us direct at (201) 767-5380. For quality, durability, value and service, **Myat is the name to know.**

MYAT, INC. • 380 CHESTNUT ST. • P.O. BOX 425 • NORWOOD, NJ 07648
TELEPHONE: (201) 767-5380 • FAX: (201) 767-4147

Circle 15 On Reader Service Card

World Radio History

Useful Engineering Formulas

RESISTORS IN PARALLEL

EQUAL RESISTORS

$$R_{TOTAL} = \frac{R}{n}$$ Where n is the total number of resistors

UNEQUAL RESISTORS

$$R_{TOTAL} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots}$$

$$R_{TOTAL} = \frac{R_1 R_2}{R_1 + R_2} \qquad R_1 = \frac{R_T R_2}{R_2 - R_T}$$

If the current through a resistor doubles, the power dissipated quadruples

BINARY TO BASE 10 CONVERSION

$$\begin{aligned} 1\ (2^3) &= 8 \\ 0\ (2^2) &= 0 \\ 1\ (2^1) &= 2 \\ 1\ (2^0) &= +\ 1 \\ &\quad 11 \end{aligned}$$

Courtesy of Delta Electronics

DIRECT POWER FORMULA

$$P = I^2R$$

Where I is the common point or base current in amperes, and R is the common point or base resistance in ohms

INDIRECT POWER FORMULA

$$P = IE(effy)$$

Where I is the final P.A. current in amperes, E is the final P.A. voltage in volts, and effy is the transmitter efficiency expressed in decimal form (79% = 0.79)

AUTOMATIC

- SWITCH TO SECONDARY OR TERTIARY STEREO INPUTS ON PRIMARY *LOSS OF CHANNEL*
- SWITCH TO SECONDARY OR TERTIARY STEREO INPUTS ON PRIMARY *LOSS OF AUDIO*
- LOSS OF CHANNEL CORRECTION
- AUDIO POLARITY CORRECTION
- User programmed sequence and time delays
- On-line audio monitoring and stereo audio switching
- Microprocessor based
- Audio error alarms and level matching

AND MORE... CALL OR WRITE FOR COMPLETE DETAILS

TITUS TECHNOLOGICAL LABORATORIES

77 Kreiger Lane, Glastonbury, CT 06033
(203) 633-5472

Circle 12 On Reader Service Card

space for 66 seconds." A digital filter then scans the spot, detecting the first and last instant of audible audio and then adjusts the commercial length to the nearest hundredth of a second.

But where the system is most appreciated by the stations is in its ability to integrate all phases of both radio operations under one computer engine. "It follows the commercial from order entry to billing," says LaVallee, adding that Astre matches the paper and audio trail from beginning to end.

As for the ending to this parable, there isn't one. But then again, perhaps what the large brains of this new age technology have in mind is to change the way we think about small market radio.

Dee McVicker is a free-lance writer and regular contributor to **RW.** *To inquire about her writing service, call 602-899-8916.*

World Radio History

How to Ready Your Stations for NRSC-2

by Harold Hallikainen

San Luis Obispo CA In April 1989, the Federal Communications Commission adopted NRSC-2, the standard recommended by the National Radio Systems Committee for regulating RF emissions. Let's take a close look at NRSC-2 and what *you* need to do.

Many people have thought, mistakenly, that the annual "proof" (equipment performance measurements) requirement was deleted in the FCC's deregulation attempts. While the audio measurements (and the audio specifications) were deleted, the RF measurement requirements were actually made more difficult (although the RF specifications did not change, until NRSC-2 was adopted).

Looking back in my 1984 copy of the Rules, section 73.1590 required audio and RF measurements to be made at least once each calendar year (with no more than 14 months between measurements). Rule 73.1590(1)(b)(v) required "measurements or evidence showing that spurious radiations, including radio frequency harmonics, are suppressed or are not present to a degree capable of causing objectionable interference."

The section went on to say that field strength readings are preferred, but observations made with a communications receiver were acceptable.

New requirements

These required measurements typically would demonstrate that harmonics and intermod were sufficiently suppressed, but did not demonstrate that the occupied bandwidth (specified in 73.44) requirements were being met. You were required to meet the specifications of 73.44 (which start with frequencies more than 15 kHz from carrier must be down at least 25 dB), but were not required to demonstrate compliance.

Several rule changes in 1984, 1985 and 1986 deleted the audio measurement requirement and "simplified" the RF measurement requirement to "merely" demonstrating compliance with 73.44 (we're really just dealing with AM stations here). As mentioned above, 73.44 includes requirements on harmonics, spurs, and "occupied bandwidth."

Everything but the occupied bandwidth specification could be measured with a field strength meter. The occupied bandwidth measurement could, I imagine, be measured with a field strength meter that has a very narrow bandwidth, high tuning resolution and high tuning accuracy. Such a meter would be similar to a "tuned voltmeter." A spectrum analyzer is merely a tuned voltmeter that automatically sweeps.

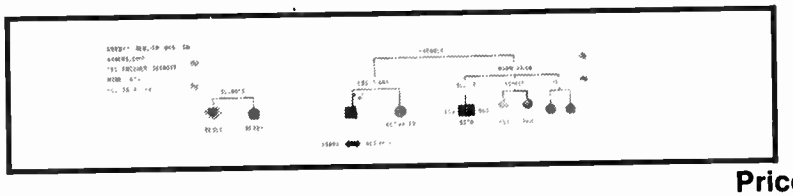
I don't know how stations have been meeting the requirements of 73.1590 (demonstrating compliance with 73.44), other than perhaps using a spectrum analyzer. My review of FCC violation notices issued in 1988 shows several stations cited for not having an equipment performance measurement report on file (they all thought the "proof" requirement had been deleted!), but I found no men tion of incomplete reports, such as demonstrating compliance on harmonics, but not occupied bandwidth. The inspectors may not have been looking for it, but it is required!

NRSC reduces interference

On 20 July 1988, the FCC adopted a Notice of Proposed Rulemaking (MM Docket 88-376, call me for a copy) proposing to reduce the allowed 25 dB frequency from 15 kHz to 10 kHz, substantially reducing interference to second adjacent channel stations. Other than reducing the frequencies at which various reductions were required, the NPRM proposed no other changes in the rules. Although NAB had suggested the Commission adopt the NRSC-1 audio standard (which specifies a standard preemphasis and a "brick wall" audio filter at 10 kHz), the Commission proposed to adopt the NRSC-2 "RF mask."

Use of NRSC-1 would have reduced interference to second adjacent channel stations (due to the brick wall filter). However, the amount of protection of those stations was not precisely defined, because the transmitter will produce energy more than 10 kHz from carrier even if there is no audio above 10 kHz being fed to it.

EBS EQUIPMENT



	Price
Model CEB Encoder-Decoder	$540
Model CE Encoder Only	$375
Model CE With Stereo Option	$405
Model CD Decoder Only **(REQUIRED FOR LPTV)**	$320
Receiver can be supplied to drive Decoder	$100

• Encoder FCC Type Accepted • Decoder FCC Certified • • Exceeds FCC Specifications •

All interconnections to the EBS equipment are made through a barrier terminal block. No special connectors necessary. In stock—available for immediate delivery.

GORMAN REDLICH MFG. CO

257 W. Union St. • Athens OH 45701 • 614-593-3150

Circle 60 On Reader Service Card

World Radio History

These above 10 kHz components can be caused by non-linearities in the modulator and modulated RF stage (and any following amplifiers). One severe non-linearity that is easily generated in the transmitter is due to overmodulation. The Commission wanted to offer an exact degree of protection, based on radiated RF, not audio.

NRSC-1 also provides a standard preemphasis for audio. If all stations used this standard and all receivers used a complementary deemphasis, we'd get a flat frequency response through the system. The lack of a standard results in widely varying audio quality between stations and receivers.

This is the "interoperability" question I often bring up (will people be able to receive what you're transmitting? Are you broadcasting color television using NTSC, but half the receivers use PAL?). The Commission currently leaves this question to the marketplace. The FCC's place is protection of the rights of a spectrum user from encroachment by another user. Other standards agencies (non-government) are to be relied upon for standards that do not directly deal with interference.

Enforcement issues

Besides the "leave it to the marketplace" argument, the Commission has a very good argument in favor of adopting of NRSC-2 over NRSC-1 in that NRSC-1 would be very difficult to enforce. Most AM audio processors now use multiband compression, resulting in a "dynamic equalization." The frequency response depends on the program content.

So ... What to do? The concept of the NRSC-1 standard seems very good. Stations should probably install an NRSC-1 box. They should also install an NRSC-1 deemphasis filter on the modulation monitor audio output. Adjust the audio processing for optimum audio on this NRSC receiver, instead of adjusting for the program director's car radio. As NRSC receivers are introduced, people will hear that it really does sound better.

One final comment on NRSC-1. It would appear that the limit on preemphasis along with the frequency spectrum of programming sets a loose limit on radiation between carrier and 10 kHz from carrier. If the high frequency audio content is low and is boosted a limited amount by preemphasis, the energy falling on the first adjacent channel is loosely limited.

Use of NRSC-1 may result in a reduction of interference to stations on first adjacent channels, depending upon what preemphasis was previously used. It would be interesting to see a spectrum analysis from carrier on out under various programming conditions.

NRSC-2 adopted

On 12 April 1989, the Commission adopted the NRSC-2 RF mask (MM Docket 88-376, call me for a copy). As described above, this rule change reduces the 25 dB down frequency from 15 kHz to 10 kHz from carrier.

On 12 April 1989, the Commission adopted the NRSC-2 RF mask, over NRSC-1. The major factor was cost.

The Report and Order points out that a major argument in favor of adopting NRSC-1 rather than NRSC-2 was cost. It was reasoned that an NRSC-1 box (less than $1000) costs less than a spectrum analyzer or splatter monitor. The Commission points out (in paragraph 32) that 73.1590 *already* requires measurements to demonstrate compliance with 73.44, so no new regulatory requirements are imposed.

The Commission did, however, partially accept this argument and actually reduced the requirements of 73.1590 by waiving the required measurements until 30 June 1994 if the station complies with NRSC-1 when initially going on the air, or by 30 June 1990. If the Commission finds (through spectrum analyzer measurements) that the station is not complying with 73.44, the station will need to make the measurements of 73.1590 to demonstrate compliance with 73.44 (after the problem is fixed).

This waiver of measurements should encourage many stations to install NRSC-1 equipment (because of cost reduction due to reduced measurements). This will help substantially in getting the NRSC-1 preemphasis standard installed in a large number of stations, making NRSC receivers sound good.

Since the measurements required by 73.1590 are only required once a year, many stations will probably not buy the equipment necessary to make the measurements (while still complying with the limits of 73.44). It would appear that consulting engineers or contract engineers could purchase the equipment and offer the service to stations, spreading the cost out among many stations.

You may find that a local television station, cable company, two way radio shop or consumer TVRO supplier has a spectrum analyzer you can use.

Summary

If you install NRSC-1 equipment by 30 June 1990, the measurements required by 73.1590 will generally be waived until 30 June 1994. After that date, you must make measurements once each calendar year (as you've been doing all along, right?) to demonstrate compliance with the new tighter occupied bandwidth specifications (NRSC-2).

These measurements are to be made with a swept frequency RF spectrum analyzer (with various specifications). Specialized receivers may be used (such as the Delta Splatter Monitor), but in case of dispute as to what is actually being radiated, the spectrum analyzer is assumed to be correct.

Harold Hallikainen is president of Hallikainen & Friends, a broadcast equipment design, manufacture, sales and installation firm. He is also a regular **RW** *contributor, as the author of the* Insight on Rules *feature. Contact him at 805-541-0200.*

—*Reprinted from* **Radio World** *July 12, 1989.*

World Radio History

With the whole world turning to Stereo . . .

Why in the world broadcast in AM Mono?

Modernize with C-QUAM® AM Stereo!

Face it. We live in a stereo world. And you join a family of winners when you choose C-QUAM AM Stereo. You'll find . . .

- Nearly 800 C-QUAM AM stations around the globe
- Almost 20 Million C-QUAM decoder IC's shipped to receiver manufacturers
- 4 countries to date with a C-QUAM AM Stereo standard
- IC technology, broadcast equipment, receiver design, international seminars and technical/marketing support . . . from studio to listener, Motorola is totally committed to AM Stereo!

For details on the Motorola C-QUAM AM Stereo system, **call Steve Kravitz collect at 708/576-0554. Fax 708/576-5479.**

Model 1400 Exciter

Model 1410 Monitor

MOTOROLA

C-QUAM® SETTING THE INDUSTRY STANDARD

C-QUAM® IS A REGISTERED TRADEMARK OF MOTOROLA INC.

Circle 48 On Reader Service Card

AM Stereo How-To's: A Systems Checkup

by John Bisset, Delta Electronics

Alexandria VA FCC deregulation has eliminated the rules requiring periodic measurement of "quality" standards (frequency response, noise, distortion, intermod, etc.). The competitive marketplace, however, demands that engineers stay on top of these parameters.

Though the job for AM monaural stations is pretty straightforward, when a second channel is added, the possibility of problems—and the resultant poor sound on the air—increases.

Switch boxes for testing

AM stereo performance tests can be made easier by building two switch boxes. The first switch box is used with the exciter to provide separate left and right outputs. The switches permit left-only and right-only measurements as well as L–R for crosstalk measurements.

Figure 1 shows the schematic for the audio oscillator switchbox. S-1, S-2, and S-3 are double pole, double throw toggle switches. The switches connect to a barrier strip on the side of an aluminum enclosure (a Bud™ or Pomona™ type box will work fine). The internal wiring is not critical—any insulated, stranded wire will do.

Figure 2 shows the schematic for the monitor output switch box. Again, an aluminum enclosure is used, and the inputs and outputs are made through chassis-mounted BNC connectors.

S-1 is a four position rotary switch—again, nothing critical. You will have four cables that will go to the modulation monitor. To reduce cable bulk, use RG-174. This small diameter, flexible coax will make interconnection easier. Marking each BNC male connector with the appropriate "L," "R," "L+R," and "L–R" labels will make interconnection easier. By making this interconnection cable 6_9 long, you can mount your monitor in the rack and place your oscillator and analyzer and oscilloscope in front of the equipment you are testing.

Mono proof

Before checking stereo performance, conduct a full mono proof, using the transmitter's internal oscillator rather than the AM stereo exciter. If some portion of the transmitter fails the mono proof, you can be assured that the problem is not caused by the stereo exciter and is isolated to the transmitter itself.

After the cursory check of mono parameters, the level of transmitter-induced IPM (Incidental Phase Modulation) should be measured. Feed a 1 kHz tone into the transmitter to modulate it 50% L+R (mono). The AM Stereo Modulation Monitor is then selected to read L–R. The IPM level is the total number of dB the meter reads, below the L+R reference level.

At the absolute worst, the IPM reading should be in the upper 20s. You'll want to get this figure down as much as possible, because it has a direct bearing on separation. Adjustment of transmitter tuning and neutralization controls while watching the modulation monitor will improve your reading. Some IPM levels may reach the high 30s depending on the transmitter and its adjustment.

With the transmitter optimized, switch back to the stereo exciter drive (disabling the transmitter's internal crystal oscillator which was used for the preceding tests). Feed the exciter with a 50% L+R (mono) signal and verify that both the exciter and monitor show a 50 percent reading. Now adjust the exciter's front panel "balance" trimpot for a null on the exciter's L–R meter.

Again, check the level of IPM, this time using the exciter as the means of supplying transmitter drive. If the IPM figure increases significantly, the exciter may require adjustment.

Audio phasing

Unless your audio chain/patch bay has been re-wired, channel phasing should not have changed. A simple means of checking audio phasing is to set the switchbox for 1 kHz at 50 percent LEFT ONLY modulation. Select the RIGHT ONLY meter on the ➤

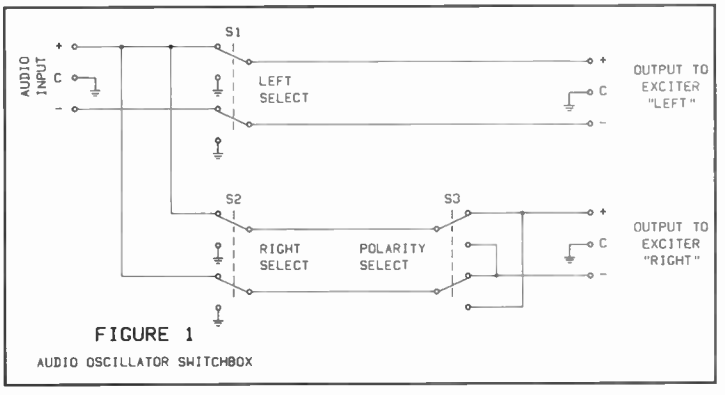


FIGURE 1
AUDIO OSCILLATOR SWITCHBOX

World Radio History

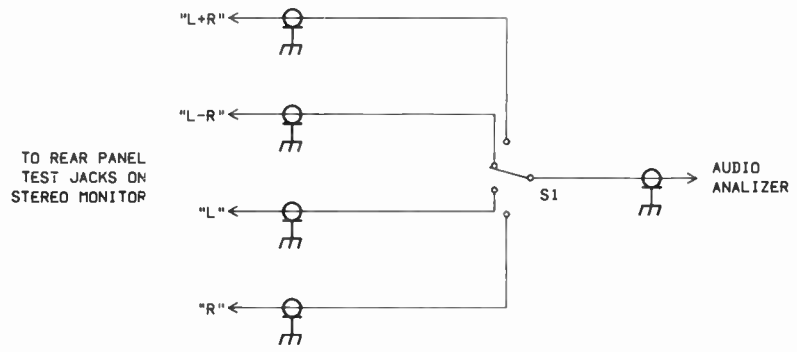


FIGURE 2
MONITOR OUTPUT SELECT SWITCHBOX

stereo modulation monitor to verify that no signal is present.

The value read off the monitor should correspond to the original IPM value. Substantial difference could indicate misadjustment of the equalization and delay settings. These can be reset using the procedure found in your manual (contact Delta for an adjustment bulletin).

As a final check of the exciter, switch the meter/pilot selector switch on the modulation monitor to PILOT. Observe that the pilot level is within the black band. This test is conducted with no modulation. It is normal for the pilot level to fluctuate with modulation. The pilot level can be verified using the L–R meter of the modulation monitor. With no modulation, the L–R meter should read just below –26 dB with proper pilot injection.

Quality proof measurements

Now that the exciter/monitor operation has been verified, "quality" proof measurements may be made. When conducting these tests, the pilot should be switched to "off." As distortion measurements are made, keep in mind that 3% is the maximum acceptable for good stereo. Higher values may point to the modulator tubes.

When measuring separation, remember that these figures will be limited by the IPM level of the transmitter. While driving the left channel (select LEFT ONLY on the switchbox feeding the exciter) with 1 kHz at 75 percent modulation, select the RIGHT ONLY output of the monitor switchbox feeding your analyzer. Record the value in dB on the chart.

Though C-QUAM generating equipment is designed for stable operation, an occasional tune-up is suggested.

Though the modulation monitor can be used, remember that the monitor uses quasi-peak detectors, and the separation numbers are typically worse than those read on external RMS detectors. Under ideal conditions, 40 dB of separation may be measured, though values in the high 20s to lower 30s are more typical. At the 75% modulation level, keep in mind that the separation figures will deteriorate. This is due to the fact that at high levels of single channel modulation, the C-QUAM feedback circuits are not as accurate.

Air Cooled Dummy Loads now in power ratings of 5kW, 10kW, 15kW, 25kW, 35kW, 50kW, and 75kW with low VSWR that is stable under power with a frequency range of 60hz to 240Mhz.

•

QUIET
COMPACT
PORTABLE

ALTRONIC RESEARCH INC.

For (OMEGALINE) RF Coaxial Load Resistors

•

WATER AND AIR COOLED MODELS FROM 5 to 200KW

•

CALL TOLL FREE
1-800-482-LOAD

•

P.O. Box 249
Yellville, AR 72687
(501)449-4093

Circle 39 On Reader Service Card

World Radio History

Measuring crosstalk

Crosstalk is measured by feeding a 1 kHz tone modulated 95 percent into the L+R mode of the switchbox. The L−R signal is selected on the monitor and a reading is obtained. Crosstalk figures are general in the mid to high 20s. L−R crosstalk is measured the same way, feeding a 95 percent 1 kHz L−R tone into the system (using the audio switchbox) and measuring the L+R.

This crosstalk measurement is traditionally better than the L+R value. Crosstalk figures of 30 to 43 dB are possible.

Though C-QUAM generating equipment is designed for stable operation, an occasional tune-up is suggested. Adjustments beyond those discussed in this article are facilitated using your system technical manual or other helpful applications bulletins provided free of charge by Delta. For more information, contact Delta toll-free at 1-800-8-DELTA-8.

John Bisset is sales manager for Delta Electronics, and was former technical consultant to RW. *He can be reached at 703-354-3350.*

TRI-MAZE Multiband Audio Processor

– NRSC OR FM STEREO –

Our competitor liked it so much, they made one just like it.

THAT LOOKS

hnat hindes inc

42 Elaine Street • R.R. 1 • Thompson, Connecticut 06277

(203) 935-9066 • (203) 935-9242

IMITATED, BUT NOT DUPLICATED

Circle 34 On Reader Service Card

Ā-MAZE high definition, Concert Hall Sound

The A-MAZE is the industry's most "Psycoacoustically Invisible" processor. Your audio image is bigger, cleaner, wider, louder . . . Guaranteed.

hnat hindes inc

42 Elaine Street • R.R. 1 • Thompson, Connecticut 06277

(203) 935-9066 • (203) 935-9242

Circle 59 On Reader Service Card

MIC-MAZE Microphone Processor

Applications: Microphones...plus

The Mic-Maze is also a multifunction device that is ideal for FM processing, SCA, STL, TV, satellite up-link, and production.

So *transparent*, that it will process FM composite baseband without artifacts.

hnat hindes inc

42 Elaine Street • R.R. 1 • Thompson, Connecticut 06277

(203) 935-9066 • (203) 935-9242

Circle 2 On Reader Service Card

World Radio History

AM STEREO INSTALLATION PROOF

AUDIO FREQUENCY

DISTORTION/SEPARATION		50	100	200	400	1K	2K	3K	5K	7.5K	10K	12.5K	15K
L+R (MONO)	95%												
L-R (STEREO)	95%												
L+R	75%												
L	75%												
R	75%												
L+R	50%												
L	50%												
R	50%												
L+R	25%												
L	25%												
R	25%												
FREQUENCY RESPONSE													
L+R	95%					0							
L-R	95%					0							
L+R	75%					0							
L	75%					0							
R	75%					0							
L+R	50%					0							
L	50%					0							
R	50%					0							
L+R	25%					0							
L	25%					0							
R	25%					0							
CROSSTALK L+R →	L-R												
CROSSTALK L-R →	L+R												

IPM	
CARRIER SHIFT	
PILOT FREQ. INS.	
OPERATING FREQUENCY	

OPTIONAL

DISTORTION

DISTORTION
SEPARATION

World Radio History

Changes on Radio's Horizon

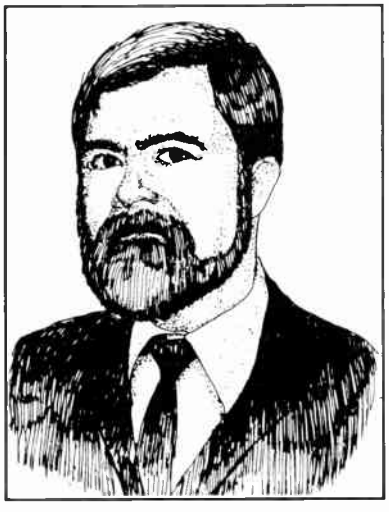
Washington DC "The telcos are coming! The telcos are coming!" The alarm is being sounded with increasing frequency by cable operators and TV broadcasters. The concern is that technological developments and regulatory changes will combine to significantly alter the video distribution marketplace, thereby setting the stage for some of today's most successful enterprises to go the way of the do-do bird.

Clearly, some stations are losing money . . .

Broadcast radio is also susceptible to these types of changes. In fact, the above scenario is already a painfully familiar one to many AM radio broadcasters. It's not too early for even the most prosperous radio broadcasters to seriously assess their long run viability, because change, especially technological change, will surely come.

Some will no doubt view any change as "bad" for broadcasting, and will fight tooth and nail to maintain the status quo. But for those savvy enough to exploit them, changes could

Alex Felker is the former chief of the Mass Media Bureau for the Federal Communications Commission.



by Alex D. Felker

create rewarding opportunities. While it is virtually impossible to predict accurately how the forces of change will affect radio broadcasting and broadcasters, one can identify some of the sources of change and speculate as to how these forces may shape radio's future.

The bad news

Radio station revenues are being increasingly constrained by two factors: The advertising "pie" is not growing as rapidly as it has historically, and the number of media outlets (broadcast and non-broadcast) receiving a slice of the revenue pie is growing rapidly.

Both of these trends are reflected in a recent study conducted jointly be the National Association of Broadcasters and the Broadcast Financial Management Association. NAB/BFM reported that on average, radio station revenues generally declined in 1988 relative to 1987. If things are this tight in a healthy expanding economy, stations' revenues could contract severely when we enter an economic downturn.

In addition to feeling the squeeze in advertising revenues, broadcasters are also experiencing the related effects of increasing competition for audience share. The increase in the number of radio stations over the last decade has been well documented, but over the next several years the most significant new competitors may well be non-broadcast media.

Because increasing channel capacity is spawning greater amounts of specialized programming, in the future cable television could siphon away a large segment of radio's audience in the home. Consider the success radio talk show host Larry King has already enjoyed on CNN, for example. And cable presentation of that staple of many local radio stations, local and regional sports programming, may become more common in the future.

Even listeners in automobiles are turning off their radios to listen to higher quality non-radio alternatives—cassettes and CDs. In the future, satellite distributed programming may make further inroads into radio's traditional domain. Moreover, some of the informational services (e.g., traffic reports) now provided almost exclusively over broadcast stations might be offered, for pay, via cellular telephone or one-way paging services.

The good news

Within these unsettling trends and dire technological predictions, however, I think there is reason to be optimistic, maybe even enthusiastic, about broadcast radio's future as a business enterprise and a medium to inform and entertain the public.

. . . but a substantial number are doing exceedingly well.

Consider first the trends surrounding station revenues and sales. The NAB/BFA study reveals that there is a flattening in average revenues. Clearly, some stations are losing money, and a few are in dire straits. But, a substantial number of stations are doing exceedingly well. Moreover, station sales are brisk and many properties are trading at what I find to be astronomically high prices.

I subscribe to that old saw about not being able to fool all of the people all of the time. Hence, to me the fact that, even in a highly competitive and increasingly crowded market, advertisers and investors continue to flock to broadcast cannot be explained merely by the greater fool theory. I think the explanation is both simpler and more fundamental. Listeners place a very high value on high quality, live entertainment. The fact that such programming is simply not available from recorded media bodes well for radio's future.

(cont. on page 62) ➤

World Radio History

ROCK'N'ROLL GRAFFITI

1,200 HITS OF THE 50's AND 60's ON COMPACT DISC!
ALL ORIGINAL HIT VERSIONS BY THE ORIGINAL ARTIST!

HALLAND

COMPACT disc DIGITAL AUDIO

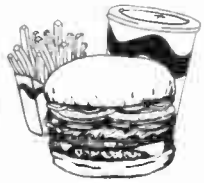
Broadcast Services Inc. introduces ROCK 'N' ROLL GRAFFITI, a compact disc library of the *most programmable* oldies of the 50's and 60's---at the unprecedented price of $1,500.00

After two years of research and thousands of hours in locating the very *best* sounding original hit versions of all tunes, we have compiled this broadcast library onto 50 CDs. The tunes are arranged in alphabetical order by artist, so that finding any tune is quick and easy. It's perfect for request shows and dedications!

Virtually all tunes have been sourced from CDs, studio tapes or R-DAT for excellent audio quality without pops, tics, or noise. All material has been checked against original ''Hit 45's'' so you're assured of getting the songs *your listeners remember* and want to hear. *No* ''sound-alikes'' or strange remixes!

ROCK'N' ROLL GRAFFITI is over 1200 hit tunes, with the convenience and sound quality of CD's, for only $1,500.00 complete. That's just $1.25 per song!

ROCK 'N' ROLL GRAFFITI IS NOW BEING SHIPPED. To order, or to receive a complementary Song Index, please call:



HALLAND
Broadcast Services, Inc.
3407 W. Olive, ste. 108 • Burbank, California 91505

(818) 567-6335

Circle 24 On Reader Service Card

Broadcast In the Digital Era

by Stanley Salek

Washington DC From the first use of compact disc (CD) players in the radio broadcast environment (about 1982), quality improvements traced to the use of digital audio in broadcasting have become increasingly obvious.

Formats of the digital age

Several companies now market CD players specifically designed for continuous operation. Some take a form similar to cartridge tape players, providing a familiar user interface. Most program suppliers now provide their entire libraries in CD format, recorded directly from original master tapes. Multiplay CD machines are available for stations that use automated/DJ assist formats.

Digital Audio Tape (DAT) is also finding greater acceptance in radio broadcasting. Because it is a recordable format, stations use DAT machines for economical direct-to-digital mastering. Realizing this, a few manufacturers have designed editing consoles that make these machines easier to use in the production environment.

Other digital audio formats also have been seen at radio stations. These include computer hard disk audio storage systems and reel-to-reel digital tape decks. A combination of the two methods also exists that uses tape for long term storage, downloading to computer disk for on-air play.

New integrated digital production and editing systems are introduced each year. Although cost prohibitive for most stations, continuing reductions in manufacturing and component costs seem to indicate that these systems will grow in popularity. ➤

Stan Salek is a staff engineer with the Science & Technology Department of the NAB. He can be reached at 202-429-5346.

Circle 51 On Reader Service Card

CHANGES IN RADIO'S HORIZON

(cont. from page 60)

Another important consideration in radio's future is the FCC's changing view of the competitive environment and how the medium should be regulated.

In refining some of its ownership rules several months ago, the Commission revealed a new public interest calculus in which broadcast ownership diversity receives less prominence, and the economic benefits of station combinations greater prominence, than was the case previously. As the competitive landscape continues to be reshaped by the emergence of non-broadcast media, this new analytical framework could produce increases in the concentration of local broadcast ownership.

The composition of the Commission has been altered substantially since that decision was reached. Still, Chairman Sikes and his colleagues have done nothing to suggest that they would be unwilling to consider some increases in the concentration of broadcast ownership.

While such a move would obviously enhance licensee profitability, it could also discourage "lowest common denominator" programming and reduce the sameness which characterizes much of radio programming today. Both of these latter effects would increase radio's attractiveness to listeners and do much to improve radio's long term viability.

Finally, the biggest threat to broadcast radio—technological advancement—could also prove to be its greatest salvation. Digital signaling technology, which is now commonplace in other areas of communications, could vastly improve the quality of broadcast radio reception, especially in the concrete canyons of our major urban centers.

What are the implications of all this for the future of radio broadcasting? Are there going to be changes? Sure! Lots of them. Technology will continue to provide more opportunities for delivering all types of information to consumers. This fact will produce more competitive pressure on the traditional model of radio broadcasting.

As a medium, broadcast radio will not only continue to survive, it will thrive because consumers want it. Its future form will undoubtedly be different than today, with its characteristics influenced greatly both by the nature of future regulatory adjustments and by the industry's ability to adopt and adapt to new technological developments.

World Radio History

Processing and transmission

Digital audio elements are used in audio processing equipment and consoles, including level control and filtering processes. Although most equipment of this type still uses a combination of analog and digital technologies, considerable improvements are being achieved.

Digital transmission via telephone and microwave systems is now more practical. A few manufacturers are marketing or working on designs that will allow full stereo digital audio transmission on T-1 type telephone circuits and standard 950 MHz STL systems.

The technology is working its way into new AM and FM transmitters as well. AM transmitters using full digital modulation schemes are now being sold, while a means for full digital FM modulation was recently introduced to broadcast manufacturers.

NAB has been working with the Audio Engineering Society to finalize and make "broadcaster friendly" a series of interfaces that allow digital audio equipment from several different manufacturers to be interconnected easily. This will provide broadcasters with the means to eventually eliminate all analog audio links.

Interest in Eureka

Also, digital audio broadcast (DAB) systems are now being studied and developed. A considerable amount of interest was generated by the European Broadcasting Union (EBU) Eureka 147 DAB system, shown at the ITU-COM convention in Geneva, Switzerland early in October, 1989.

The system, designed for terrestrial use (for both fixed and mobile reception), is said to be capable of transmitting 16 simultaneous stereo audio channels in about 4 MHz to 6 MHz total bandwidth. A sophisticated transmission algorithm is being further developed to control multipath distortion and other negative transmission effects. Preliminary demonstrations have been somewhat impressive, with the received signal exhibiting a noticeable "durability" over varying terrain conditions. Some US manufacturers have shown interest in and also may be working on similar systems.

In the US and other countries, space allocation for any DAB system would likely come from the television spectrum or surrounding frequencies. This use would have to be coordinated with advanced television plans to accommodate such a system.

As with all emerging technologies, more sophisticated and less costly digital system "building blocks" are introduced to equipment designers and manufacturers, almost on a daily basis. Sophisticated, yet easily operated and maintained station digital audio and transmission link systems are now in practical use, or at least conceivable for radio broadcasting, while full-digital broadcast systems for the future are being developed and tested.

You can measure...

with the best monitor and the most accurate test set.

The FMM-2/FMS-2 series monitors provide an even greater degree of precision measurement than ever before... **You can measure** S/N below **90 dB, You can measure** crosstalk below **85 dB, You can measure** separations of better than **70 dB, You can measure** frequency response to better than **0.25 dB, You can measure** distortions to lower than **0.01%**, and much more... Our uncluttered panels and autoranging voltmeters make these measurements a dream.

BELAR CALL ARNO MEYER (215) 687-5550
ELECTRONICS LABORATORY, INC.
LANCASTER AVENUE AT DORSET, DEVON, PENNSYLVANIA 19333
Call or write for more information on Belar AM, FM, Stereo, SCA and TV monitors.

Circle 20 On Reader Service Card

World Radio History

National Association of Broadcasters

1771 N Street, NW, Washington, DC 20036

Unless otherwise indicated all numbers should be preceeded by 202-429

(202) 429-5300

Advanced Television Systems Committee (ATSC) 5345
Broadcast Capital Fund (BROADCAP) 5393
Broadcast Ind. Council. to Improve American Productivity (BICIAP) 5330
Broadcast Education Association (BEA) 5355
Broadcast Pioneers Library Catherine Heinz 223-0088

NAB Department Listings

Accounting 5432
Administration 5440
Billing ..... (800) 626-5542
Building Maintenance 5331
Data Processing 5349
Conventions and Meetings 5356
Employment Clearinghouse 5497
Exhibit Office 5335
Government Relations 5301
GR Hot Line ..... (800) 424-8806
Insurance 5492
International Consultant 5451
Legal 5430
Library & Information Ctr. 5490
Lobby 5333
Minority & Special Services 5498
Personnel 5438
Public Affairs & Comm. 5350
Publications 5376
Toll-free (Pubs & Ins) . (800) 368-5644
President 5444
Production 5394
Radio 5420
Radio Membership 5400
Research & Planning 5380
Science & Technology 5346
Station Services 5373
Television 5362
Television Membership 5363
Tarpac 5318

Federal Communications Commission

Broadcast Related Phone Listing

**Unless noted, all numbers are in Area Code 202, Washington, D.C. Area Code 717 refers to the Gettysburg, PA office, Area Code 301 refers to the laboratory in Laurel, MD.*

Subject	Telephone Number
Access Charge (CCB)	
• Rules and Policies	632-9342
• Tariff	632-6387
Accounting systems (CC)	634-1661
Advisory Committees	
• Radio Broadcasting	632-6485
• Emergency Broadcast System	632-3906
• National Public Safety	632-7060
Alien Restricted Permits (FOB)	632-7240
Allocation	
• Broadcast	634-6530
• Call Signs	634-1923
• Call Sign Block	653-8126
• Call Sign Policy	653-8126
Charts and Tables (OET)	653-8108
• Government (OET)	653-8141
• Non-Government (OET)	653-8108
• International (OET)	632-8126
Amateur Licenses (PRB)	(717) 337-1212
Annual Report Form (CC)	632-7084
Annual Employment Report (CCB)	632-0745
Antennas & Towers (FOB)	632-7521
Application Status	
• Amateur (PRB)	(717) 337-1212
• Aviation (PRB)	
• Aircraft	(717) 337-1212
• Aviation Ground	(717) 337-1511
• Business (PRB)	(717) 337-1511
• Cellular	632-6400
• Commercial Operator (FOB)	632-7240
• Common Carrier	634-1800
• Domestic Satellite	634-1624
• Mobile Services (CCB)	254-6810
• Microwave (CCB)	634-1706
• Multichannel Service (CCB)	634-1706
• International (CCB)	632-7265
• Experiment (OET)	653-8146
• General Mobile (PRB)	(717) 337-1511
• Industrial (PRB)	(717) 337-1511
• Land Transportation (PRB)	(717) 337-1511
• Equipment Authorization RF Devices only:	
• 24 Hour computer access	(301) 725-1072
• Non-computer access	(301) 725-1585
• Offshore Radio Service (CCB)	653-5560
• Rural Radio Service (CCB)	653-5560
• Microwave (Industrial) (PRB)	(717) 337-1421
• Public Safety (PRB)	(717) 337-1511
• Radio, TV, & Aux. Serv. (MM)	634-6307
Assignment of Microwave Common Carrier Licenses (CCB)	634-1706
Auctions (OPP)	653-5940
Automobile Emergency (PRB)	(717) 337-1212
Bills (Legislative) (OLA)	632-6405
Broadcast, Inspection of Stations (FOB)	632-7014
Broadcast Services—(MMB)	
• *AM Service*	
• Engineering Rules:	
• Existing Stations	632-7010
• Minor Changes Applications	254-9570
• New stations and major changes Applications	254-9570
• STLs; RPUs, Intercity Relays	634-6307
• Non-Engineering Rules:	
• Advertising Questions/Comments	632-7551
• Application Forms	632-7272
• Assignment/Transfer Applications	254-9470
• Construction Permit Applications	254-9570
• Emergency Broadcast System	632-3906
• Political Broadcasting	632-7586
• Programming Questions	632-7048
• Renewal Applications	254-9572
• Equal Employment Opportunity	632-7069
• Reports	
• Employment (Form 395B)	632-7069
• Ownership (Form 323)	632-7258
• *FM Services*	
• Engineering Rules	
• Existing Stations	632-6908
• Minor Changes Applications	632-6908
• New Stations/Major Changes	632-6908
• SCA	632-7166
• STLs; RPUs; Intercity Relays	634-6307
• Translators/Boosters	634-6307
• Advertising Questions	632-7551
• Application Forms	632-7272
• Construction Permits	632-6908
• Educational FM	632-6908
• Emergency Broadcast System	632-3906
• Political Broadcasting	632-7586
• Programming Questions	632-7551/632-7048
• Renewal Applications	632-3954
• Equal Employment Opportunity	632-7069
• Employment (Form 395B)	632-7069
• Ownership (Form 323)	632-7258
• SCA's Stereo-Multiplex	632-7166
Bulletins, Request for (OPA)	632-7000
Business Radio (PRB)	(717) 337-1212
Registration (MMB)	632-7076
• Complaints (Subscribers)	632-7048
• Franchising	632-7076
• General Radio and TV	632-7048
• Microwave	
• Legal	632-7480
• Engineering	254-3420
• Pole Attachments (CCB)	632-4890
• Policy	
• Access	632-7480
• Public Reference Room	632-7076
• Special Relief	632-7480
• Technical Standards & Rules	254-3420
Cablegrams (CCB)	632-7265
Call Letters (Signs—)	
• Private Radio Services	(717) 337-1212
• Broadcast	634-1923
Campus Radio Stations (OET)	653-8288
Carrier Equipment (CCB)	634-1800
Cases in Court (OGC)	632-7112
Cellular Mobile Radio	632-6400
Cellular (Recorded Message)	653-5858
Certification of RF Gear (OET)	653-6288
Civil Air Patrol (PRB)	
• Applications/Licenses	(717) 337-1212
• Rules	632-7175
Coast Stations (PRB)	
• Applications/Licenses	(717) 337-1212
• Rules/Hearings	632-7175
Commercial Operators—(FOB)	
• Examinations (D.C. Area)	(301) 962-2729
• Examinations (Other Areas)	632-7240
• All other matters	632-7240
Commission Proceedings	632-7000
Common Carrier Radio (CCB)	
• International & Satellite	632-7265
• Mobile Services	632-6400
• Microwave Services	634-1706
Complaints—	
• Broadcast (TV & Radio)	632-7048
• Advertising Questions	632-7551
• Political Broadcasting	632-7586
• Programming	Questions/Religious
• Common Carrier—	
• Informal Complaints & Inquiries	632-7553
• Telephone	632-7553
• Telegraph/Telegram	632-7553
• Pole Attachments (CCB)	632-4887
• Rates	632-7553
• Interference to Radio & TV	
• Washington, DC Area	(301) 962-2727
• All Other Areas—Refer to local field installations	
Compliance—	
• Registration (MMB)	254-3407
• Common Carrier Accounting (CCB)	634-1861
• Experimental (OET)	653-8141
• Incidental Radiation (OET)	653-8288
• Land Mobile (PRB)	632-7125
• Aviation & Marine (PRB)	632-7197
• Personal & Amateur (PRB)	632-7197
Conferences	
International—CCIR, WARC (OET)	653-8126
CCITT (CCB)	632-3214
Conflict of Interest (OGC)	632-6990
Congressional Liaison (OLA)	632-6366
Consumer Assistance/Small Business	632-7000
Control Devices (non-licensed) (OET)	653-8288
Copy Contractor	857-3800
Cordless Telephone (Pt. 15) (OET)	653-8288
Court Cases (OGC)	632-7112
Customer Owned Equipment—	
• Attach to Telephone (CCB)	634-1833
Customer Toll Dialing (CCB)	632-7553
Depreciation Rules (CCB)	632-7500
Development Stations	
• Aviation or Marine (PRB)	(717) 337-1431
• Common Carrier (CCB)	634-1706
• Experimental (OET)	653-8288
• Dial-a-Porn Complaints	632-7553
Diathermy Approval (OET)	(301) 725-1585
Digital Terminations Systems (DTS)	634-1706
Digital Electronic Message Svc	634-1706
Direct Broadcasting Satellites	632-9356
Direct Distance Dialing (CCB)	632-5550
Domestic Public (CCB)	
• Auxiliary Test and Repeater Stations	653-5560
• Cellular Radio	632-6400
• Land Mobile Radio Service	653-5560
• Microwave	634-1706
• Rural Radio	653-5560
Duplication Contractor (ITS)—	
• Washington, DC	9-857-3800

World Radio History

Subject	Telephone
• Gettysburg, PA	(717) 337-1433
Eavesdropping (Electronic) (OGC)	632-6990
Electronic Switching (Telephone) (CCB)	634-1800
Emergency Broadcasting System (EBS)	632-3906
Employment Verification	**632-6234**
Enforcement—Common Carrier Bureau	632-4887
Enforcement—Private Radio Bureau Forfeitures Show Cause Orders Revocations. Suspensions	632-7197
• Land Mobile (PRB)	632-7125
• Aviation & Marine	632-7197
• Personal & Amateur	632-7197
Requests for Enforcements	
• Washington, DC Area (FOB)	(301) 962-2727
• All other areas—Refer to local field office (FOB)	
Engineering Surveys (OET)	632-7080
Environmental Law (NEPA)(CGC)	632-6990
Equipment Measurement (OET)	(301) 725-1585
Examinations—(FOB)	
• Washington, DC Area	(301) 926-2727
• Outside Washington, DC	632-7240
Ex Parte Rules (OGC)	632-6990
Facsimile—Wire (CCB)	634-1800
Fairness Doctrine	632-7586
FCC Rules (Interpretations) (OGC)	632-6990
Fee Information	632-FEES
Field Disturbance (Pt.15)	653-6265
Field Offices	
• Common Carrier (CCB)	634-1861
• Field Public Service Staff	634-1940
Fire (PRB)	(717) 337-1212
Foreign Attachments—	
• Telephone (CCB)	634-1833
• Interconnection (CCB)	634-1800
Forfeitures/Fines	
• Mobile Services (Includes CB)	632-7197
• Collection of (OGC)	632-6444
Forms Distribution—	
By form number only	632-7272
General form request	632-7000
Freedom of Information (OGC)	632-6990
Frequencies Allocations—	
• Government (OET)	653-8147
• Non-Government (OET)	653-8108
• Allocation Treaties (OET)	653-8144
• International (OET)	653-8126
• Lists	
• Government (OET)	653-8147
• Non-Government (OET)	653-8108
• Notification and Registration (OET)	653-8126
• Usage Data & Utilization (OET)	653-8108
General Counsel (OGC)	632-7020
General Mobile Radio (PRB)	(717) 337-1212
Harrassing Telephone Calls (CCB)	632-7553
Hearing Calendar (OLJ)	632-7680
Incidental Radiation (Rules) (OET)	653-6288
Information—General (OPA)	**632-7000**
Infraction Reports—International (OET)	653-6138
Injunctions (OGC)	632-7112
Inspections (FOB)	632-7014
Interception of Radio Comms (OGC)	632-6990
Interference Complaints	
• Washington, DC Area (FOB)	(301) 962-2727
• All Other Areas (Refer to Local Field Office)	
• Requests for Monitoring (FOB)	632-6975
International Conferences (Future)	653-6126
Conference (past)	632-7025
WARC (OET)	632-7025
• Conferences and Meetings (OET)	632-7025
• Frequency Allocations (OET)	632-7025
• Frequency Allocation Tables (OET)	632-7025
• Frequency Coordination (OET)	653-6126
• Frequency Lists (OET)	653-8126
• Interference (OET)	653-8126
Interlocking Directors (CCB)	632-4887
• Permits to Operate in Canada	653-8126
• Radio Publications (OET)	653-6126
• Satellites Systems Coordination	653-6153
• Telecommunications Union (OET)	653-8126
• Telegraph & Telephone Rates (CCB)	632-5550
• Treaties & Agreements (OET)	653-6144
Investigations—	
• Unlicensed Operations	
• Washington, DC Area (FOB)	(301) 962-2727
• All other areas refer to local field office (FOB)	
• Interference	

Subject	Telephone
• Washington, DC Area (FOB)	(301) 962-2727
• All other areas refer to local field office (FOB)	
Ionosphere (OET)	653-8166
IRAC (Interdepartment RAC) (OET)	632-7025
Land Mobile—	
• Common Carrier (CCB)	653-5560
• Other than CC (PRB)	(717) 337-1212
• Public Safety	(717) 337-1212
• Special Emergency	(717) 337-1212
• Business	(717) 337-1212
• Other Industrial	(717) 337-1212
• Land Transportation	(717) 337-1212
Land Transportation (PRB)	(717) 337-1212
Law Suits Litigation (OGC)	632-7112
Law, General (OGC)	632-6990
Leased Facilities (CCB)	632-7553
Library (FCC) (OMD)	**632-7100**
License	
• Amateur (PRB)	(717) 337-1212
• Business (PRB)	(717) 337-1212
• Commercial Operator (FOB)	632-7240
• Domestic Satellite	634-1624
• Mobile Services (CCB)	632-6400
• Cellular	632-6400
• Microwave (CCB)	634-1706
• Wire or Cables (Auth. or Cert.) (CCB)	634-1800
Internat'l & Satellite (CCB)	632-7265
• Experimental (OET)	653-8146
• General Mobile (PRB)	(717) 337-1212
• Industrial (PRB)	(717) 337-1212
• Land Transportation (PRB)	(717) 337-1212
• Marine (PRB)	(717) 337-1212
• Microwave (Industrial) (PRB)	(717) 337-1421
• Operators Licenses (FOB)	632-7240
• Public Safety (PRB)	(717) 337-1212
• Radio (See Broadcast Services)	
Lighting devices (RF) (Pt. 18) (OET)	653-6288
Local Government Radio (PRB)	(717) 337-1212
Manufacturing (PRB)	(717) 337-1212
Marine Services (PRB)	
• Applications/Licenses	(717) 337-1212
• Rules/Hearings	632-7175
MD's Licensing	634-1706
Measurement for	
• Type Acceptance	(301) 725-1585
• Type Approval	(301) 725-1585
• Certification	(301) 725-1585
• Notification	(301) 725-1585
• Verification	(301) 725-1585
• Registration (Part 68)	634-1833
Mergers and Acquisitions (CCB)	632-4887
Metered Service (CCB)	632-7553
Microwave—	
• Auxiliary—Common Carrier (CCB)	634-1706
• Auxiliary—Mass Media (MM)	634-6307
• Closed Loop (CCB)	634-1706
• Data Base (OET)	653-8163
• Digital Electronic Message (CCB)	634-1706
• Multipoint Distribution (MDS) (CCB)	634-1706
• Ovens (OET) (Pt. 18)	653-6288
• Radio Relay (CCB)	634-1706
• General/Operational	632-6497
Military Stations (OET)	653-6141
Mobile Telephone Services (CCB)	653-5560
Mobilization Planning (OET)	632-7025
Monitoring (FOB)	632-6975
• Monitoring Stations (FOB)	632-7593
Monitoring Telephone Svc. (CCB)	632-5550
Motor Carrier (PRB)	(717) 337-1212
Multipoint Distribution	634-1706
National Environmental Policy (OGC)	632-6990
Navigation (Air or Water) (PRB)	632-7175
News Gathering/Publishing (PRB)	(717) 337-1212
Noise—Radio (OET)	632-7025
Obstruction Markings—Antenna (FOB)	632-7521
Offshore Radio Service (CCB)	653-5560
Off-the-Air Pickup (CCB)	634-1706
One-Way Paging and Signaling (CCB)	653-5560
Operating Revenues—	
• Int'l., Telephone & Telegraph (CCB)	632-7084
Operator Licenses (FOB)—	
• Commercial	
• Administration & Suspension of	632-7240
• Examinations (1st, 2nd & 3rd Class)	
• Washington, DC Area	(301) 962-2728

Subject	Telephone
• All Other Areas	632-7240
• License Records (Commercial)	632-7240
• Restricted Radiotelephone Permit (FOB)	
• U.S. Citizens—DC	(301) 962-2729
• U.S. Citizens—All Other Areas	632-7240
• Aliens—All Areas	632-7240
Oral Arguments (OMD)	632-7535
Original Plant Cost (Telephone) (CCB)	632-3772
Paging—Common Carrier (CCB)	653-5560
Paging—One-way (PRB)	(717) 337-1212
Personnel—Employment (OMD)	632-7106
Physicians Radio—Private (PRB)	(717) 337-1212
Point-to-Point Microwave—	
• Common Carrier (CCB)	634-1706
• Private (PRB)	(717) 337-1212
Pole Attachments (CCB)	632-4890
Political Broadcasting	632-7586
Power (Electric, Gas, Water) (PRB)	(717) 337-1212
Press Relations (OPA)	632-5050
Press (Relay)(PRB)	(717) 337-1212
Privacy Act—Procedures (OGC)	632-6990
Private Carrier Comms (PRB)	(717) 337-1212
Private Operational Fixed Services (PRB)	
• Microwave Applications	
• Technical Questions	(717) 337-1212
• Status of	(717) 337-1212
Private Wire Systems (CCB)	634-1800
Procurement (OMD)	634-1528
Propagation—Radio Waves (OET)	632-7025
Property—Common Carrier (CCB)	634-1861
Public Affairs, Office of	632-5050
Public Information—	
• Consumer Assistance	632-7260/632-7000
• Legislation	632-6405
• Press & News Media	632-5050
Public Reference Rooms—	
• Carrier Reports (CCB)	632-7084
• Carrier Tariffs (CCB)	632-5550
Public Safety (PRB)	(717) 337-1212
Radar—	
• Intrusion Alarms (OET)	653-6288
• Aviation or Marine (PRB)	
• Applications/Licenses	(717) 337-1212
• Rule Interpretations	632-7175
Radiation hazards (OET)	653-8169
Radio Broadcasting (See Broadcasting Services)	
Radio Complaints	632-7048
Radio Control Devices	
• Non-licensed (Pt. 15) (OET)	653-8288
• Non-licensed (Pt. 95) (OET)	653-8288
• (PRB)	632-4964
• Non-licensed (other Pts.) (PRB)	632-4964
• (OET)	653-6288
Radio Frequency Devices (OET)	653-6288
Radiograms (CCB)	632-7265
Radiolocation—Industrial (PRB)	(717) 337-1212
Radio Propagation (OET)	632-7025
Radiotelegraph—	
• Common Carrier (CCB)	632-7265
• Marine (PRB)	
• Operator License, Issuance of (FOB)	632-7240
Radiotelephone—	
• Applications/Licenses	(717) 337-1212
• Rule Interpretations	632-7175
• Common Carrier Services (CCB)	653-5560
• Equipment	(301) 725-1585
• Operator License Issuance of (FOB)	632-7240
• Permits, Restricted (FOB)	632-7240
Railroad (PRB)	(717) 337-1212
Real Property (FOB Field Installations)	632-7593
Recording Phone Conversations (CCB)	632-7553
Records Management (OMD)	634-1535
Reduction of Carrier Service (CCB)	632-7553
Relay—Microwave (CCB)	634-1706
Relay Press (PRB)	(717) 337-1212
Religious Petition (RM 2493)	**632-7000**
Repair and Calibration	(301) 725-1585
Rescue Squads (PRB)	(717) 337-1212
Restricted Radiation Devices (OET)	653-8288
Retirements (Telephone Plants) (CCB)	634-1861
Rules and Regulations—	
• Aviation and Marine	632-7175
• Business	634-2443
• Other, Industrial	634-2443
• Land Transportation	634-2443

Subject	Telephone
• Microwave (PRB)	634-2443
• Personal and Amateur	632-4964
• Public Safety	634-2443
Rules—Ship Earth Station	632-7175
• Interpretation of (Gen.) (OGC)	632-6990
Rural Radio (CCB)	653-5560
Safety—Sea (PRB)	632-7175
Safety Manager (OMD)	632-7541
Sampling and Measurements	(301) 725-1585
Satellite—Sanction (FOB)	
• International Facilities (CCB)	632-7265
• Domestic Facilities (CCB)	634-1624
• International Coordination	653-8144
• Maritime (PRB)	632-7175
• Rates (CCB)	632-5550
• Systems (CCB)	634-1624
• Spread Spectrum (OET)	653-8163
• Coordination and Interference (OET)	653-8153
Search & Rescue (FOB)	632-6975
Security Officer (OMD)	632-7143
Ship Inspections (FOB)	632-7014
Ship Licensing (PRB)	(717) 337-1212
Ship Rules/Exemptions	632-7175
Single Side Band—Standards (OET)	653-6288
Special Emergency (PRB)	(717) 337-1212
Speed of Service—	
• Telephone or Telegraph (CCB)	634-1800
Split Channel Operations (CCB)	653-5560
Standards—Licensed Gear (OET)	653-6288
State Guard (PRB)	(717) 337-1212
Statistics—	
• Common Carrier (CCB)	632-0745
Studio Transmitter Links—	
• Mass Media (MMB)	634-6307
• Common Carrier (CCB)	634-1706
Submarine Cable (CCB)	632-7265
Sunspot Cycle (OET)	653-8166
Taping of Phone Calls (OGC)	632-6990
Tariff Schedules (PRB)	(717) 337-1212
Telecommunications for the Deaf (CCB)	632-6999
Telephone Interconnection (CCB)	634-1800
Telegraph Service (CCB)	632-7876
Telephone Lines (CCB)	632-1800
Telephone Telegraph Rates (CCB)	632-5550
Teletypewriter Exchanges (TWX) (CCB)	632-5550
TELEX	
• International & Domestic (CCB)	632-7265
Testing Equipment	(301) 725-1585
Tie-Line—Telegraph Telephone (CCB)	632-5550
Toll Charges (CCB)	632-5550
Tort Claims (Legal) (OGC)	632-6990
Towers—Painting and Lighting of (FOB)	632-7521
Towing (PRB)	(717) 337-1212
Transfers—	
• Microwave License (CCB)	634-1706
Transit Systems (PRB)	(717) 337-1212
Transportation—Land (PRB)	(717) 337-1212
Treaties—	
• Administration Interpretation (OGC)	632-6990
• Frequency Allocation (OET)	653-8126
Treaty Library (OET)	653-8126
Troposphere (OET)	632-7025
• Interference (D.C. Area) (FOB)	(301) 962-2729
• All other areas—Refer to Local Field Office	
• Military (OET)	653-8141
• Pickup (Common Carrier) (CCB)	634-1706
Type Acceptance (OET)	(301) 725-1585
Type Approval (OET)	(301) 725-1585
Ultrasonics Equipment (OET)	653-8247
Unlicensed Operators—	
• Investigation of (FOB)	632-6345
• Administrative Sanctions (FOB)	632-7240
Violations Records	
• FOB Violation Records (FOB)	632-7278
Walkie-Talkies (OET)	653-6288
Watch Officer (Monitoring) (FOB)	632-6975
Wire Facilities (CCB)	634-1800
Wireless Microphones—	
• Non-licensed (OET)	653-6288
• Licensed (PRB)	(717) 337-1212
• Licensed (MMB)	632-7505
Wiretapping (OGC)	632-6990
Yellow Page Advertising (CCB)	632-7553

World Radio History

DISTRIBUTOR DIRECTORY

The following distributors serving the broadcast industry would be glad to help you with any of your requirements.

HALL Electronics

THE BEST DEALS ON QUALITY REBUILT & BRAND NEW BROADCAST EQUIPMENT

We BUY & TRADE equipment too!
Please phone or send for our latest flyer.

10:00AM-6:00PM EST

804-974-6466
FAX 804-974-6450

1305-F Seminole Trail
Charlottesville, VA 22901

American Media Services

Authorized Distributor for

Ampex 456 Grand Master Recording Tape

NAT'L:	(800)	345-1953
TEXAS:	(800)	521-1953
LOCAL:	(817)	535-1953
FAX:	(817)	536-1953

CORNELL-DUBILIER MICA CAPACITORS

FROM STOCK

JENNINGS VACUUM CAPACITORS

FROM STOCK

JENNINGS VACUUM RELAYS

SIERCOM ASSOCIATES INC.

2215 Faraday Ave., Suite A
Carlsbad, California 92008
(619) 438-4420

THE SOURCE

CALL US FOR ALL YOUR EQUIPMENT NEEDS

Toll free:
800-223-8202
In Florida:
305-651-5752

ELECTREX COMPANY

SPENCER
Broadcast & Communications

AUDIO—VIDEO—RF
Where Service is #1

Now in our 10th year

CALL 602-242-2211
FAX 843-2860

SANGAMO-ACUSHNET MICA CAPACITORS

PLASTIC CORP.—NON-PCB OIL FILLED CAPACITORS

RF-ANTENNA AMMETERS

RCA-RAYTHEON-AEL TRANSMITTER PARTS

TRANSFORMERS & CHOKES 250 WATT THRU 50 kW

COMMERCIAL RADIO COMPANY
BOX 43, CAVENDISH VT 05142
802-226-7582

CONSULTANTS

North America — RF & Audio

Mirkwood Engineering Services

Broadcasting and Telecommunications Consultants

Rural and Remote Site Installations and Field Service

Studio Design and Installation

Project Supervision and Management

501 Park Ave
Claremont, NH 03743

(603) 542-6781
Gary Savoie

PARAMOUNT

INSTALLATION AND SERVICE OF BROADCAST ANTENNA SYSTEMS/TOWER MAINTENANCE & ERECTION

WESTMONT, NJ (609) 869-0222

AUDIO CONCEPTS & ENGINEERING

Broadcast Audio
- Consultation
- Installation
- Optimization

P.O Box 459
Mechanicsville, VA 23111
(804) 798-6633 (804) 356-8364

JEFFREY P. LOUGHRIDGE

Consulting Communications Engineers
- FCC Data Bases
- FCC Applications and Field Engineering
- Frequency Searches and Coordination
- AM-FM-CATV-ITFS-LPTV

OWL ENGINEERING, INC.

1306 W. County Road. F,
St. Paul, MN 55112
(612)631-1338 Member AFCCE

TOWER SERVICES
Light Replacement
Routine Maintenance
Ground Systems
Painting
20 years Experience

John Nix

PO Box 13244 Salem, OR 97309
503-581-4056
1-800-321-4056

MAGRILL ENGINEERING
Radio Engineering Consultants

FCC Applications - Upgrades
Pre-purchase evaluations
Station planning & Design
Turnkey systems - Field service
Experienced, Economical & Fast

(904) 591-3005

Barry Magrill, *President*, Member IEEE
P.O. Box 1010
Fairfield, FL
32634

SOFTWARE

FM CHANNEL SEARCH

FM Database pool

MSDOS
EGA Graphics-Color
Broadcast Technical Consulting

Doug Vernier
Broadcast Consultant
1600 Picturesque Drive
Cedar Falls, IA 50613
319-266-7435

DOWNEAST ENGINEERING

147 Durham Rd., Freeport, ME 04032
(207) 865-9002

Electronic Repairs & Services
Equipment Piled Up in Need of Repairs?
(Qualified Service Technicians)
New & Used Equipment (Call for Price) New Studio Designs

BROADCAST SPECIALISTS
WILLIAM H. YANIK
(Manager, Sales and Service)

FCC's Engineering
FM and TV Data Bases for your PC

Call today to request a free sample.

Communications Data, Inc.
6105 E Arlington Blvd
Falls Church VA 22044
(703) 534-0034

RF and Audio — *Coast to Coast*

STEVE VANNI ASSOCIATES, INC.
BROADCAST TECHNICAL CONSULTANTS

Project Management
Facility Planning

P.O Box 422 Auburn, NH 03032
(603)483-5365

HARMON'S TOWER SERVICE, INC.

Maintenance Painting,
Antenna & Equipment
Installation,
Winch Services

453 B Broadway
Columbus, GA. 31901
(404) 327-1074

RADIO SYSTEMS ENGINEERING

FCC Applications • Design
• Installation • Field Service

Experienced & Affordable

4289 Roanridge
Las Vegas, Nevada 89120

24 Hr: (702) 454-2085

SPENCER BROADCAST

The Radio Station Specialists

Chuck Spencer
Phoenix, AZ
602-242-2211

R.L. HOOVER

Consulting Telecommunications Engineer

11704 Seven Locks Road
Potomac MD 20854
301-983-0054

Member AFCCE

World Radio History

Radio World®

1990 Annual use until February 1, 1991

FREE Subscription/Renewal Card

I would like to receive or continue receiving **Radio World** FREE each month. ☐ YES ☐ NO

Signature _____ Date _____

Please print and include all information:

Name _____ Title _____

Company/Station _____

Address _____

City _____ State _____ ZIP _____

Business Telephone ( ) _____

Please circle only one entry for each category:

I. Type of Firm

D. Combination AM/FM station
A. Commercial AM station
B. Commercial FM station
C. Educational FM station
E. Network/group owner
F. Recording studio
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) _____

III. Purchasing Authority

1. Recommend 2. Specify 3.Approve

Reader Service

Please first fill out contact information at left. Then check each advertisement for corresponding number and circle below. NOTE: Circle no more than 15 numbers, otherwise card will not be processed.

001	021	041	061	081
002	022	042	062	082
003	023	043	063	083
004	024	044	064	084
005	025	045	065	085
006	026	046	066	086
007	027	047	067	087
008	028	048	068	088
009	029	049	069	089
010	030	050	070	090
011	031	051	071	091
012	032	052	072	092
013	033	053	073	093
014	034	054	074	094
015	035	055	075	095
016	036	056	076	096
017	037	057	077	097
018	038	058	078	098
019	039	059	079	099
020	040	060	080	100

Subscription/Reader Service Card

1990 Radio World Annual Book Order

To order additional copies of this Annual, complete this card and enclose $14.95 for each Annual ordered. Mail to address on reverse side.

SHIP TO:

Name: _____

Address: _____

City: _____ **State:** _____ **Zip Code:** _____

I wish to order _____ **copies** **Amount enclosed $** _____

Radio World®

1990 Annual use until February 1, 1991

FREE Subscription/Renewal Card

I would like to receive or continue receiving **Radio World** FREE each month. ☐ YES ☐ NO

Signature _____ Date _____

Please print and include all information:

Name _____ Title _____

Company/Station _____

Address _____

City _____ State _____ ZIP _____

Business Telephone ( ) _____

Please circle only one entry for each category:

I. Type of Firm

D. Combination AM/FM station
A. Commercial AM station
B. Commercial FM station
C. Educational FM station
E. Network/group owner
F. Recording studio
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) _____

III. Purchasing Authority

1. Recommend 2. Specify 3.Approve

Reader Service

Please first fill out contact information at left. Then check each advertisement for corresponding number and circle below. NOTE: Circle no more than 15 numbers, otherwise card will not be processed.

001	021	041	061	081
002	022	042	062	082
003	023	043	063	083
004	024	044	064	084
005	025	045	065	085
006	026	046	066	086
007	027	047	067	087
008	028	048	068	088
009	029	049	069	089
010	030	050	070	090
011	031	051	071	091
012	032	052	072	092
013	033	053	073	093
014	034	054	074	094
015	035	055	075	095
016	036	056	076	096
017	037	057	077	097
018	038	058	078	098
019	039	059	079	099
020	040	060	080	100

Subscription/Reader Service Card

World Radio History

Place
Stamp
Here

Radio World
PO Box 1214
Falls Church VA 22041

Radio World
PO Box 1214
Falls Church VA 22041

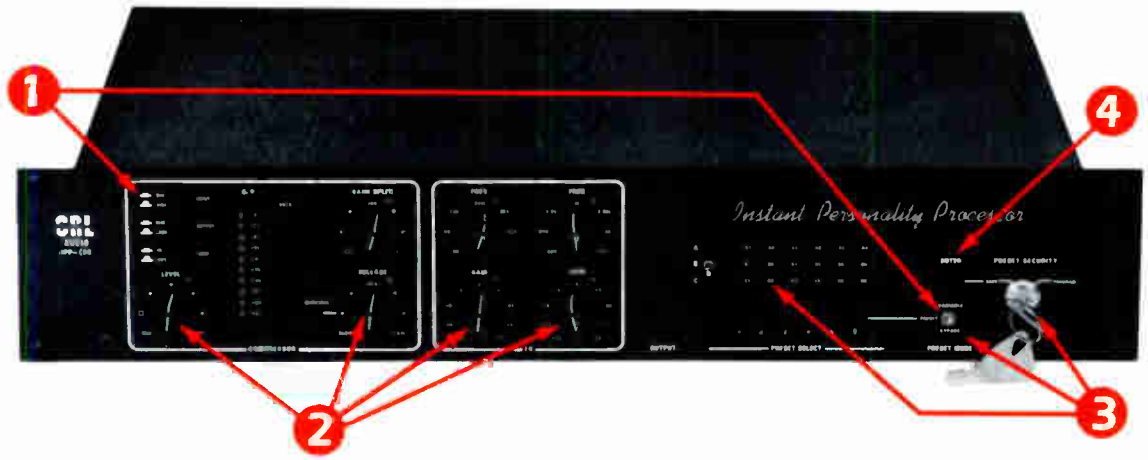
Place
Stamp
Here

Radio World
PO Box 1214
Falls Church VA 22041

World Radio History

The CRL IPP-100

The CRL IPP-100 is a new approach to microphone processing. By combining innovative digital control technology to advanced processor design, a powerful yet easy to use unit has evolved. The IPP-100 has a wide range microphone pre-amp built in that drives a two-band constant Q graphic equalizer. This is followed by a powerful two band compressor. 18 memory preset positions store programs. Full remote control capability, plus an audio loop-thru port, and front panel key lock are added features.



HOW TO PROGRAM A DIGITALLY CONTROLLED MICROPHONE PROCESSOR

1. Select mic or line level in; switch to variable mode.
2. Adjust input level, band split and compressor release; set up equalizer section.

LIKE THE SOUND?

3. Move the key to program, flip the switch to preset. Select a preset position.
4. Push the enter button.
5. Repeat up to 17 more times for more or different personalities.

The IPP-100R

An accessory remote control box mounts on the console or control point.

THE PROFESSIONAL'S CHOICE

CRL SYSTEMS

Circuit Research Labs, Inc.

World Radio History

NRSC Conversion Products from CRL

PMC-450 Tri-Band Peak Modulation Controller

The CRL PMC-450 Tri-band peak modulation controller incorporates many unique designs originally developed for AM stereo. This unit offers state-of-the-art circuitry coupled with precise implementation of the NRSC standards for the loudest, cleanest signal on the AM dial. The PMC-450 consists of a powerful input compressor, followed by a tri-band limiter section and NRSC compliant low-pass filter. The flexible design of the PMC-450 allows it to be used as a stand alone processor, or in conjunction with various audio AGC's and pre-processors.

SMP-950 Tri-Band AM Stereo Matrix Processor

The CRL SMP-950 Tri-band AM STEREO MATRIX PROCESSOR offers state-of-the-art circuitry coupled with precise implementation of the NRSC standards for the loudest, cleanest signal on the AM dial. AM Stereo is quite different from FM and requires special techniques to provide full stereophonic fidelity while maintaining full monophonic compatibility. The CRL patented matrix processing circuitry is designed specifically to meet this criteria.

SPF-300 Standard Pre-Emphasis/Filter for AM Broadcast Transmission

The CRL Standard Pre-Emphasis/Filter contains all the functions necessary to convert virtually any monaural audio processing chain to meet the NRSC (National Radio Systems Committee) Voluntary National Standard of January 10, 1987. This transmission standard defines specific pre-emphasis and filtering requirements which are intended to help solve many of the technical concerns in AM broadcasting. The pre-emphasis curve was developed to allow receiver manufacturers to employ a complementary de-emphasis characteristic in wideband radios while improving the frequency response of narrower and medium-bandwidth radios. The filter specification, which limits transmitted audio bandwidth to 10 kHz, is intended to greatly reduce much of the interference between stations by reducing the conditions that cause "splatter" effects.

MDF-400/800 De-Emphasis/Filter for AM Monitors

The CRL Monitor De-Emphasis/Filter provides all the functions required to update any AM modulation monitor or wideband monitor receiver for the recently approved voluntary transmission standard. This allows easier setup of audio processing equipment by emulating the audio characteristic of the best-possible commercially produced radios. Additionally, the unit has features which can reduce interference typically heard in the station air monitor.

THE PROFESSIONAL'S CHOICE

CRL SYSTEMS

Circuit Research Labs, Inc.
2522 West Geneva Drive
Tempe, Arizona 85282-3192 U.S.A.
(800) 535-7648 (602) 438-0888 FAX 438-8227

World Radio History

HEAR and SEE AUDIO PHASE REVERSAL

1R.U STEREO AUDIO MONITOR

Model AMP 1A shown with optional level meters and phase indicator

FEATURES

Only ONE Rackspace high

Extended response for more reliable detection of audio path problems

True STEREO monitoring without center "hole"

Instant audible alert of Out of Phase source

THOROUGH magnetic shielding

Simple installation

Numerous options available

DESCRIPTION

The AMP 1A Audio Monitor Panel provides self-powered full stereo monitoring with superior high frequency response in the smallest rack mount package available. The astonishing audio quality of its cousin the AMP 1 has been enhanced by a much extended treble response. This permits easy detection of many subtle audio path problems which may be most evident as a background whine or noise. While conserving precious rackspace the AMP 1A eliminates the installation hassle and added on look of separate speakers amp offering equal or better sound quality and these additional benefits of its unique design.

* The center "hole" effect in near field monitoring is avoided by combining the bass frequencies from both channels into the center driver while the side drivers handle the mid and high frequency ranges to maintain good stereo separation.
* Due to superior cancellation the user is immediately alerted when the audio feeds are or become out of phase.

The AMP-1A is so well magnetically shielded that it may be located immediately above, below or to either side of most CRT displays video monitors with NO color purity disturbances or other image distortions even on a blank red screen! Extra shielding is possible for situations where a slight color tinge occurs.

Only three connections to the AMP 1A are required: the two line level audio feeds (via XLR 3-F's or RCA Phono jacks) and the external AC power pack connection to an AC mains outlet.

The standard unit is configured for most applications. For special requirements a number of standard and custom options are available. Standard ones include visual phase and level indicators and various input switching arrangements. A premium version (flatter response and lower distortion) is available for more critical applications.

2R.U STEREO AUDIO MONITOR

FEATURES

Audiophile quality drivers in a convenient two RU package

Wide response, low distortion and enough volume for most any location

True STEREO monitoring without center "hole"

Instant audible alert of Out of Phase source

THOROUGH magnetic shielding

Simple installation

Many options available

DESCRIPTION

The AMP 2 Audio Monitor Panel offers extra high quality, self powered full stereo monitoring at high volume levels in a convenient rackmount package. Listeners hearing the AMP 2 will be impressed with its wide response, low distortion and high SPL capability, which is suitable for almost any noisy location. Requiring only two rackspaces the AMP 2 eliminates the installation hassle and added on look of separate speakers amplifier offering equal-or-better sound quality AND two other significant benefits of its unique design.

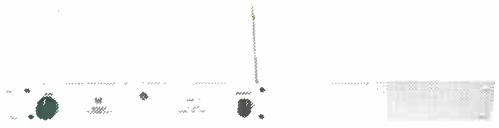
* The center "hole" effect in near field monitoring is avoided by combining the bass frequencies from both channels into the center driver while the side drivers handle the mid and high frequency ranges to maintain good stereo separation.
* Due to superior cancellation the user is immediately alerted when the audio feeds are or become out-of phase.

Extensive magnetic shielding permits the AMP 2 to be located immediately above, below or to either side of most CRT displays video monitors with NO color purity disturbances or other image distortions (even on a blank red screen!)

Only three connections to the AMP 2 are required: the two line level audio feeds (via XLR 3-F's or RCA Phono jacks) and the external AC power pack connection to an AC mains outlet.

The standard unit, which includes extended range LED Peak Level meters and visual phase indication, is configured for most applications. For special requirements a number of standard or custom options, such as various input switching arrangements, are available.

TRI-OUTPUT STEREO POWER AMP



FEATURES

36 Watts RMS total power, drives Auratone 5MCV to > 110dB SPL

Extra compact size, locate where convenient for operator

Center-channel woofer output - permits full Stereo near-field monitoring without center "hole"

Instant audible alert of out-of phase feeds

Only one rack unit high, one half rack wide, 8" deep. May be positioned directly above or below VTRs without blocking their ventilation grilles

Also available as a compact cost effective stereo power amp

DESCRIPTION

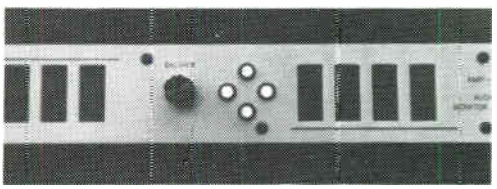
The AMP 5, used in conjunction with a three-driver speaker unit such as the Auratone 5MCV, permits the same unique method of full stereo audio monitoring which its bigger brother the AMP-1 has made popular.

The active crossover of this bi-amplified design routes the midrange and treble portions of each stereo channel to its respective side speaker. The bass frequencies (only) are combined and fed to the center speaker. This approach provides full stereo near-field monitoring without an annoying "hole in the center". And the complete electrical cancellation of program material fed to the center speaker instantly alerts the operator if the audio channels are, or become, out of-phase.

In situations where physical constraints (depth limits, ventilation requirements etc.) or extremely high ambient noise preclude using the AMP 1 or AMP 2, the AMP 5 offers operating people an equally convenient audio monitoring facility.

The AMP 5 is also available with a regular, full bandwidth stereo output of 18-12 Watts RMS (4 ohm/8 ohm) per channel. Order model AMP 5ST.

AUDIO PHASE INDICATOR



FEATURES

Instantaneous visual indication of relative phase of a stereo feed's channels

clearly distinguishes between mono and stereo sources

Gives analog indication of "phaseyness" of stereo sources

Provides same information as X-Y scope at a fraction of the size, power used, and cost

Go/No-go level indication: source absent/present/overload

DESCRIPTION

The IPI 1 provides convenient visual indication of an audio source's level and relative phase. The innovative LED display makes these important parameters visible at a glance in a very cost effective add-on module for our AMP- series of audio monitoring products.

Because the IPI 1 operates on an instantaneous basis, the display clearly distinguishes stereo sources from mono ones as well as providing a simple to interpret analog indication of the proportion of out-of-phase information the source contains: a parameter of great importance for stereo programs received on monaural sets.

The Go/No-go level indicators are another cost-effective innovation from Wohler Technologies. When the audio level rises above a preset level (eg. 25dBm) the LED for that channel comes on. Should the level exceed a higher preset threshold (say +4dBm) the LED color will change to Red. This approach provides useful information without duplicating the meters on most sources (usually tape machines).

Both the upper and lower thresholds may be set as required. The lower threshold (turn on of amber LED) is soft, spanning approximately a 4 dB range. The upper threshold is very sharp, the entire transition from amber to red occuring within a half dB change in level. The level display is integrated into the phase indication to facilitate interpretation of conditions where the absence of signal in one or both channels prevents indication of their relative phase.

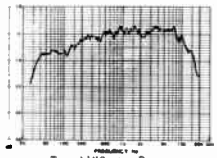
APPLICATIONS: Patch Bay Areas · Production Facilities · Cart Decks · STL · Transmitter Facilities · Satellite Links · Phone Line Monitors · Two-way Radio systems

Wohler Technologies, Inc.
1349 Kansas St. San Francisco 94107
(415) 285-5462 FAX: (415) 821-6414

World Radio History

SPECIFICATIONS

INPUT IMPEDANCE	100 kΩ 22 kΩ bal /unbal
INPUT LEVEL FOR MAX OUT (VOLUME FULL ON)	0 dBv-12 dBv bal /unbal
INPUT OVERLOAD	+ 26-+14 dBv bal /unbal
PEAK ACOUSTIC OUTPUT LEVEL (@ 2 ft)	104 dB S P L Minimum
RESPONSE, TENTH OCTAVE	±5 dB 100Hz 16kHz
	10 dB @ 40Hz, 20kHz
RMS OUTPUT POWER, EACH SIDE AMPLIFIER (4Ω)	20W/11W transient/continuous
RMS OUTPUT POWER, BASS AMPLIFIER (4Ω)	36W 20W transient continuous
TOTAL POWER CONSUMPTION MAXIMUM AVERAGE	35 W
DISTORTION ELECTRICAL	less than 1%THD
	@ any level below limiting threshhold
DISTORTION ACOUSTIC	6% or less at worst case frequencies above 140 Hz
	typically less than 1 5%
HUM AND NOISE	better than -64 dB below full output
MAGNETIC SHIELDING	less than one gauss anywhere on top or bottom surface or panel edges
CONNECTORS	Loop thru XLR 3 (balanced inp)
	RCA phono (single-ended inp)
DIMENSIONS (height width depth)	3 5e10X10 in 88x483x254 mm
WEIGHT (including power sfrw)	approx 15 lbs 6 8 kg



Typical 1/10 octave Response

(0 dBv ref 0 775 VRMS)

The AMP 2's power supply is U L approved An international version of the power transformer is also available for operation from a 230V 50/60Hz power source

Features and Specifications subject to improvement without notice

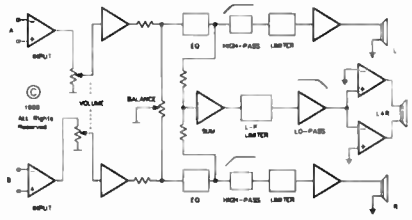
OPTIONS

Wohler Technologies will adapt the AMP-2 to your special needs, at a reasonable cost Some of the options available are multiple sets of inputs with selector switch(es), input gain switch, mono switch, specialized input connectors, transformer-coupled inputs headphone jacks, dual concentric or entirely separate volume controls, FULL output power 12VDC operation or internal power supply, and additional magnetic shielding Just contact the factory or your dealer or manufacturer's rep with your specific needs

WARRANTY

Satisfaction guaranteed Any customer's initial purchase of up to five units may be returnec within three weeks of receipt for a complete refund of the purchase price, less shipping costs each way (Units must be returned securely packaged, in new, undamaged and unaltered condition) NO unit returned may have been dissassembled in any way, credit for such units will be DENIED! Units with standard options may also be returned, but those having custom options are generally NOT returnable Wohler Technologies also guarantees the AMP-2 to be free of defects in materials and workmanship. We will repair or replace, at our expense, any unit which fails under normal operation, for one year after date of purchase by the original end-user

BLOCK DIAGRAM



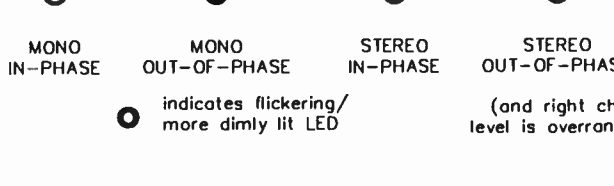
GUIDE TO INTERPRETING THE IPI-1 DISPLAY

The green LED indicates In Phase, red indicates Out Of Phase. The two amber LEDS on either side are for level indication in each channel. (If there's no signal present in either or both channels, no indication of phase is possible; the side LEDs then show which signal(s) is/are missing) An overrange indication is also included with the side LEDs: when the audio level rises above a pre-set threshhold, e.g. +8dBm, the LED in that channel will change color from amber to red. The amber LEDs will usually give the best indication when their turn-on range is set around - 25dBm. The upper threshold may be set independently of the lower, but changing the lower one will also change the upper one.

Since the IPI-1 operates on an instantaneous basis, the display also distinguishes a stereo source from a mono one. Any stereo source contains some opposite-phase information, so both green and red LEDs will flicker with a stereo source, whereas with a mono source, only one or the other will be on. If a stereo source has been recorded with multiple and/or widely-spaced mics, the phase relationship between the two channels may be fairly random. (Many orchestral recordings exhibit this characteristic.) Accordingly, analogous to a fuzzy circle on an X-Y (Lissajous) display, both the red and green LEDs will flicker with near equal intensity. Thus this method of phase indication provides a simple, and accurate indication of audio phase relationships between the two channels, and the resulting amount of cancellation which will occur in the mono mix.

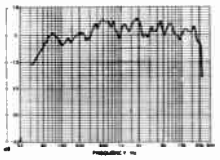
WARRANTY

Your satifaction is guaranteed. Any customer's initial purchase of up to five units may be returned within three weeks of receipt for a complete refund of the purchase price, less shipping costs each way. (Units must be returned securely packaged, in new, undamaged and unaltered condition.) NO unit returned may have been dissassembled in ANY way; credit for such units will be DENIED! Units with standard options may also be returned, but those having custom options are generally NOT returnable.
Wohler Technologies also guarantees the IPI-1 to be free of defects in materials and workmanship. We will repair or replace, at our expense, any unit which fails under normal operation, for three years after date of purchase by the original end-user.



SPECIFICATIONS

INPUT IMPEDANCE	100 kΩ 10 kΩ bal /unbal
INPUT LEVEL FOR MAX OUT (VOLUME FULL ON)	0 dBv 12 dBv bal /unbal
INPUT OVERLOAD	+ 26-+14 dBv bal /unbal
PEAK ACOUSTIC OUTPUT LEVEL (@ 2 ft)	96 dB S P L
RESPONSE, SIXTH OCTAVE	±7 dB 80Hz-15kHz, sixth octave
	10 dB @ 50Hz 20kHz
RMS OUTPUT POWER EACH SIDE AMPLIFIER (4Ω)	18W/10W transient/continuous
RMS OUTPUT POWER BASS AMPLIFIER (4 Ω)	32W/18W transient/continuous
TOTAL POWER CONSUMPTION MAXIMUM AVERAGE	35 W
DISTORTION ELECTRICAL	less than 15%THD @ any level below limiting threshold
DISTORTION ACOUSTIC (incl cabinet resonances)	8% or less at worst case frequencies above 180 Hz typically less than 2%
HUM AND NOISE	better than -65 dB below full output
MAGNETIC SHIELDING	less than one gauss anywhere on top or bottom surface or panel edges
CONNECTORS	Loop-thru XLR-3 (balanced inp)
	RCA phono (single ended inp)
DIMENSIONS (height width depth)	7 "3x19X12 in 44 5x483x298 mm
WEIGHT (including power sfrw)	14 lbs 6 4 kg



Typical 1/6 octave Response

(0 dBv ref 0 775 VRMS)

The AMP-1A's power supply is U L approved An international version of the power transformer is also available for operation from a 230V 50/60Hz power source

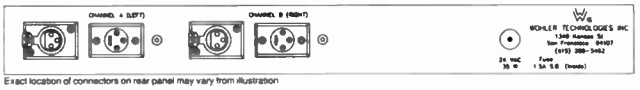
Features and Specifications subject to improvement without notice Consult factory for details regarding the premium version

OPTIONS

Wohler Technologies will adapt the AMP-1A to your special needs, at a reasonable cost Some of the options available are multiple sets of inputs with selector switch(es), input gain switch, mono switch, specialized input connectors, level meters, visual phase indication, transformer-coupled inputs headphone jacks dual concentric or entirely separate volume controls, FULL output power 12VDC operation or internal power supply and additional magnetic shielding Just contact the factory or your dealer or manufacturer s rep with your specific needs

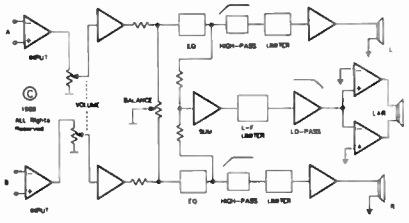
WARRANTY

Satisfaction guaranteed Any customer s initial purchase of up to five units may be returned within three weeks of receipt for a complete refund of the purchase price less shipping costs each way (Units must be returned securely packaged, in new, undamaged and unaltered condition) NO unit returned may have been dissassembled in any way, credit for such units will be DENIED! Units with standard options may also be returned, but those having custom options are generally NOT returnable Wohler Technologies also guarantees the AMP 1A to be free of defects in materials and workmanship We will repair or replace, at our expense, any unit which fails under normal operation, for one year after date of purchase by the original end-user



Exact location of connectors on rear panel may vary from illustration

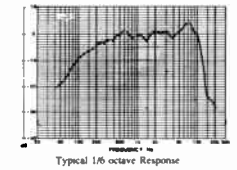
BLOCK DIAGRAM



SPECIFICATIONS

INPUT IMPEDANCE	100 kΩ, balanced
INPUT OVERLOAD	+ 26 dBv
PEAK ACOUSTIC OUTPUT LEVEL (@ 2 ft)	* 112 dB S P L
RESPONSE, SIXTH OCTAVE	* ±4 dB 100Hz, 12kHz
RMS OUTPUT POWER, EACH SIDE AMPLIFIER (8Ω)	9W/6W transient /continuous
RMS OUTPUT POWER, BASS AMPLIFIER (8Ω)	18W/12W transient/continuous
TOTAL POWER CONSUMPTION, MAXIMUM AVERAGE	28 W
DISTORTION, ELECTRICAL	less than .2%THD @ any level below limiting threshold
DISTORTION, ACOUSTIC	* 5% or less at worst case frequencies above 80Hz, typically less than 1 5%
HUM AND NOISE	better than -62 dB below full output
CONNECTORS	XLR-3
DIMENSIONS (height and width of front panel)	1 75 x 19 in (44 5 x 483 mm)
(width and depth of chassis)	8 5 x 8 in (216 x 203 mm)
(chassis normally located along Left half of F P)	
WEIGHT (including power sfrw)	2 2 lbs (1 0 kg)
(the Auratone 5MCV weighs approx 8 lbs (3 kg))	
(0 dBv ref 0 775 VRMS)	

*NOTE All acoustic performance data are based on measurements taken with an Auratone 5MCV believed to be a representative production sample Wohler Technologies cannot accept any responsibility regarding acoustic performance of these speaker units



Typical 1/6 octave Response

AURATONE 5 MCV

The AMP 5's power supply is U L approved An international version of the power transformer is also available for operation from a 230V 50/60Hz power source

Features and Specifications subject to improvement without notice

OPTIONS

Wohler Technologies will adapt the AMP 5 to your special needs, at a moderate cost However, due to space limitations of the standard chassis, most options will require either a larger chassis or an additional one beside the main one, if they are to be fully enclosed Some of the options available are multiple sets of inputs with selector switch(es) input gain switch, mono switch, specialized input connectors, level meters, visual phase indication transformer-coupled inputs headphone jack dual concentric or entirely separate volume controls FULL output power 12VDC operation or internal power supply Just contact the factory or your dealer or manufacturer s rep with your specific needs

WARRANTY

Satisfaction guaranteed Any customer s initial purchase of up to five units may be returned within three weeks of receipt for a complete refund of the purchase price less shipping costs each way (Units must be returned securely packaged, in new, undamaged and unaltered condition) NO unit returned may have been dissassembled in any way credit for such units will be DENIED! Units with standard options may also be returned, but those having custom options are generally NOT returnable (Of course, Wohler Technologies cannot cover Auratone products with this policy)
Wohler Technologies also guarantees the AMP 5 to be free of defects in materials and workmanship We will repair or replace, at our expense any AMP 5 which fails under normal operation for two years after date of purchase by the original end-user

Exact location of connectors on rear panel may vary from illustration

BLOCK DIAGRAM

Wohler Technologies, Inc.
1349 Kansas St. San Francisco 94107
(415) 285-5462 FAX: (415) 821-6414

World Radio History

DIRECTORIES & PROFILES

In the following pages, you will find three tools for keeping track of vendors and their products.

We hope these listings will save you time and help you find the products you want to buy.

Product Source Book 68

The Product Source Book is an index which lists companies according to the type of equipment they make or distribute. The product information was provided by the vendors themselves, in response to a questionnaire sent by **Radio World** in 1989.

Supplier Source Book 84

Our Supplier Source Book lists names and addresses of the companies found in the Product Source Book.

Company Profiles 97

Those of you looking for more information on the companies listed can turn to the Company Profiles, in which firms have provided details about their businesses and products.

World Radio History

A

ACOUSTIC MATERIALS

Acoustic Systems
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Alpha Audio
ASC - Tube Traps
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiotechniques
AVC Systems
Bradley Broadcast Sales
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corp.
Hall Electronics
Hy James, Inc.
Martin Audio Video Corp
Oakwood Audio Labs Ltd.
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
UAR Professional Systems

AMPLIFIERS

Audio

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Ashly Audio, Inc.
Audio Broadcast Group, Inc.
Audio Services Corporation
Audio Technologies, Inc.
AudioLine, Inc.
Audiomedia
Audiotechniques
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BGW Systems, Inc.
Bogen Communications, Inc.
Bradley Broadcast Sales
Broadcast Devices, Inc.
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Bryston/Bryston Vermont Ltd.
CaVox/Tape-athon Corporation
Control Technology Inc.
Delta Electronics Inc.
Electro-Voice Inc.
Electronic Industries, Inc.
ESE
Excalibur Electronics
Full Compass Systems, Ltd.
Furman Sound, Inc.
General Broadcast Supply, Inc.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corp.
H & E Micro-trak Corporation
Hall Electronics
Henry Engineering
Holzberg Inc.
Hy James, Inc.
J.N.S. Electronics, Inc.
JBL Professional
Jensen Transformers Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Logitek Electronic Systems Inc.
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co.
Nady Systems
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Panasonic/Ramsa
PARCOM
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
QSC Audio Products
Radio Design Labs
Ram Broadcast Systems
Rane Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
RTS Systems
Russco Electronics Mfg. Inc.
Sescom Inc.
Spectra Sonics
Symetrix Inc.
Tape-athon/Cavox
Urei
Valley International
Ward-Beck Systems Ltd.
Wheatstone Corp
Wohler Technologies
Yamaha Music Corp. of America
Zercom Corporation

RF

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AVR Communications Limited
Barrett Associates, Inc.
Belar Electronics Laboratory, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Supply West
Broadcasters General Store
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Elcom Bauer
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
J.N.S. Electronics, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Litronix Corporation
Nady Systems
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Spectra Sonics
Tepco Corporation

Audio Distribution

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Aphex Systems, Ltd.
Audio Broadcast Group, Inc.
Audio Services Corporation
Audio Technologies, Inc.
AudioLine, Inc.
Audiomedia
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BGW Systems, Inc.
Bogen Communications, Inc.
Bradley Broadcast Sales
Broadcast Audio Corp
Broadcast Devices, Inc.
Broadcast Electronics
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Bryston/Bryston Vermont Ltd.
BSM Systems
CaVox/Tape-athon Corporation
Conex Electro-Systems, Inc.
Control Technology Inc.
Di-Tech Inc.
Electronic Industries, Inc.
ESE
Excalibur Electronics
Full Compass Systems, Ltd.
Funke & Associates
Gaines Audio
General Broadcast Supply, Inc.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Grass Valley Group
Guarantee Radio Supply Corp.
H & E Micro-trak Corporation
Hall Electronics
Henry Engineering
Holzberg Inc.
Hy James, Inc.
J.N.S. Electronics, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Logitek Electronic Systems Inc.
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co.
Modulation Sciences, Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Pacific Recorders & Engineering Corp.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Radio Design Labs
Radio Systems
Ram Broadcast Systems
Rane Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
RTS Systems
Russco Electronics Mfg. Inc.
Sequoia Electronics
Sescom Inc.
Sine Systems, Inc.
Spectra Sonics
UAR Professional Systems
Versatech Industries, Inc.
Ward-Beck Systems Ltd.
Wheatstone Corporation

ANTENNAS

FM

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Supply West
Broadcasters General Store
Cablewave Systems
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Dielectric Communications
Electronic Industries, Inc.
Electronics Research, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corp.
Hall Electronics
Harmon's Tower Service
Harris Corp
Holzberg Inc.
Hy James, Inc.
IBSS
Jampro Antennas
Landy Associates, Inc.
LDL Communications
Lita Broadcasting Distributors

World Radio History

Litronix Corporation
Mart Haller Co.-Exporters
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Paramound Communications Systems
Parcom
Pro Media
Professional Audio Supply
Radiation Systems/Mark Antennas
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Scala Electronic Corporation
Tennaplex Systems, Ltd.
Transcom Corporation

AUTOMATION

Station Business

Custom Business Systems, Inc.
IBSS
RF Specialties of Pennsylvania, Inc.
Summit Software Systems

Newsroom

Broadcasters General Store
Columbine Systems Inc.
IBSS
Media Computing, Inc.
Sine Systems, Inc.

Radio Program

Absolute Broadcast Automation
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Broadcast Automation, Inc.
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Century 21 Programming, Inc.
Concept Productions
Control Technology Inc.
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harris Corp
Holzberg Inc.
Hy James, Inc.
IBSS
Media Touch
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
PARCOM
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Schafer Digital
Schafer International
Sentry Systems
Sono-Mag Corporation
Versatech Industries, Inc.

B

BATTERIES

American Media Services
Audio Services Corporation
AVC Systems
BJM Electronics Ltd.
Broadcast Services Co.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Fusion Electronics, Inc.
Guarantee Radio Supply Corporation
Holzberg Inc.
Landy Associates, Inc.
Martin Audio Video Corp
PARCOM
Periphex, Inc.
Pierce-Phelps, Inc.
Professional Audio Supply

BUILDING, PREFRABRICATED

Allied Broadcast Equipment
Andrew Corporation
LDL Communications
Sine Systems, Inc.

C

CABINENTS, CASES AND RACKS

Acoustic Systems
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Allied Satellite Equipment
Amco Engineering Co.
American Media Services
Arrakis Systems
Atlas/Soundolier
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Fiberbilt Cases Inc.
Fidelipac Corporation
Full Compass Systems, Ltd.
Gaines Audio
Giesler Broadcasting Supply, Inc.
GKM Mfg. Corp.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
H & E Micro-trak Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
J Storeel Corp.
J.N.S. Electronics, Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
LPB, Inc.
Martin Audio Video Corp
Milam Audio Co.
Murphy Studio Furniture
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Paramound Communication Systems
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Radio Systems
Ram Broadcast Systems
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Sono-Mag Corporation
Spectra Sonics
The Express Group
Wheatstone Corp

CART MACHINES

Play Only

A/V Technology International, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiomedia
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
Downeast Engineering
Electronic Industries, Inc.
Fidelipac Corporation
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
International Tapetronics
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Otari Corporation
Pacific Recorders & Engineering Corp.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Sono-Mag Corporation
Transcom Corporation

Record/Play

360 Systems
A/V Technology International, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiomedia
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
Downeast Engineering
Electronic Industries, Inc.
Fidelipac Corporation
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
International Tapetronics
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Otari Corporation
Pacific Recorders & Engineering Corp.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics

World Radio History

Sono-Mag Corporation
Transcom Corporation

Multi-deck

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiomedia
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
Downeast Engineering
Electronic Industries, Inc.
Fidelipac Corporation
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
International Tapetronics
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Sono-Mag Corporation
Transcom Corporation

CASSETTE RECORDERS

Accurate Sound Corporation
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
CaVox/Tape-athon Corporation
Control Technology Inc.
Electronic Industries, Inc.
Fostex Corp. of America
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
PARCOM
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Studer Revox
Tape-athon/Cavox
TASCAM
Telectro Systems Corporation
UAR Professional Systems
Uher of America
Yamaha Music Corp. of America

CLEANERS, RECORD, CD AND OTHER

Caig Labs
Nitty Gritty Record Care Products

COMPACT DISC (CD) PLAYERS

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Century 21 Programming, Inc.
Control Technology Inc.
DENON America Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa
PARCOM
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sono-Mag Corporation
Studer Revox
TASCAM
Transcom Corporation
UAR Professional Systems

COMPONENTS

Transistors

Audiotechniques
BJM Electronics Ltd.
Broadcast Services Co.
Electronic Industries, Inc.
Fusion Electronics, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Parcom
Richardson Electronics
Riggins Electronic Sales
Thor Electronics Corp.

Capacitors

American Media Services
BJM Electronics Ltd.
Broadcast Services Co.
Commercial Radio Company
Downeast Engineering
Electronic Industries, Inc.
Fusion Electronics, Inc.
Hall Electronics
Lita Broadcasting Distributors
LSI Jennings
Martin Audio Video Corp
Parcom
Richardson Electronics Ltd.
Riggins Electronic Sales
Surcom Associates, Inc.
Wide Range Electronics Corporation

Resistors

Altronic Research
BJM Electronics Ltd.
Broadcast Services Co.
Commercial Radio Company
Electronic Industries, Inc.
Guarantee Radio Supply Corporation
Lita Broadcasting Distributors
Martin Audio Video Corp
Parcom
Power Film Systems, Inc.
Riggins Electronic Sales
Shallco
Tech Laboratories, Inc.
Wide Range Electronics Corporation

COMPUTER

Hardware

AVR Communications Limited
Columbine Systems Inc.
Computer Concepts Corporation
Concept Productions
Custom Business Systems, Inc.
Guarantee Radio Supply Corporation
Lasalle Music and Pro Audio
Martin Audio Video Corp
Media Computing, Inc.
Nordic Software, Inc.
PARCOM
Register Data Systems
The Management
Time & Temperature Company of S.D.

Software and Peripherals

AVR Communications Limited
Columbine Systems Inc.
Computer Concepts Corporation
Concept Productions
Custom Business Systems, Inc.
Doug Vernier Broadcast Consulting
Downeast Engineering
Fostex Corp. of America
Jensen Transformers Inc.
Lasalle Music and Pro Audio
Litronix Corporation
Martin Audio Video Corp
Media Computing, Inc.
Nordic Software, Inc.
Parcom
Plastic Reel Corp. of America
Pyramid Audio, Inc.
Register Data Systems
Text Technologies, Inc.
The Management
Time & Temperature Company of S.D.

CONSOLES

On-Air

A/V Technology International, Inc.
Allen & Heath
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Amco Engineering Co.
AMEK/TAC U.S. Operations
Analog Digital Synergy, Inc.
Arrakis Systems
Audio Broadcast Group, Inc.
Audio Technologies, Inc.
AudioLine, Inc.
Audiomedia
Auditronics
Autogram Corp
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Audio Corp
Broadcast Electronics

World Radio History

Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Dorrough Electronics
Douglas Ordon & Company, Inc.
Downeast Engineering
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
GLW Enterprises, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
H & E Micro-trak Corporation
Hall Electronics
Hallikainen & Friends, Inc.
Harris Corp
Holzberg Inc.
Howe Technologies Corporation
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Logitek Electronic Systems Inc.
LPB, Inc.
Martin Audio Video Corp
McCurdy Radio Industries
McMartin Industries
Media Touch
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Pacific Recorders & Engineering Corp.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Radio Design Labs
Radio Systems
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Russco Electronics Mfg. Inc.
Sequoia Electronics
Sony Professional Audio
Soundcraft
Transcom Corporation
UAR Professional Systems
Ward-Beck Systems Ltd.
Wheatstone Corporation
Yamaha Music Corp. of America

Production

A/V Technology International, Inc.
Allen & Heath
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Amco Engineering Co.
AMEK/TAC U.S. Operations
Analog Digital Synergy, Inc.
Arrakis Systems
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiologic
Audiotechniques
Auditronics
Autogram Corp
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Audio Corp
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
DDA
Douglas Ordon & Company, Inc.
Downeast Engineering
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
GLW Enterprises, Inc.
Grant Becker Enterprises
Grass Valley Group
Guarantee Radio Supply Corporation
H & E Micro-trak Corporation
Hall Electronics
Holzberg Inc.
Howe Technologies Corporation
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Logitek Electronic Systems Inc.
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co.
Nedtek
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Otari Corporation
Pacific Recorders & Engineering Corp.
Panasonic/Ramsa
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Radio Design Labs
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Russco Electronics Mfg. Inc.
SECK
Sequoia Electronics
Sony Professional Audio
Soundcraft
Spectra Sonics
TASCAM
Transcom Corporation
UAR Professional Systems
Ward-Beck Systems Ltd.
Wheatstone Corporation
Yamaha Music Corp. of America

Remote

Allen & Heath
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AMEK/TAC U.S. Operations
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiologic
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Audio Corp
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Comrex Corporation
Conex Electro-Systems, Inc.
Control Technology Inc.
Douglas Ordon & Company, Inc.
Electronic Industries, Inc.
Excalibur Electronics
Full Compass Systems, Ltd.
Furman Sound, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
GLW Enterprises, Inc.
Grant Becker Enterprises
Grass Valley Group
Guarantee Radio Supply Corporation
H & E Micro-trak Corporation
Hall Electronics
Hallikainen & Friends, Inc.
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Logitek Electronic Systems Inc.
Martin Audio Video Corp
Media Touch
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa
Parcom
Pierce-Phelps, Inc.
Posthorn Recordings
Professional Audio Supply
Pyramid Audio, Inc.
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Russco Electronics Mfg. Inc.
SECK
Sequoia Electronics
Shure Bros.
Sony Professional Audio
Soundcraft
Spectra Sonics
Telfax Communications
Tri-Tech, Inc.
UAR Professional Systems
Ward-Beck Systems Ltd.
Yamaha Music Corp. of America
Zercom Corporation

CONSULTING

Engineering and Design Services

Allied Broadcast Systems
ASC - Tube Traps
Audio Concepts and Engineering Services
Audio Services Corporation
AudioLine, Inc.
Audiomedia
AVC Systems
AVR Communications Limited
Broadcast Equipment Sales & Engineering
Central Tower, Inc.
Commercial Radio Company
Dataworld
Doug Vernier Broadcast Consulting
Downeast Engineering
Electronics Research, Inc.
Fred A. Nudd Corporation
Full Compass Systems, Ltd.
GKM Mfg. Corp.
Holzberg Inc.
Hy James, Inc.
IBSS
Intraplex, Inc.
Kenneth R Meades
Landy Associates, Inc.
Lasalle Music and Pro Audio
Litronix Corporation
Magrill Engineering
Martin Audio Video Corp
Milam Audio Co.
Moffet, Larson & Johnson, Inc.
Multiphase Consulting
National Supervisory Network
Northeast Broadcast Lab, Inc.
Nott Ltd.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Owl Engineering, Inc.
Pacific Recorders & Engineering Corp.
Pierce-Phelps, Inc.
Radio Systems
Radio Systems Engineering
Raines Electromagnetics
Ray H. Rosenblum
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Rick Nudd, Ltd.
Ron Radio Communications
Ronald J. Grandmaison, P.E. Consultant
Sine Systems, Inc.
Spectra Sonics
Spencer Broadcast
Steve Vanni Associates
Target Tuning, Inc.
Transtector Systems Inc.

World Radio History

UAR Professional Systems
Wide Range Electronics Corporation

CONTRACT ENGINEERING SERVICES

Allied Broadcast Systems
Audio Concepts and Engineering Services
AVC Systems
Broadcast Equipment Sales & Engineering
Downeast Engineering
Full Compass Systems, Ltd.
Funke & Associates
Holzberg Inc.
Lasalle Music and Pro Audio
Magrill Engineering
Multiphase Consulting
National Supervisory Network
Old Dominion Broadcast Eng. Serv.
Radio Systems Engineering
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Ron Radio Communications
Target Tuning, Inc.
Versatech Industries, Inc.

D

DIGITAL AUDIO TAPE (DAT) MACHINES

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
Audiolab Electronics, Inc.
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Concept Productions
Control Technology Inc.
Electronic Industries, Inc.
Fostex Corp. of America
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Harris Corp
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Music Director Programming Service
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Radio Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Sono-Mag Corporation
Sony Professional Audio
TASCAM
UAR Professional Systems

DIGITAL AUDIO WORK STATIONS

360 Systems
AKG Acoustics
Allied Broadcast Equipment
Allied International
Alpha Audio
AudioLine, Inc.
AVC Systems
Bradley Broadcast Sales
Broadcast Services Co.
Broadcasters General Store
Control Technology Inc.
Douglas Ordon & Company, Inc.
Full Compass Systems, Ltd.
Hy James, Inc.
Intraplex, Inc.
Lasalle Music and Pro Audio
Lexicon Inc.
Martin Audio Video Corp
Media Touch
Milam Audio Co.
New England Digital
Oakwood Audio Labs Ltd.
Pro Media
Pyramid Audio, Inc.
Schafer Digital
Studer Revox
Symetrix Inc.
UAR Professional Systems
Waveframe Corporation

DISTRIBUTORS

Regional

Audiomedia
AVC Systems
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Crouse-Kimzey
Electrex Company
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Jim Walters Co.
Lake Systems
Martin Audio Video Corp
Northeast Broadcast Lab, Inc.
Parcom
Pierce-Phelps, Inc.
Posthorn Recordings
Research Associates, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Tapex Corporation
The Clements Company
UAR Professional Systems

National

A/V Technology International, Inc.
Allied Broadcast Equipment
Allied Satellite Equipment
Audio Broadcast Group, Inc.
Audiotechniques
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Cartridge Service Inc.
Broadcast Services Co.
Broadcasters General Store
Commercial Radio Company
Control Technology Inc.
Crouse-Kimzey
Electrex Company
Full Compass Systems, Ltd.
Funke & Associates
General Broadcast Supply, Inc.
Hall Electronics
Holzberg Inc.
Lake Systems
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Pierce-Phelps, Inc.
Posthorn Recordings
Professional Audio Supply
Research Associates, Inc.
Ron Radio Communications
Spencer Broadcast
Thor Electronics Corp.

International

A/V Technology International, Inc.
Allied Broadcast Canada
Allied International
American Media Services
Audio Services Corporation
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcasters General Store
Comex Worldwide Corporation
Commercial Radio Company
Control Technology Inc.
Electrex Company
Full Compass Systems, Ltd.
Guarantee Radio Supply Corporation
IBSS
Lake Systems
Lita Broadcasting Distributors
Pierce-Phelps, Inc.
Professional Audio Supply
Raks Corporation of America, Inc.
Schafer International
Thor Electronics Corp.
VIF International

DUMMY LOADS

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Altronic Research
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Bird Electronics Corporation
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Commercial Radio Company
Continental Electronics
Dielectric Communications
Electro Impulse Laboratory, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Guarantee Radio Supply Corp.
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
RF Systems
Ron Radio Communications
Trophpeter Electronics

E

ENCODERS/DECODERS

Tone and EBS Equipment

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Di-Tech Inc.
Electronic Industries, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Gorman Redlich Mfg. Co.
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
Intraplex, Inc.
Monroe Electronics, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
TFT Inc.

EXCITERS

AM Stereo

Allied Broadcast Canada
Allied Broadcast Equipment

World Radio History

Allied International
Audio Broadcast Group, Inc.
Audiologic
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Delta Electronics Inc.
Electronic Industries, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Jim Walters Co.
Micro Controls, Inc.
Motorola Inc./AM Stereo
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Transcom Corporation
TTC Wilkinson

FM

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audiologic
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Litronix Corporation
Micro Controls, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Tepco Corporation
Transcom Corporation
TTC Wilkinson

F

FIBER-OPTIC PRODUCTS

ADC Telecommunications, Inc.
Allied Broadcast Equipment
Broadcast Services Co.
Broadcasters General Store
Comrex Corporation
Douglas Ordon & Company, Inc.
Electronic Systems Laboratories, Inc.
Grass Valley Group
Holzberg Inc.
Intraplex, Inc.
PARCOM

H

HEADPHONES, HEADSETS

AKG Acoustics
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio Services Corporation
Audio-Technica U.S., Inc.
AudioLine, Inc.
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Beyer Dynamic Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Fostex Corp. of America
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Nady Systems
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
R-Columbia Productions
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
RTS Systems
Sennheiser Electronic Corporation
Stanton Magnetics Inc.
Systems Wireless Ltd.
TASCAM
Television Equipment Associates, Inc.
UAR Professional Systems
Yamaha Music Corp. of America

HEADS AND REFURBISHING SERVICES

American Media Services
AMP Services
Cart Mart
Electronic Industries, Inc.
Hall Electronics
JRF Magnetic Sciences
Magnetic Reference Laboratory
Martin Audio Video Corp
Milam Audio Co.
Parcom
R & A Broadcast Services
R.B. Annis Co Inc.
Riggins Electronic Sales
Saki Magnetics Inc.
Sequoia Electronics
Sprague Magnetics
VIF International

I

INSTRUCTIONAL MATERIALS

First Light Video Publishing
Focal Press

INTERCOMS

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Atlas/Soundolier
Audio Services Corporation
Auditronics
AVC Systems
Beyer Dynamic Inc.
Bogen Communications, Inc.
Broadcasters General Store
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Gentner Electronics Corporation
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
R-Columbia Productions
Ram Broadcast Systems
RF Specialties of Pennsylvania, Inc.
RTS Systems
Swintek Enterprises, Inc.
Systems Wireless Ltd.
Telectro Systems Corporation
Ward-Beck Systems Ltd.

L

LIGHTNING PROTECTION AND POWER CONDITIONING

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AVR Communications Limited
Barrett Associates, Inc.
Best Power Technology, Inc.
Broadcast Equipment Sales & Engineering
Broadcasters General Store
Columbine Systems Inc.
Comad Communications Limited
Commercial Radio Company
Continental Electronics
Cortana Corporation
Current Technology, Inc.
Electronic Industries, Inc.
Energy Control Systems
Full Compass Systems, Ltd.
Furman Sound, Inc.
General Broadcast Supply, Inc.
Grant Becker Enterprises
Holzberg Inc.
Hy James, Inc.
Lita Broadcasting Distributors
Litronix Corporation
MCG Electronics Inc.
Northeast Broadcast Lab, Inc.

World Radio History

Paramound Communications Systems
Parcom
Pro Media
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Transtector Systems Inc.

M

MACHINE SYNCHRONIZERS FOR ATRS

Allied Broadcast Equipment
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiotechniques
AVC Systems
Bradley Broadcast Sales
Broadcast Services Co.
Control Technology Inc.
Douglas Ordon & Company, Inc.
Full Compass Systems, Ltd.
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
UAR Professional Systems

MICROPHONES AND ACCESSORIES

Accurate Sound Corporation
AKG Acoustics
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Atlas/Soundolier
Audio Broadcast Group, Inc.
Audio Services Corporation
Audio-Technica U.S., Inc.
AudioLine, Inc.
Audiomedia
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Beyer Dynamic Inc.
BJM Electronics Ltd.
Bogen Communications, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Bruel & Kjaer Instruments, Inc.
Continental Electronics
Control Technology Inc.
Douglas Ordon & Company, Inc.
Electronic Industries, Inc.
Fostex Corp. of America
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jensen Transformers, Inc.
Jim Walters Co.
Karl Heitz, Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milab
Milam Audio Co.
Nady Systems
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
R-Columbia Productions
Radio Design Labs
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sennheiser Electronic Corporation
Shure Bros.
Swintek Enterprises, Inc.
Systems Wireless Ltd.
TASCAM
Yamaha Music Corp. of America

MICROWAVE EQUIPMENT

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
AVR Communications Limited
Bradley Broadcast Sales
Broadcast Services Co.
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Environmental Technology, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hy James, Inc.
IBSS
Marti Electronics, Inc.
Micro Controls, Inc.
Microwave Filter
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
TFT Inc.
Verda
Will-Burt Co.

MIDI EQUIPMENT

360 Systems
Allied Broadcast Equipment
Aphex Systems, Ltd.
Audio Services Corporation
Audiologic
Audiotechniques
AVC Systems
Bradley Broadcast Sales
Broadcasters General Store
Full Compass Systems, Ltd.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Peavey Electronics Corporation
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Rane Corporation
TASCAM
UAR Professional Systems
Yamaha Music Corp. of America

MOBILE PRODUCTION VANS

Allied Broadcast Equipment
Antenna Technology Corporation
Audio Broadcast Group, Inc.
Broadcast Services Co.
Holzberg Inc.
Pierce-Phelps, Inc.
Pyramid Audio, Inc.

MONITORS

AM

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Belar Electronics Laboratory, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Commercial Radio Company
Continental Electronics
Control Technology Inc.
Delta Electronics Inc.
Downeast Engineering
Electronic Industries, Inc.
Funke & Associates
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
J.N.S. Electronics, Inc.
Jim Walters Co.
Motorola Inc./AM Stereo
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
TFT Inc.
Transcom Corporation

FM

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Belar Electronics Laboratory, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Delta Electronics Inc.
Downeast Engineering
Electronic Industries, Inc.
Funke & Associates
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
J.N.S. Electronics, Inc.
Jim Walters Co.
Modulation Sciences, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
QEI Corporation
Radio Design Labs
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications

World Radio History

TFT Inc.
Transcom Corporation

MUSIC LIBRARIES
Airforce Broadcast Services Inc.
Allied Broadcast Canada
Allied International
AudioLine, Inc.
Barrett Associates, Inc.
Broadcast Programming
CaVox/Tape-athon Corporation
Century 21 Programming, Inc.
Control Technology Inc.
Creative Support Services
Hy James, Inc.
Kala Music
Martin Audio Video Corp
Music Director Programming Service
Pyramid Audio, Inc.
Schafer Digital
Sopersound Music Library
Sound Ideas
Tape-athon/Cavox
UAR Professional Systems
Valentino Production Music & Sound

N

NATIONAL OFF-PREMISE CONTROL
National Supervisory Network

NRSC EQUIPMENT
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Circuit Research Labs
Delta Electronics Inc.
Electronic Industries, Inc.
Energy-Onix Broadcast Equipment Co.
Funke & Associates
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hnat Hindes
Holzberg Inc.
IBSS
Inovonics
Jim Walters Co.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Orban a Division of AKG Acoustics, Inc.
Parcom
Pro Media
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications

NOISE REDUCTION EQUIPMENT
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiotechniques
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
DBX Professional Products
Dolby Laboratories Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Lasalle Music and Pro Audio
Marti Electronics, Inc.
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
UAR Professional Systems
Valley International

P

PATCH PANELS, JACKS, PLUGS, CONNECTORS
Acoustilog, Inc.
ADC Telecommunications, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Accessories
AudioLine, Inc.
Audiotechniques
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Canare Cable Inc.
Commercial Radio Company
Connectronics Corporation
Control Technology Inc.
Dielectric Communications
Downeast Engineering
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Furman Sound, Inc.
Gaines Audio
General Broadcast Supply, Inc.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Jim Walters Co.
Kings Electronics Co., Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Radio Systems
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
TASCAM
Trimm Inc.
Trophpeter Electronics
UAR Professional Systems
Ward-Beck Systems Ltd.
Zercom Corporation

PHASORS
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Broadcast Equipment Sales & Engineering
Broadcasters General Store
Commercial Radio Company
Continental Electronics
Delta Electronics Inc.
Elcom Bauer
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Kintronic Labs
Martin Audio Video Corp
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
RF Systems
Ron Radio Communications

PHONO
Cartridges
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio-Technica U.S., Inc.
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.

World Radio History

RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Stanton Magnetics Inc.
UAR Professional Systems

Turntables and Tone Arms

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiotechniques
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
H & E Micro-trak Corporation
Hall Electronics
Henry Engineering
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Russco Electronics Mfg. Inc.
Sequoia Electronics
UAR Professional Systems

POWER SUPPLIES AND GENERATORS

Allied Broadcast Canada
Allied International
Audio Services Corporation
AVC Systems
Barrett Associates, Inc.
Beckman Industrial Corporation
Best Power Technology, Inc.
Broadcasters General Store
Current Technology, Inc.
Eagle Hill Electronics, Inc.
Full Compass Systems, Ltd.
Gaines Audio
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Holzberg Inc.
J.N.S. Electronics, Inc.
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Nady Systems
OPAMP Inc.
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RTS Systems
Solar SignAge, Inc.
Spectra Sonics
Transtector Systems Inc.
Wide Range Electronics Corporation

PROCESSING

Audio EQ and Limiting

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Aphex Systems, Ltd.
Ashly Audio, Inc.
Audio Broadcast Group, Inc.
Audio Concepts and Engineering Services
Audio Technologies, Inc.
AudioLine, Inc.
Audiologic
Audiomedia
Audiotechniques
Auditronics
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
BSS
Circuit Research Labs
Control Technology Inc.
Cutting Edge Technologies
DBX Professional Products
Delta Electronics Inc.
Dorrough Electronics
Downeast Engineering
Electro-Voice Inc.
Electronic Industries, Inc.
Eventide, Inc.
Eventide Clockworks
Full Compass Systems, Ltd.
Furman Sound, Inc.
General Broadcast Supply, Inc.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hnat Hindes
Holzberg Inc.
Hy James, Inc.
IBSS
Inovonics
J.N.S. Electronics, Inc.
JBL Professional
Jim Walters Co.
Klark Teknik Electronics Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Modulation Sciences, Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Orban a Division of AKG Acoustics, Inc.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Ram Broadcast Systems
Rane Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Sequoia Electronics
Sescom Inc.
Somich Engineering
Symetrix Inc.
UAR Professional Systems
Urei
Valley International
Ward-Beck Systems Ltd.
White Instruments, Div. of Cvan R., Inc.
Yamaha Music Corp. of America

Studio Effects

AKG Acoustics
Allied Broadcast Equipment
Allied International
Aphex Systems, Ltd.
Ashly Audio, Inc.
Audio Broadcast Group, Inc.
Audio Concepts and Engineering Services
Audio/Digital, Inc.
AudioLine, Inc.
Audiologic
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Devices, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Circuit Research Labs
Control Technology Inc.
DBX Professional Products
Douglas Ordon & Company, Inc.
Electronic Industries, Inc.
Eventide, Inc.
Eventide Clockworks
Full Compass Systems, Ltd.
Furman Sound, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Klark Teknik Electronics Inc.
Lasalle Music and Pro Audio
Lexicon Inc.
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Orban a Division of AKG Acoustics, Inc.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Spectra Sonics
UAR Professional Systems
Valley International
Yamaha Music Corp. of America

PROGRAM DISTRIBUTORS AND SERVICES

Broadcast Programming
CaVox/Tape-athon Corporation
Concept Productions
Holzberg Inc.
Kala Music
Music Director Programming Service

PUBLIC ADDRESS (PA) SYSTEMS

Ashly Audio, Inc.
Atlas/Soundolier
Audio Services Corporation
AVC Systems
Bogen Communications, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Control Technology Inc.
Electro-Voice Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Furman Sound, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Hy James, Inc.
JBL Professional
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa

World Radio History

Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
Tape-athon/Cavox
Telectro Systems Corporation

R

RF FILTERS

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AVR Communications Limited
Barrett Associates, Inc.
Bird Electronics Corporation
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Commercial Radio Company
Dielectric Communications
Electronic Industries, Inc.
Electronics Research, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Lasalle Music and Pro Audio
LDL Communications
Microwave Filter
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
RF Systems
Spectra Sonics
Tepco Corporation

RECEIVERS

Radio

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Services Corporation
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bogen Communications, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Control Technology Inc.
Full Compass Systems, Ltd.
Gorman Redlich Mfg. Co.
Grant Becker Enterprises
Hall Electronics
Hamtronics Inc.
Holzberg Inc.
J.N.S. Electronics, Inc.
Jim Walters Co.
Lasalle Music and Pro Audio
Marti Electronics, Inc.
Motorola Inc./AM Stereo
Nady Systems
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Target Tuning, Inc.

Satellite

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Allied Satellite Equipment
Antenna Technology Corporation
AVCOM of Virginia, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Broadcast Services Co.
Control Technology Inc.
Downeast Engineering
Fusion Electronics, Inc.
Grant Becker Enterprises
Holzberg Inc.
Intraplex, Inc.
PARCOM
RF Specialties of Pennsylvania, Inc.
Wegener Communications, Inc.

SCA

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Antenna Technology Corporation
Applied Micro Technology, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Erko Technologies
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Lita Broadcasting Distributors
Marti Electronics, Inc.
Micro Controls, Inc.
Modulation Sciences, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Target Tuning, Inc.

REEL-TO-REEL RECORDERS

Accurate Sound Corporation
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiomedia
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Automation, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
CaVox/Tape-athon Corporation
Continental Electronics
Control Technology Inc.
Downeast Engineering
Electronic Industries, Inc.
Fostex Corp. of America
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Otari Corporation
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Sono-Mag Corporation
Sony Professional Audio
Studer Revox
Tape-athon/Cavox
TASCAM
Telectro Systems Corporation
UAR Professional Systems
Uher of America
VIF International
Wide Range Electronics Corporation

REMOTE CONTROL AND TELEMETRY

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Burk Technology, Inc.
Commercial Radio Company
Continental Electronics
Control Technology Inc.
Delta Electronics Inc.
Downeast Engineering
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Hallikainen & Friends, Inc.
Holzberg Inc.
Hy James, Inc.
Marti Electronics, Inc.
Micro Controls, Inc.
Monroe Electronics, Inc.
Moseley Associates
National Supervisory Network
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Sine Systems, Inc.
Solar SignAge, Inc.
TFT Inc.
Versatech Industries, Inc.

RPU SYSTEMS

Moseley
Marti Electronics
TFT, Inc.

S

SCA EQUIPMENT

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Applied Micro Technology, Inc.
Audio Broadcast Group, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Burk Technology, Inc.
CaVox/Tape-athon Corporation
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.

World Radio History

Erko Technologies
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Marti Electronics, Inc.
McMartin Industries
Micro Controls, Inc.
Modulation Sciences, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Orban a Division of AKG Acoustics, Inc.
Parcom
Pro Media
Professional Audio Supply
Radio Design Labs
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Tape-athon/Cavox
TFT Inc.

SATELLITE EQUIPMENT

Antennas

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Allied Satellite Equipment
Andrew Corporation
Antenna Technology Corporation
Antennas for Communications, Inc.
AVR Communications Limited
Broadcast Services Co.
Comex Worldwide Corporation
Comtech Antenna Systems, Inc.
Downeast Engineering
Environmental Technology, Inc.
Holzberg Inc.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
Satellite Transmission and Reception Specialists (STARS)
Scientific Atlanta

Electronics

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Allied Satellite Equipment
Antenna Technology Corporation
AVC Systems
AVCOM of Virginia, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Comex Worldwide Corporation
Dolby Laboratories Inc.
Downeast Engineering
Guarantee Radio Supply Corporation
Hallikainen & Friends, Inc.
Holzberg Inc.
Intraplex, Inc.
RF Specialties of Pennsylvania, Inc.
Satellite Transmission and Reception Specialists (STARS)
Schafer Digital
Scientific Atlanta
Sine Systems, Inc.
Wegener Communications, Inc.

SPEAKERS AND ENCLOSURES

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Atlas/Soundolier
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiomedia
Auernheimer Labs and Co.
Auratone Corporation
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bogen Communications, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Control Technology Inc.
Douglas Ordon & Company, Inc.
Electro-Voice Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
JBL Professional
Jim Walters Co.
Klark Teknik Electronics Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Nady Systems
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Panasonic/Ramsa
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Spectra Sonics
Tannoy North America
TASCAM
Telectro Systems Corporation
Turbosound
Urei
Wohler Technologies
Yamaha Music Corp. of America

STL EQUIPMENT

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Continental Electronics
Control Technology Inc.
Electronic Industries, Inc.
Funke & Associates
Fusion Electronics, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Graham-Patten Systems
Grant Becker Enterprises
Hall Electronics
Hamtronics Inc.
Holzberg Inc.
Hy James, Inc.
Intraplex, Inc.
Lita Broadcasting Distributors
Litronix Corporation
Marti Electronics, Inc.
Micro Controls, Inc.
Moseley Associates
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Systems Wireless Ltd.
TFT Inc.
Transcom Corporation
Wegener Communications, Inc.

SWITCHERS, AUDIO ROUTING

360 Systems
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
BSM Systems
Chrontrol Corporation
Conex Electro-Systems, Inc.
Control Technology Inc.
Di-Tech Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Gentner Electronics Corporation
GLW Enterprises, Inc.
Grant Becker Enterprises
Grass Valley Group
Hall Electronics
Holzberg Inc.
Hy James, Inc.
International Tapetronics
J.N.S. Electronics, Inc.
Jim Walters Co.
Landy Associates, Inc.
Logitek Electronic Systems Inc.
Martin Audio Video Corp
Micro Controls, Inc.
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Pacific Recorders & Engineering Corp.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Professional Audio Supply
Pyramid Audio, Inc.
Radio Design Labs
Ram Broadcast Systems
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Sine Systems, Inc.
Telfax Communications
Titus Technological Laboratories
Versatech Industries, Inc.
Wheatstone Corporation
Wide Range Electronics Corporation
Yamaha Music Corp. of America

T

TAPE

Cartridge

A/V Technology International, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
AudioLine, Inc.
Audiomedia
Audiopak, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Cartridge Service Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West

World Radio History

Broadcasters General Store
Cart Mart
Control Technology Inc.
Electronic Industries, Inc.
Fidelipac Corporation
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
International Tapetronics
J & I Audio/Video
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
R & A Broadcast Services
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Sequoia Electronics
Tapex Corporation
UAR Professional Systems
Western International

Cassette

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Cartridge Service Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
J & I Audio/Video
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Raks Corporation of America, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Ron Radio Communications
UAR Professional Systems

DAT

A/V Technology International, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Bradley Broadcast Sales
Broadcast Cartridge Service Inc.
Broadcast Equipment Sales & Engineering
Broadcast Supply West
Broadcasters General Store
Concept Productions
Dic Digital
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
J & I Audio/Video
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Music Director Programming Service
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Panasonic/Ramsa
Parcom
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Radio Systems
Raks Corporation of America, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
UAR Professional Systems

Reel-to-Reel

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio Services Corporation
AudioLine, Inc.
Audiopak, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Bradley Broadcast Sales
Broadcast Cartridge Service Inc.
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
J & I Audio/Video
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Music Director Programming Service
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
TASCAM
UAR Professional Systems
VIF International

Cleaners, Erasers, and Evaluators

Accurate Sound Corporation
Allied Broadcast Canada
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audio Concepts and Engineering Services
Audiolab Electronics, Inc.
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Comad Communications Limited
Electronic Industries, Inc.
Fidelipac Corporation
Full Compass Systems, Ltd.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
International Tapetronics
Lasalle Music and Pro Audio
Magnefax International, Inc.
Magnetic Reference Laboratory
Martin Audio Video Corp
Microtran Company
Milam Audio Co.
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
R.B. Annis Co Inc.
Research Technology International
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Standard Tape Laboratory, Inc.
TASCAM
UAR Professional Systems
VIF International
Wide Range Electronics Corporation

Duplicators

Accurate Sound Corporation
Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
AudioLine, Inc.
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Services Co.
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corp.
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Kala Music
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Magnefax International, Inc.
Martin Audio Video Corp
Milam Audio Co.
Music Director Programming Service
National Audio Co. Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Otari Corporation
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Raks Corporation of America, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.

World Radio History

Sony Professional Audio
TASCAM
Telectro Systems Corporation
UAR Professional Systems
Valentino Production Music & Sound

TELEPHONE EQUIPMENT

Hybrids

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio/Digital, Inc.
AudioLine, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Comrex Corporation
Control Technology Inc.
Electronic Industries, Inc.
ESE
Full Compass Systems, Ltd.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Graham-Patten Systems
Grant Becker Enterprises
H & E Micro-trak Corporation
Hall Electronics
Henry Engineering
Holzberg Inc.
Hy James, Inc.
IBSS
Intraplex, Inc.
Jim Walters Co.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Microtran Company
Milam Audio Co.
Monroe Electronics, Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Symetrix Inc.
Telfax Communications
Telos Systems
Time & Temperature Company of S.D.
Tri-Tech, Inc.
Zercom Corporation

Bandwidth Extenders

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
AudioLine, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Comrex Corporation
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Gentner Electronics Corporation
Giesler Broadcasting Supply, Inc.
Graham-Patten Systems
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Jim Walters Co.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Ron Radio Communications
Telfax Communications

TEST EQUIPMENT

Distortion Analyzers

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Amber Electro Design Inc.
Audio Precision
AVC Systems
AVR Communications Limited
Broadcast Services Co.
Broadcast Supply West
Bruel & Kjaer Instruments, Inc.
Commercial Radio Company
Douglas Ordon & Company, Inc.
Electronics Research, Inc.
Electronic Industries, Inc.
Electronics Research, Inc.
Full Compass Systems, Ltd.
Funke & Associates
Guarantee Radio Supply Corporation
Hartmann Associates
Holzberg Inc.
Hy James, Inc.
Landy Associates, Inc.
Martin Audio Video Corp
Northeast Broadcast Lab, Inc.
Parcom
Pierce-Phelps, Inc.
Posthorn Recordings
Potomac Instruments, Inc.
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Sound Technology
TFT Inc.

Oscilloscopes

A/V Technology International, Inc.
Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
AVC Systems
AVR Communications Limited
Beckman Industrial Corporation
BJM Electronics Ltd.
Broadcast Services Co.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Fusion Electronics, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Hartmann Associates
Holzberg Inc.
Northeast Broadcast Lab, Inc.
Pierce-Phelps, Inc.
Professional Audio Supply
Ram Broadcast Systems

RF Radiation Test Gear

Allied Broadcast Canada
Allied International
Bird Electronics Corporation
Commercial Radio Company
Holaday Industries Inc.
Holzberg Inc.
Professional Audio Supply
Radio Design Labs
Research Associates, Inc.
Verda

Spectrum Analyzers

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Amber Electro Design Inc.
Antenna Technology Corporation
Audiotechniques
AVC Systems
AVCOM of Virginia, Inc.
Broadcast Services Co.
Broadcasters General Store
Bruel & Kjaer Instruments, Inc.
Delta Electronics Inc.
Full Compass Systems, Ltd.
Funke & Associates
Fusion Electronics, Inc.
Hartmann Associates
Holzberg Inc.
IFR Systems Inc.
IVIE
Klark Teknik Electronics Inc.
Landy Associates, Inc.
Martin Audio Video Corp
Milam Audio Co.
Pierce-Phelps, Inc.
Posthorn Recordings
Professional Audio Supply
Pyramid Audio, Inc.
Sound Technology
White Instruments

Test Systems

ADC Telecommunications, Inc.
Allied Broadcast Equipment
Allied International
Amber Electro Design Inc.
Audio Precision
AVC Systems
AVR Communications Limited
Beckman Industrial Corporation
Belar Electronics Laboratory, Inc.
Bird Electronics Corporation
Bruel & Kjaer Instruments, Inc.
Commercial Radio Company
Delta Electronics Inc.
Dorrough Electronics
Douglas Ordon & Company, Inc.
Full Compass Systems, Ltd.
Funke & Associates
Gaines Audio
Hall Electronics
Hartmann Associates
Holzberg Inc.
J.N.S. Electronics, Inc.
Landy Associates, Inc.
Northeast Broadcast Lab, Inc.
Parcom
Potomac Instruments, Inc.
Professional Audio Supply
R.B. Annis Co Inc.
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Sescom Inc.
Sound Technology
Tentel Corporation
TFT Inc.
Wohler Technologies

TIME CODE EQUIPMENT

Allied Broadcast Equipment
Allied International
Audio Broadcast Group, Inc.
Audio Services Corporation
Audiotechniques
AVC Systems
AVR Communications Limited
Bradley Broadcast Sales
Broadcast Services Co.
Broadcasters General Store
Control Technology Inc.
Douglas Ordon & Company, Inc.
ESE
Fostex Corp. of America
Full Compass Systems, Ltd.
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
JRF Magnetic Sciences
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Otari Corporation
Parcom
Peavey Electronics Corporation
Posthorn Recordings
Professional Audio Supply
Pyramid Audio, Inc.

World Radio History

Research Associates, Inc.
UAR Professional Systems
Wide Range Electronics Corporation

TIMERS AND CLOCKS

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
American Media Services
Audio Broadcast Group, Inc.
Audiolab Electronics, Inc.
Auditronics
Autogram Corp
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Chrontrol Corporation
Conex Electro-Systems, Inc.
Control Technology Inc.
Electronic Industries, Inc.
ESE
Full Compass Systems, Ltd.
GLW Enterprises, Inc.
Grant Becker Enterprises
Hall Electronics
Holzberg Inc.
Hy James, Inc.
Jim Walters Co.
Landy Associates, Inc.
Martin Audio Video Corp
Monroe Electronics, Inc.
Northeast Broadcast Lab, Inc.
Oakwood Audio Labs Ltd.
Old Dominion Broadcast Eng. Serv.
Pacific Recorders & Engineering Corp.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Radio Design Labs
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Sequoia Electronics
Sine Systems, Inc.
Time & Temperature Company of S.D.

TOOLS AND GAUGES

Audiotechniques
BJM Electronics Ltd.
Brian R. White Co., Inc.
Broadcast Services Co.
Broadcast Supply West
Canare Cable Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Guarantee Radio Supply Corporation
Martin Audio Video Corp
Paladin Corporation
Professional Audio Supply
Vertigo

TOWERS

Allied Broadcast Equipment
Aluma Tower Company, Inc.
American Media Services
Andrew Corporation
Barrett Associates, Inc.
Central Tower, Inc.
Continental Electronics
Electronic Industries, Inc.
ERI Installations
Express Tower Co. Inc.
Fred A. Nudd Corporation
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harmon's Tower Service
Holzberg Inc.
John Nix Co.
LDL Communications
Lita Broadcasting Distributors
Mart Haller Co.-Exporters
Nott Ltd.
Paramound Communication Systems
Parcom
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Southern Tower Service Co., Inc.
Transmission Structures Ltd.
Utility Tower Company
Will-Burt

Guys & Lights

Aluma Tower Company, Inc.
American Media Services
Andrew Corporation
AVR Communications Limited
Barrett Associates, Inc.
Brighter Idea Strobes, Inc.
Central Tower, Inc.
Continental Electronics
Cortland Cable Company
ERI Installations
Express Tower Co. Inc.
Flash Technology
Fred A. Nudd Corporation
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harmon's Tower Service
Holzberg Inc.
John Nix Co.
LDL Communications
Lita Broadcasting Distributors
Mart Haller Co.-Exporters
Paramound Communications Systems
Parcom
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Rick Nudd, Ltd.
Ron Radio Communications
Southern Tower Service Co., Inc.
Transmission Structures Ltd.
Utility Tower Company

Tower Services

Andrew Corporation
Broadcast Communications Systems, Inc.
Central Tower, Inc.
Electronics Research, Inc.
ERI Installations
Express Tower Co. Inc.
Fred A. Nudd Corporation
Guarantee Radio Supply Corporation
Harmon's Tower Service
Holzberg Inc.
John Nix Co.
LDL Communications
Old Dominion Broadcast Eng. Serv.
Paramound Communications Systems
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Southern Tower Service Co., Inc.
Transmission Structures Ltd.
Utility Tower Company

TRAFFIC

Columbine Systems Inc.
Custom Business Systems, Inc.
The Management

TRANSFORMERS

Audio

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Audio Services Corporation
Barrett Associates, Inc.
BJM Electronics Ltd.
Bogen Communications, Inc.
Broadcasters General Store
Commercial Radio Company
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Jensen Transformers Inc.
Martin Audio Video Corp
Microtran Company
Milam Audio Co.
Old Dominion Broadcast Eng. Serv.
OPAMP Inc.
Parcom
Peavey Electronics Corporation
Peter W. Dahl Co., Inc.
Pierce-Phelps, Inc.
Professional Audio Supply
Radio Design Labs
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
Riggins Electronic Sales
Ron Radio Communications
Russco Electronics Mfg. Inc.
Sescom Inc.
Spectra Sonics

RF

Allied Broadcast Canada
Allied Broadcast Equipment
Allied International
Broadcasters General Store
Commercial Radio Company
Control Technology Inc.
Delta Electronics Inc.
Electronics Research, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Hy James, Inc.
Lita Broadcasting Distributors
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Systems

TRANSLATORS, COMBINERS

LDL Communications
TEPCO Corp

TRANSMISSION LINE

Flexible Cable, Waveguide

Allied Broadcast Canada
Allied Broadcast Equipment
American Media Services
Andrew Corporation
Antennas for Communications, Inc.
AVR Communications Limited
Barrett Associates, Inc.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Cablewave Systems
Commercial Radio Company
Continental Electronics
Dielectric Communications
Electronic Industries, Inc.
Electronics Research, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Hall Electronics
Holzberg Inc.
Hy James, Inc.
LDL Communications
Lita Broadcasting Distributors
Myat, Inc.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.

World Radio History

Ron Radio Communications
Scala Electronic Corporation
Transcom Corporation

TRANSMITTERS

AM

0-100 watts

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
CCA Electronics
Continental Electronics
Control Technology Inc.
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harris Corp
Holzberg Inc.
IBSS
LPB, Inc.
McMartin Industries
Nautel, Ltd.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

100-1kW

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
CCA Electronics
Comex Worldwide Corporation
Commercial Radio Company
Continental Electronics
Control Technology Inc.
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harris Corp
Holzberg Inc.
Hy James, Inc.
Lita Broadcasting Distributors
McMartin Industries
Nautel, Ltd.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

1kW-50kW

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
CCA Electronics
Commercial Radio Company
Continental Electronics
Control Technology Inc.
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
Fusion Electronics, Inc.
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harris Corp
Holzberg Inc.
Hy James, Inc.
Lita Broadcasting Distributors
Litronix Corporation
McMartin Industries
Nautel, Ltd.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

50kW +

Allied Broadcast Canada
Allied Broadcast Equipment
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
CCA Electronics
Continental Electronics
Control Technology Inc.
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Guarantee Radio Supply Corporation
Harris Corp
Holzberg Inc.
McMartin Industries
Nautel, Ltd.
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Transcom Corporation
TTC Wilkinson

0-100 watts

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
CCA Electronics
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Downeast Engineering
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Harris Corp
Holzberg Inc.
IBSS
Lita Broadcasting Distributors
Litronix Corporation
McMartin Industries
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
QEI Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

FM

100-1kW

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Supply West
Broadcasters General Store
CCA Electronics
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Downeast Engineering
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Harris Corp
Holzberg Inc.
IBSS
Landy Associates, Inc.
Lita Broadcasting Distributors
Litronix Corporation
McMartin Industries
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
QEI Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

1kW-10kW

Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Supply West
Broadcasters General Store
CCA Electronics
Comad Communications Limited
Continental Electronics
Control Technology Inc.
Downeast Engineering
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Harris Corp
Holzberg Inc.
IBSS
Landy Associates, Inc.
Lita Broadcasting Distributors
Litronix Corporation
McMartin Industries
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
QEI Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications

World Radio History

Transcom Corporation
TTC Wilkinson

10kW +
Allied Broadcast Canada
Allied Broadcast Equipment
Audio Broadcast Group, Inc.
Audiomedia
AVR Communications Limited
Barrett Associates, Inc.
Bext Inc.
Bradley Broadcast Sales
Broadcast Electronics
Broadcast Equipment Sales & Engineering
Broadcast Supply West
Broadcasters General Store
CCA Electronics
Continental Electronics
Control Technology Inc.
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
Fusion Electronics, Inc.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Harris Corp
Holzberg Inc.
Landy Associates, Inc.
Lita Broadcasting Distributors
Litronix Corporation
McMartin Industries
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Professional Audio Supply
QEI Corporation
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Ron Radio Communications
Transcom Corporation
TTC Wilkinson

0-1kW
Allied Broadcast Equipment
CCA Electronics
Continental Electronics
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
Guarantee Radio Supply Corporation
Harris Corp
Lita Broadcasting Distributors
Nautel, Ltd.
Old Dominion Broadcast Eng. Serv.
Transcom Corporation
TTC Wilkinson

1kW-50kW
Allied Broadcast Equipment
CCA Electronics
Continental Electronics
Elcom Bauer
Energy-Onix Broadcast Equipment Co.
Harris Corp
Lita Broadcasting Distributors
Nautel, Ltd.
Old Dominion Broadcast Eng. Serv.
Transcom Corporation
TTC Wilkinson

50kW +
Allied Broadcast Equipment
CCA Electronics
Continental Electronics
Energy-Onix Broadcast Equipment Co.
Harris Corp
Nautel, Ltd.
Old Dominion Broadcast Eng. Serv.
Transcom Corporation
TTC Wilkinson

TUBES

Transmitting
American Media Services
AVR Communications Limited
BJM Electronics Ltd.
Broadcast Supply West
Commercial Radio Company
Continental Electronics
Control Technology Inc.
Econco
Electronic Industries, Inc.
Freeland Products, Inc.
Fusion Electronics, Inc.
Giesler Broadcasting Supply, Inc.
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Lita Broadcasting Distributors
Litronix Corporation
Mart Haller Co.-Exporters
Old Dominion Broadcast Eng. Serv.
PARCOM
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Richardson Electronics
Richardson Electronics Ltd.
Thor Electronics Corp.
Vacuum Tube Industries, Inc.

Receiving
American Media Services
BJM Electronics Ltd.
Commercial Radio Company
Electronic Industries, Inc.
Fusion Electronics, Inc.
Guarantee Radio Supply Corporation
Lita Broadcasting Distributors
Mart Haller Co.-Exporters
Martin Audio Video Corp
Old Dominion Broadcast Eng. Serv.
Professional Audio Supply
Richardson Electronics
Richardson Electronics Ltd.
Thor Electronics Corp.
Vacuum Tube Industries, Inc.

W
WARNING LIGHTS, STUDIO

Enberg Electronics
Fidelipac
Titus Tech Labs

WIRE

Audio
Allied Broadcast Canada
Allied Broadcast Equipment
American Media Services
AudioLine, Inc.
Audiotechniques
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
Beyer Dynamic Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Canare Cable Inc.
Commercial Radio Company
Connectronics Corporation
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Northeast Broadcast Lab, Inc.
Old Dominion Broadcast Eng. Serv.
Parcom
Peavey Electronics Corporation
Pierce-Phelps, Inc.
Posthorn Recordings
Pro Media
Professional Audio Supply
Pyramid Audio, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Spectra Sonics
Thor Electronics Corp.

Coax
Allied Broadcast Equipment
American Media Services
AVC Systems
AVR Communications Limited
Barrett Associates, Inc.
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Broadcast Supply West
Broadcasters General Store
Cablewave Systems
Canare Cable Inc.
Commercial Radio Company
Connectronics Corporation
Downeast Engineering
Electronic Industries, Inc.
Full Compass Systems, Ltd.
General Broadcast Supply, Inc.
Giesler Broadcasting Supply, Inc.
Grant Becker Enterprises
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Hy James, Inc.
IBSS
Landy Associates, Inc.
Lasalle Music and Pro Audio
Lita Broadcasting Distributors
Martin Audio Video Corp
Milam Audio Co.
Old Dominion Broadcast Eng. Serv.
Parcom
Pierce-Phelps, Inc.
Pro Media
Professional Audio Supply
Research Associates, Inc.
RF Specialties of Pennsylvania, Inc.
RF Specialties of Washington, Inc.
Riggins Electronic Sales
Scala Electronic Corporation
Thor Electronics Corp.
Trophpeter Electronics

Other
Allied Broadcast Canada
Allied Broadcast Equipment
American Media Services
Audiotechniques
AVR Communications Limited
BJM Electronics Ltd.
Bradley Broadcast Sales
Broadcast Equipment Sales & Engineering
Broadcast Services Co.
Canare Cable Inc.
Commercial Radio Company
Connectronics Corporation
Control Technology Inc.
Electronic Industries, Inc.
Full Compass Systems, Ltd.
Guarantee Radio Supply Corporation
Hall Electronics
Holzberg Inc.
Landy Associates, Inc.
Lasalle Music and Pro Audio
Martin Audio Video Corp
Old Dominion Broadcast Eng. Serv.
PARCOM
Pro Media
Professional Audio Supply
RF Specialties of Pennsylvania, Inc.
Thor Electronics Corp.

World Radio History

A

A/V Technology Intl
PO Box 275
Newton Centre, MA 02159
Contact: Gerard Abeles, Pres
617-965-5656 FAX: 617-965-1865

ADC Telecommunications
4900 W 78th St
Minneapolis, MN 55435
Contact: Lynne High
800-255-3891 FAX: 612-893-3292

AEG Bayly Inc
167 Hunt St
Ajax, Ontario, L1S 1P6 Canada
Contact: Allan P Proctor
416-683-8200 FAX: 416-683-8186

AKG Acoustics
77 Selleck St
Stamford, CT 06902
Contact: Tim Derwallis
203-348-2121 FAX: 203-324-1942

ANT Telecommunications Inc
211 Perry Pkwy, Ste 4
Gaithersburg, MD 20877
Contact: Natalie Hutson
301-670-9777

ART, Applied Research & Technology
215 Tremont St
Rochester, NY 14608
716-436-2720

ASC - Tube Traps
P.O. Box 1189
Eugene, OR 97440
Art Noxon, President

ATI (Audio Technologies Inc)
328 W Maple Ave
Horsham, PA 19044
Contacts: Sam Wenzel/Ed Mullin
215-443-0330 FAX: 215-443-0394

AVAB America Inc
967 Howard St
San Francisco, CA 94103
415-421-3562

AVC Systems, Division of Vaughn Communications
7901 Computer Ave So
Minneapolis, MN 55435
Contact: Jack Dailey
612-832-3232 FAX: 612-831-0791

AVCOM of Virginia Inc
500 Southlake Blvd
Richmond, VA 23236
804-794-2500 FAX: 804-794-8284

AVR Communications, Ltd. (East)
595 Middlefield Road, Unit 8
Scarborough, Ontario, CANADA
MIV 3S2
Ian Schmidt, Eastern Sales Manager
1-416-297-9377 FAX: 416-297-4757

AVR Communications, Ltd. (West)
2615 126 Ave., S.W.
Calgary, Alberta, CANADA T2W 3V5
Wilf Rice, Western Sales Manager
1-403-251-0707 FAX: 403-281-2695

AVR Grp/Audio Video Research
5 Walnut Terr
Newton, MA 02160

Absolute Broadcast Automation
82 Main St
Westernport, MD 21562
Contact: Jack Mullen, Jr
301-786-4661

Accu-Weather Inc
619 W College Ave
State College, PA 16801
814-237-0309

Accurate Sound Corp
3515 Edison Way
Menlo Park, CA 94025
415-365-2843 FAX: 415-365-3057

Acoustic Systems
415 East St Elmo Rd
Austin, TX 78745
Contact: Tim Jarvis, Sales Mgr
800-531-5412 FAX: 512-444-2282

Acoustilog, Inc.
19 Mercer St
New York, NY 10013
Contact: Alan Fierstein, Pres
212-925-1365

Acoustionics Sound/Shelex
PO Box 3752
Hollywood, CA 90078
Contact: Shelly A Herman, Owner

Adams-Smith
34 Tower St
Hudson, MA 01749
617-562-3801

Adelphon
PO Box 7256
Ft Worth, TX 76111
Contact: Henry Mcginnis, Pres
817-335-8666

Agfa-Gevaert Inc Magnetic Tape Div
275 North St
Teterboro, NJ 07608
201-288-4100

Aiphone Intercom Systems
1700 130th Ave NE
Bellevue, WA 98005
206-455-0510

Airforce Broadcast Services, Inc.
216 Carlton Street
Toronto, Ontario, CANADA M5A 2L1
Richard Loth, Director of Mktg & Sales
1-416-961-2541 FAX: 416-961-7754

Air System Technologies, Inc.
14232 Marsh Lane, Suite 339
Dallas, TX 75234
Contact: Tom Becker, Pres.
214-402-9660 800-828-6302

Alden Electronics Inc
40 Washington St
Westboro, MA 01581
617-366-8851

Dan Alexander Audio
2944 San Pablo Avenue
Berkeley, CA 94702
Contact: Dan Alexander
415-644-2363 FAX: 415-644-1848
TWX:

Allen & Heath
5 Connair Road
Orange, CT 06477
Charles Augustowski, V.P./Sales Mgr.
203-795-3594 FAX: 203-795-6814

Allied Broadcast Equipment, Atlanta
Shannon Towers
4405 Mall Blvd Ste 125
Union City, GA 30291
Contacts: John Timm, Judy Spell, Mark Drummond
800-622-0022 FAX: 404-964-2820

Allied Broadcast Equipment, Canada
10 Pearce St Unit 6
Richmond Hill, ONT L4B 1B6
Canada
416-731-3697 FAX: 416-764-0729

Allied Broadcast Equipment, Chicago
5215 Old Orchard Rd Ste 970
Skokie, IL 60077
Contacts: John Grayson, Tom Harle, Rick Funk, Dave Buck
800-622-0022 FAX: 312-470-9017

Allied Broadcast Equipment, Dallas
Community Credit Union Bldg
1101 E Plano Pkwy Ste B
Plano, TX 75074
Contacts: Pat Hurley, Tom Lewis
800-622-0022 FAX: 214-578-9162

Allied Broadcast Equipment, Los Angeles
3808 Riverside Dr Ste 203
Burbank, CA 91505
Contacts: Tony Mezey, Jr., Rick Sietsema, Cal Vandegrift
800-622-0022 FAX: 818-843-5145

Allied Broadcast Equipment, Richmond
3712 National Rd West (Corp Hq)
PO Box 1487
Richmond, IN 47374
Contacts: Scott Beeler, Dave Gill, Chuck Maines, Bob Groome
800-622-0022 FAX: 317-962-8961

Allied Broadcast Systems, Bryan
PO Box 4551
Bryan, TX 77805-4551
Contact: Steve Sampson
800-622-0022 FAX: 409-268-0113

Allied Broadcast Systems, Newport Beach
4500 Campus Drive Ste 202
Newport Beach, CA 92660
Contact: Chuck Rockhill, Dir of Systems Sales
800-622-0022 FAX: 714-752-0855

Allied Bulletin Board
EM: 317-935-0531

Allied Emergency Services
3712 National Rd West
Richmond, IN 47374
Contact: Glenn Rawlings
317-935-0455

Allied International
3712 National Rd West
Richmond, IN 47374
Contact: Joe Ziemer
317-935-1704 FAX: 317-962-8961

Allied Satellite Equipment
3712 National Rd West
Richmond, IN 47374
800-622-0322 FAX: 317-966-6321

Allied Used Equipment
3712 National Rd West
Richmond, IN 47374
800-622-0022 FAX: 317-966-6321

Alpha Audio
2049 W Broad St
Richmond, VA 23220
Contact: Kathy Wynne/Bobbi Winn
804-358-3852 FAX: 804-358-9496

Altec Lansing Corp
PO Box 26105
Oklahoma City, OK 73126-0105
405-324-5311

Altronic Research Inc
PO Box 249
Yellville, AR 72687
Contact: Alice Miligan
501-447-4093 FAX: 501-449-4091

Aluma Tower Co Inc
PO Box 2806
Vero Beach, FL 32961-2806
Contact: T.E. Gottry, VP/General Manager
407-567-3423 FAX: 407-567-3432

Amber Electro Design
3391 Griffith St
St Laurent Pq, H4T 1W5 Canada
Contact: Wayne Jones
514-735-4105 FAX: 514-340-1468

Amco Engineerig
3801 N Rose St
Schiller Park, IL 60176
Contact: Jim Walenda, Mktg
312-671-6670 FAX: 312-671-9469

Amek/Tac US Operations
10815 Burbank Blvd
N Hollywood, CA 91601
Contact: Sue Jones
818-508-9788 FAX: 818-508-8619

American Media Services
P.O. Box 1953, 4817 Panola Drive
Ft. Worth, TX 76101
Genie Sims, Owner
817-535-1953 800-356-1953
FAX: 817-536-1953

Amp Services
224 Datura St #614
W Palm Beach, FL 33401
Contact: Chris Rappolt, Mktg Mgr
407-659-4805

Amperex Electronics Corp Klystron Division
230 Duffy Ave
Hicksville, NY 11802
516-931-6200

Amperex Electronics Corp
Providence Pike
Slatersville, RI 02876
Contact: Greg J Murphy
401-762-3800

Ampex Corp Magnetic Tape Div
401 Broadway M/S 22-02
Redwood City, CA 94063
Contact: Phil Ritte, Dir Mktg
415-367-3888 FAX: 312-593-6000

Amtel Systems Inc
33 Main St
Nashua, NH 03060
603-880-9011

Analog Digital Synergy, Inc.
120 S.W. 21 Terrace, C-104
Fort Lauderdale, FL 33312
Lutz Meyer, President
305-791-1501 FAX: 305-791-8986

Andrew Corp
10500 W 153rd St
Orland Park, IL 60462
Contact: Jerry Tuttle, Mktg Mgr
708-349-3300 FAX: 708-349-5943

World Radio History

R B Annis Co
1101 N Delaware St
Indianapolis, IN 46202
Contact: R.B. Annis, President
317-637-9282 FAX: 317-637-9282

Anritsu America Inc
15 Thornton Rd
Oakland, NJ 07436
201-337-1111

Antenna Technology Corp
1140 East Greenway St.
Mesa, AZ 85203
Contact: Gary Hatch,
Dir of Sls & Mktg
602-264-7275 FAX: 602-898-7667

Antennas For Communications
334 Cypress Rd
Ocala, FL 32672-3198
904-687-4121 FAX: 904-687-1203

Anvil Cases
PO Box 888
Rosemead, CA 91770
Contact: Dean Marlon, Ad Dept

Aphex Systems Ltd
11068 Randall St
Sun Valley, CA 91352
818-767-2929 FAX: 818-767-2641

Apple Frequency Measuring Svc
PO Box 997
Burlington, NC 27216
919-584-0448

Applied Digital Technology Inc
39 West 14th St
New York, NY 10011
212-929-2360

Applied Micro Technology
3116 Merriam Lane
Kansas City, KS 66106
Contact: Steve Hathaway, Engr Mgr
913-362-9422 FAX: 913-262-5115

Arben Design
600 W Roosevelt Rd
W Chicago, IL 60185
312-231-5077

Arrakis Systems Inc
2619 Midpoint Dr
Ft Collins, CO 80525
Contact: Michael Palmer
303-224-2248 FAX: 303-493-1076

The Art Studio
1300 Timberline Office Park
Austin, TX 78746
Contact: Jack Wilson

Artel Communications Corp
22 Kane Industrial Dr
Hudson, MA 01749
Contact: C R Paulson, Dir Mktg

Asaca/Shibasoku Corp
12509 Beatrice St
Los Angeles, CA 90066
Contact: Bruce Cope, VP Mktg/Engr
213-827-7144

Ashley Audio
100 Fernwood Ave
Rochester, NY 14621
Contact: Robert French,
Sr VP Mktg
716-544-5191 FAX: 716-266-4589

Associated Production Music
888 Seventh Ave
New York, NY 10106
212-977-5680

Atlantic Research Corp
5390 Cherokee Ave
Alexandria, VA 22312
703-642-4000

Atlas/Soundolier
1859 Intertech Dr
Fenton, MO 63026
Contact: Herbert M Jaffee, VP
314-349-3110 FAX: 314-349-1251

Auburn Instruments
107 Church St
Watertown, MA 02172
617-923-4747

Audi-Cord Corp
A1845 West Hovey Ave
Normal, IL 61761
Contact: Carol A Williams
309-452-9461 FAX: 309-452-0893

Audico Inc
219 Crossen Ave
Elk Grove Village, IL 60007
Contact: William R Hinkle, Pres
312-640-1030

Audient Marketing Services
POB 7217
Mission Hills, CA 91346
Contact: Erika Lopez

Audio & Design
PO Box 786
Bremerton, WA 98310
206-275-5010

Audio Accessories Inc
Mill St
Marlow, NH 03456
Contact: Timothy J Symonds,
Ops Mgr
603-446-3335 FAX: 603-446-7543

Audio Broadcast Group Inc
2342 S Division Ave
Grand Rapids, MI 49507
Contact: David E Veldsma
616-452-1596 FAX: 616-452-1652

Audio Concepts & Engineering Services
P.O. Box 459
Mechanicsville, VA 23111
Jeff Loughridge, President
804-550-3337

Audio Digital Inc
1000 S Bertelsen No 4
Eugene, OR 97402-5421
G Hardesty, President
503-687-8412 800-423-1082
FAX: 503-687-0632

Audio Eng Assoc
1029 N Allen Ave
Pasadena, CA 91104
Contact: Wes Dooley, Pres

Audio Logic
5639 South Riley Lane
Salt Lake City, UT 84107
Contact: Dean Stubbs
801-268-8400 FAX: 603-672-4246

Audio Precision
PO Box 2209
Beaverton, OR 97075
Contact: Thomas Minter,
Dir of Sales & Mktg, U.S.A.
503-627-0832 FAX: 503-641-8906

Audio Service Corp
10639 Riverside Dr
N Hollywood, CA 91602
818-980-9891 FAX: 818-980-9911

Audio-Technica U S, Inc
1221 Commerce Dr
Stow, OH 44224
Contact: Mark Taylor, Prod Assistant
216-686-2600 FAX: 216-688-3752

Audio-Video Engineering Co
65 Nancy Blvd
Merrick, NY 11566
516-546-4239

Audio/Digital Inc
1000 S Bertelsen Rd Ste 4
Eugene, OR 97402
Contact: Kathleen Gallagher
800-423-1082 FAX: 503-687-0632

Audioforce
37 W 20 St
New York, NY 10011
Contact: Sid Zimet, Sales Mgr

Audiolab Electronics Inc
5831 Rosebud Lane, Bldg C
Sacramento, CA 95864
Contact: Ron Stofan, VP
916-348-0200 FAX: 916-348-1512

Audioline Inc
2323J Bluemound Rd
Waukesha, WI 53186
Contact: Barbara Gutknecht,
Mktg Dir
414-785-9166 FAX: 414-785-0789

Audiomedia Associates
PO Box 29264
New Orleans, LA 70189
Contact: Corey Meyer, Pres
504-586-0140

Audiopak Inc
PO Box 3100
Winchester, VA 22601
Contact: Gordon Stafford,
VP Sales
818-240-0282 FAX: 703-667-6379

Audiotechniques Inc
1619 Broadway
New York, NY 10019
Contact: Robert Berliner, VP/GM
212-586-5989 FAX: 212-489-4936

Audisar Inc
PO Box 1561
Bellevue, WA 98009
Contact: Robert Munger
206-868-5217

Auditronics Inc
3750 Old Getwell Rd
Memphis, TN 38118
Contact: Murray Shields,
Dir of Sales
901-362-1350 FAX: 901-365-8629

Audix Corp
5635 W. Las Positas Blvd
Pleasanton, CA 94566
415-463-1112 FAX: 415-463-2149

Auernheimer Labs & Co
4561 E Florence Ave
Fresno, CA 93725
Contact: Curley Auernheimer,
Owner
209-442-1048

Auratone Corp
PO Box 698
Coronado, CA 92118
Contact: Jack Wilson, Pres
619-297-2820 FAX: 619-296-8743

Autogram Corp
1500 Capital Ave
Plano, TX 75074
Contact: Ernie T Ankele Jr, Pres
214-424-8585 800-327-6901

B

B & K Precision
6460 W Cortland
Chicago, IL 60635
Contact: Martin Plude, Adv Mgr
312-889-9087

B&B Systems
28111 North Ave Stanford
Valencia, CA 91355
Contact: B Burnsed, Pres

BGW Systems Inc
13130 S Yukon Ave
Hawthorne, CA 90250
Contact: Brian Wachner, Pres
213-973-8090 FAX: 213-676-6713

BJM Electronics Ltd
2589 Richmond Terrace
Staten Island, NY 10303
Contact: Ed Knieriem
718-442-0223 FAX: 718-442-1451

BSM Systems Inc
PO Box 19007
Spokane, WA 99219
Contact: Marceen Zappone,
Sls Mgr
509-838-0110 FAX: 509-624-2941

BSS
30 B Banfi Plaza North
Farmingdale, NY 11735
Contact: Dave Talbot, Product Mgr
516-249-3660 FAX: 516-420-1863

BSW (Broadcast Supply West)
7012 27th St West
Tacoma, WA 98406
Contact: Patrick Medved, VP Sales
800-426-8434 FAX: 206-565-8114

Bald Mountain Lab
230 Bellevue Rd
Troy, NY 12180
Contact: Robert Henry
315-279-9753

Barcus-Berry Electronics Inc
5500 Bolsa Ave Ste 245
Huntington Beach, CA 92649
Contact: William Matthies, VP
Sales 800-233-8346

Barrett Associates Inc
3205 Production Ave
Oceanside, CA 92054
Contact: Barrett Meyer
619-433-5600

Basys Inc
900 N Shoreline Blvd
Mountain View, CA 94043
Contact: Peter Kolstad
415-969-9810

Basys International
45 Mortimer St
London, WIV 1PF England

Beckman Industrial Corp
3883 Ruffin Rd
San Diego, CA 92123
619-495-3200 FAX: 619-268-0172

Belar Electronics Laboratory Inc
119 Lancaster Ave
Devon, PA 19333
Contact: Arno Meyer, Pres
215-687-5550 FAX: 215-687-2686

Belden Electronic Wire & Cable
PO Box 1980
Richmond, IN 47375
Contact: Bill Hayes, Mktg
Communications Mgr
317-983-5200

Dick Bellow Sales Inc
13405 Floyd Cir Ste 102
Dallas, TX 75243
Contact: Sales Mgr

Benchmark Media Systems Inc
3817 Brewerton Rd
N Syracuse, NY 13212
Contact: David May
315-452-0400 FAX: 315-452-1316

Benchmark Snd Co
3819 Brewerton Rd
N Syracuse, NY 13212
Contact: Allen H Burdick, Owner

World Radio History

M A Benington Inc
2459 Cuchura Dr
Birmingham, AL 35244
Contact: Mike Benington, Pres

Besco International
5946 Club Oaks Dr
Dallas, TX 75248
Contact: Richard Witkovski, Pres

Best Power Technology, Inc
PO Box 280
Necedah, WI 54646
608-565-7200 FAX: 608-565-2221

Bext Inc
739 Fifth Ave #7a
San Diego, CA 92101
Contact: Anne De Fazio, Pres
619-239-8462 FAX: 619-239-8474

Beyer Dynamic Inc
5-05 Burns Ave
Hicksville, NY 11801
Contact: Mike Solomon, Mktg Mgr
516-935-8000 FAX: 516-935-8018

Bird Electronic Corp
30303 Aurora Rd
Solon, OH 44139
Contact: William F. Kail,
Dir Domestic Sales
216-248-1200 FAX: 216-248-5426

Bogen Communications, Inc
50 Spring St, PO Box 575
Ramsey, NJ 07446
Contact: David A. Chambers,
Dir of National Sales
201-934-8500 FAX: 201-934-9832

Bogner Broadcast Equipment
603 Cantiague Rock Rd
Westbury, NY 11590
Contact: Leonard King
516-997-7800

Bonneville Prod
130 Social Hall Ave
Salt Lake City, UT 84111
Contact: Douglas Borba, Mktg Dir
801-237-2400

Boonton Electronics Corp
791 State Highway 10
Randolph, NJ 07869
201-584-1077

Boynton Studio Inc
Melody Pines Farm
Morris, NY 13808
Contact: Roger Boynton
607-263-5695 FAX: 607-263-2373

Bradley Broadcast Sales
8101 Cessna Ave
Gaithersburg, MD 20879
Contact: Neil Glassman, Sls Mgr
301-948-0650 800-732-7665
FAX: 301-330-7198

Bretford/Knox
9715 Soreng Ave
Schiller Park, IL 60176
312-678-2545

Brighter Ideas Strobes
P.O. Box 54
Verona, WI 53593
Contact: Jeff Crooks, Pres
608-845-6753 FAX: 608-845-5413

Broadcast Audio Corp
11306 Sunco Dr
Rancho Cordova, CA 95742
Contact: John Fernandez
916-635-1048 FAX: 916-638-0512

Broadcast Automation Inc
4125 Keller Springs Ste #122
Dallas, TX 75244
Contact: Wayne Duncan/
Earl Bullock
214-380-6800 FAX: 214-380-0823

Broadcast Cartridge Service
15131 Triton Ln Ste 108
Huntington Beach, CA 92649
Contact: Lora L. Crafton, Pres
714-898-7224 FAX: 714-891-6977

Broadcast Circuit Systems
2250 Lake Ave #110
Ft Wayne, IN 46805
Contact: J Didier

Broadcast Comm Systems Inc
PO Box 131
Verona, WI 53593-0131
Contact: John Crooks, VP
608-845-6755 FAX: 608-845-5413

Broadcast Devices Inc
5 Crestview Ave
Peeksville, NY 10566
Contact: Bob Tarsio
914-737-5032

Broadcast Electronics Inc
PO Box 3606
Quincy, IL 62305
Contact: Curtis I Kring
217-224-9600 FAX: 217-224-9607

Broadcast Equipment & Supply Co Inc
Box 3141
Bristol, TN 37620
Contact: Cliff Droke, Pres
615-878-2531

Broadcast Equipment Sales & Engineering Inc
PO Box 20331
Jackson, MS 39202-1331
Contact: Jeffery Corkren, Pres
601-857-8573 FAX: 601-857-2346

Broadcast Microwave Services Inc
7322 Convoy Ct
San Diego, CA 92111
619-560-8601

Broadcast Programming
2211 Fifth Ave
Seattle, WA 98121
Contact: Edith Hilliard, Gen Mgr
206-728-2741 800-426-9082
WA ST 800-255-8511 FAX:
206-441-6582

Broadcast Services Co
Rt 3 Box 45E
Four Oaks, NC 27524
Contact: Neal Davis, Owner
919-934-6869 FAX: 919-934-1537

Broadcast Services Inc
2877 Kalakaua Ave
Honolulu, HI 96815
Contact: Alan Roycroft
808-521-6311

Broadcast Systems Inc
8222 Jamestown Dr
Austin, TX 78758
800-531-5232

Broadcast Tech Partners
1 Fawcett Place
Greenwich, CT 06836
Contact: Mr Eugene Cooper

Broadcast Technology of Colorado
PO Box 1310
Gunnison, CO 81230
Contact: Barbara J Bowman
303-641-5503 FAX: 303-641-3094

Broadcasters General Store
2480 SE 52nd St
Ocala, FL 32671
Contact: Chris Shute
904-622-9058 FAX: 904-629-7000

Browning Labs
8151 NW 74th Ave
Miami, FL 33166
Contact: Robert Brown, Pres

Bruel & Kjaer Instruments
185 Forrest St
Marlboro, MA 01752
Contact: J A Pelz, Adv Mgr
508-481-7000 FAX: 508-485-0519

Bryston/Bryston Vermont Ltd
979 Franklin Ln
Maple Glen, PA 19002
Contact: Martin Bartelstone, VP
800-673-2899

Bud Industries Inc
4605 East 355th St
Willoughby, OH 44094
216-946-3200

Burk Technology
7 Lomar Dr
Pepperell, MA 01463
Contact: Peter Burk, Pres
508-433-8877 800-255-8090
FAX: 508-433-8981

Burlington Audio/Video Tapes Inc
106 Mott St
Oceanside, NY 11572
Contact: Rudy Schwartz
800-331-3191 FAX: 516-678-2503

C

CBSI (Custom Business Systems Inc)
PO Box 67
Reedsport, OR 97467
Contact: Steve Kenagy, VP Mktg
503-271-3681 FAX: 503-271-5721

CCA Electronics Inc
PO Box 426
Fairburn, GA 30213
Contact: Ron Baker, Pres
404-964-3530 FAX: 404-964-2222

CCI
2001 Hickory Valley Rd #C
Chattanooga, TN 37421
Contact: John Brady, Pres

CRL (Circuit Research Labs)
2522 W Geneva
Tempe, AZ 85282
Contact: William Ammons
800-535-7648 FAX: 602-438-8227

CSI Electronics Inc
PO Box 965
Highland City, FL 33846-0965
Contact: Jorge Bicocchi, Mktg Mgr
813-647-1904

CTI Installations Inc
PO Box 530
Newburgh, IN 47629-0530
Contact: Ray R. Ryan, Pres
1-812-853-0595 FAX: 812-853-6652

CaVox/Tape-Athon Corp
13633 Crenshaw Blvd
Hawthorn, CA 90250
213-676-6752 FAX: 213-676-9532

Cablewave Systems Inc
60 Dodge Ave
North Haven, CT 06473
Contact: W P Meola,
National Sales Mgr
203-239-3311 FAX: 203-234-7718

Caig Labs
PO Box J
Escondido, CA 92025
Contact: M Lohkemper, Mgr
619-743-7143 FAX: 619-743-2460

California Microwave
990 Almanor Ave
Sunnyvale, CA 94086
408-720-6229

Calrec Audio
PO Box 786
Bremerton, WA 98310
206-275-5009

Calzone Case Co
225 Black Rock Ave
Bridgeport, CT 06605
203-367-5766

Canare Cable Inc
511 5th St #G
San Fernando, CA 91340
Contact: Barry Brenner, GM
818-365-2446 FAX: 818-365-0479

Capitol Production Music
1750 N Vine St
Hollywood, CA 90028
213-461-2701

Carolina Maps
PO Box 8026
Greenville, NC 27835
Contact: Rick Lanham
919-757-0279 FAX: 919-752-9155

Carvin Corp
1155 Industrial Ave
Escondido, CA 92025
619-747-1710

Catel Telecommunications Inc
4050 Technology Blvd
Fremont, CA 94537
Contact: Julie Latchford,
Customer Svc
415-659-8988

CeCo Communications Broadcast Div
2115 Ave X
Brooklyn, NY 11235
Contact: Tony Ianna, Ad Mgr
718-646-6300

Celwave
Route 79
Marlboro, NJ 07746
Contact: Steve Oldinger, Ad Mgr
201-462-1880 FAX: 201-462-6919

Central Tower Inc
PO Box 530
Newburgh, IN 47630
Contact: Nancy Ryan
812-853-0595 FAX: 812-853-6652

Century 21 Programming Inc
14444 Beltwood Parkway
Dallas, TX 75244
Contact: Dave Scott, Pres
800-937-2100 FAX: 214-392-2100

Cetec Vega
9900 Baldwin Pl
El Monte, CA 91731
Contact: Ken Bourne, Mktg Dir
818-442-0782 FAX: 818-444-1342

Champion Motor Coach Inc
5573 North St
Dryden, MI 48428
Contact: Paul Degrieck, Mktg Mgr

Jules Chen & Assoc
1730 M St Ste 400
Washington, DC 20032

Chester Cable Div Celwave Systems
PO Drawer D
Chester, NY 10918
914-469-2141

Chrontrol Corp
9707 Candida St
San Diego, CA 92126
Contact: Michelle DuBreiul,
Mktg Dir
619-566-5656 FAX: 619-566-0140

Clarcom Computers
PO Box 131
Vandalia, IL 62471
Contact: Neil Clark

Clear-Com
1111 17th St
San Francisco, CA 94107
Contact: Leslie Elliott, Ad Mgr
415-861-6666 FAX: 415-861-3176

World Radio History

Clements Co
PO Box 1286
Carpinteria Beach, CA 93013
Contact: Jerry Clements, Pres
805-684-5415 FAX: 805-684-9316

Coastcom Inc
2312 Stanwell Dr
Concord, CA 94520
Contact: E M Buttner

Coaxial Dynamics Inc
15210 Industrial Pkwy
Cleveland, OH 44135
Contact: Robert Scott,
Exec VP & GM
216-267-2233 FAX: 216-267-3142

Coherent Communications
13756 Glenoaks Blvd
Sylmar, CA 91342
Contact: Ivan Kruglak
818-362-9393

Columbine Systems Inc
1707 Cole Blvd
Golden, CO 80401
Contact: Mark Fine, Dir of Sales
303-237-4000 FAX: 303-237-0085

Comad Communications Ltd
1435 Bonhill Rd Unit #34
Mississauga, Ont, L5T 1M1
Canada
Contact: Emil Adamyk, Pres
416-676-9171 FAX: 416-676-9175

Comark Communications Inc
Rte 309 & Advance Lane
Colmar, PA 18915
Contact: Stuart M Kravitz, Mktg Dir
215-822-0777 FAX: 413-569-0679

Comex Worldwide Corp
1645 NW 79th Ave
Miami, FL 33126
Contact: Jack Rickel, Pres
305-594-0850 FAX: 305-591-7298

Commercial Radio Co
Duttonsville School Dr
Cavendish, VT 05142
Contact: Dan Churchill, GM
802-226-7582 FAX: 802-226-7738

Communitronics Ltd
160 Wilbur Place
Bohemia, NY 11716
516-567-8320

Competition Specialties
4535 S Blosser Rd
Santa Maria, CA 93455
Contact: Jim Mussell

Comprompter Inc
141 South 6th St
La Crosse, WI 54601
Contact: Ralph King, Pres
608-785-7766 FAX: 608-782-4674

Compucan
PO Box 831360
Richardson, TX 75083
Contact: Michele Geopferick

CompuSonics
PO Box 27516
Concord, CA 94527
Contact: Ted Tripp
415-676-8899 FAX: 415-686-3376

Computer Concepts Corp
8375 Melrose Dr
Lenexa, KS 66214
913-541-0900 800-255-6350
FAX: 914-541-0169

Comrex Corp
65 Nonset Path
Acton, MA 01720
Contact: Lynn Distler, VP Sales
508-263-1800 FAX: 508-635-0401

Comsearch Inc
11720 Sunrise Valley Dr
Reston, VA 22091
Contact: Jerry Schulman,
Mktg Mgr
703-620-6300

Comtech Antenna Corp
3100 Communications Rd
St Cloud, FL 32769
407-892-6111 FAX: 407-957-3402

Comtech Data
350 N Hayden Rd
Scottsdale, AZ 85257
Contact: Ray Kelsey, Dir Mky

Comtronix Systems
PO Box 388
Westfield, MA 01085
413-568-7311

Concept Productions
1224 Coloma Way
Roseville, CA 95661
Contact: Dick Good, Sales Mgr
916-782-7754 800-348-4800
FAX: 916-786-8304

Conex Electro-Systems Inc
PO Box 1342
Bellingham, WA 98227
Contact: Bob Tria, Mktg
206-734-4323 FAX: 206-676-4822

Connect Systems Inc
23731 Madison St
Torrance, CA 90505
Contact: Kirk Mckloren
213-373-6803

Connectronics Corp
652 Glenbrook Rd
Stamford, CT 06906
Contact: Richard Chilvers, Exec VP
203-324-2889 FAX: 203-324-7027

Continental Electronics
PO Box 270879
Dallas, TX 75227
214-381-7161 FAX: 214-381-4949

Control Concepts Corp
PO Box 1380
Birmingham, NY 13902-1380
607-724-2484

Control Technology Inc
2950 SW 2nd Ave
Ft Lauderdale, FL 33315
Contact: Michael Quinn, Sales Mgr
305-761-1106 FAX: 305-764-3298

Cortana Corp
PO Box 2548
Farmington, NM 87401
Contact: Evelyn Nott
505-325-5336 FAX: 505-326-2337

Cortland Cable Co
PO Box 330
Cortland, NY 13045-0330
Contact: John J. Dower, Pres
607-753-8276 FAX: 607-753-3183

Countryman Associates Inc
417 Stanford Ave
Redwood City, CA 94063
415-364-9988

Creative Support Services
1950 Riverside Dr
Los Angeles, CA 90039
Contact: Mike Fuller, Mktg Mgr
213-666-7968 FAX: 213-660-2070

Crouse-Kimzey
3507 W Vickery
Fort Worth, TX 76107
Contact: Mark Bradford
817-737-9911 FAX: 817-377-9707

Crown International Inc
1718 W Mishawaka Rd
Elkhart, IN 46517
219-294-8000

Current Technology
1400 S Sherman Ste 202
Richardson, TX 75083
Contact: P Diamond
214-238-5300 FAX: 214-238-0911

Custom Business Systems
PO Box 67
Reedsport, OR 97467
Contact: Steve Kenagy, VP Mktg

Cutting Edge Technologies
2501 W 3rd
Cleveland, OH 44113
Contact: Frank Foti
216-221-7626 FAX: 216-621-2801

D

dbx Professional Products
(A Division of AKG)
645 Bryant St
San Francisco, CA 94107
Contact: David Roudbush, Mktg
Mgr
415-957-1067 FAX: 415-957-1070

D D A
30B Banfi Plaza North
Farmingdale, NY 11735
Contact: Sam C Spennacchio
516-249-3660 FAX: 516-420-1863

D1 Products Inc
95 E Main St
Huntington, NY 11743
Contact: B Kutny
516-673-6866 FAX: 516-673-6893

DB Co/Div of Pierce Indust
3120 E Pico
Los Angeles, CA 90023
213-264-7855

DOD Electronics
5639 South Riley Lane
Salt Lake City, UT 84107
Contact: Dean Stubbs
801-268-8400 FAX: 801-262-4966

DSI Communications Inc
12 N Willow St
Montclair, NJ 07642
201-746-9307 FAX: 201-744-9059

DYMA Engineering Inc
Box 1535
Los Lunas, NM 87031
Contact: Wally Cunningham, VP
505-865-6700

Da-Lite Screen Co Inc
PO Box 137
Warsaw, IN 46580
219-267-8101

Peter W Dahl Co Inc
5869 Waycross Ave
El Paso, TX 79924
Contact: Peter Dahl
915-751-2300 FAX: 915-751-0768

Dalsat Inc
PO Box 1960
Plano, TX 75074
Contact: Max Ashmead, VP Mktg

Data Communications Corp
Broadcast Div
3000 Directors Row
Memphis, TN 38131
901-345-3219

Data For Small Systems
2020 Pennsylvania Ave #236 NW
Washington, DC 20006
Contact: Rich Pomeroy
703-276-9442

Datatek Corp
1121 Bristol Rd
Mountainside, NJ 07092
Contact: Robert Rainey

Dataworld
PO Box 30730
4827 Rugby Ave Ste
200 Bethesda, MD 20814
Contact: Bob Richards
301-652-8822 FAX: 301-656-5341

Datum Inc
1363 S State College Blvd
Anaheim, CA 92805
714-533-6333

Davilyn Corp
13406 Saticox St
N Hollywood, CA 91605
Contact: D Kasper, Pres

Dayton Industrial Corp/Fox
4518 Taylorsville Rd
Dayton, OH 45424
Contact: Robert Mcdougall
513-236-3591 FAX: 513-233-5805

Delcom Corp
6019 South 66th East Ave
Tulsa, OK 74145
918-494-9500

Delta Electronics Inc
5730 General Washington Dr
Alexandria, VA 22312
Contact: John P Bisset
703-354-3350 FAX: 703-354-0216

Delta Lab Research Inc
1 Progress Way
Wilmington, MA 01887
Contact: Jim Camacho, Ad Mgr

Deltamod
2821 9th
Berkeley, CA 94710
Contact: D A Maisel, Pres

Denon America Inc
222 New Road
Parsippany, NJ 07054
Contact: Laura Tyson, Sales Engr
201-575-7810 FAX: 201-808-1602

Di-Tech Inc
48 Jefryn Blvd
Deer Park, NY 11729
Contact: Anthony Bolletino,
Dir of Mktg
516-667-6300 FAX: 516-595-1012

Dic Digital
2 University Plaza
Hackensack, NJ 07601
Contact: Kevin Kennedy, Natl Mktg
Mgr
201-487-4605 FAX: 201-487-1026

Dielectric Communications
Tower Hill Rd
Raymond, ME 04071
Contact: Colleen Mitchell
207-655-4555 FAX: 207-655-4669

Digital Broadcast Systems Inc
184 Mechanic St
Southbridge, MA 01550
617-764-4386

Digitech
5639 South Riley Lane
Salt Lake City, UT 84107
Contact: Dean Stubbs
801-268-8400 FAX: 801-262-4966

Dolby Laboratories Inc
100 Potrero Ave
San Francisco, CA 94103
Contact: Kevinn Tam, Bdcst Tech
Mgr
415-558-0200 FAX: 415-863-1373

Dorrough Electronics
5221 Collier Pl
Woodland Hills, CA 91364
Contact: Kay Dorrough
818-999-1132 FAX: 818-998-1507

World Radio History

Downeast Engineering
147 Durham Rd
Freeport, ME 04032
Contact: Bill Yanik
207-865-9002

H M Dyer Electronics Inc
2982 Wixom Rd
Milford, MI 48042
Contact: Mike Dyer
313-685-2560

Dynair Electronics
5275 Market St
San Diego, CA 92114
Contact: Robert Jacobs
619-263-7711

Dynatech Bdct
6400 Enterprise Lane
Madison, WI 53719
Contact: Chuck Soholdt, Ad Mgr
FAX: 703-550-7560

E

EEG Enterprises Inc
1 Rome St
Farmingdale, NY 11735
516-293-7472

EEV
4 Westchester Plaza
Elmsford, NY 10523
914-592-6050

EFI Corp
350 W 2700 South
Salt Lake City, UT 84115
Contact: George Stewart, Pres
800-221-1174 FAX: 801-977-0200

ESL (Electronic Systems Labs Inc)
110 SW 21st Terrace Ste B-107
Ft Lauderdale, FL 33312
305-791-1501

EMCEE Broadcast Products
PO Box 68
White Haven, PA 18661
717-443-9575

EMT-Franz Gmbh
Postfach 1520
Lahr, D-7630 W Germany

ESE
142 Sierra St
El Segundo, CA 90245
Contact: Bob Meyers, VP
213-322-2136 FAX: 213-322-7033

ESL Inc
120 SW 21st Terrace C-104
Ft Lauderdale, FL 33312
Contact: Lutz Meyer, Pres
305-791-1501 FAX: 305-791-8986

Eagle Hill Elect
Rt 2 Box 354
Chestertown, MD 21620-9802
Contact: B Johnson, Pres
301-778-3240

Eastern Acoustics Work
PO Box 111
Framingham, MA 01701
Contact: Kenneth Berger

Econco
1318 Commerce Ave
Woodland, CA 95695
Contact: Debbie Storz, Sales
916-662-7553 800-532-6626
FAX: 916-666-7760

Edcor Product Assurance Corp
16782 Hale Ave
Irvine, CA 92714
714-863-1529 FAX: 714-298-7117

Eimac Div of Varian
48 Campbell Lane
Menlo Park, CA 94025
Contact: W Orr, Adv Mgr

Elcom Bauer
6199 Warehouse Way
Sacramento, CA 95826
Contact: Paul Gregg, Pres
916-381-3750 FAX: 916-381-4332

Electrex Co
18620 NE 2nd Ave
Miami, FL 33179
Contact: Ben Ostrovsky, Pres
305-651-5752 FAX: 305-654-1386

Electro Impulse Lab Inc
116 Chestnut St
Redbank, NJ 07701
Contact: Mark Rubin, Pres
201-741-0404 FAX: 201-747-7153

Electro-Voice Inc
600 Cecil St
Buchanan, MI 49107
Contact: Don Kirkendall, Ad Mgr
616-695-6831 FAX: 616-695-1304

Electrodenics
PO Bx 333
Comack, NY 11725
Contact: Matt Kruger

Electronic Equipment Bank
516 Mill St
Vienna, VA 22180
Contact: R F Robinson

Electronic Industries
PO Bx 266
Oshkosh, WI 54902
Contact: Gordon Dailey, Bdct Sales
414-235-8930 FAX: 414-235-4233

Electronic Research
108 Market St
Newburgh, IN 47630
Contact: Bill Elmer, VP Sales
812-853-3318 FAX: 812-858-5706

Electronic Specialty
135 N Illinois St
Springfield, IL 62702
Contact: Ed Davison

Electronics Diversified Inc
1675 Northwest 216th Ave
Hillsboro, OR 97124
503-645-5533

Electrotechnics
POB 953
Seattle, WA 98111
Contact: David Ziskin, Pres

Elicon
940 S Leslie St
La Habra, CA 90631
714-870-6647

Emcor Products/Crenlo Inc
1600 4th Ave, Nw
Rochester, MN 55901
Contact: Tom Regnier, Ad Mgr
507-289-3371 FAX: 507-287-3405

Emergency Alert Receiver Inc
PO Box 20629, Cathedral Stat
New York, NY 10021
212-695-4767

Enberg Electronics
PO Box 55087
Indianapolis, IN 46220
Contact: Mike Ringenberger, Pres
317-253-3866

Energy Control Systems
PO Box 330607
Ft. Worth, TX 76163
Contact: Jeff Edwards, Owner
817-483-8497 FAX: 817-572-2242

Energy-Onix Broadcast Equip Co
PO Bx 923
Hudson, NY 12534
Contact: Bernard Wise, Pres
518-828-1690 FAX: 518-828-8476

Ennheiser Electronic Corp
6 Vista Dr/PO Box 987
Old Lyme, CT 06371
Contact: Sales
203-434-9190 FAX: 203-434-1759

Enterprise Systems
2790 N Academy Ste 210
Colorado Springs, CO 80917
Contact: George Beattie

Entrack Corp
2115 Pullman Ave
Belmont, CA 94002
Contact: Steve Krampf, Pres

Environmental Satellite Data
5200 Auth Rd
Suitland, MD 20746
301-423-2113

Environmental Technology Inc
1302 High St
South Bend, IN 46618
Contact: Steve Leykauf, Mktg Mgr
219-233-1202 FAX: 219-233-2152

Equipto Electronics Corp
351 Woodlawn Ave
Aurora, IL 60506-9988
312-897-4691

Erko Technologies
7610 Burlington St
Omaha, NE 68127
Contact: Lawrence A Martin, Sales Mgr
402-331-2632

Ethereal Concepts
210 Golden Gate Dr
Dayton, OH 45459
Contact: Lonnie Domnitz, Owner

Evans Sales & Mrktng
509 A Ligon Dr
Nashville, TN 37204
Contact: Sales Mgr

Eventide Inc
One Alsan Way
Little Ferry, NJ 07643
Contact: Gil Griffith
201-641-1200 FAX: 201-641-1640

Excalibur Electronics
4604 Sand Rock Ln
Chantilly, VA 22021-2468
Contact: Bill Ashley, VP

Excalibur Industries
12419 Foothill Blvd
Lake View Terrace, CA 91342
Contact: John Gresch

The Express Group
3518 3rd Ave
San Diego, CA 92103
Contact: Bob Burns, Dir of Mktg
619-298-2834

Express Tower Co Inc
PO Box 37
Locust Grove, OK 74352
Contact: Dyke A Dean, Mktg Dir
918-479-6484 FAX: 918-479-6485

F

Fairchild Sound Equipment Corp
75 Austin Blvd
Commack, NY 11725
Contact: Herman Post, Pres
516-543-5200 FAX: 602-941-0023

Fairlight Instruments
2945 Westwood Blvd
Los Angeles, CA 90064
Contact: Rita Lambert

Fiberbilt Cases
601 West 26th St
New York, NY 10001
Contact: Paul Lownan, Sales Mgr
212-675-5820 FAX: 212-691-5935

Fidelipac Corp
PO Box 808
Moorestown, NJ 08057
Contact: Jack Ducart, Dir of Sales
609-235-3900 FAX: 609-235-7779

First Light Video Publishing
374 N. Ridgewood Place
Los Angeles, CA 90004
Contact: Rosemary Guthrie, Dir of Sales & Mktg
213-467-1700 FAX: 213-461-1085

Fitz Sound Co
912 N Midkiff
Midland, TX 79701
Contact: Mike Fitz-Gerald, Owner

Flash Technology
55 Lake St
Nashua, NH 03060
Contact: Lew Wetzel, VP Sales
603-883-6500 FAX: 603-883-0205

John Fluke Mfg Co Inc
PO Box C9090
Everett, WA 98206
206-356-5293

Focal Press
80 Montvale Ave
Stoneham, MA 02180
Contact: Kevin Kopp
617-438-8464 FAX: 617-438-1479

Fort Worth Tower Co Inc
PO Box 8597
Fort Worth, TX 76124-0597
Contacts: Betty Moore/Carl Moore
817-457-3060 FAX: 817-429-6010

Mel Foster Tech Sales, Inc
7611 Washington Ave So
Edina, MN 55434
Contact: Sales Mgr

Fostex Corp
15431 Blackburn Ave
Norwalk, CA 90650
Contact: Mark Cohen, National Sales Mgr
213-921-1112 FAX: 213-802-1964

Freeland Products Inc
75412 Hwy 25
Covington, LA 70433
Contact: W T Freeland, Pres
800-624-7626 FAX: 504-892-7323

Frese Software
122-C S Chelan Ave
Wenatchee, WA 98801
Contact: Glen Frese

Full Compass Systems
5618 Odana Rd
Madison, WI 53719-1208
Contact: Jonathan Lipp, Owner
608-271-1100 800-356-5844
FAX: 608-273-6336

Fuller Sound
1948 Riverside Dr
Los Angeles, CA 90039
Contact: Mike Fuller

Funke & Assoc
908 Marilyn Dr
Campbell, CA 95008
Contact: Kent McGuire, Sales
408-866-0648 FAX: 408-866-1975

Furman Sound Inc
30 Rich St
Greenbrae, CA 94904
Contact: Jim Furman, Pres
415-927-1225 FAX: 415-927-4548

World Radio History

Fusion Electronics Inc
15 Main St, PO Box 170
East Rockway, NY 11518-0170
Contact: Sid Sussman, VP
516-599-6400 800-645-2300
FAX: 516-599-6495

G

G & M Power Products Inc.
943 N Orange Dr
Los Angeles, CA 90038
213-850-6800

GBC Electronics
Rt 2, Box 310
Blountville, TN 37617
Contact: Bruce Cooke

GKM Mfg Corp
47 Bridgewater St
Brooklyn, NY 11222
Contact: John D'Augelli, GM
718-388-4114 FAX: 718-384-1325

GLW Enterprises
437 Atlas Dr
Nashville, TN 37211
Contact: Theresa Parsley, Ad Mgr
615-331-8800 FAX: 615-331-8883

GML America
8150 Leesburg Pike Ste 910
Vienna, VA 22180
703-790-0101

Gaines Audio
1237 E Main St
Rochester, NY 14617
Contact: Jon Gaines, Owner
716-266-0780 800-442-0780

Garner Industries
4200 W 48th St
Lincoln, NE 68504
Contact: Robert Bobrowski, Mktg Mgr
402-464-5911 FAX: 402-464-6960

Gemini Electronic Marketing
111 Elm St
Edmonds, WA 98020
Contact: Sales Mgr

General Broadcast Supply Inc
PO Box 372
Eureka Springs, AR 72632
Contact: T.S. Butler, Pres
501-253-8127 FAX: 501-253-6151

Generic Computer Systems
357 N Main St
Butler, PA 16001
412-283-1500

Gentner Electronics Corp
1825 Research Way
Salt Lake City, UT 84119
Contact: Gary Crowder, National Sales Mgr
801-975-7200 FAX: 801-977-0087

Gexco International Inc
317 St Paul's Ave
Jersey City, NJ 07306
Contact: Philip J Desantis, VP

Giesler Bdct Supply
5914 Maple
Houston, TX 77074
Contact: Bernie Giesler, Pres
800-634-8601 FAX: 713-774-1306

Goldline
PO Box 115
West Redding, CT 06896
Contact: Martin Miller, Mktg Mgr
FAX: 203-938-8740

Gorman & Assoc
222 Richmond St
Providence, RI 02903
Contact: Stan Duggan, Bdct Prod Supvr

Gorman-Redlich Mfg Co
257 W Union St
Athens, OH 45701
Contact: Jim Gorman, Owner
614-593-3150 FAX: 614-592-3898

Gotham Audio Corp
1790 Broadway 8th Fl
New York, NY 10019
212-765-3410

Graham-Patten Systems
13451 Colfax Hwy, PO Box 1960
Grass Valley, CA 95945
Contact: Jim Prouty
916-273-8412 800-547-2489

R J Grandmaison, PE
11213 Split Rail Ln
Fairfax Station, VA 22039
Contact: Ronald J Grandmaison
703-764-0513

Grant Becker Enterprises
4110 West Bank Ave
Tampa, FL 33624
Contact: Grant Becker, Owner
813-960-8153

The Grass Valley Group Inc
Box 1114
Grass Valley, CA 95945
Contact: Jay Cook
916-478-3000 FAX: 916-478-3187

Gresham Leon (Ppl) Ltd
Lower Way
Thatcham, Berks, RG13 4RE
England

R Griffin & Assoc
133 W 19th
New York, NY 10111
Contact: Robert Griffin, Pres

James Grunder & Assoc Inc
5925 Beverly
Mission, KS 66202
913-831-0188

Guarantee Radio Supply
1314 Iturbide St
Laredo, TX 78040
Contact: M Flores, Pres
512-723-6913 FAX: 512-727-8458

H

H & E Micro-Trak
165 Front St
Chicopee, MA 01013
Contact: W Stacy, VP Mktg
413-733-8743

HM Electronics Inc
6675 Ridge Rd
San Diego, CA 92121
Contact: Matt Riches
619-535-6060 FAX: 619-452-7207

HM Electronics Inc
9675 Business Park Ave
San Diego, CA 92131
619-578-8300

HME Inc
6675 Mesa Ridge Rd
San Diego, CA 92121
Contact: Randy Opela, Natl Sales Mgr

Hal Comm.
PO Box 365
Urbana, IL 61801
Contact: Ken Sartain, Mktg Mgr

Hall Electronics
1712 Allied St
PO Box 7732
Charlottesville, VA 22901
Contact: Jon Hall
804-977-1100 FAX: 804-974-6450

Mart Haller Inc
305 Palermo Ave
Coral Gables, FL 33134
Contact: Pat Haller, Sales Mgr
305-444-4617 FAX: 305-445-7551

Hallikainen & Friends Inc
141 Suburban Rd #E-4
San Luis Obispo, CA 93401
Contact: Harold Hallikainen, Pres
805-541-0200 FAX: 805-544-6715

Hamtronics
65 Moul Rd
Hilton, NY 14468
Contact: Jerry Bogt, Pres
716-392-9430 FAX: 716-392-9420

Hannay Reels
600 E Main St
Westerlo, NY 12193
518-797-3791

Clifford B Hanney & So
Box A
Westerlo, NY 12193
Contact: James Doonan

Harmon's Tower Service
435B Broadway
Columbus, GA 31901
Contact: Al Harmon, Pres
404-327-1074

Harris Corp, Broadcast Div
PO Box 4290
Quincy, IL 62305-4290
Contact: Ronald C Frillman, Mgr, Domestic Radio Sales
217-222-8200 FAX: 217-222-7041

Harris Video Systems
960 Linda Vista
Mountain View, CA 94043
Contact: Dave Northern
415-969-9100 FAX: 415-594-3110

Harrison Systems Inc
PO Box 22964
Nashville, TN 37202
Contact: Claude Hill, VP Mktg
615-834-1184

Hartmann Associates
5 Nestlingwood Dr
Long Valley, NJ 07853
Contact: A David Hartmann, Pres
201-850-3750 FAX: 201-850-3751

Karl Heitz Inc
PO Box 427
Woodside, NY 11377
718-565-0004

Henry Engineering
503 Key Vista Dr
Sierra Madre, CA 91024
Contact: Hank Landsberg
818-355-3656 FAX: 818-355-0077

Hirschmann Co
Industrial Row/Box 229
Riverdale, NJ 07457
Contact: Andy Swenson, Sales Mgr
201-835-5002 FAX: 201-835-8354

Hnat Hindes Inc
42 Elaine St, RR #1
Thompson, CT 06277
Contact: Bonnie Hnat
203-935-9066

Holaday Industries Inc
14825 Martin Dr
Eden Prairie, MN 55344
Contact: Burton Gran, Pres
612-934-4920 FAX: 612-934-3604

Holzberg Inc
PO Box 323
Sea Bright, NJ 07760
Contact: Herb Holzberg
800-242-7298 FAX: 201-842-7552

Houston International Teleport
3003 Moffit Lane
Missouri City, TX 77489
Contact: Anna Sterling, Admin Assist

Howe Technologies Corp
2300 Central Ave Ste 3
Boulder, CO 80301
Contact: Terry Sweeney, VP Sales
303-444-4693 800-525-7520
FAX: 303-444-8447

Hy James Inc
24166 Haggerty
Farmington Hills, MI 48024
Contact: Henry J. Root, Pres
313-471-0027 FAX: 313-471-2611

I

IBSS Canada
Box 303
Binbrook Ontario, Canada
Contacts: C Kenst/R Meuser
416-692-3330 FAX: 416-692-4033

IER (Industrial Equipment Representatives)
4630 Border Village Rd Ste G
San Ysidro, CA 92073
Contact: Alex Rodriguez
619-428-2261 FAX: 619-428-3483

IFR Systems Inc
10200 West York St
Wichita, KS 67215
Contact: Thomas Dideum, Mktg Mgr
316-522-4981 FAX: 316-524-2623

IGM Communications
1100 11th St
Bellingham, WA 98226
Contact: Carl Peterson, Dir Bdct Sales/Mktg
FAX: 206-734-7939

ITC (Intl Tapetronics/3M Broadcasting & Related Products)
2425 S Main St
Bloomington, IL 61704
Contact: Jim Woodworth, Sales Rep
800-447-0414 FAX: 309-828-1386

ITT Jennings
970 Mclaughlin
San Jose, CA 95122
Contact: Rod Neibaur

ITW Switches/II Toolworks Co
6615 W Irving Pk Rd
Chicago, IL 60634
Contact: Rick Magnuson, Mktg Mgr Pnl Swtrs/Sys

ITW Switches/II Toolworks Co
6615 W Irving Pk Rd
Chicago, IL 60634
Contact: Robert Quirk, Mktg Mgr Pnl Sys

Image Devices Inc
1825 NE 149th St
Miami, FL 33181
Contact: Bill Reiter, Mktg Mgr

World Radio History

Industrial Acoustics Co
1160 Commerce Ave
Bronx, NY 10462
212-931-8000

Industrial Components Corp
PO Box 668
Willbraham, MA 01095
Contact: Stephen Welch, Pres

Information Transmission Systems Corp
375 Valley Brook Rd
McMurray, PA 15317
412-941-1500

Informotion
2715 Electronic Ln
Dallas, TX 75220
Contact: Woody Taylor, VP

Inmark Corp
38 Brushwood Rd
Stamford, CT 06903
Contact: Lars Giers

Innovative Automation
3316 19th Ave Se
Rio Rancho, NM 87124
Contact: Don Prentice, Pres
505-891-0501

Inovonics Inc
1305 Fair Ave
Santa Cruz, CA 95060
Contact: James B Wood, Mktg Mgr
408-458-0552 FAX: 408-458-0554

Interface Electronics
6710 Alder
Houston, TX 77081
Contact: Louis Stevenson

International Cinema Eq Co
6750 NE 4th Ct
Miami, FL 33138
Contact: S Krams

International Electro-Magnetics
350 Eric Dr
Palatine, IL 60067
312-358-4622

International Magnetics
4411 Red Maple Ct
Cocord, CA 94521
Contact: Bob Kearns

International Map Service
85 S Union Blvd D-2
Lakewood, CO 80228
Contact: Lynn Montoya

International Music Co
1316 E Lancaster
Fort Worth, TX 76102
817-336-5114

International Teletronics Inc
PO Box 738
Williamstown, NJ 08094
Contact: John F Hayes, VP

Intraplex Inc
PO Box 2427
Littleton, MA 01460
Contact: Roger L Shaw,
Product Mgr
508-486-3722 FAX: 508-486-0709

Ivie
1366 W Center St
Orem, UT 84057
Contact: Glen Meyer, Mktg Mgr
801-224-1800 FAX: 801-224-7526

J

J and I
20899 Kelvin Palce
Woodland Hills, CA 91367
Contact: Gil Grieger, Owner
818-992-4961

JBL Professional
8500 Balboa Blvd
Northridge, CA 91329
Contact: Mark Gander, VP Mktg
818-893-8411 FAX: 818-893-3639

J.N.S. Electronics Inc
PO Box 32550
San Jose, CA 95152
Contact: John E. Leonard Jr., Pres
408-729-3838 FAX: 408-926-1003

JRF Magnetic Sciences
POB 121
Greendell, NJ 07839
Contact: John R. French, Pres
201-579-5773 FAX: 201-579-6021

JRF Magnetic Sciences Inc
101 Landing Rd
Landing, NJ 07850
201-398-7426

JVC Corp
41 Slater Drive
Elmwood Park, NJ 07407
Contact: Roberts, Spec Prod Mgr

Jaffie Communications
122 E 42nd St
New York, NY 10168
Contact: D Harewood

Jampro Antennas Inc
6939 Power Inn Rd
Sacramento, CA 95828
Contact: Doug Schukar
916-383-1177 FAX: 916-383-1182

Jensen Tools Inc
7815 South 46th St
Phoenix, AZ 85044
602-968-6241

Jensen Transformers Inc
10735 Burbank Blvd
N Hollywood, CA 91601
Dave Hill/Kris Ellis
213-876-0059 FAX: 818-763-4574

Jim Walters Co
5017 Kalanianaole Hwy
Honolulu, HI 96821
Contact: Jim Walters, Owner
808-373-2701 FAX: 808-373-4436

Johnson Electronics
4301 Metric Dr
Winter Park, FL 32792
Contact: Robert W Peters
407-677-4030 FAX: 407-679-1288

K

Kala Music
4200 W Main St
Kalamazoo, MI 49007-2729
Contact: Stephen C. Trivers, Pres
800-289-KALA (5252) FAX:
616-345-1436

Kay Industries Inc
604 N Hill St
South Bend, IN 46617
Contact: Aaron Katz, VP Mktg

R.L. Kennedy & Associates
PO Box 141
Waynesville, NC 28786
Contact: Richard L. Kennedy
704-648-3283

Kenneth R. Meades
PO Box 71098
Los Angeles, CA 90071
Contact: Kenneth R. Meades,
Owner/Mgr
213-662-2463

Kidd Communications
4096 Bridge St Ste 4
Fair Oaks, CA 95628
Contact: Chris Kidd, Pres
916-961-6411

Kings Electronics Co Inc
40 Marbledale Rd
Tuckahoe, NY 10707
Contact: Henry Pessah, Comm
Mgr
914-793-5000 FAX: 914-793-5092

Kinstone Inc
PO Box 508
Paterson, NJ 07544
201-279-9700

Kintronic Laboratories Inc
PO Box 845
Bristol, TN 37621-0845
Contact: Tom King, Assist Div Engr
615-878-3141 FAX: 615-878-4224

Klark-Teknik Electronics
30-B Banfi Plaza North
Farmingdale, NY 11735
Contact: Sam C Spennacchio
516-249-3660 FAX: 516-420-1863

L

LBA Technology Inc
PO Box 8026
Greenville, NJ 27835-8026
Contact: Ron Chaffee
919-757-0279 FAX: 919-752-9155

LCR Systems
180 Bellmead
Shreveport, LA 71105
Contact: Larry Clifton

LDL Communications Inc
14440 Cherry Lane Ct #201
Laurel, MD 20707
Contact: G J Wilson, Pres
301-498-2200 FAX: 301-498-7952

LNR Communications Inc
180 Marcus Blvd
Hauppauge, NY 11788
Contact: Mktg Mgr

LPB Inc
28 Bacton Hill Rd
Frazer, PA 19355
Contact: John P Tiedeck
215-644-1123 FAX: 215-644-8651

LSI Jennings
970 McLaughlin Ave
San Jose, CA 95122
Contact: E.V. Valehrach,
Dir of Mktg
408-292-4025 FAX: 408-286-1789

La Salle Audio Systems
PO Box 820 Astor Station
Boston, MA 02123
Contact: Mark Parsons, Csit
800-533-3388 FAX: 617-536-4878

Lacentra Advertising
1101 Embarcadero Rd
Palo Alto, CA 94303
Contact: Bruce Lacentra

Lake Systems
287 Grove St
Newton, MA 02166
Contact: Les Arnold, Sales Mgr
617-244-6881 FAX: 617-527-3159

Landy Associates Inc
1890 E Marlton Pike
Cherry Hill, NJ 08003
Contact: James E. Landy, Pres
609-424-4660 FAX: 609-424-3590

Landy Associates Inc
330 Bear Hill Rd
Waltham, MA 02154
617-890-6325

Larcan Communications Equipment Inc
6520 Northam Dr
Mississagua, Ont, L4V 1H9
Canada
Contact: P A Dickie, Pres
416-678-9970

Lasalle Music & Pro Audio
1090 Boylston St
Boston, MA 02215
Contact: Marek Stycos,
Pro Audio Mgr
617-536-2030 FAX: 617-536-4878

D N Latus & Co Inc
PO Box 1720
Helena, MT 59624
406-442-3940

Lauderdale Electronic Labs
16 Southwest 13th St
Ft Lauderdale, FL 33315
305-764-7755

Lawrence Behr Associates Inc
PO Box 8026
Greenville, NC 27835
Contact: Raymond Rohrer
919-757-0279 FAX: 919-752-9155

Leader Instruments Corp
380 Oser Ave
Hauppauge, NY 11788
Contact: Bob Sparks, Ad Mgr
516-231-6900

Leaming Industries
15339 Barranca Pkwy
Irvine, CA 92718
Contact: Kim Litchfield
714-727-4144 FAX: 714-727-3650

Lenco
PO Box 348
Jackson, MO 63755
Contact: Jim Rhodes,
Audio Prod Mgr

Leonine Technology
PO Box 32550
San Jose, CA 95152
Contact: John Leonard, Pres

Lexicon Inc
100 Beaver St
Waltham, MA 02154
Contact: Larry Rich, Bdct Sales
Mgr
617-891-6790 FAX: 617-891-0340

Lightning Deterrent Corp
5321 South Kedzie Ave
Chicago, IL 60632
Contact: Don Hudalla, Mktg Mgr

Lightning Elimination
12516 Lakeland Rd
Santa Fe Springs, CA 90670
Contact: Hal Proppe, VP Mktg

Lightning Eliminators & Consultants Inc
6687 Arapahoe Rd
Boulder, CO 80303
Contact: Hans Dettmar
303-447-2828 FAX: 303-447-8122

Lindburg Enterprises Inc
9707 Canida St
San Diego, CA 92126
Contact: Mr Earl Lindburg

Lindco Commercial Audio
57 Glencoe Rd
Columbus, OH 43214
Contact: Christopher E Lind

Lineau Assoc Inc
4 Terry Drive, #15
Newton, PA 18940
Contact: Sales Mgr

World Radio History

Lines Audio/Visual Systems
219 S Jefferson
Springfield, MO 65806
Contact: Bud Lines, Pres

Charles J Lipow Inc
18040 Sherman Way Ste 513
Reseda, CA 91335
Contact: Charles Lipow

Lita Broadcasting Dist
6912 NW 72nd Ave
Miami, FL 33166
Contact: Luis C. Endara, Pres
305-887-1223 FAX: 305-887-0405

Litronix Corp
6912 NW 72nd Ave
Miami, FL 33166
Contact: Luis C. Endara, Pres
305-887-1223 FAX: 305-887-0405

Logitek
3320 Bering Dr
Houston, TX 77057
Contact: Tag Borland, Pres
800-231-5870 FAX: 713-782-7597

Lyle Cartridges
115 S Corona Ave
Valley Stream, NY 11582
Contact: Eric Lewinter, VP
800-221-0906 FAX: 516-561-7793

M

M/A-Com Mac Inc
5 Omni Way
Chelmsford, MA 01824
Contact: Yong Lee, Pres
617-272-3100 FAX: 312-635-3032

MCG Electronics
12 Burt Dr
Deer Park, NY 11729
Contact: Christine Coyle, Ad Mgr
516-586-5125 FAX: 516-586-5120

MCL Inc
501 S Woodcreek Dr
Bolingbrook, IL 60439-4999
Contact: Frank Morgan, Ad Mgr

MDL/Microwave Devlp Lab Inc
10 Michigan Dr
Natick, MA 01760

MIT Inc
14130 NW Science Park Dr
Portland, OR 97229
Contact: Mo Wagner, Pres

MXR Innovations
215 Tremont St C/O App Resch
Rochester, NY 14608
Contact: Mitch Milton

Magnefax Int
Rt 1
Rogers, AR 72756
Contact: Dennis W Tallakson, Pres
501-925-1818 FAX: 501-925-1841

Magnetic Reference Lab
229 Polaris Ave Ste 4
Mountain View, CA 94043
Contact: John G Mcknight, Pres
415-965-8187 FAX: 415-965-8548

Magrill Engineering
PO Box 1010
Fairfield, FL 32634
Contact: Barry Magrill, Owner
904-591-3005

The Management
PO Box 1-36457
Ft Worth, TX 76136
Contact: Peter Charlton, Pres
817-625-9761 800-334-7823
FAX: 817-624-9741

Manion Outdoors
PO Box 4024
Appleton, WI 54915
Contact: Ms Derse Smith Todd,
Sales Promo Dir

Marathon Products
334 W Boylston St
W Boylston, MA 01530
Contact: Mike Tracy

Marcom
PO Box 66507
Scotts Valley, CA 95066
Contact: Marty Jackson, Pres
408-438-4273

Mark Antenna Products Inc
2180 S Wolf Rd
Des Plaines, IL 60018
Contact: Richard Thomas, Pres
312-298-9420 FAX: 312-635-7946

Marketing Technics
6666 N Oliphant
Chicago, IL 60631
Contact: George Vadik, Ad Mgr

Marti Electronics
1501 N Main Box 661
Cleburne, TX 76031
Contact: Selene Nix
817-645-9163 FAX: 817-641-3869

Martin Audio Video Corp
423 West 55 St
New York, NY 10019
Contact: Mike Bogen, VP
212-541-5900 FAX: 212-541-9128

McCarron Kane Inc
44 N Altadena Ste 200
Pasadena, CA 91107
Contact: Roy McCarron

McCurdy Radio Industries
108 Carnforth Rd
Toronto Ontario, M4A 2L4 Canada
Contact: Omar Fattah
416-751-6262 FAX: 416-751-6455

McMartin Industries
4500 South 76th
Omaha, NE 68127
Contact: John Miller, VP
712-366-1300 FAX: 712-366-3915

Media Computing Inc
3506 East Meadow Dr
Phoenix, AZ 85032
Contact: Larry L Baum
602-482-9131

Media Graphics
821 Virginia Ave.
Langhorne, PA 19047
Contact: Bob Jeffreys, Owner

Media Touch Systems Inc
50 Northwestern Dr
Salem, NH 03079
603-893-5104 FAX: 603-893-6390

Merlin Engineering Works
1880 Embarcadero
Palo Alto, CA 94303
Contact: John Streets, Pres

Metropolis Audio Marketing Inc
1199 Amboy Ave
Edison, NJ 08837
Contact: Tom Bensen

Micro Communications Inc
PO Box 4365
Manchester, NH 03108
Contact: Tom Vaughn
603-624-4351 FAX: 603-624-4822

Micro Controls Inc
PO Bx 728 Hwy 174 S
Burleson, TX 76028
Contact: Jeff Freeman, Pres
817-295-0965

Micro-Trak Corp
165 Front St
Chicopee, MA 01013
Contact: Billy Stacy
413-594-8501

Microdyne Corp
PO Box 7213
Ocala, FL 32672
Contact: E Courrier, Mktg Mgr
904-687-4633 FAX: 904-687-3392

Micron Audio Products Ltd
210 Westlake Dr
Valhalla, NY 10595
914-761-6520

Microtime Inc
1280 Blue Hills Ave
Bloomfield, CT 06002
Contact: Chris Smith, G. Mathias

Microtran Co
145 East Mineola Ave PO Box 236
Valley Stream, NY 11582-0236
Contact: Lou Anne O'Connor
516-561-6050 FAX: 516-561-1117

Microwave Filter Co
6743 Kinne St
E Syracuse, NY 13057
Contact: Bernadette Andaloro,
Ad Mgr
315-437-3953 FAX: 315-463-1467

Mid-America Automation Corp
1822 Laramie
Manhattan, KS 66502
Contact: Dave McFarland, Pres
913-537-3289

Milab
30b Banfi Plaza North
Farmingdale, NY 11735
Contact: Sam C Spennacchio
516-249-3660 FAX: 516-420-1863

Milam Audio Co
1470 Valle Vista
Pekin, IL 61554
Contact: Ken Musselman,
Sales Mgr
309-346-3161 FAX: 309-346-6431

Jay Mitchell Assoc
PO Box 1285
Fairfield, IA 52556
Contact: Jay Mitchell

Mitsubishi International Corp
46305 Landing Parkway
Fremont, CA 94538
415-651-9931

Mitsubishi Pro Audio Group
225 Parkside Dr
San Fernando, CA 91340
Contact: William E Windsor, Sr
Mktg Exec
818-898-2341

Mobile Specialty Vehicles
450 N Somerset
Indianapolis, IN 46222
Contact: Contact: Ad Mgr

Modular Audio Products
Brookhaven R&D Park 1 Roned Rd
Shirley, NY 11967
Contact: Peter Visconti, Mktg Mgr

Modulation Associates Inc
897 Independence Ave
Mountain View, CA 94043
Contact: William Benison
415-962-8000 FAX: 415-962-8180

Modulation Sciences Inc
115 Myrtle Ave
Brooklyn, NY 11201
Contact: Bob Ross, Sales Mgr
718-625-7333 800-826-2603
FAX: 718-260-8286

Moffet, Larson & Johnson Inc
5203 Leesburg Pike #100
Falls Church, VA 22041
Contact: Wally Johnson
703-842-5660 FAX: 703-842-5672

Monfort Electronics Mkt
8788 Robbins Rd
Indianapolis, IN 46268
Contact: Sales Mgr
FAX: 317-876-2384

Monroe Electronics Inc
100 Housel Ave
Lyndonville, NY 14098
Contact: Roland Phillips,
Application Eng
716-765-2254 FAX: 716-765-9330

Morcom International
4302 Evergreen Ln #203
Annandale, VA 22003
Contact: Manuel Ojeda

Moseley Associates Inc
111 Castilian Dr
Santa Barbara, CA 93117-3093
Contact: Dave Chancey,
Natl Sales Mgr
805-968-9621 FAX: 805-685-9638

Motorola AM Stereo
1216 Remington Rd
Schaumburg, IL 60173
Contact: Steve Kravitz
312-576-0554 FAX: 312-576-3258

Multilink
23801 Calabasas Rd
Calabasas, CA 91302
Contact: John Ulrick, Pres

Multiphase Consulting
5827 Columbia Pike Ste 310a
Falls Church, VA 22041
Contact: Henry Stewart
703-379-1665

Murphy Studio Furniture
4153 N Bonita St
Spring Valley, CA 92077
Contact: Dennis Murphy, Pres
619-698-4658 FAX: 619-698-1268

The Music Director Programming Service
PO Box 51978
Indian Orchard, MA 01151
Contact: Budd Clain, GM
413-783-4626

The Musicworks Inc
PO Box 111390
Nashville, TN 37211
615-790-1200

Muticomm Telecommunications
1755 S Jeff Davis Hwy, #1103
Arlington, VA 22202
Contact: Bev Schronce

Myat Inc
PO Box 425
Norwood, NJ 07648-0425
Contact: Phil Cindritch, Pres
201-767-5380 FAX: 201-767-4147

N

NEC America Inc Broadcast Equipment Div
1255 Michael Dr
Wood Dale, IL 60191
Contact: Jeff White, Adv Mgr

NKT Elektronik
Brondbyvestervej 95
Golstrup, DK-2600 Denmark

Nady Systems Inc
1145 65th St
Oakland, CA 94608
Contact: Katie Forrest
415-652-2411 FAX: 415-652-5075

World Radio History

Nagra Magnetic Recorders Inc
19 West 44th St Ste 715
New York, NY 10036
Contact: Don Notto, Sales Mgr
212-840-0999

Nakamichi America Corp
19701 S Vermont Ave
Torrance, CA 90502
Contact: Karen Nathan,
Pro Audio Coord
213-538-8150 FAX: 213-324-7614

Nalpak Video Sales Inc
1937-C Friendship Dr
El Cajon, CA 92020
619-258-1200

Narac Bdcst
9221 Kanawha
Tucson, AZ 85741
Contact: P Palagonia

Narda Microwave Corp
435 Moreland Rd
Hauppauge, NY 11788
Contact: John Coppola, Mktg Mgr
516-231-1700

National Audio Co Inc
Box 3657, G.S.
Springfield, MO 65808
Contact: Steve Stepp, Pres
417-863-1925 FAX: 417-863-7825

National Supervisory Network
PO Box 578
Avon, CO 81620
Contact: Bill Sepmeier, Pres
303-949-7774 800-345-8728
FAX: 303-949-4364

National TV Systems Co
2113 Wells Branch/Bldg 6 #100
Austin, TX 78728
Contact: Suzy Maupin, Ad Mgr

Nautel Electronic Laboratories Ltd
Hacketts Cove, RR#1
Tantallon, Nova Scotia,
Canada BOJ 3JO
Contact: Jorgen B. Jensen,
Mgr AM Bdcst Sales
902-823-2233 FAX: 902-823-3183

Neotek Corp
1154 W Belmont
Chicago, IL 60657
Contact: Susan Gosstrom
312-929-6699 FAX: 312-975-1700

Network Production Music Inc
11021 Via Frontera
San Diego, CA 92127
619-451-6400

The Network
PO Box 685
Fairfax, CA 94930
Contact: Katherine Arnold

Neumade Products Corp
200 Connecticut Ave
Norwalk, CT 06584
203-866-7600

Rupert Neve Inc
Berkshire Industrial Pk
Bethel, CT 06801
Contact: Barry Roche, Pres
203-744-6230

New England Digital
49 North Main St
White River Junc, VT 05001
Contact: Franklin B Sullivan,
VP/Mktg & Sales
802-295-5800 FAX: 802-296-2075

New Resource
28 Mount Blue St
Norwell, MA 02061
Contact: Sales Mgr

New World Audio Express
4792 Clairemont Mesa Blvd
San Diego, CA 92117
Contact: Jim Scott
800-854-2005

Nitty Gritty Record Care Products
4650 Arrow Hwy, Suite #F4
Montclair, CA 91763
Contact: Michael Baskind,
National Sales Mgr
714-625-5525

John Nix
PO Box 13244
Salem, OR 97309
Contact: John Nix
503-581-4056 800-321-4056

Norac Broadcast Power Systems
1401 O'Kane Ste 19
Lardeo, TX 78040
512-726-0130

Nordic Software
3939 N 48 St
Lincoln, NE 68504-3182
Contact: James Wrenholt
402-466-6502 FAX: 402-466-5982

North Coast Marketing
707 West 10th St
Erie, PA 16502
Contact: Sales Mgr

Northeast Broadcast Lab Inc
PO Box 1179
S Glen Falls, NY 12803
Contact: Criss Onan, Sales Mgr
518-793-2181 FAX: 518-793-7423

Northwestern Inc
1224 SW Broadway
Portland, OR 97205
Contact: Robert Lindahl, Pres
800-547-2252

Nortronics Co Inc
8101 North Tenth Ave
Minneapolis, MN 55427
Contact: Wes Bry
612-540-8677 800-328-5640
FAX: 612-540-8678

Nott, Ltd
4001 La Plata Hwy, PO Box 761
Farmington, NM 87401
Contact: Ron Nott, Pres
505-327-5646 FAX: 505-326-1261

Fred A Nudd Corp
PO Box 577
Ontario, NY 14519
Contact: Bonnie Hays, Gen Mgr
315-524-2531 FAX: 315-524-4249

Rick Nudd Ltd
4897 Arbor Rd
Walwort, NY 14568
Contact: Rick Nudd, Owner
1-315-524-5495

Nytone Electronics
2424 South 900 West
Salt Lake City, UT 84119

O

Oakwood Audio Labs, Ltd
652 King Edward St
Winnipeg, Manatoba,
Cananda R3H OP2
Contact: Ron Paley,
Bdcst Sales Mgr
204-786-6715 FAX: 204-783-5805

Old Dominion Broadcast Engr Service
9505 Lakewater Ct
Richmond, VA 23229
Contact: Sam Straus, Pres
804-740-4717

Omega International
2691 Richter Ste 116
Irvine, CA 92714
Contact: Mark Hutchins
714-553-0564 FAX: 714-553-0533

One Stop Broadcast Supply
2210 S M Street
Oxnard, CA 93033-7147

Opamp Labs Inc
1033 N Sycamore Ave
Los Angeles, CA 90038
Contact: B Losmandy, Mgr
213-934-3566 FAX: 213-464-0977

Orban Associates Div of AKG
645 Bryant St
San Francisco, CA 94107
Contact: Howard Mullinack, Mktg
415-957-1067 FAX: 415-957-1070

Orcad Systems Corp
1049 SW Base Line St Ste 500
Hillsboro, OR 97123
503-640-5007

Douglas Ordon & Co Inc
211 E Ohio St Ste 1116
Chicago, IL 60611
Contact: Douglas F Ordon, Pres
312-527-4569 FAX: 312-527-4572

Ortofon Inc
122 Dupont St
Plainview, NY 11758
Contact: Michele Port
516-349-9180

Otari Corp
378 Vintage Park Dr
Foster City, CA 94404
Contact: Sally Olson Saubolle
415-341-5900 FAX: 415-341-7200

Owl Engineering
1306 West City Rd F, Suite 105
St. Paul, MN 55112
Contact: Garrett G. Lysiak, Pres
1-612-631-1338 FAX: 612-631-3502

P

PAS (Professional Audio Supply)
5700 E Loop 820 S
Ft Worth, TX 76119-7050
Contacts: Dan Rau/John Reed,
Natl Sales Mgr
800-433-7668 FAX: 817-483-9952

PME
111 Stanford Ct
Grass Valley, CA 95945
Contact: William Fink, Cslt

Pacific Recorders & Engineering Corp
2070 Las Palmas Dr
Carlsbad, CA 92009
Contact: Anders Madsen
Sales & Mktg Mgr
619-438-3911 FAX: 619-438-9722

Pala Electronic Inc
3200 Teakwood
Edmond, OK 73013
Contact: Linda Kaye, Exec VP

Paladin Corp
3543 Old Conejo Rd #102
Newbury Park, CA 91320
Contact: Ron Vogel, Mktg Mgr
805-499-0318 FAX: 805-499-4006

Palex Co
6330 Ashdale Rd
Cleveland, OH 44124
Contact: H Heller, CE

Panasonic - Ramsa Div
6550 Katella Ave
Cypress, CA 90630
Contact: Steve Woolley
Sales & Mktg Mgr
714-373-7278 FAX: 714-373-7242

Panasonic Industrial Co
One Panasonic Way
Secaucus, NJ 07094
Contact: Ad Mgr
201-348-7620

Panasonic/Prof Audio Dept
6550 Katella
Cypress, CA 90630
Contact: Gene Juall, Mktg Mgr
714-373-7278

Paramount Communications Systems
10 West Albertson Ave
Westmont, NJ 08108
Contact: Michael Moskowitz, Pres
609-869-0222 FAX: 609-858-3076

Parcom Inc
750-A N Carroll Ave
Southlake, TX 76092
Contact: Darryl E. Parker, Pres
817-481-7221 FAX: 817-488-7615

Park Leasing Co
PO Box 1719
Des Moines, IA 50306
Contact: Bob Arnold, Pres

Parsons Audio
192 Worcester St (Rt 9)
Welesley Hills, MA 02181
Contact: Mark Parsons
617-431-8708 FAX: 617-431-8710

Patch Bay Designation
4742 San Fernando Rd
Glendale, CA 91204
Contact: Scott Lookholder, Ad Mgr
818-241-5585

Peak Audio
3107 Bedlington Pl
Holland, PA 18966
Contact: M Sirkis

Peavey Electronics Corp
711a St Box 2898
Meridian, MS 39301
Contact: Lance Schmidt
Sales & Mktg Dir
601-483-5365 FAX: 601-484-4278

Penny & Giles
2716 Ocean Park Blvd Ste 1005
Santa Monica, CA 90405
213-393-0014

Periphex Inc
149 Palmer Rd
Southbury, CT 06488
Contact: Erwin Phillip, VP Sales
203-264-3985 800-634-8132
FAX: 203-262-6943

Phase Audio
1545 Monroe
Memphis, TN 38104
Contact: Jim Woodward, GM

Phase Linear
4134 N United Parkway
Schiller Park, IL 60176
Contact: Peter Horsman, Natl
Sales Mgr Pro Div

Phoenix Systems
POB 297
Hickory, MS 39332
Contact: John H Roberts, Pres

World Radio History

Peirce-Phelps Inc
2000 North 59th St
Philadelphia, PA 19131-3099
Contact: Douglas Wilkins, Mktg Mgr
215-879-7171 800-862-6800
FAX: 215-878-5252

Pirod Inc
PO Box 128
Plymouth, IN 46563

Plastic Capacitors Inc
2623 N Pulaski Rd
Chicago, IL 60639
Contact: Tom Brown, Mktg Mgr
312-489-2229 FAX: 312-489-0496

Plastic Reel Corp of America
Brisbin Ave
Lyndhurst, NJ 07071
Contact: Pat Baccarella, VP
201-933-5100 FAX: 201-933-9468

Polar Research
POB 1
Thief River Fall, MN 56701
Contact: Kim Ballou

Polycom Corp
142 E Ontario
Chicago, IL 60611
Contact: Joe Hassen

Polyline Corp
1233 Rand Rd
Des Plaines, IL 60016
Contact: John Kaiser, Pres

Posthorn Recordings
142 West 26th St
New York, NY 10001
Contact: Jerry Bruck, Owner/Pres
212-242-3737 FAX: 212-924-1243

Potomac Instruments
#932 Philadelphia Ave
Silver Spring, MD 20910
Contact: David G Harry, Sales Mgr
301-589-2662

Power Film Systems Inc
PO Box 485
Yellville, AR 72687
Contact: Alice Milligan, Sales Dir
501-449-4091 FAX: 501-449-4093

Precision Design
27106 South 46th Ave
Kent, WA 98032
206-852-5070

Pro Media
3563 San Pablo Dam Rd
El Sobrante, CA 94803
Contact: David Shantz, Bdcst Sales
415-222-0307 FAX: 415-223-9147

Procart
7012 27th St West
Tacoma, WA 98466
206-565-4546

Programming Plus
PO Box 90486
Pacific Beach, CA 92109-0860
619-272-7587

Pyramid Audio Inc
450 W Taft Dr
S Holland, IL 60473
Contact: Rob Vukelich, Pres
708-339-8014 FAX: 708-339-8024

Q

QEI Corporation
One Airport Dr
PO Box D
Williamstown, NJ 08094
Contact: Jeff R Detweiler
609-728-2020 FAX: 609-629-1751

QSC Audio Products
1926 Placentia Ave
Costa Mesa, CA 92627
Contact: Pete Kalmer
714-645-2540 FAX: 714-645-7927

Quantum Audio Labs Inc
1909 Riverside Dr
Glendale, CA 91201
818-841-0970

Quick Set Inc
3650 Woodhead Dr
Northbrook, IL 60062
Contact: Mark Stolman

R

R & A Broadcast Services
8684 Route 21
Naples, NY 14512
Contact: Mike Hotchkiss, Owner
716-374-5280

R-Columbia Products Co Inc
2008 St Johns Ave
Highland Park, IL 60035
Contact: Irving Rozak
312-432-7915

RAKS
201 Rt 17 Ste 300
Rutherford, NJ 07070
201-438-0119

RE Electronics
31029 Center Ridge
Cleveland, OH 44145
Contact: Bruce Graven, Sales Dept

RE Instruments Corp
31029 Center Ridge Rd
Westlake, OH 44145
Contact: Tom Zavesky, Mktg Mgr
216-871-7617

RF Gain Ltd
116 S Long Beach Rd
Rockville Centre, NY 11570
Contact: Dave Gilden, Pres

RF Scientific Inc
4609 Pkwy Commerce Bld 606-C
Orlando, FL 32808
Contact: Angelo Miceli, VP

RF Specialties of California
3463 State St Ste 229
Santa Barbara, CA 93105
805-682-9429 FAX: 805-682-4396

RF Specialties of Florida
PO Box 397
Niceville, FL 32578
Contact: Bill Turney
904-678-8943 FAX: 904-729-2744

RF Specialties of Missouri
RR #2, Box 152H
Kearney, MO 64060
Contact: Chris Kreger
816-635-5959 FAX: 816-635-4508

RF Specialties of Nebraska
2003 Brewster Rd
Bellevue, NE 68005
402-734-5521

RF Specialties of Pennsylvania
121 Conneaut Dr
Pittsburgh, PA 15239
Contact: Tom Monahan, Pres
412-733-1994 FAX: 412-327-9336

RF Specialties of Texas
PO Box 7630
Amarillo, TX 79114
Contact: Don Jones
806-372-4518 FAX: 806-372-1833

RF Specialties of Washington Inc
19237 Aurora Ave N
Seattle, WA 98133
Contact: John Schneider, Pres
206-546-6546 FAX: 206-546-2633

RF Systems
Div of Audiolab Electronics
5831 Rosebud Ln Bldg C
Sacramento, CA 95841
Contact: Robert E. Stofan, Pres
916-348-0200 FAX: 916-348-1512

RF Technology Inc
16 Testa Pl
So Norwalk, CT 06854
Contact: John Brandt, Engr

RMS Electronics Inc
50 Antin Place
Bronx, NY 10462
212-892-1000

ROH Div of Anchor Audio
913 W 223rd St
Torrance, CA 90502
Contact: Jim Van Waay, Pres
213-533-1498 FAX: 213-533-6050

UNR ROHN Inc
PO Box 2000
Peoria, IL 61601
Contact: Mike Fleissner, Equip Shelters Sales Mgr
309-697-4400

RPG Diffusor Systems Inc
12003 Wimbleton St
Largo, MD 20722
Contact: Dr Peter D'Antonio, Pres
301-249-5647 FAX: 301-249-3912

RTI (Research Technology International)
4700 Chase Ave
Lincolnwood, IL 60646
312-677-3000

RTS Systems Inc
1100 W Chestnut St
Burbank, CA 91506
Contact: Kim Murphy, Sales Admin
818-566-6700 FAX: 818-843-7953

Radcom Inc
POB 372
Eureka Springs, AR 72632
Contact: T Butler

Radio Design Labs
PO Box 1286
Carpinteria, CA 93013
Contact: Jerry Clements, Dir of Mktg & Sales
805-684-5415 FAX: 805-684-9316

Radio Resources
PO Box 8782
BWI Airport, MD 21240
Contact: Ashley Scarborough
301-859-1500

Radio Systems Engineering
4289 Roan Ridge
Las Vegas, NV 89120
Contact: Gale Gilbreath
702-454-2085

Radio Systems Inc
110 High Hill Rd
Bridgeport, NJ 08014-0458
Contact: Daniel Braverman, Pres
609-467-8000 800-523-2113
FAX: 609-467-3044

Raines Electromagnetics
13420 Cleveland Dr
Potomac, MD 20850
302-279-2972

Raks Corp of America Inc
201 Rt 17 Ste 300
Rutherford, NJ 07070
Contact: Sinan Turkomer, Exec VP
201-438-0113 FAX: 201-438-3185

Steve Raleigh Broadcast Services
POB 3403
Princeton, NJ 08540
Contact: Steve Raleigh, Pres

Ram Broadcast Systems Inc
346 West Colfax St
Palatine, IL 60067
Contact: Ron Mitchell, Pres
312-358-3330 FAX: 312-358-3577

Ramko Research
3501 Sunrise Blvd #4
Rancho Cordova, CA 95670
Contact: Ray Kohfeld, Pres
916-635-3600 FAX: 916-635-0907

RANE
10802 47th Ave W
Everett, WA 98204
Contact: Larry Winter, VP Mktg
206-355-6000 FAX: 206-347-7757

Raven Screen Corp
124 East 124th St
New York, NY 10035

Reach Inc
301 South 68th St
Lincoln, NE 68510
Contact: Jon Canaday, Pres

Register Data Systems
PO Box 1246
Perry, GA 31069
Contact: Lowell Register, Pres
912-987-2501 FAX: 912-987-7595

Research Associates Inc
230 S Sierra Madre
Colorado Springs, CO 80903
Contact: Bill Cook, Pres & GM
719-594-9464

Research Technology International
4700 Chase
Lincolnwood, IL 60646
Contact: Tom Tisch, VP Sales
708-677-3000 FAX: 708-677-1311

Richardson Electronics
40 West 267 Keslinger Rd
La Fox, IL 60147
Contact: Larry Broome, Product Mgr Bdcst
312-208-2386 800-323-1770
FAX: 312-208-2550

Riggins Electronic Sales
3272 E Willow St
Long Beach, CA 90806
Contact: George Riggins, Pres
213-598-7007

Riviera Broadcast Leasing
9200 Sunset Blvd, #601
Los Angeles, CA 90069
Contact: Henri Ballinger

Ron Radio Communications
PO Box 201
Brightwaters, NY 11718
Contact: Jim Saunders, Pres
516-666-3525 800-666-3525
FAX: 516-665-6482

Rosco Labs Inc
36 Bush Ave
Port Chester, NY 10573
914-937-1300

World Radio History

Ray H. Rosenblum
PO Box 38296
Pittsburg, PA 15238
Contact: Ray H. Rosenblum, Media Broker
412-963-6311

Ruslang Corp
320 Dewey St
Bridgeport, CT 06605
Contact: Frank Ruskay
203-384-1266

Russco Electronics Mfg Inc
5690 E Shields Ave
Fresno, CA 93727
Contact: Russell C Friend, Pres
209-291-5591

S

S C M S Inc
10201 Rodney Blvd
Pineville, NC 28134
Contact: Bob Cauthen, Sales Mgr/CATV
800-438-6040 FAX: 704-889-4540

SCA Data Systems Inc
3000 Ocean Park Blvd #3002
Santa Monica, CA 90405
Contact: Ad Mgr

SWR Inc
PO Box 215
Goffstown, NH 03045
Contact: Jack Kruger
603-529-2500

Saki Magnetic
26600 Agoura Rd
Calabasas, CA 91302
Contact: Trevor Boyer, Mktg
818-880-4054 FAX: 818-880-6242

Howard W Sams & Co Inc
4300 West 62nd St
Indianapolis, IN 46268

Satellite Consultants International
PO Box 1509
Idaho Springs, CO 80452
Contact: Ms Terri Johnson, VP Sales Mktg

Satellite Transmission & Reception Specialists
3003 Moffett Ln
Houston, TX 77489
Contact: Barry Frishman, Mgr Audio Sales
713-438-3600 FAX: 713-438-9407

Savco Broadcast Equipment Inc
PO Box 850427
Richardson, TX 75085
214-783-1438

Scala Electronic Corp
PO Box 4580
Medford, OR 97501
Contact: Dan Fowler, Mktg Mgr
503-779-6500 FAX: 503-779-3991

Schafer Digital
9431-A Harwin
Houston, TX 77036
Contact: Mike Krehl, Pres & CEO
713-784-9400 FAX: 713-784-8565

Schafer International
5801 Soledad Mountain Rd
La Jolla, CA 92037
Contact: Paul Schafer, Pres
619-456-8000 FAX: 619-456-1350

Schafer World Communications Corp
PO Box 31
Marion, VA 24354-0031
Contact: Bob Dix
703-783-2000 FAX: 703-783-2064

Schelectronics
3066 Hazy Park Dr
Houston, TX 77082
Contact: Randy Schell

Peter E Schmitt Co, Inc
240 Grand Ave
Leonia, NJ 07605
Contact: Sales Mgr

Schoeps/Posthorn Recordings
142 West 26th St 10th Floor
New York, NY 10001
212-242-3737

Scientific Atlanta Inc
420 North Wickham Rd
Melbourne, FL 32935
Contact: Mel Nance
407-242-0272 FAX: 407-259-3942

L J Scully Mfg Corp
138 Hurd Ave
Bridgeport, CT 06604
Contact: L J Scully Jr, Pres
203-368-2332

Seck
8500 Balboa Ave
Northridge, CA 91329
818-893-4351 FAX: 818-893-3639

Secoa
2731 Nevada Ave N
Minneapolis, MN 55427
612-546-6313

Selco Products
7580 Stage Rd
Buena Park, CA 90621
Contact: Lori Aaron, Adv Mgr
714-521-8673

Sencore Inc
3200 Sencore Dr
Sioux Falls, SD 57117
Contact: John Perry, Natl Sales Mgr
605-339-0100

Sennheiser Electronic Corp
6 Vista Dr, PO Box 987
Old Lyme, CT 06371
Contact: Tony Tudisco, VP Mktg
203-434-9190 FAX: 203-434-1759

Sentry Systems
2211 Fifth Ave
Seattle, WA 98121
Contact: Lee Hurley, GM
206-728-8651 FAX: 206-441-6582

Sequoia Electronics
1131 Virginia Ave
Campbell, CA 95008
Contact: Mel Crosby, Sales Mgr
408-866-8434

Sescom Inc
2100 Ward Dr
Henderson, NV 89015
Contact: Franklin Miller, Pres
702-565-3400 FAX: 702-565-4828

Seven Seas Audio
3614 Woodlawn Ave
North Seattle, WA 98103
Contact: Keith Keller, Owner

Shallco Inc
PO Box 1089
Smithfield, NC 27577
Contact: Michael Sutton
919-934-3135

Shepler Electronics
5653 Weymouth Dr
Rockford, IL 61111
Contact: J Shepler, Sr Design Engr

Shively Labs
19 Harrison Rd
Bridgton, ME 04009
Contact: Jonathan R Clark, Sales Coord
207-647-3327 FAX: 207-647-8273

Shook Electronic Enterprises Inc
6630 Topper Pky
San Antonio, TX 78233
Contact: J Hollenbeck Shook, Dir
512-653-6761

Shure Brothers Inc
222 Hartrey Ave
Evanston, IL 60202
Contact: John F Phelan, Mktg
312-866-2200 FAX: 312-866-2279

Sine Systems
3704 Inglewood Circle S
Nashville, TN 37216
Contact: John Pate
615-228-3500

Si-Tex
PO Box 6700
Clearwater, FL 34618
Contact: William F Burgin, Mktg Mgr

W Lee Simmons & Associates Inc
1036 William Hilton Pky #200f
Hilton Head Isle, SC 29928
Contact: W Lee Simmons
803-785-4445 FAX: 803-785-4445

Sims Vibration Control
2797 152nd Ave, NE #7
Redmond, WA 98052
Contact: Robert Spotler, VP, Dir of Mktg

Sims Vibration Dynamics
17724 15th Ave NE
Seattle, WA 98155
Contact: 206-362-0700

Software Technologies Inc
6 Shetland Cl
Salem, NH 03079
Contact: Mark Richards, GM

Solar SignAge Inc
13006 Mula Lane
Stafford, TX 77477
Contact: Kevin L Conlin, Pres
713-933-1578 FAX: 713-933-0100

Solid State Logic
Begbroke
Oxford, England OX5 1RU
Contact: Noel Bell
44-08675-4353

Solway Inc
PO Box 7647
Hollywood, FL 33081
Contact: Martin Munger
305-962-8650

Somich Engineering
1208 Stoney Run Trail
Broadview Heights, OH 44147
Contact: Jim Somich, Owner
216-526-4561 FAX: 216-526-4561

Sono-Mag Corp
1833 W Hovey Ave
Normal, IL 61761
Contact: J Housour, VP
309-452-5313 FAX: 309-452-2521

Sony Corp of America Communications Products Co
1600 Queen Anne Rd
Teaneck, NJ 07666
Contact: Charles Taylor
201-833-5200 FAX: 201-833-2880

Soper Sound Music Library
PO Box 498
Palo Alto, CA 94301
415-321-4022 800-227-9980
FAX: 415-321-9261

Sound Com Corp
227 Depot St
Berea, OH 44017
Contact: Roy Stuewe
216-234-2604 FAX: 216-234-2614

Sound Concepts
Box 135
Brookline, MA 02146
Contact: John Bubbers

Sound Ideas
105 W Beaver Creek Rd
Suite 4
Richmond Hill, Ontario
Canada L4B 1C6
Contact: Brian Nimens, Pres
416-886-5000 FAX: 416-886-6800

Sound Merchandising
926 Sheridan Rd
Glencoe, IL 60022
Contact: Sales Mgr

Sound Technology
1400 Dell Ave
Campbell, CA 95008
Contact: Robert Anderson, VP
408-378-6540 FAX: 408-378-6847

Sound Workshop Pro Audio Products
1324 Motor Pkwy
Hauppauge, NY 11788
516-582-6210

Sound Workshop
79 Express St
Plainview, NY 11803
Contact: Lee B Pomerantz
516-932-6570 FAX: 516-932-6573

Soundcraft
8500 Balboa Blvd
Northridge, CA 91329
Contact: David Kimm
818-893-4351 FAX: 818-893-3639

Southeast Electronics Inc
PO Box 41308
Jacksonville, FL 32203
904-356-3007

Southern Tower Service Co
PO Box 1387
Suffolk, VA 23434
Contact: James L Corlew
804-539-8365 FAX: 804-539-2047

Specialty Vehicles
450 N Somerset Ave
Indianapolis, IN 46222
Contact: W K Kimmel, Pres

Spectra Sonics
3750 Airport Rd
Ogden, UT 84405
Contact: Gregory D Dilley
801-392-7531 FAX: 801-392-7531

Spencer Broadcast Inc
7003 W Union Hills Dr
Peoria, AZ 85345
Contact: Charles Spencer, Pres
602-242-2211 FAX: 602-843-2860

A W Sperry Instruments
245 Marcus Blvd
Hauppauge, NY 11788
516-231-7050

Sphere Electronics
9960 Canoga Ave
Chatsworth, CA 91311
Contact: David Holmes

Spool Tool
PO Box 474
Lebanon, OH 45036
Contact: Burdette Sweny, Pres

Sprague Magnetics Inc
15720 Stagg St
Van Nuys, CA 91406
Contacts: John Austin Jr/ May Harrow
818-994-6602 FAX: 818-994-2153

World Radio History

Stainless Inc
Third & Montgomery Sts
North Wales, PA 19454
Contact: H William Guzewicz
215-699-4871

Standard Tape Laboratory Inc
26120 Eden Landing Rd #5
Hayward, CA 94545
Contact: Frank G Lennert, Pres
415-786-3546 FAX: 415-786-1180

Stanton Magnetics Inc
101 Sunnyside Blvd
Plainview, NY 11803
Contact: Pete Bidwell, Sales Mgr
516-349-0235 FAX: 516-349-0230

Stantron Unit of Zero Corp
6900 Beck Ave
N Hollywood, CA 91605
Contact: Guy Tessier
818-841-1825 FAX: 818-841-8892

Star Case
648 Superior
Munster, IN 46321
219-922-4440 FAX: 219-922-4442

Star Systems
462 Merrimack St
Menthuen, MA 01844
Contact: Ed Burns

Steimke Engrg
PO Box 3101
Quincy, IL 62305
Contact: Jeff Steimke

Steve Vanni & Assoc
PO Box 422
Auburn, NH 03032
Contact: Steve Vanni, Pres
603-483-5365 FAX: 603-483-2352

Storeel Corp
PO Box 80523
Atlanta, GA 30366
Contact: Carolyn Galvin, Pres
404-459-3280 FAX: 404-457-5535

Studer Revox America Inc
1425 Elm Hill Pike
Nashville, TN 37210
Contact: Doug Beard, Sales Mgr
615-254-5651 FAX: 615-256-7619

Studio Technologies
5520 West Touhy Ave
Skokie, IL 60077
Contact: Jennifer Shore, Adv Coord
312-676-9177 FAX: 312-982-0747

Studio-Sonics Corp
1165 Tower Rd
Schaumburg, IL 60195
Contact: James R Stemke, Pres
312-843-7400

Suministros Gonzalez
1500 Bay Rd #1158
Miami Beach, FL 33139
Contact: Manuel J Gonzalez, Owner

Summit Software Systems Inc
4810 Riverbend Rd Ste 100
Boulder, CO 80301
Contact: Kathy Waldrop
800-323-2905 FAX: 303-443-9934

Sunbelt Mfg Co
Vienna Industrial Park
Vienna, GA 31092
Contact: Ben Johnston, Mktg Mgr

Surcom Associates
2215 Faraday Ave #A
Carlsbad, CA 92008
Contact: A J Link
619-438-4420 FAX: 619-438-4759

Swaine Studio Inc
2515 Harriman Ln
Redondo Beach, CA 90278
Contact: Gay D Swaine, Pres

Swintek Enterprises Inc
965 Shulman Ave
Santa Clara, CA 95050
Contact: John Hernandez, Mktg Mgr
408-727-4885 FAX: 408-727-3025

Switchcraft Inc
5555 N Elston Ave
Chicago, IL 60630
Contact: Patrick Jones
312-792-2700 FAX: 312-792-2129

Symetrix Inc
4211 24th Ave West
Seattle, WA 98199
Contact: Will Lewis, Dir of Sales & Mktg
206-282-2555 FAX: 206-283-5504

Systemation
3900 Inverness Lane
Plano, TX 75075
Contact: David Gerety

Systems Wireless Ltd
465 Herndon Parkway
Herndon, VA 22070
Contact: William Sien, VP
703-471-7887 FAX: 703-437-1107

T

TASCAM
7733 Telegraph Rd
Montebello, CA 90640
Contact: Ken Hirata
213-726-0303 FAX: 213-727-7656

TDK Electronics Corp
12 Harbor Park Dr
Port Washington, NY 11050

TFT Inc
3090 Oakmead Village Dr
Santa Clara, CA 95052-8088
Contact: Jesse Maxenchs, Dir Mktg
408-727-7272 FAX: 408-727-5942

TOA Electronics Inc
480 Carlton Ct
S San Francisco, CA 94080
Contact: Joe Green, Mktg Mgr
415-621-2949

TTC (Television Technology Corp)
PO Box 1385
Broomfield, CO 80020
Contact: Alex Delay
303-665-8000 FAX: 303-673-9900

TV Systems
2113 Wells Branch/Bldg 6 #100
Austin, TX 78728
Contact: Cary Fitch

Taber Manufacturing & Engrg Co
1880 Embarcadero Rd
Palo Alto, CA 94303
Contact: Veldon Leverich
415-493-3811

Tandberg of America Inc
1 Labriola Ct
Armonk, NY 10504
914-273-9150

Tannoy North America Inc
300 Gage Ave Unit #1
Kitchener, Ont, N2M 2C8 Canada
Contact: Bill Calma
519-745-1158 FAX: 519-745-2364

Tape-Athon/Cavox
13633 Crenshaw Blvd
Hawthorn, CA 90250
Contact: Lee Tate, Pres
213-676-6752 FAX: 213-676-9532

Tapex Corp
228 5th St, Suite 2
West Des Moines, IA 50265
Contact: Vic Blacketer, Sales Mgr
515-274-3087

Tapscan
3000 Riverside Galleria, 1111
Birmingham, AL 35244
Contact: J Christian, Pres

Target Head Enterprise
5360 East Raymond St
Indianapolis, IN 46203
Contact: Geo Cecil Frye

Target Tuning
6 Caesar Place
Moonachie, NJ 07074
Contact: Dan Flohr, Pres
201-935-8880 FAX: 201-935-6548

Taube Violante Advert
PO Box 504
Norwalk, CT 06856
Contact: Jean Crawford

Tech Laboratories Inc
500 10th St
Palisades Park, NJ 07650
Contact: Nino M. Vlacich, VP
201-944-2221 FAX: 201-944-1653

Techni-Tool
5 Apollo Rd Box 368
Plymouth Meeting, PA 19462
Contact: Bonnie Burgemeister, Adv Mgr

Technology Plus
6502 Robin Forrest
San Antonio, TX 78239
Contact: Bill Smith, Proj Mgr

Tektan Inc
PO Box 271872
Concord, CA 94572
415-798-2222

Tektronix Inc
Box 500
Beaverton, OR 97077
Contact: Sales Mgr
503-627-7111 FAX: 503-627-6905

Tel-Wire Corp
7 Michael Ave
Farmingdale, NY 11735
Contact: Marty Ingram, GM

Tele-Midi
30 N Raymond Ave, #601
Pasadena, CA 91103
Contact: Sales Mgr

Tele-Wire Supply Co
1620 W Crosby Rd
Carrollton, TX 76006

Telectro Systems Corp
96-18 43rd Ave
Corona, NY 11368
Contact: Harry Sussman, Eng Mgr
718-651-8900 FAX: 718-651-4103

Telex Communications Inc
9600 Aldrich Ave South
Minneapolis, MN 55420
Contact: Donald Mereen, Dir of Mktg
612-884-4051 FAX: 612-884-0043

Telfax Communications
PO Box 31
Webster City, IA 50595
Contact: Craig Pringle, Owner
515-832-1263 FAX: 515-832-1217

Telnox Ltd
55 Montpellier Blvd
St Laurent, Quebec, H4N 2G3 Canada
Contact: Jacques Coutellier, Pres
514-744-1785 FAX: 514-744-2797

Telos Systems
1729 Superior Ave
Cleveland, OH 44114
Contact: Steve Church, Pres
216-241-7225 FAX: 216-241-4103

Temtron Electronics Ltd
15 Main St
E Rockaway, NY 11518
Contact: Sid Sussman
516-599-6400

Tennaplex Systems Ltd
21 Concourse Gate
Nepean, Ontario, K2E 7S4 Canada
Contact: Marvin Crouch
613-226-5870 FAX: 613-727-1247

Tentel Corp
4475 Golden Foothill Pkwy
El Dorado Hills, CA 95630
Contact: Chuck Fodor, Sales Eng
916-939-4005 FAX: 916-939-4114

Tepco Corp
PO Box 680
Rapid City, SD 57709
Contact: Jerry Johnson, Sales Mgr
605-343-7200

Texas Electronics Inc
PO Box 7225 B
Dallas, TX 75209
Contact: J R Tozer
214-631-2490

Text Technologies Inc
1475 South Quebec Way, #8, PO Box 242
Denver, CO 80224
Contact: John Clark, Pres
303-751-7619

Thermodyne Intl Ltd
20850 S Alameda
Long Beach, CA 90810
Contact: Walter Wolf

3M Magnetic Media Division
Bldg 223-55-01, 3M Center
St Paul, MN 55144-1000
Contact: Richard J Collins
612-733-1082

360 Systems
18740 Oxnard St
Tarzana, CA 91356
Contact: Robert Easton, Pres
818-342-3127 FAX: 818-342-4372

Thor Electronics Corp
321 Pennsylvania Ave
Linden, NJ 07036
Angelo Crudele, Sales VP
800-666-8467 FAX: 201-486-0923

Time & Temperature Co of SD
PO Box 3605
Rapid City, SD 57709-3605
Contact: Don Grant, VP Sales & Mktg
605-787-4805 800-658-5432

Tinet Inc
2611 Temple Heights Dr Ste F
Oceanside, CA 92056
Contact: Paul Scott

Titus Technological Laboratories
77 Kreiger Lane Ste 914
Glastonbury, CT 06033
Contact: Lawrence Titus, Pres
203-633-5472

World Radio History

Townsend Broadcasting Systems
79 Mainline Dr
Westfield, MA 01085
Contact: Barry R Huntsinger

Transcom Corp
201 Old York Rd Ste 207
Jenkintown, PA 19046
Contact: Martin Cooper, Pres
215-884-0888 FAX: 215-884-0738

Transmission Structures Ltd
PO Box 907
Vinita, OK 74301
Contact: Tom Snow, VP Mktg
918-256-7883 FAX: 918-256-2558

Transtector Systems Inc
10701 Airport Dr
Hayden Lake, ID 83835
Contact: Steve Caron, Mktg Coord
800-829-2901 FAX: 208-772-9016

Trident USA Inc
280 Mill St Extension
Lancaster, MA 01523

Trimm Inc
PO Box 489
Libertyville, IL 60048-0489
Contact: Harry Lewis, Sales
312-362-3700 FAX: 708-680-3888

Tri-Tech Inc
2415 East Skelly Dr
Tulsa, OK 74105
918-425-5588 800-852-1333

Trompeter Electronics Inc
31186 La Baya Dr
Westlake Village, CA 91362
Contact: Dave Nerone, Ad Mgr
818-707-2020 FAX: 818-706-1040

Turbosound
30 B Banfi Plaza North
Farmingdale, NY 11735
Contact: Sam Spennachio,
National Sales Mgr
516-249-3660 FAX: 516-420-1836

TV Equipment Assoc Inc
PO Box 393
South Salem, NY 10590
Contact: Bill Pegler, Pres
914-763-8893 FAX: 914-763-9158

U

UAR Professional Systems
8535 Fairhaven
San Antonio, TX 78229
Contact: Robert Bruce, Mgr
512-690-8888

UREI
8500 Balboa Blvd
Northridge, CA 91329
Contact: Mark Gander
818-893-8411 FAX: 818-893-3639

US Audio Inc
PO Box 40878
Nashville, IN 37204
615-297-1098

US Tape & Label
1561 Fairview Ave
St Louis, MO 63132
Contact: Byron Crecelius, VP Mktg

Uher of America
7067 Vineland Ave
N Hollywood, CA 91605
Contact: John Belgiorno, Pres
818-764-1120

United Recording
681 Fifth Ave
New York, NY 10022
Contact: Anita Adams

Utility Tower Co
PO Box 12369
Oklahoma City, OK 73157
Contact: Reggie Wright,
Eng & Sales
405-946-5551 FAX: 405-947-8466

V

VIF International
PO Box 1555
Mountain View, CA 94042
Contact: Gordon Mackechnie
Advisor International Operations
408-739-9740 800-848-4428
FAX: 408-739-0809

Vacuum Tube Ind Inc
506 N Warren Ave, PO Box 2009
Brockton, MA 02403
Contact: Joani Mallett, Mktg Mgr
508-584-4500 FAX: 508-584-0096

Valentino Production Music & Sound Effects Library
151 West 46th St
New York, NY 10036
Contact: Thomas Valentino, Pres
212-869-5210 800-223-6278

Valley International Inc
PO Box 40306
Nashville, TN 37204
Contact: Norman Baker, Pres
615-383-4737 FAX: 615-269-5441

Vanner Inc
745 Harrison Dr
Columbia, OH 43204
614-272-6263

Varian Continental Electronics Div
PO Box 270879
Dallas, TX 75227
Contact: W Rice,
US Bdct Sales Mgr
214-381-7161 FAX: 214-381-4949

Vaughn Communications
7951 Computer Ave So
Minneapolis, MN 55435
Contact: Beth Evans
612-831-2248 FAX: 612-831-0791

Vector Technology Inc
203 Airport Rd
Doylestown, PA 18901
Contact: Melvyn Lieberman
215-348-4100 FAX: 215-348-3167

Vega, A Mark IV Company
9900 Baldwin Place
El Monte, CA 91731-2204
Contact: Kenneth M Bourne
818-442-0782 FAX: 818-444-1342

Doug Vernier Broadcast Cslt
1600 Picturesque Dr
Cedar Falls, IA 50613
Contact: Doug Vernier, Pres
319-266-7435 FAX: 319-273-2682

Versa Count
553 Lively Blvd
Elk Grove Village, IL 60007
Contact: Charles Piper

Versatech Industries Inc
14750 South Grant St
Bixby, OK 74008
Gene B. Randall Jr, Pres
918-366-7400

Vertigo Recording
12115 Magnolia Ste 116
N Hollywood, CA 91607
Contact: Charles Bolis
818-907-5161

W

Ward-Beck Systems Ltd
841 Progress Ave
Scarborough, Ont, M1H 2X4
Contact: Eugene L. Johnson,
Sales Eng
416-438-6550 FAX: 416-438-3865

Waveframe Corp
2511 55th St
Boulder, CO 80301
Contact: Courtney Spencer
303-447-1572 FAX: 303-447-2351

Waters Manufacturing
Longfellow Ctr
Wayland, MA 01778
Contact: Peggy Angel, Ad Mgr

Weather Central
5725 Tokay Blvd
Madison, WI 53719
Contact: Bob Lindmeier, Bdcst Mgr

Weather Services Corp
131A Great Rd
Bedford, MA 01730
Contact: G Stamos, VP Mktg

Wegener Communications
11350 Technology Cir
Duluth, GA 30136
Contact: Kenneth D Leffingwell
404-623-0096 FAX: 404-623-0698

Weisel Communications
228 1/2 Melrose
Youngstown, OH 44512
Contact: Charles Weisel

West Coast Audio Inc
65 W Easy St Ste 102
Simi Valley, CA 93065
805-583-3800

Western Intl Communications
505 Burrard St Ste 1960
Vancouver, Bc, V7X 1M6 Canada
604-526-3214

Westlake Audio Prof Prod Mfg Grp
2696 Lavery Ct Unit 18
Newbury Park, CA 91320
805-499-3686

Wheatstone Corp
6720 VIP Parkway
Syracuse, NY 13211
Contacts: G Snow, P Bagshaw
315-455-7740 FAX: 315-454-8104

White Instruments Inc
Box 90099
Austin, TX 78709
Contact: Emory Straus
512-892-0752 FAX: 512-892-0855

Brian R White Co, Inc
313 Henry Station Rd
Ukiah, CA 95482
Contact: Larry J Richmond
707-462-9795 FAX: 707-462-4800

Wide Range Electronics Corp
174 Chesterfield Ind Blvd
Chesterfield, MO 63005
Contact: Otto Rauhut, VP
314-532-5887

Wilkinson Electronics
PO Box 1385
Broomfield, CO 80020
Contact: Mkt Mgr

Will-Burt Co, TMD Div
401 Collins Blvd
Orrville, OH 44667
Contact: Donald S Barlow,
Sales Mgr
216-682-7015 FAX: 216-684-1190

Martin Williams
10 So 5th St
Minneapolis, MN 55402
Contact: Marlene Ordof

Wiltronix Inc
16850 Oakmont Ave
Washington Grove, MD 20880
301-258-7676

Winchell Mkting Comm
1315 Cherry St
Philadelphia, PA 19107
Contact: Joan Meagher

Winsted Corp
10901 Hampshire Ave South
Minneapolis, MN 55438
Contact: G R Hoska
800-447-2257 FAX: 612-944-1546

Wireworks Corp
380 Hillside Ave
Hillside, NJ 07205
201-686-7400

Wohler Technologies
1349 Kansas St
San Francisco, CA 94107
Contact: Will Wohler, Pres
415-285-5462 FAX: 415-821-6414

World Tower Co
PO Box 405
Mayfield, KY 42066
Contact: Nate Sholar

Worrell Assoc
300 College St
Ft Worth, TX 76104
Contact: Chuck Worrell

X

XIT Grounding Systems
25845 S Frampton Ave
Harbor City, CA 90701
213-530-8000

Y

Yamaha International Corp
PO Box 6600
Buena Park, CA 90622
Contact: Bob Shomaker
714-522-9011 FAX: 714-739-2680

Z

Z-Comm
870 S Sierra Ave
Solana Beach, CA 92075
Contact: Larry E Zaiser, Cslt
619-481-5999

Zercom Corp
PO Box 84, Zercom Dr
Merrifield, MN 56465
Contact: Jeff Zernov, Pres
218-765-3151 FAX: 218-765-3900

Zimmer Broadcast Co
PO Box 1810
Cape Girardeau, MO 63701
Contact: John Zimmer

World Radio History

COMPANY PROFILES

The following section is paid advertisement. Text of the profiles was provided by the companies and is reproduced unchanged, except for minor editorial revisions.

Companies appear in alphabetical order; space considerations may have prevented such order in some instances.

ATI	98
Broadcast Services	99
JRF Magnetic Sciences, Inc.	99
Broadcast Automation	100
Broadcast Supply West	101
CCA Electronics, Inc.	102
Gentner Electronics	102
Central Tower Inc.	103
Delta Electronics	104
Hallikainen & Friends Inc.	105
Henry Engineering	106
Moseley Associates	106
J.N.S. Electronics	107
QEI Corporation	108
Spencer Broadcast Inc.	109
SCA Data Systems	110
Multiphase Consulting	111

World Radio History

THE ATI GUYS

"Sam" "Ed"

Audio Technologies, Inc.
328 W. Maple Avenue
Horsham, PA 19044
Phone: (215) 443-0330
Fax: (215) 443-0394

Co-owners:

SAMUEL B. WENZEL, President, born 1934, married. 1951-55 served U.S. Armed Forces. BSEE 1959 City College of New York. MSEE 1963 Drexel University. 1959 - 1961 - AIL Design Engineer. 1961-1976- Philco Ford, Senior Engineering Specialist Terrestrial and Satellite Communications. 1976 - 1979 - Ampro Scully Co., as Vice-President and General Manager. 1979 - Co-founded ATI.

EDWARD M. MULLIN, Vice-President, born 1938, married. BSEE 1961 Drexel University. 1961 - 1964 - ITA Corp. Audio Design Engineer. 1964 - 1967 - Omnidata Corp - Digital & Electromechanical Design engineer. 1967 - 1979 Ampro Scully Co. successively as Design Engineer, Chief Engineer and President. 1979 Co-founded ATI.

ATI - Audio Technologies Incorporated was incorporated in the state of Pennsylvania in August 1979. We are now in our eleventh year. The company was organized and is co-owned equally by Samuel B. Wenzel and Edward M. Mullin. The initial ATI designs which are still manufactured, are the Micro Amp Series of Mike, Line, Distribution and Turntable Amplifiers. These products have been augmented by a full line of Consoles and "Problem Solver" products directed toward the broadcast and pro-sound industries. ATI's market is worldwide. 80% of sales are domestic, 20% are international.

ATI's manufacturing facility and headquarters occupy 10,000 sq. ft. in beautiful downtown Horsham, Pennsylvania, a suburb of Philadelphia. The principal activity at the plant is the manufacturing of ATI's extensive proprietary product line of audio equipment, along with marketing/sales and engineering offices.

ATI supports the National SBE and local SBE chapter 18 and is an associate member of NAB and NSCA.
The "Micro-Amp Series" - Premium Mike Amplifiers, Turntable Amplifiers, Line Amplifiers, Audio Distribution Amplifiers, Meter and Monitoring systems.
The "Vanguard Series" - Eight and twelve mixer, dual channel stereo broadcast consoles.
The "Encore Series", of Ulti-mike, Line, Turntable Amplifiers, Audio Distribution Amplifiers and Multi-Amplifier arrays.
The "Match-Maker" and "Disc-Patcher" line of bi-directional and uni-directional interface systems for level matching IHF leads to 600 ohms.
The "Emph-a sizer" - A Mike and Line Audio Processor.

Principal Dealers:

Allied Broadcast Equipment, Audio Broadcast Group, Bradley Broadcast Sales, Broadcast Supply West, Crouse - Kimzey Co., Broadcasters General Store, Martin Audio/Video, Northeast Broadcast Labs and other domestic and international dealers.

1990 trade shows where ATI will exhibit:

NAB '90, Radio '90, SBE National '90, Regional SBE Shows, Univ. of Wisconsin Broadcasters Clinic

DEDICATED TO SOUND ENGINEERING

Circle 1 On Reader Service Card

World Radio History

BROADCAST SERVICES CO.

Home Office: Rt.3 Box 45E, Four Oaks, NC 27524
Phone: 919-934-6869 FAX: 919-934-1537 Telex: 575082
President & Founder: Neal Davis
Inside Manager: Cindy Edwards; Office Manager: Lorine Davis
District Sales Office: P.O. Box 309 Front Royal, VA 22630
Phone: 703-635-1413. FAX : 703-635-9762. Telex: 62046263
Keith Arnett, District Sales Manager

Neal Davis has over twenty years experience in the technical areas of broadcasting and recording, including work for the American Forces Radio and Television Network, positions at various radio and television broadcast facilities, and lab engineering work at GTE/Sylvania. Davis holds a degree in electronics and an unlimited FCC Radiotelephone operator's license. He is a former Chapter Officer with the SBE and a member of the SMPTE.

In 1975 Davis founded Broadcast Services Co., an equipment dealership offering a variety of added services. Through the years Davis firmly established his company as the leading full- service supplier of broadcast equipment in the mid-Atlantic region. In 1987, he purchased EME, Inc., an established equipment rep firm with a wide range of video and communications product lines, also located in North Carolina. Both companies operate as part of The Davis Communications Group, Inc., a technical management company with broadly-based interests in the communications industry.

Company History

A Part of The Davis Communications Group, Inc., Broadcast Services Co. serves an extensive list of broadcasters throughout the mid-Atlantic area. Founded in 1975, it is one of the region's oldest broadcast equipment suppliers, and has provided equipment and "value added" service to nearly every major broadcast facility in NC, SC, VA, MD and DC.

Broadcast Services is system oriented, and specializes in serving the needs of large broadcast groups. As a result, the company often is the sole source supplier in major facility build-outs.

Founded on the concept of personal service to every customer, Broadcast Services Co. has maintained its customer commitment with complete technical service facilities and a parts supply depot for primary product lines. Constant attention has also been paid to administrative support as well, and the company maintains operations with an up-to-date Wang computer system. The computer system not only supports Broadcast Services but provides all of the data processing requirements of sister company EME, Inc. via a 120-mile dedicated telco data link. To further enhance response capability, all offices are equipped with facsimile machines and telex terminals.

The home office also maintains a complete electronic publishing system along with its own graphics camera, thus allowing complete in-house control and preparation of up-to-the-minute newsletters, sales notices and product catalogs.

In conjunction with The Davis Communications Group, Inc. and sister company EME, Inc., Broadcast Services Co. has developed the CELLULAR PRODUCTION UNIT, a proprietary interface which allows broadcast audio equipment to be fed directly into the cellular phone network thus providing a reliable and cost effective alternative to conventional RPU systems.

Major Product Lines

Broadcast Services Co. is a full service dealer for Auditronics audio consoles, Otari tape recorders (MX and MIR Series), Fidelipac and ITC cart machines, Broadcast Electronic audio and RF products, West Penn wire, Andrew transmission line and Graphics Express furniture, as well as an extensive array of supporting products. Broadcast Services Co. and EME, Inc. are also dealers for the CELLULAR PRODUCTION UNIT.

Trade Shows

Broadcast Services Co. supports and exhibits at all state broadcast association trade shows in the region. The company also frequently does presentations at area SBE chapters.

Circle 3 On Reader Service Card

JRF MAGNETIC SCIENCES

249 Kennedy Road
P.O. Box 121
Greendell, NJ 07839
(201)579-5773

JRF Company, Inc. was formed in 1979 by John and Cookie French to offer the recording industry a premium quality head refurbishing facility. The business was based in their home until a move to office space in Landing, NJ in 1981. During the five years there JRF experienced a growth spiral that saw four more full-time employees brought on board and an evergrowing list of clients. In 1984, the French's started a spin-off company called Magnetic Sciences Inc. to handle the sales of magnetic recording heads and related parts as well as custom assembly and design work. Today these companies are known as JRF Magnetic Sciences.

In order to keep up with the equipment and inventory space demanded by its growth, JRF soon outgrew the Landing facility. In December of 1986 JRF moved into its own building in Greendell, NJ, with triple the previous space, allowing for more efficient working conditions, more equipment and inventory showroom. In the two years there four more employees have been added to the staff, making JRF Magnetic Sciences the foremost head refurbishing center in the world.

The JRF staff now represents over 25 years of magnetic head design, development, and manufacturing experience in recording studio and high speed tape duplication heads and product development. The laboratory and engineering facility utilizes state of the art relapping and testing equipment to insure precision magnetic head refurbishing. Complete head assemblies are aligned by use of sophisticated optical/digital fixturing equipment designed by JRF. Digital readout for movement and mechanical placement enables assemblies to be aligned for guide height, track placement, azimuth, zenith (tilt), wrap and head to tape contact area all within .001. And all assemblies are returned with the exclusive JRF TEST REPORT (copywritted) detailing the condition of the assembly with detailed explanation.

In addition, as a stocking parts dealer the JRF Magnetic Science product line and extensive inventory includes a wide range of replacement magnetic heads (many designed by JRF and manufactured to their stringent specs) and parts for Ampex, Otari, Sony/MCI, Studer Teac and Fostex studio machines as well as Electro Sound, Audio Tek, MTI and Liberty tape duplication equipment. Also available are the full line of MRL alignment tapes and CTCC alignment tapes. The client list includes recording studios, tape duplication and major network radio and TV facilities and service companies throughout the world.

New to the product line are Center Track Time Code conversion kits. The Otari TC-50 time code FM processor, designed for use with the Otari MX5050 series tape machine, has been converted to work with the Studer A80, Sony/MCI JH110 A/B, Ampex ATR-102 and Otari MX5050 MKII and select other model machines. The conversion kit includes everything necessary to convert a stock ¼-inch tape machine to full function CTCC capability.

In 1990, JRF will exhibit their product line at the NAB Atlanta and AES Los Angeles.

Circle 21 On Reader Service Card

World Radio History

BROADCAST AUTOMATION INC

4125 Keller Springs, Suite 122
Dallas, TX 75234

Earl R. Bullock is President and owner of Broadcast Automation, Inc. Mr. Bullock has over 30 years experience in radio automation and digital control systems. He holds both bachelors and masters degrees in electrical engineering. Mr. Bullock designed the Schafer 900 series automation systems and served as customer service manager for Cetec for four years. He has extensive experience with the Cetec 7000 and Harris SC-90 systems, as well as IGM (both old and new), SMC and Format Sentry systems.

Broadcast Automation was started in 1980 as a division of Century 21 Programming and operated as BASS (Broadcast Automation Sales and Service). The company started out rebuilding automation systems and custom-configuring them for Century 21's syndicated format customers. This allowed the syndicator to provide full service to its customers, supplying them with both the program material and the equipment to implement their formats. Purchased and incorporated by Earl Bullock in 1983, BAI continues its proud tradition of supplying full service to its customers. Today, BAI cooperates with all syndicators, including customers who provide their own programming, in making certain that each system fully satisfies the requirements of the format which it will run.

In keeping with our long-time philosophy of complete, personalized service, BAI remains a relatively small company, with three full-time employees and one part-timer. We are active in our local SBE chapter and will be exhibiting at the 1990 NAB and Radio 90 shows this year. At the present time, we do not sell through distributors/dealers. We currently sell all our products direct to the end-user. Our product line includes Live Assistant, the Ultimate Live Assist Controller, as well as a complete line of major upgrades and replacement parts for the SMC 250 Carousel. We also remanufacture Carousels, reel-to-reels, cart decks, and automation controllers. BAI represents all the major manufacturers of new automation systems and source equipment, as well. We specialize in turnkey systems, custom-configured to each customer's specific requirements, including custom design work when required. BAI includes training and installation with each new system sold, because we want to make the transition to a new automation system as easy as possible for everyone involved. In addition, we offer what we think is the best warranty in the business.

Our reputation for quality, dependability, and service truly makes BAI the only name in **Broadcast Automation** you need to know.

Circle 42 On Reader Service Card

World Radio History

BSW®

BROADCAST SUPPLY WEST

America's Full-Time Broadcast Supplier

Irving D. Law, CEO/Founder
As a pioneer in broadcast telemarketing, Irv Law founded BSW in 1973. He recognized the need for a single source supplier offering outstanding prices, service, and selection. Under his leadership, BSW has succeeded in providing the solutions to these needs.

Representing over 200 prestige manufacturers, Broadcast Supply West is one of the largest broadcast audio equipment distributors in America. For 17 years, BSW has been providing equipment to broadcasters and other audio professionals worldwide. Thousands of repeat customers continue to put their trust and confidence in us daily.

Over the years BSW has focused on being more than a company that simply sells equipment at a good price. From the beginning we have chosen to build solid, long lasting relationships with our clients. It is the commitment of all our employees to offer prompt, courteous and professional service with a personal touch that sets us apart as the industry leader.

To offer broadcasters maximum access to BSW, we are open 12 hours a day, Monday thru Friday (6am to 6pm Pacific, 9am to 9pm Eastern) with toll-free service from all 50 states including Puerto Rico, Virgin Islands and Canada.

Our annual catalog has become a standard reference book containing the most sought out equipment for every phase of audio production and broadcasting. Additionally, we send out regular sales flyers that include special pricing on featured products as well as information on the newest technology available. If you're not receiving our publications, call us toll free to get put on our mailing list.

Trade Shows; NAB, NAB Radio, National SBE

BSW Officers (pictured left to right):
Tim Schwieger, V.P. Marketing
Patrick Medved, V.P. Sales
Bernice McCullough, President

1-800-426-8434
ORDERS • INFORMATION • SPECIFICATIONS

BSW • 7012 27th Street W • Tacoma, WA 98466 • FAX 206-565-8114

Circle 27 On Reader Service Card

World Radio History

CCA Electronics, Inc.

360 Bohannon Road
P.O. Box 426
Fairburn GA 30213
404-964-3530
Fax: 404-964-2222
President: Ron Baker
Sales: John Binsfeld
Customer Service Rep: Gerry Meier
Production Manager: Jerry Henry
Engineering: Richard Wagner

Since its organization in 1962, CCA has been one of the worlds leading suppliers of radio transmitters. They pioneered many broadcast transmitter concepts which remain standard practice in the industry today. They are best known for their simple, straight forward, inherently stable GROUNDED GRID design.

CCA acquired the SINTRONIC line of transmitters in 1984, and added the CSI line in 1988. They are dedicated to the single business of manufacturing quality radio transmitters.

Distribution:

The majority of CCA's products are sold overseas through a worldwide network of agents and communications companies. Many products are sent to the Tropics where CCA's straight forward design and sturdy materials are required to meet the severe environmental conditions.

In Mexico they are represented by RF Specialty Products Inc., 5547 Randolph Boulevard, San Antonio, Texas, 78233, (512) 654-4771, and in Canada by Caveco Equipment Limited, 1121 Bellamy Road, N., Unit 10, Scarborough, Ontario M1H3B9, (416) 438-6230.

Domestic distribution is accomplished through factory direct marketing, making CCA the most value-competitive transmitter in the U.S. market.

Facilities:

CCA Electronics, Inc. is located a mere 12 miles from the world's busiest airport, Atlanta Hartsfield International. This location gives CCA the ability to dispatch emergency parts and service faster than anyone in the industry. The Fairburn, Georgia facility houses a large modern assembly and test area for the CCA and CSI transmitter lines. Also included within the facility are the Engineering, Research and Development, and Sales Departments, along with the Administrative offices of the company.

Major Products:
AM Plate Modulated Transmitters
FM Grounded Grid Transmitters
Short-Wave Transmitters

CCA ELECTRONICS, INC.

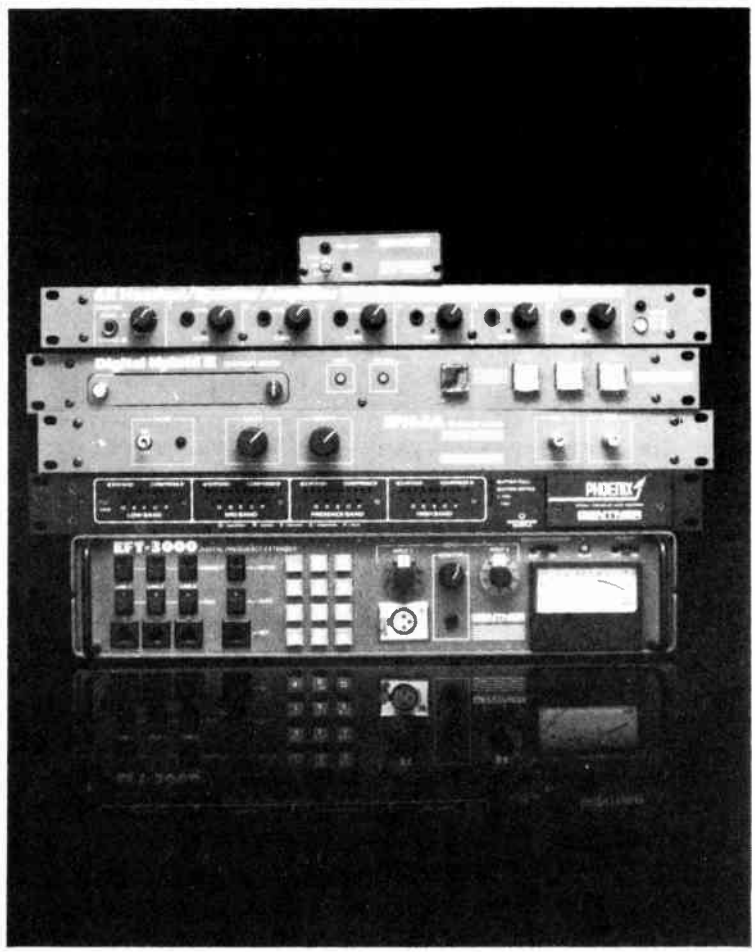
Ron Baker

President and Chief Executive Officer of CCA since 1984, Ron started his career in radio as a disc jockey in the '60s. In the '70s his interests turned to engineering where he quickly gained experience through his involvement in the construction of over 100 radio stations throughout the country, many of which he had major ownership. In the late '70s he became the leading salesman for CCA.

John Binsfeld

John joined CCA in 1989 as Director of Sales. He has a strong engineering background including several years as an independent technical consultant and over 5 years as Chief Engineer for another major transmitter manufacturer. John brings over 20 years experience in the transmitter business to CCA.

Circle 23 On Reader Service Card



- **Telephone Interface Equipment** - *on-air, talk shows, recordings*
- **Remote Broadcast Equipment**
- **Transmitter Remote Control**
- **Pre-wired Audio Patch Panels**
- **Audio Routing**
- **Audio Processing**

GENTNER
ELECTRONICS
CORPORATION

1825 Research Way
Salt Lake City, Utah 84119-2348
Phone: (801) 975-7200
FAX: (801) 977-0087

Circle 35 On Reader Service Card

World Radio History

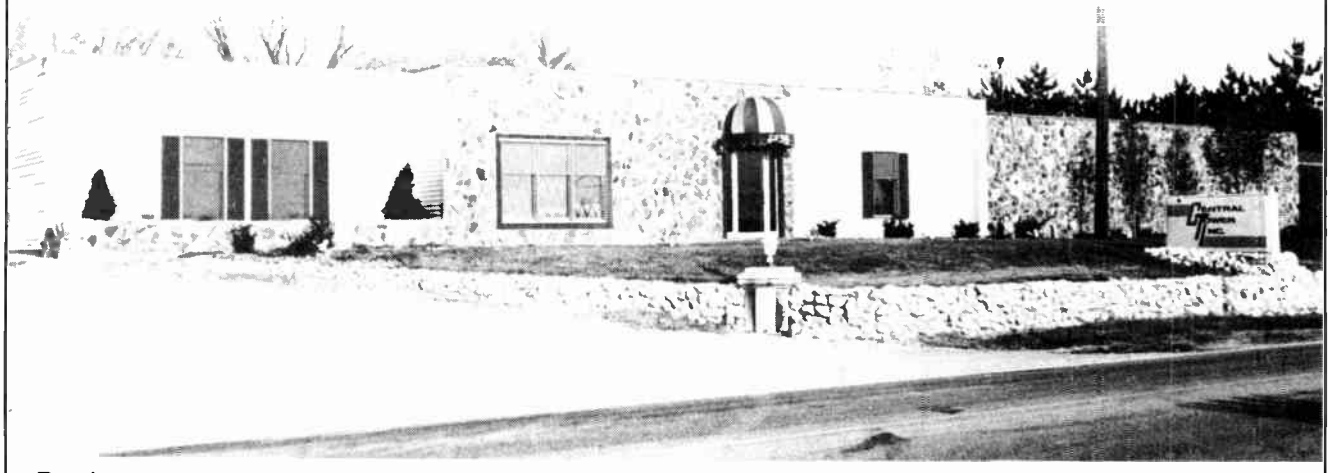
CENTRAL TOWER INCORPORATED

PO Box 530
Newburgh, IN 47629

Phone: (812) 853-0595
Fax: (812) 853-6652

President: **Ray R. Ryan**
VP/Engineering: **Ernie R. Jones, P.E.**
VP/Sales: **Terrence Becht**
VP/Finance: **Nancy Ryan**

Production Manager: **John Thrall**
Installations Supervisor: **Skip Lowrey**



Products:
- Guyed towers
  18" to 60" face, all welded
  48" to 120" face, bolt together
  Microwave
- Self-supporting towers
- Antenna poles
- Ice shields
- Grounding systems

Services:
- Engineering structural analysis
- Steel fabrication
- Tower & antenna system installation
- Tower & antenna system maintenance & repair
- Turn-key project supervision

Central Tower offers several advantages when initiating a tower construction or repair project. Twenty-five years of experience in broadcast equipment manufacturing and repair afford the expertise necessary to be a leader in the industry.

Among the other advantages CTI can offer, is the single source option which provides:
- custom, in-house engineering,
- complete fabrication facility
- factory installation service.

This option insures straight line accountability resulting in project excellence.

Central Tower is located in Newburgh, Indiana. This central location allows economic pricing, expedient pattern testing and delivery. Our modern 18,000 square foot facility encloses a state-of-the-art manufacturing operation. Three staff engineers and four installation crews allow CTI to provide the best possible product.

Trade Shows: NAB, SBE, Radio 90

CTI's engineers are SBE members and participate in state and regional SBE functions. Please call or write if you have structural questions or desire a chapter presentation concerning code application or other structural and maintenance areas.

Circle 53 On Reader Service Card

World Radio History

DELTA ELECTRONICS

"The Above Standard Industry Standard"

5730 General Washington Drive
Post Office Box 11268
Alexandria, VA 22312

Phone: 703-354-3350
FAX: 703-354-0216
Telex: 90-1963

Founded: 1962, by Stephen Kershner and Charles Wright

President: John Wright
VP/Marketing: Joseph Novak
VP/Engineering: William Fox
VP/Production: Friedel Groene
VP/Finance: Robert Stebbins
General Manager: Ron Wheeler
Broadcast Products Sales Manager: John Bisset

An Introduction To Delta Electronics

In 1962, the principals left the consulting engineering firm of A.D. Ring to form Delta Electronics. With their extensive background in consulting a number of unique products were developed for the broadcast engineer. The OIB Operating Impedance Bridge and TCA Toroidal Coupled Ammeter are two such products that have revolutionized the maintenance of broadcast stations. Delta's special expertise in transmitter/receiver-to-antenna interfacing and remote monitor/control systems has led to a number of product developments for the HF Communications industry as well as commercial broadcasters. Strip-line switching matrices, receiver multicouplers, and balanced line antenna switches are a few of our HF products. Though the company's roots are in HF and AM broadcast, Delta also provides products for the FM and TV industries, such as the High Power Pulse Reflectometer, Coaxial Transfer Switches, and Transmitter Power Controllers.

Delta Electronics is located in Alexandria, Virginia, just a few miles from Washington, D.C. Manufacturing, testing, laboratory, engineering and administrative functions are housed in a single, modern, 35,000 square foot building. By combining all areas of a product's construction into one location, high standards of quality—synonymous with the Delta name—can be maintained. Delta Electronics is an employee owned company.

Trade Shows: NAB, SBE, NAB Radio '90
Delta also participates in many state and regional SBE shows. If you are interested in Delta providing an SBE presentation for your chapter, call today.

Major Products:
AM Splatter Monitor - (see our Buyer's Guide Reprint on page 137)
AM Stereo Exciter/Monitor - (see our Buyer's Guide Reprint on page 138)
Stereo Noise Generator
High Power Pulse ReFlectometer - (see our Buyer's Guide Reprint on page 136)
Coaxial Transfer Switches - (see our Buyer's Guide Reprint on page 139)
Toroidal Current Transformers - (see sampling system reprint on page 140)

DELTA ELECTRONICS

Call us today and Discover the Delta Difference!
1-800-8-DELTA-8

Circle 25 On Reader Service Card

World Radio History

Hallikainen & Friends

(Left to right) **Harold Hallikainen, Jim Christian, Milind Paranjpe, Mars Dehaesus, Betsy Ehrler and Becky Wilson**

Company Formation

H&F was founded in 1974 by Frank Calabrese, Eric Dausman, Len Filomeo, Gerry Franke, Harold Hallikainen and Rick Smith. The company was originally a "contract engineering" group, serving 12 stations on the central coast of California. In 1977, the company began designing, manufacturing and selling products for the broadcast industry. The need for these products was evident from our work with local stations. With each product, we've avoided the use of "brute force engineering" (keep adding parts 'til it works!), taking the time to develop an elegant design, using as few parts as possible (the ideal design has zero parts).

Staff

Harold Hallikainen (President) handles sales, technical support and new product hardware and software design.
Betsy Ehrler (Secretary and Treasurer) is responsible for all accounting, inventory control, purchasing and production scheduling.
Milind Paranjpe does new product software design.
Becky Wilson and Mars Dehaesus are responsible for the electronic and mechanical assembly of our products.
Jim Christian handles production testing of all our products.

In addition, the company founders, most of whom are still on the Board of Directors, along with our customers provide input needed to develop new products.

Products

Our products can be broken into two groups: remote control and audio.

The remote control group consists of the TEL171 and TEL172 digital telemetry systems, the ITO177 Intelligent Transmitter Operator and the DRC190 remote control system.

The TEL171 and TEL172 upgrade the Moseley TRC-15A and PBR-30 analog remote controls to digital metering, improving accuracy and ease of operation. The ITO177 interfaces the TEL171 to a Commodore 64 or 128 computer, allowing user programmed automatic control and logging of broadcast transmitters.

The DRC190 is a flexible remote control system. Each site includes an extended Microsoft Basic interpreter, allowing the user to program the automatic control and logging of the system. The system uses internal data packet modems to allow up to 100 sites to share a single communications link. The system also allows up to 100 analog inputs and 96 status inputs at each site in the system. Some of the larger installations include a nine site radio transmitter control system relying on the standard data packet system, a nine site television transmitter control system using dial up telephone lines and a 30 site radio transmitter control system using dial up telephone lines.

The audio group consists of the TVA142 mixer module and the TVA132 output module. These rack mount modules can be combined into a mixing system providing 36 inputs. These products find application in radio and television newsrooms, dub centers, edit suites, and on air control rooms.

Product Development

We expect to have several new products ready for the NAB in Atlanta. These include a new low cost transmitter remote control system, a multiple dish satellite steering system and a tower light sensor.

The new remote control system utilizes standard terminals or computers as the control point terminal. The transmitter site equipment utilizes a standard processor board along with custom I/O boards and software. The standard system provides 48 analog inputs, 48 status inputs and 48 control outputs. It can be linked to the control point(s) by any voice grade or digital circuit, including dedicated lines, dial up lines, subcarriers or radio links.

The multiple dish steering system utilizes the same hardware as the new remote control system. The control point(s) can be standard computer terminals or computers. The user interface is through "bounce bar" menus. The control point can be linked to the remote terminal over any digital or voice grade circuit, including dedicated lines, dial up lines, subcarriers or radio links. The system includes a scheduler for automatic dish steering and generates a printed log of all actions.

The tower light sensor is powered by current sense transformers. It rectifies the sensed current and passes it through an active low pass filter. The output of this filter (a steady DC voltage proportional to the sum of the products of lamp currents and duty cycles) is available to drive the analog inputs of remote control systems. In addition, a window detector drives an open drain output suitable for driving the status inputs of remote control systems. This output is pulled low when all lights are operating properly. It will be released on the failure of any lamp or the flasher. Each sensor unit includes three sensors, suitable for three single beacon towers or a single three beacon tower.

Technical Support

H&F provides 24 hour technical support. We can generally solve the problem over the phone, or will air-freight required parts immediately.

Hallikainen & Friends, 141 Suburban Road, Building E4, San Luis Obispo, CA 93401-7590
Phone 805-541-0200 • FAX 805-544-6715 • Telex 4932775 HFI UI

Circle 54 On Reader Service Card

World Radio History

Henry Engineering

503 Key Vista Drive
Sierra Madre CA 91024
818-355-3656
Fax: 818-355-0077

Henry Engineering was founded in 1982 by current President Hank Landsberg to formally produce products which Landsberg originally "built from scratch" during his career as a Chief Engineer. His first products were retro-fit modules for Autogram broadcast consoles and the well known Matchbox, selling over 5000 units since its introduction.

Henry Engineering specializes in unique, low cost "problem solver" products.

Henry Engineering products are affordable by every station. Most products are unique and manufactured in a 4000 square-foot facility by six assemblers, a staff which has remained unchanged since 1983. All products recieve 100% testing before shipment; return rate is below one percent.

Major Products:
The Matchbox; Turntable Controller; MixMinus Plus; Superelay; LogiConverter; Telecart II; SynchroStart, and U.S.D.A. A new product is the FAST TRAC automatic dubbing system, a unique "one-pot console" for dubbing and editing stations. (See product review elsewhere in this issue.) Also retro-fit "turbo modules" for older Autogram and Collins consoles.

Henry Engineering products are distributed through dealers such as Allied Broadcast Equipment, Broadcast Supply West, Bradley Broadcast Sales, Crouse-Kimzey, Broadcasters General Store, Broadcast Services Company, and others. Contact Henry Engineering for the name of your nearest dealer.

Trade Shows: NAB, SBE National. We often supply "give away" items for drawing at various shows.

We Build Solutions

Hank Landsberg

President

Director of Engineenng for Drake-Chenault for 15 years. Designed/built multi-studio complex including custom designed audio consoles and tape duplicating system. In broadcast industry since 1972. Hobbies: ham radio, photography, live music recording, antique jukebox collection.

Circle 13 On Reader Service Card

Moseley

Moseley Associates, a subsidiary of General Research Corp., Inc. has been recognized and respected as a leader in the communications industry since 1959. Based in Santa Barbara, Moseley designs, manufactures and markets electronic communications equipment for diversified telecommunications industries and the radio and television industry. Moseley products are in service in over 100 countries. The company, over 100 employees strong, is actively represented in over 60 countries. Over 15,000 STL systems are in service around the world and over 5000 Remote Control systems telecontrol aviation, utility, satellite, telecommunications and broadcast equipment round the clock. Moseley has also successfully designed, installed and commissioned national microwave and SCADA networks worldwide.

The president, Dr. Douglas Hogg, also holds the position of Director of Engineering. Dr. Hogg, holding a PhD in Physics from the University of California at Santa Barbara, has been with Moseley almost three years after spending nine years with Moseley's sister company General Research Corp. He has provided technical review and support for Moseley since 1981. Prior to his position at General Research, he held a faculty position in the Physics Department at the University of California at Santa Barbara.

Products:

Studio Transmitter Links	Remote Controls	Remote Programming Link	Data Communications	Subcarriers
PCL 6000	MRC 1620-with TaskMaster20 software	RPL 4000	DataMux	SCD-8
PCL 606	MRC 2-with MasterController software		CL-100	SCG-8
				Music-4

Data SCA Products

Sales: Moseley sells direct and also employs a distributor and OEM network.
1990 Trade Shows: NAB, SBE, Radio'90

Moseley Associates Incorporated • 111 Castilian Drive, Santa Barbara, CA 93117 • A Flow General Company
Phone 805-968-9621 • Telex 658448 • FAX 805-685-9638

Circle 49 On Reader Service Card

World Radio History

John E. Leonard Jr.
President J.N.S. Electronics

P.O. Box 32550
San Jose, CA 95152
(408) 729-3838
FAX (408) 926-1003

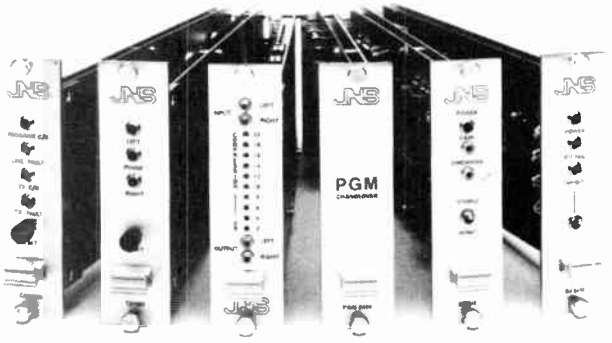
John N. Stannard
Vice-President J.N.S. Electronics

J.N.S. Electronics, Inc. has been formed by two former broadcasters sharing over 50 years of station and broadcast equipment manufacturing experience. This hands-on experience has lead to the development of products that do jobs as needed by the broadcaster. The 50-plus years of experience shared by founders John E. Leonard, Jr. and John N. Stannard result in products with exceptional performance and reliability.

The firm spans two continents. J.N.S. Electronics, Inc. has corporate and sales offices in San Jose, CA. Manufacturing occurs in both California and Australia. Products of the firm include a system that provides broadcasters a new method of solving a number of audio, video and RF jobs. This system, the 8000 Series Modular System, has been designated **'the FRAME'**.

John Leonard is known to many in the broadcasting community. From technical and on-air work in Pennsylvania, he entered Gates Radio in the late 60's. Fifteen years were spent with Moseley Associates, the last five in general management positions marking the firm's conversion from privately-held to part of a public corporation. Most recently he developed and was instrumental in the industry's acceptance of dial telephone transmitter remote control. In October of 1989 a patent was issued to him for that technology. Recent technical publications include the aural STL chapter in the NAB Engineering Handbook.

John Stannard is equally well known in the Australian broadcast community. Initial broadcast work in Australia began as maintenance engineer at HSV-7 in Melbourne, then BTV-6 chief engineer in Ballarat. He served as technical director for ATV-0 (now ATV-10) in Melbourne. After an involvement in low-light TV camera work for medical use in Canada with Westinghouse in the late 60's, he returned to Australia with E.M.I as their director of sales. With his development of some of the modules now making up the 8000 Series, he founded J.N.S. Electronic Industries in Melbourne, Australia in 1973. This modular system has been well received there, and now represents a standard in that country. He is a Companion of the Institution of Radio and Electronics Engineers Australia.



Modules from **'the FRAME'** from J.N.S. Electronics, INC.

'the FRAME' can be configured to amplify, switch, match, equalize, demodulate, or generate. Two frames are available to house and power from 2 or up to 10 different modules. Sixteen modules are currently available for **'the FRAME'**, with additional, new modules in development for release at the 1990 NAB convention. Jobs being done by these 16 modules include:

- **Mono or Stereo Audio Distribution**
- **Audio Monitor Amplifiers**
- **Video Distribution**
- **Audio Failure Sensing**
- **Stereo Presence/Validity Measurement**
- **Program Changeover, automatic and manual**
- **RF Demodulation**

Trade shows for 1990: NAB, SBE, Radio'90. Participation in a number of state and regional meetings are scheduled.
Products are marketed through select distributors and by direct sales.

Circle 19 On Reader Service Card

World Radio History

One Airport Drive, P.O. Box D
Williamstown, NJ 08094
(800) 334-9154 Service Phone: (609) 728-2020 (24 hours)
Fax: (609) 629-1751

Charles Haubrich, President
William J. Hoelzel III, Senior Vice President/Marketing
John Pilman, Senior Vice President/Engineering
Jeffrey R. Detweiler, National Sales Manager

Founded in 1971

QEI was founded May 1971 by Charles Haubrich, William Hoelzel and John Pilman. The three principals all have distinguished backgrounds in electronics and broadcast engineering, including extensive experience with the Burroughs Corporation, the Broadcast Division of AEL and Ayden Corporation.

Initially, QEI designed and manufactured modulation monitors, frequency monitors and special receivers which were branded and sold by CCA Electronics. In 1973, the company began designing, manufacturing and marketing FM transmitters, exciters, modulation monitors and test equipment under its own name. The first QEI products developed by the company were the Model 675 FM exciter and the Model 772F stereo generator, along with an SCA generator and various audio processing equipment. The Model was the first all-solid-state, 20 watt, phase-locked-loop, frequency synthesized FM exciter available to the commercial broadcast industry—it is still in production today, having sold over 1000 units, including those made for American Electronics Labs and CSI Electronics. More recently, QEI introduced the Model 695 Exciter. Its phase-locked-loop oscillator, vericap circuitry, fully broadbanded design, nearly unmeasurable distortion and automatic modulation control make the 695 the most advanced exciter available.

QEI developed its first all-solid-state FM amplifier, a 150 watt model, in 1976: similar amplifiers with 300 and 500 watts output power followed shortly thereafter. All three are still in production, having won industry-wide acceptance along with the Model 675 exciter, both as main transmitters for low-power applications and as emergency backup transmitters. All three of these transmitters have both U.S. FCC and Canadian DOC Type Acceptance.

Building on its established low power designs, QEI next developed a 1 kW solid-state modular FM transmitter, and introduced the FMQ series of grounded grid triode final amplifier FM transmitters, with output power levels of up to 30 kW. QEI's grounded grid triode design provides stable operation and long tube life in the final amplifier stage. The modular solid state driver stages (again based on proven QEI low power transmitters) are conservatively designed for maximum reliability. Many QEI transmitters are available with the optional ARC 27, a microprocessor-based automatic remote control system, including remote diagnostics, developed by QEI engineers.

In 1980, QEI introduced the first test unit designed for FM broadcasting. The Model 691 FM Monitor/Test Set combines specialized modulation monitoring functions with a wide range of other test functions. Thanks to its flexibility, usefulness and reasonable price, the Model 691 has become the industry standard for monitoring and test equipment.

In 1989, QEI introduced CAT-Link, a bidirectional digital STL/TSL which sends and receives FM composite and other audio and data channels over 1.544 MB telco T1 lines. CAT-Link is already improving the sound of FM stations across the country.

QEI's manufacturing plant, together with its research and development facilities, are located in a 14,000 square foot complex adjacent to Cross Keys Airport in Williamstown, NJ. Its proximity to Philadelphia International Airport makes emergency parts shipments or service calls in response to QEI's 24 hour service phone quick and convenient.

From the initial engineering to final board stuffing, soldering and assembly, QEI products are designed and manufactured completely in-house, allowing the company to maintain the highest standards of quality control. The engineering and manufacturing staff uses Tektronic Model 8540 and 8550 microprocessor development systems along with a full complement of Tektronics and Hewlett-Packard test equipment. A complete sheet metal and machine shop is also part of the manufacturing operation.

QEI operates a twin engine Cessna 310 aircraft for sales and service purposes. The company has an excellent credit rating: Its Dun & Bradstreet number is Duns 05-901-3805. QEI markets its products direct and through major broadcast distributors.

Major Products: Model 675 FM Exciter, Model 695 FM Exciter, Model 691 FM Monitor/Test Set, 675T150/300/500 FM Transmitters, FMQ3500/5000/10000, FMQ20000B/30000B FMQ60000 FM Transmitters, ARC 27 Automatic Remote Control System, CAT-Link Bidirectional Digital STL/TSL

Trade Shows: NRB, NAB, SBE National Convention

Circle 7 On Reader Service Card

World Radio History

SPENCER BROADCAST INC.

Professional Broadcast Equipment Sales
7003 W. Union Hills Drive
Glendale AZ 85308
602-242-2211
Fax: 602-843-2860

President: Charles G. Spencer

VP/Marketing: Carol S. Spencer

Spencer Broadcast consists of Chuck Spencer and Carol Spencer who keep control of service requirements and client needs. Our offices are highly computerized to insure efficiency in order, process, and followup.

Charles G. Spencer

Chuck Spencer has over 27 years in electronics with the last twenty in AM/FM Broadcasting. He spent 3 years with Collins Radio in Broadcast Field Service, 10 years as CE with a successful FM in Phoenix and helped conceive, design, and build Churchill Radio Productions.

Spencer Broadcast is celebrating its 10th year as an equipment supplier and designer of radio station properties. With a client base nationwide, Spencer serves as a reliable source for equipment and technical information and services.

Carol Spencer

Product Lines

We proudly carry a complete line of over 150 products for the broadcaster, from cart tape to entire radio stations including towers, buildings, and all accessories. Some major brands handled include: Orban Associates, Broadcast Electronics, Fidelipac, Jampro, Dielectric Communications, Electro-Voice, Shure, Technics, Marti, TFT, Sennheiser, JBL, UREI, TTC, and Scotch.

Trade Show Participation

Spencer Broadcast has participated at the past ten NAB shows with equipment suppliers. At these shows, time is set aside for client meetings and a schedule is available from our offices.

Spencer Broadcast actively supports the SBE and assists members with technical problems when the need arises. Chuck Spencer also specializes in station evaluations.

Circle 5 On Reader Service Card

World Radio History

S.C.A.
Data Systems Inc.

3000 Ocean Park Blvd.
Suite 3002
Santa Monica, CA 90405
[213] 452-2506
FAX: [213] 450-5307

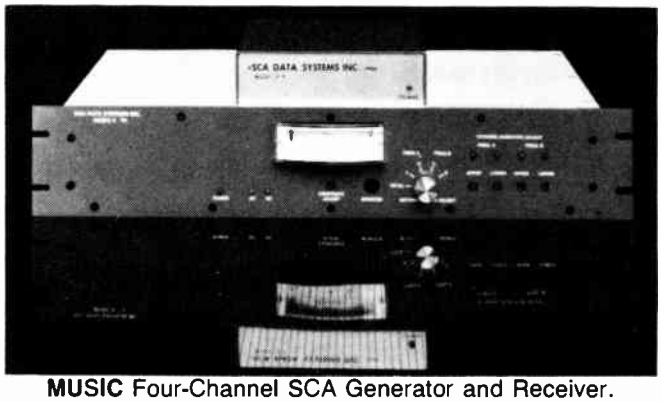
Steven Davis
Mr. Davis has been President of SCA Data Systems since its conception in 1984. He is responsible for the marketing, product development, and system engineering. Steve holds several patents in the communications field.

Lawrence J. Karr
Mr. Karr is the Chairman and co-founder of SCA Data Systems. He is responsible for advanced product design and development, and shares overall management responsibility with Mr. Davis. Larry is the holder of six issued U.S. patents.

Company History
SCA Data Systems, Inc. was founded in October 1984 and currently has 8 employees. We are located in Santa Monica, just minutes away from the Los Angeles beaches.

Our principal areas of expertise include digital and analog signal processing, algorithm optimization, and novel methods of hardware/software minimization.

In the radio frequency receiving apparatus area, we have designed and/or manufactured a number of innovative products. These include the most sophisticated and reliable FM subcarrier data systems, which incorporate digital tracking loops, forward acting error correcting codes, and statistical signal quality monitoring. We also manufacture a FM subcarrier music system with 4 times the channel capacity than other systems. The technology for this system is patented. Further, we manufacture to the MBS/EBU standard, 57kHz DSP based paging generators, and related devices, which have been well received by paging system operators.



MUSIC Four-Channel SCA Generator and Receiver.

In addition, we have developed comprehensive modelling and simulation software which allows us to evaluate overall system performance prior to fabrication of system components.

Major Products
Paging Generator
Paging Combiner
19.2 Kbit half channel SCA data system
9600 bit/sec SCA half channel data system
Music 4 (TM) multi-channel SCA music system
Data 4 multi-channel SCA data system

For domestic sales please contact SCA Data Systems direct.

Trade Shows
NAB, NSCA, IBMA, IPMA

Circle 31 On Reader Service Card

World Radio History

multiphase consulting

Contract Engineering Service

founded in 1978 by Henry Stewart and John Bisset

General Manager:
Henry Stewart

Chief Engineer:
Kevin Strom

(703) 379-1665
answered 24 hours

5827 Columbia Pike
Suite 310A
Falls Church, VA 22041

An example of a studio project involving Multiphase

Now beginning its 12th year of service to broadcasters, Multiphase Consulting provides affordable contract engineering, emergency, and special project services. Our involvement in projects is customized to the specific need. Whether it's a turnkey system or simply an "extra pair of hands" to complete a project deadline, Multiphase can solve your dilemma. Our experienced engineers are former Major Market CE's who offer responsible, affordable broadcast engineering services. Experienced in both audio and RF, Multiphase is qualified to offer station assessments and evaluations.

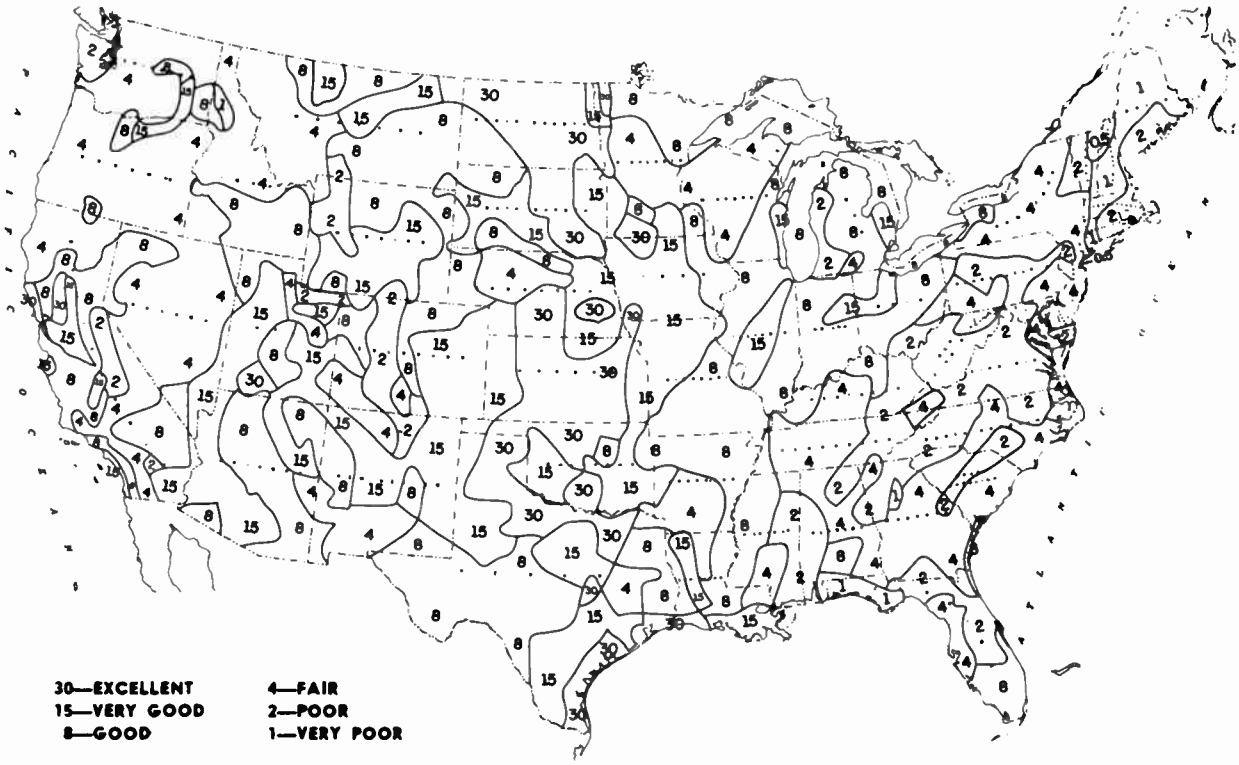
Multiphase is recognized as an authorized installer for C-QUAM® AM Stereo systems, and also provides system tuneups for existing stereo installations. In addition, Multiphase provides a stock of rental test equipment including the Delta Splatter Monitor, Operating Impedance Bridges, Receiver Generators, and the High Power Pulse Reflectometer for checking transmission lines. Managers and station owners can obtain a free FCC Checklist to assist in their station operation by circling the reader service card number below.

® C-Quam is a registered trademark of Motorola, Inc.

• FULLY FCC LICENSED AND SBE CERTIFIED •

Circle 29 On Reader Service Card

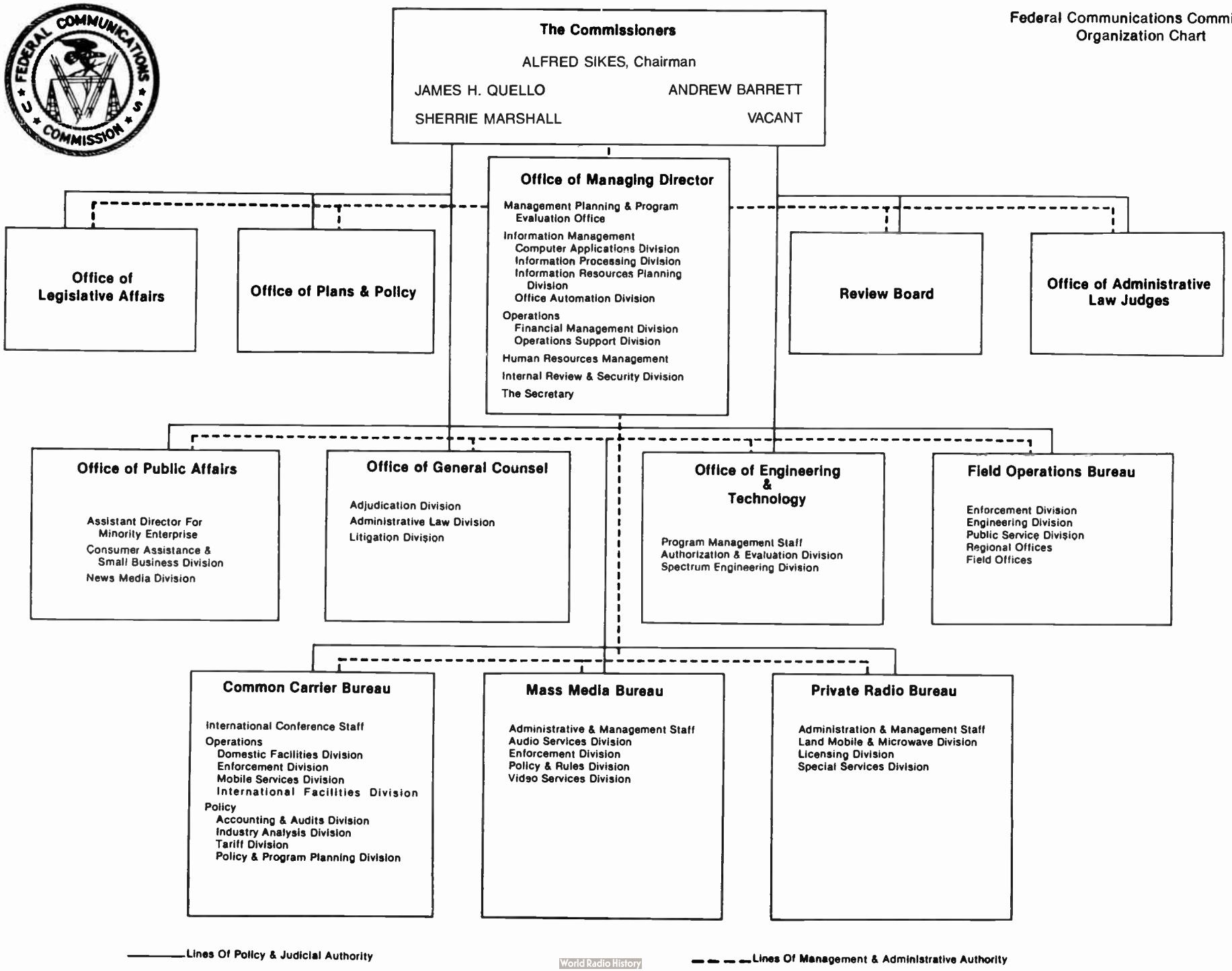
Estimated Ground Conductivity



Courtesy of Varian, Continental Electronics Division

World Radio History

Federal Communications Commission
Organization Chart



World Radio History

INDICES & REPRINTS

In the following pages are indices of the news, features and Buyers Guide stories appearing in **Radio World** from 1 January to 27 December 1989.

Each index uses a numerical system to denote issue date and page number—the month and day are separated by a slash, while the day and page are separated by a colon. Thus, an entry of 2/22:6, for example, refers to a story in the 22 February 1989 issue, on page 6.

Subject Index 114

The Subject Index lists the news stories of the past year, cross-referenced by the topics covered in each story.

Author Index 122

The Author Index provides a listing of the feature stories published in 1989, according to author name.

Buyers Guide Index 124

The Buyers Guide Index is a comprehensive list of 1989's equipment reports, referenced by company name.

Buyers Guide Reprints 125

The final element in this part of the **Radio World Annual** is selected reprints from this year's Buyer's Guides. Companies whose products appear in these reprints have been arranged alphabetically.

World Radio History

SUBJECT INDEX

A

ABC Radio Network
signs 10-year agreement with GE Americom for satellite transmission of programming, 8/9:20

Absolute Broadcast Automation
Satellite System 100, 2/22:44

Active device course
analyzing transistor design (part V), 6/14:42
diode use in power supplies (part IV), 5/24:22
field effect devices (part VII), 7/12:30
how semiconductors are made (part II), 4/26:22
integrated circuit primer (part XI), 9/6:36
solid state diode operation (part III), 5/10:20
square one to solid state (part I), 4/12:25
transistor circuit connection (part IX), 8/9:24
transistors in typical usage (part VIII), 7/26:28
transistors in voltage regulation (part X), 8/23:26
transistor specs (part VI), 6/28:24
the venerable vacuum tube (part XII), 9/27:32

AES. *See* Audio Engineering Society

Airforce Broadcast Services, Inc.
The New Production Music Library, 6/28:33

Air System Technologies Inc.
wing-mounted system collects coverage, contours data, 12/13:20

AKG Acoustics
buys Orban Associates, 6/14:33
letter of intent to purchase dbx Professional Products Division, 6/14:33
unveils new desktop system at NAB convention, 6/14:1

Alaska Public Radio Network (APRN)
new production studio, 3/22:20

Alpine
1390 FMX stereo tuner, 2/8:13

Amateur radio policies
industry groups ask FCC to liberalize policy on news broadcasting by amateur radio, 1/1:9

American FM Translator Association
formed to promote FM translator service, 9/27:1

American Music Licensing Company
music fee claim may be scam, 8/9:12

American National Standards Institute (ANSI)
NAB opposes ANSI draft RF radiation standard, 9/27:17

American Public Radio
production team produces smooth *Prairie Home Companion*, 7/12:1

AM radio
AM interference rule may help coverage area, 9/27:34, 10/25:32
"AM Rebound" session at Radio '89, 10/11:19
AM stereo study results in, 6/28:3
barriers to quality, 4/26:42
blind engineers run AM stations, 5/10:23
Carolina AMs simulcast TV news at six, 6/28:13
certification mark discussed at NAB-EIA meeting from which press is barred, 7/26:1
directional array sampling systems repair, 8/23:22
editorial on FCC plan for *en banc* meeting, 11/8:5
editorial suggests rethinking of NRSC, 11/22:5
era of change, 4/26:42
FCC calls open forum, 10/25:1
FCC denies renewal of WBUZ-AM, Fredonia NY, license to Catoctin Broadcasting Corp., 3/22:8
FCC en banc hearing seen as positive, 12/27:13
FCC filings continue support for NRSC-1, 2/8:12
FCC pressed on band expansion, 12/27:13
FCC proposal to eliminate restrictions on daytime contour protection on AM band generally opposed by industry groups, 1/1:9
FCC proposal to reduce AM interference favored by most broadcasters, 7/12:1
FCC proposal would allow "negotiated interference," 3/22:1
FCC proposed rules would reduce AM interference, 6/28:19
FCC's en banc hearing airs AM's ills, 12/13:1
FCC technical criteria improvement rule changes endorsed by most broadcasters, 2/8:1
FCC tightening of Part 15 rules could reduce AM interference, 5/10:17
FM Class A1 concept detailed, 6/14:5
FM Class A1 may help AM daytimers, 3/22:5, 5/10:9
Hey, it's "only" AM, 12/27:6
IEEE Symposium focuses on transmission, 10/25:8
insights, 4/26:42, 4/26:43
local AM pleasures, 7/26:8
low power transmitters popular, 4/26:36
NAB convention transmission offerings, 6/14:23
NAB executive committee approves recommendations on transmission, interference, and reception, 4/26:11
NAB to push certification mark, 12/27:3
NAB urges FCC to hold talks on critical AM issues, 9/27:2
noise blanking, 1/15:32
NRSC meets on AM certification mark, 11/22:15
Radio '89 engineering session, 10/11:29
Radio Taino from Cuba blanks out US AMs, 4/26:3
real estate values tempt AMs to sell, 9/6:1
RSS calculations to include co- and adjacent channel interference, 8/9:22
Sikes airs AM views, 12/13:10
single RSS that would take into account both co- and adjacent channel signals favored by Radio Advisory Committee, 11/8:3
staying current, 4/26:43
upgrading with NRSC-1, 6/28:44
WNEW-AM New York to be shared by Westwood One and Metropolitan Broadcasting, 5/10:18
WWNZ-AM, Orlando FL, tower construction halted by injunction, 12/13:16

AM stereo
C-QUAM chips improve, 10/11:12
manufacturers oppose AM stereo bills, 12/13:1
patent infringement claims against Motorola by Hazeltine and Kahn, 11/8:10
phasing problems, 10/11:44
receivers hard to come by, 4/12:29
stalking the AM stereo car radio, 9/6:43

Antenna monitors
interface for AM antenna monitor remote control systems, 2/22:20

Antennas
Chicago's Hancock Building antenna serves nine FM stations, 5/10:1
Chicago's Hancock Building serves nine FM stations, 11/22:8
elevated radial ground systems, 5/24:38
FCC review of FM directional antennas ruling sought, 5/10:3
FM short spacing allowed by FCC with use of directional antennas, 1/15:1
FM short spacing draws fire, 3/22:10
ice storms prompt power cutbacks, 4/12:3
landfill site of KRLA-AM, Los Angeles CA, 2/8:21
low-profile AM antenna study results to be presented at NAB convention, 1/15:3
low-profile antennas have growing support, 4/26:7
manufacturers assess directional antenna rule, 5/24:34
motorized coaxial transfer switches, 5/24:42
NAB anti-skywave antenna project nears launch, 6/28:9
NAB anti-skywave antenna ready for testing by April, 1/15:3
NAB anti-skywave antenna test project behind schedule, 4/26:7
OSHA charges SST with safety violations regarding Colony MO antenna collapse, 1/15:1
PARAN system at heart of Washington state controversy, 1/15:10

Aphex
Aural Exciter Type III, 6/28:47

Applications
broadcasters resist application lottery, 7/12:8
FCC proposes station application lottery, 2/22:1
filings with FCC support allowing upgrade of facilities with shift of community of license without competing applications, 3/8:8
NAB asks FCC to freeze non-applicant buyouts during comparative licensing process, 3/22:14

Ariel Corp.
digital microphone, 10/11:10

ATI
DA10,000 distribution amplifier, 7/26:45

Audi-Cord
cart machine, 12/27:48

Audio Engineering Society (AES)
NAB decides to assist in developing digital interface standard, 6/14:10

Audio Engineering Society (AES) convention, Hamburg, West Germany
convention draws US firms, 4/26:14

Audio Engineering Society (AES) convention, New York NY
convention theme is "Audio for the Next Decade and Beyond," 10/11:9
desktop audio entries are key to show, 11/22:18

Audiometrics
AMCDS 1000A CD player, 2/22:43

Audio processing
guest editorial suggests keeping modulation within rational limits, 10/25:5
guidelines, 1/1:25
Los Angeles loudness war feared with Westwood One's highly processed Pirate Radio, 5/10:1
ModMinder for more loudness, less processing, 6/28:43
multiband limiters, 12/13:40
NAB convention offerings, 6/14:36
Orban appraises state of radio audio chain, 6/28:40
PCs break into studio audio, 1/1:15
quality and loudness, 11/8:25
real-world audio processing, 12/13:23
SBE session on FM processing, 11/8:19
Shannon's Pirate Radio includes heavy audio processing, 12/13:13
tapes versus local stations, 1/1:18

Audio switchers
find industry niche, 7/26:43

Auditronics
400 Series console, 8/23:33

Autogram
Pacemaker console, 8/23:43

Automatic Transmission Systems (ATS)
FCC rules, 3/8:21

Automation
live assist automation is the next frontier, 2/22:38

B

BAI
Live Assistant live assist control unit, 7/26:53

Barrett, Andrew
confirmed by Congress after tough confirmation hearing, 9/6:8
confirmed by Senate for FCC post, 8/23:2
FCC commissioner nominee, 7/12:3

Bellcore
developing digital telephone system, 10/25:8
Integrated Services Digital Networks (ISDN) digital phone line under test, 8/9:20

Beyer Dynamics
microphones, 3/22:40

Birach Broadcasting Corporation
FCC approves dial hop petition for WNZK-AM, Westland MI, 6/28:10

Boozer, Barnard
FCC calls upon the Justice Department to investigate abuses of application process, 9/6:3

World Radio History

Bose Corp.
Bose/MIT study pans FMX, 2/22:1
editorial on FMX study, 2/22:5
firms continue FMX plans despite negative study, 2/22:3
FMX study authors stick by their research, suggest listening tests, 8/9:3
FMX study has little effect, 5/24:8
industry takes sides on FMX in wake of Bose/MIT study, 3/8:1
NRSC tables FMX issue since not all sides were represented, 3/22:1
proposes radio engineers' listening tests for FMX, 8/9:3

Brinkley, Dr. John R.
radio legend, 7/12:26, 8/9:32

Broadcast Audio
Series VI console, 8/23:42

Broadcast Electronics, Inc.
Dura Trak 90 cart machine, 12/27:39
FX-50 exciter, 11/22:38
MVDS remote control, 1/15:46
SAT 16 automation system, 2/22:44
Trak 90 console, 8/23:39

Broadcasters for Equal Air Rights (BEAR)
coalition forms to fight FAA over tower construction and frequency control, 10/25:1

Broadcast industry. *See* Radio industry

Broadcast Technology Association (BTA) of Japan
AM stereo study results, 6/28:3

Broadcast Technology Partners (BTP)
Bose/MIT study pans FMX; supporters defend system, 2/22:1
editorial on NAB's interest in FMX, 3/22:5
FMX market acceptance increases, 1/15:9
headquarters moves to Bloomfield Hills, MI, 7/26:1
industry takes sides on FMX in wake of Bose/MIT study, 3/8:1
NRSC tables FMX issue since not all sides were represented, 3/22:1
three staffers hired to promote FMX, 9/6:25

C

Call signs
histories of call signs, 2/8:27, 3/8:26, 4/12:29, 5/10:27, 7/12:26, 9/6:42
Minnesota Airwaves, 1912 Through 1939, 1/1:18

Carillon Technology
divests Professional Products Division of dbx Inc., 5/10:15

Cartridge machines
analyzing the future, 12/27:40
NAB convention offerings, 6/14:24

CBS Radio
power outage hits CBS Radio, 6/28:3
will convert AM stations and Washington Bureau to a satellite network, 10/11:15

Central Tower
1000' antenna tower, 5/24:40

CES. *See* Consumer Electronics Show

Charleston SC
Hurricane Hugo knocks stations off air, causes damage, 10/25:3

Circuit boards
letting circuit boards breathe, 8/9:30

Class A. *See* FM radio

Clipping
composite clipping controversy continues, 9/27:3, 10/11:18
NRSC FM subgroup seeks opinions on both sides after furor over one-sided paper, 9/27:3
NRSC sparks debate over composite clipping, 8/23:1

Compact disc (CD) players
care and feeding, 12/27:44

Compact discs (CDs)
getting more from CDs, 5/10:29
replacing turntables, 3/22:33
RIAA opposes recordable compact discs (CD-R), 2/8:1
Sony-Taiyo Yuden form partnership START Lab for recordable CDs, 7/26:20

Computers
computer-based automation memory, 7/26:24
computerizing radio news, 9/6:51
FCC suggestion on digital screening would affect personal computers, 7/12:8
getting more bang from your computer buck, 12/27:33
HyperCard for Macintosh, 3/22:19
HyperCard training for station use, 6/28:36
hypermedia, concept, 3/22:30
hypermedia for broadcasters, 3/22:19
KBEE-FM, Modesto CA, uses PC automation, 10/25:25
making broadcast production music, 7/12:27
PCs break into studio audio, 1/1:15
Radio '89 session on PCs in radio, 10/25:26
Synclavier lets KIIS-FM, Los Angeles CA, go tapeless, 1/15:12

Comrex
STLX console, 10/25:40

Concept Productions
CAPS I automation system, 2/22:35

Consoles
digital consoles not needed, 8/23:34
mix-minus circuit, 10/25:29
NAB convention offerings, 6/14:7
NAB convention preview, 4/12:N13
revitalizing/reviving consoles, 9/6:39, 9/27:24
updating consoles, 7/26:26

Consulting
collecting payments owed, 7/26:21
database marketing, 6/28:23
getting started, 12/27:26
marketing letters, 5/24:13
selling yourself as an engineering consultant, 3/22:26, 4/26:21

Consumer Electronics Show (CES)
agenda shows latest trends to be highlighted, 1/1:19
FMX receivers debut, 2/8:13
NRSC meeting, 2/8:13
radio improvements explored at CES session, 2/8:14

Continental
813A transmitter, 11/22:37
317C-2 solid state RF driver, 4/26:40
insight on AM, 4/26:43

CTE
transmitters, 11/22:50

Cuba
Radio Taino blanks out US AMs, 4/26:3

Culver, Corky
Corky goes Top 40, 8/9:37

Cutforth, Tim
buys station for $1, 9/27:16

Cutting Edge Technologies
Vigilante FM multiband limiter, 6/28:43

D

DAT/USA International
DAT players set for US consumer sales, 2/8:15

Daytimers. *See also* AM radio
FCC approves dial hop petition for WNZK-AM, Westland MI, 6/28:10
FM class A1 may help AM daytimers, 3/22:5, 5/10:9, 6/14:5

dbx Inc.
Carillon divests Professional Products Division of dbx Inc., 5/10:15, 6/14:33
Carillon sells OEM Products, 6/14:33

Delta
ASE/ASM exciter/monitor, 4/26:45
SM-1 splatter monitor, 1/15:38

Denon
DN 950FA CD player, 12/27:49

Denon America Inc.
AM radios to meet NRSC standards, 10/11:1

Desktop audio
digital control and signal manipulation, 4/12:22
Dyaxis digital desktop workstation used in schools, 3/8:34
hard disk editing, 4/26:24
NAB convention offerings, 6/14:1
NAB convention preview, 4/12:N6
PCs break into studio audio, 1/1:15
Synclavier lets KIIS-FM, Los Angeles CA, go tapeless, 1/15:12

Desktop radio
AES show highlights desktop audio, 11/22:18

Dick, Brad
elected SBE president, 10/25:11
election results to be announced at SBE convention, 9/27:21
SBE presidency candidate, 8/9:1

Digital audio tape (DAT)
adding timecodes to DAT, 2/8:26, 3/8:30
assessing the DAT compromise, 9/27:44
DAT players set for US consumer sales, 2/8:15
defending DAT's durability, 6/14:44
effects of industry compromise, 9/6:29
EIA drafts DAT copy legislation, 10/11:12
industry reaches compromise, 8/23:1
NAB convention offerings, 6/14:24
WMTR-FM, Toledo OH, first all-DAT radio station in US, 2/22:1

Digital audio technology. *See also* Desktop audio
advances in I/O technologies, 12/13:27
Ariel Corp. debuts digital microphone, 10/11:10
basic digital concepts, 10/11:37
Bellcore developing digital telephone system, 10/25:8
delving into R-DAT, 10/25:31
digital cable radio, 12/13:27
digital consoles not needed, 8/23:34
FCC suggests digital screening, 7/12:8
future of radio, 2/8:23
generator models, 3/8:33
Integrated Services Digital Networks (ISDN) digital phone line under test, 8/9:20
Motorola develops analog-to-digital converter chip, 4/12:11
NAB convention offerings, 6/14:8
NAB convention preview, 4/12:N6, 4/12:N10
PCs break into audio, 1/1:15
Public Radio Conference highlights, 7/12:15
radio industry lags in digital, 6/14:7
resolution in digital recording, 1/1:26
switching over to digital, 5/10:26
Synclavier lets KIIS-FM, Los Angeles CA, go tapeless, 1/15:12
Tascam's DA-50 DAT recorder, 11/22:30
testing the Panasonic SV-3500 DAT recorder, 12/27:24
workstation wish list, 11/8:37

Digital interface. *See also* Musical Instrument Digital Interface
AES/EBU digital interface channel status information, 8/9:34
AES/EBU digital interface study, 7/12:23
guest editorial says users can help with AES/EBU interface standard, 7/26:5
NAB convention preview, 4/12:N19
NAB decides to assist AES in developing standard, 6/14:10
standards, 3/8:30

Digital modulation. *See* Modulation

Digital radio
ICT CD/8 service offered via TV cable, 3/8:9

Directional antennas. *See* Antennas

Diversity tuning
slowly winning supporters, 8/9:10

Dolby
SR processing system, 12/27:48

Donahue, Paul
interview, 6/14:14

Dorrough
610A discriminate audio processor, 6/28:50

Drug abuse
omnibus drug bill may affect FCC license grants, 1/1:3

Duggan, Ervin
FCC commissioner nominee, 12/27:1

Duopoly rules
new rules benefit stations, 7/12:3
stations benefit from rule change, 1/1:3

E

EBS
FCC fines, 4/12:18

World Radio History

Education
survey finds employer tuition policies spur technical education, 5/24:10
thoughts on audio production education, 5/24:17, 7/26:23, 9/27:28

EIA. *See* Electronics Industries Association

Electromagnetic Energy Policy Alliance (EEPA)
radio frequency emissions hot topic at annual meeting and symposium, 4/12:3, 5/10:13

Electronics Industries Association (EIA)
agenda shows trends to be highlighted at International Consumer Electronics Show, 1/1:19
drafts DAT copy legislation, 10/11:12
press barred from NAB-EIA meeting on AM radio certification mark, 7/26:1

Emergency Broadcasting System (EBS)
revisions sought by NAB, 11/8:3

Engineering. *See also* Active device course; Licensing
AM antenna monitor interface, 2/22:20
AM directional array sampling systems repair, 8/23:22
AM engineering, Radio '89 session, 10/11:29
AM stereo phasing problems, 10/11:44
analog versus digital metering, 1/15:15
a basic utility tone generator, 11/22:29
blind engineers run AM stations, 5/10:23
booster synchronization, 9/27:26
circuit board stressors and problem solving, 8/9:30
communication with air staff, 5/24:19
computer-based automation memory, 7/26:24
consulting marketing letters, 5/24:13
contract engineering, 9/6:53
creative engineering, 2/22:18
dealing with people, 8/9:43
deflating an overblown ego, 11/8:28
designing a tunable demodulator, 4/26:27
digital thermometer design, 7/26:18
double-checking connections, 7/12:20
equalization, 2/22:26
equalizing telco remote lines, 2/22:16
exchanging ideas through networking, 12/27:32
generator models, 3/8:33
hum in the broadcast chain, 12/27:31
interruptible feedback, 11/8:41
life as a contract engineer's wife, 11/22:27
making something from nothing, 3/8:20
managers should listen to their stations, get technical help, 12/13:43
mental disentrenchment, 3/22:25
messiness and radio, 10/25:10
mix-minus circuit for consoles, 10/25:29
modulation muting relays, 3/22:29
NAB engineers professional development session, 6/14:29
odds and ends, 1/15:20
ohm and volt value changes in 1990, 1/15:9
optimizing STL performance, 2/22:32
Part 94 frequencies, 10/25:47
pass-reject traps, 4/12:27
phase, matching and other system tuning, 1/15:22
poor man's distribution amplifier, 5/10:19
power output measurements, 1/15:20
preamp alternative to a second STL site, 3/22:29
pressurized line saves down-time, 9/6:35
production values upgrading, 4/26:28
recording basics, 1/1:22
reviving a worn-out console, 9/6:39, 9/27:24
selling yourself as an engineering consultant, 3/22:26, 4/26:21
setting up a board for special effects, 5/24:16
smart car starter, 6/28:18
spring tonic for tired stations, 4/12:17
sprucing up air sound, 3/22:28
staff training in technical topics, 4/26:27
stamp out Techno-Lemmings, 9/27:14
standards for quality, 1/15:23
studio speakerphones, 9/6:40
survey finds employer tuition policies spur technical education; classifies engineers into groups, 5/24:10
switch for recorder upkeep, 4/26:20
Symetrix and audio quality, 8/23:18
topographic maps for station coverage, 5/24:15
transmitter high voltage problems, 1/1:16
treating cranky transmitters, 1/15:30
tunable demodulator for SCPC services, 3/22:17
Ufer ground system, 12/13:32
updating old consoles, 7/26:26
using motorized coaxial transfer switches, 5/24:42
utility line driver amp design, 5/24:20
voltage switch idea, 1/15:17

Environmental Protection Agency (EPA)
EPA probes Universal Capacitor for allegedly selling new PCB-filled capacitors without a permit, 3/8:1
suspends work on RF emissions standards, 1/15:9
underground fuel tank testing rules enacted, 9/6:7

Equal Employment Opportunity (EEO)
NAACP files complaints against license renewal for 22 North Carolina and South Carolina radio stations, 1/1:10

Equalization
basics of, 2/22:26
telco remote lines, 2/22:26

Equipment. *See also* Engineering; Test equipment; specific equipment
analog versus digital metering, 1/15:15
ballast lamps, 1/15:26
editorial on trend toward mediocrity and professional use of consumer equipment, 1/15:5
encouraging creativity with new equipment, 3/8:5
making something from nothing, 3/8:20
NAB convention preview, 4/12:N6, 4/12:N8, 4/12:N9, 4/12:N10, 4/12:N11, 4/12:N13, 4/12:N19
standards for quality, 1/15:23
tunable demodulator for SCPC services, 3/22:17
voltage switch idea, 1/15:17
VTVM probes, 1/15:26

ERI
panel and helix antennas, 5/24:33

F

Facilities
Alaska Public Radio Network gets new production studio, 3/22:20
Chicago's Hancock Building antenna serves nine FM stations, 5/10:1, 11/22:8
consolidation of Money Radio Network and flagship station KMNY under one roof, 5/24:27
FCC eyes upgrades to its lab facilities, 10/25:12
KBEE-FM, Modesto CA, uses PC automation of DAT and CD players, 10/25:25
KDHT-FM, Denver CO, constructs AM-FM studios, 12/27:23
KLDD-AM antenna site includes bug blower, 7/12:29
messiness and radio, 10/25:10
VOA's Greenville NC relay station, 8/23:31, 11/22:21
VOA's Greenville NC relay station also serves training, education, and research purposes, 12/27:27
WABC-AM, WPLJ-FM New York relocate to fast track studios, 7/26:37, 8/23:28
WEEI-AM, Boston MA, moves to Main Street, 6/28:20
West Virginia Public Radio's studio buffered from planes, trains and automobiles, 11/22:31
WMUS-AM-FM, Muskegon-Grand Rapids MI, gets state-of-the-art studio, 9/27:36
WOX-AM/KIIK-FM, Cedar Rapids IA, share new facilities, 1/15:21
WXBM-FM, Pace FL, renovates the Radio Ranch, 2/22:27
WXXK-FM, Newport NH, combines modern technology with Victorian facilities, 4/26:30

FCC
acts on 95 indecency complaints, 11/22:13
AM interference rule may help coverage area, 9/27:34, 10/25:32
AM radio en banc hearing airs AM's ills, 12/13:1
AM radio en banc hearing seen as positive, 12/27:13
AM radio open forum called, 10/25:1
AM radio proposal would allow "negotiated interference," 3/22:1
AM radio technical criteria improvement rule changes endorsed by most broadcasters, 2/8:1
ATS rules, 3/8:21
cites three radio stations for indecency, 9/27:8
Class A group petitions for reconsideration of power hike, 10/25:1
Class A hike debate continues with latest FCC filings, 2/8:9
Class A upgrade list due soon, 11/8:22
Class C3 list released, 9/27:23
commissioner, staff comings and goings, 9/27:7
commissioner candidates approved after tough confirmation hearing, 9/6:8
competing license filings on the rise, 1/15:1
court holds FCC did not follow notice and comment requirements in 1984 docket 80-90 rulemaking creating 684 new FM channels, 4/12:1
DCO log review, 9/6:34
denies renewal of WBUZ-AM, Fredonia NY, license to Catoctin Broadcasting Corp., 3/22:8
dial hop petition filing approved, 6/28:10
digital screening suggested, 7/12:8
Duggan nominated for commissioner, 12/27:1
early retirement option impact, 3/8:16
editorial on communications policy and the new administration, 2/8:5
editorial on FAA-FCC spectrum allocation controversy, 6/28:5
editorial on regulatory burdens and financial strain, 8/9:5
editorial reassessment of FCC philosophy, 4/26:5
Emergency Broadcasting System revisions sought by NAB, 11/8:3
enforcement of rules, 3/8:21, 4/12:18
equipment performance measurement requirements, 5/10:37
eyes upgrades to its lab facilities, 10/25:12
FCC-FAA battle brews over spectrum allotment, 6/28:1
FCC-FAA seek compromise on towers, interference, 11/22:7
FM channels created by 80-90 appear secure despite court ruling declaring FCC violated administrative procedures, 6/14:2
FM short spacing draws fire, 3/22:10
FM stations allowed to broadcast in short-spaced locations, 1/15:1
guest editorial on FAA-FCC spectrum allocation controversy, 6/28:5
higher fine limits proposed, 9/6:1
IF separation rule changes approved, 3/22:3
license renewal reform actions limit payoffs, require applicant information, 4/26:1
Marshall, Barrett are commissioner nominees, 7/12:3
Mass Media Bureau Chief Felker receives FCC's Gold Medal for distinguished service, 1/15:3
NAB asks FCC to freeze non-applicant buyouts during comparative licensing process, 3/22:14
National Radio Quiet Zone move rejected, 5/24:3
network control systems rules, 3/8:21
nighttime contours under study by Radio Advisory Committee, 11/8:3
NRSC-2 approved, 4/26:2
operator requirements, 3/8:21
ownership waivers of one-to-a-market rule approved under certain conditions, 1/15:7
paperwork requirements for stations, 1/1:21
PARAN system information sought before approval of requests to operate stations in Portland OR area, 1/15:10
Patrick resigns, 4/26:1
power outage hits FCC, 6/28:3

World Radio History

proposal to reduce AM interference favored by most broadcasters, 7/12:1
proposed rules would reduce AM interference, 6/28:19
public interest vs. marketplace philosophy, 4/26:17
remote control rules, 3/8:21
review of FM directional antenna ruling sought, 5/10:3
reviews indecency filings, 10/11:3
Sikes, Marshall, and Barrett confirmed by Senate, 8/23:2
Sikes nominated for chairman, 7/26:1
station fined for failure to know FM efficiency, 10/11:35
STL deadline imminent, but broadcasters, manufacturers confused, 11/8:1
supplemental budget appropriation averts furloughs, 1/1:2
tightening of Part 15 rules could reduce AM interference, 5/10:17
tower lighting reminder issued in wake of helicopter crash and near misses, 7/26:3

Federal Aviation Administration (FAA)
BEAR coalition fights against new FAA tower rule, 10/25:1
editorial on FAA-FCC spectrum allocation controversy, 6/28:5
FCC-FAA battle brews over spectrum allotment, 6/28:1
FCC-FAA seek compromise on towers, interference, 11/22:7
guest editorial on FAA-FCC spectrum allocation controversy, 6/28:5

Felker, Alex
FCC Mass Media Bureau Chief receives FCC's Gold Medal for distinguished service, 1/15:3

Fidelipac
Dynamax CTR100 cart machine, 12/27:43

FM boosters
choosing a site, 10/11:42

FM radio
booster synching, 9/27:26
Class A group from new England to lobby in DC for power hike, 4/26:13
Class A group re-petitions FCC, 10/25:1
Class A hike debate continues with latest FCC filings, 2/8:9
Class A increases to 6kW: what it will cost, 11/22:47
Class A members resign, withhold NAB dues to protest power hike opposition, 1/1:1
Class A power hike filings show industry divisiveness, 1/1:5
Class A power hike on case-by-case basis tentatively supported by Quello and Dennis, 5/24:1
Class A's identified for C3 relief, 5/10:12
Class A stations get selective hikes, 8/9:1
Class A survival manual, 12/27:30
Class A upgrade list due soon, 11/8:22
Class A upgrades primer, 11/22:46
Class A1 may benefit AM stations, 3/22:5, 5/10:9, 6/14:5
Class C3 established, 4/26:1
Class C3 list released by FCC, 9/27:23
composite clipping controversy continues, 9/27:3, 10/11:18
court holds FCC did not follow notice and comment requirements in 1984 docket 80-90 rulemaking creating 684 new FM channels, 4/12:1
editorial on FAA-FCC spectrum allocation controversy, 6/28:5
editorial on FCC Class A power hike decision, 8/9:5
editorial on FM's future, 5/24:5
editorial suggests support for NAB's Class A compromise, 1/1:7
effect of FCC rules may be to hurt short spacing, 5/24:18
FCC allows FM stations to broadcast in short-spaced locations, 1/15:1
FCC fines station for failure to know FM efficiency, 10/11:35
FCC review of FM directional antennas ruling sought, 5/10:3
filings with FCC support allowing upgrade of facilities with shift of community of license without competing applications, 3/8:8
FM channels created by 80-90 appear secure despite court ruling declaring FCC violated administrative procedures, 6/14:2
FM short spacing draws fire, 3/22:10
FM working group to study reducing interference from stereo transmission, 5/10:7
guest editorial on FAA-FCC spectrum allocation controversy, 6/28:5
guest editorial says solid state FM already a reality, 12/27:5
IEEE Symposium focuses on transmission, 10/25:8
IF separation rule changes approved, 3/22:3
KABL-FM/AM stays on air despite earthquake, 11/22:1
KJOI-FM, Los Angeles CA, sale breaks record, 12/13:14
KMOD-FM, Tulsa OK, spoofs MTV's "Remote Control" game show, 9/6:46
KURA-FM, Ouray CO, sold for $1, 9/27:16
Los Angeles loudness war feared with Westwood One's Pirate Radio on the air, 5/10:1
manufacturers assess directional antenna rule, 5/24:34
multipath testing on at WAEB-AM-FM, Allentown PA, 7/26:20
multipath testing results show more study needed, 11/22:17
multipath testing underway at WAEB-AM-FM, Allentown PA, 8/23:1
multipath tests show unpredictability, raise more questions, 10/25:7
NAB convention transmission offerings, 6/14:23
NRSC multipath field tests would yield data on FM interference, 3/22:1
NRSC sparks debate over composite clipping, 8/23:1
Radio '89 examines new technical advancements for FM, 10/11:25
76 kHz SCA new choice, 11/8:29
solid state transmitters still on horizon, 11/22:43
Virginia FMs, WPLZ-FM Petersburg and WYND-FM Spotsylvania Courthouse, go to satellite simulcast, 8/23:7
WJLK-FM, Asbury Park NJ, sold, 1/1:5
WYHY-FM, Nashville TN, assists in solving murder case, 12/27:15

FM translators
American FM Translator Association formed, 9/27:1
battle lines: diversity vs. localism, 9/6:23
Bergen County NJ broadcaster fights for Ft. Lee FM privileges, 9/27:1
Bergen County NJ declares radio state of emergency in support of efforts to get FCC to allow local programming, 11/8:1
Bergen County NJ petition fought by broadcasters, 10/11:8
La Tour's one-man advocacy, 12/27:10
legislation that would limit FM translators gets little industry reaction, 12/27:10
NAB opposes FCC noncommercial educational translator rule, 5/10:7

FMX
Bose Corp. proposes radio engineers' listening tests, 8/9:3
Bose Corp. study authors stick by their research, suggest listening tests, 8/9:3
Bose/MIT study has little effect, 5/24:8
Bose/MIT study pans FMX; supporters defend system, 2/22:1
Broadcast Technology Partners hires three staffers to promote
Broadcast Technology Partners moves headquarters to Bloomfield Hills, MI, 7/26:1
editorial, 2/22:5
editorial on NAB's interest in FMX, 3/22:5
firms continue FMX plans despite negative research report, 2/22:3
industry takes sides on FMX in wake of Bose/MIT study, 3/8:1
market acceptance increases, 1/15:9
NRSC tables FMX issue since representatives from only one side were present, 3/22:1
receivers debut at CES, 2/8:13

Formats
Pirate Radio, 5/10:1

Fort Collins CO
radio time comes from WWV in, 12/13:33

Fostex
6301 studio monitor, 3/22:34

4-K Radio
benefits from new duopoly rule, 1/1:3

Fritts, Eddie
advocates radio reform, 6/14:29

G

Gannett Broadcasting
Donahue interview, 6/14:14

GE American Communications
ABC Radio Network signs 10-year agreement for satellite transmission of programming, 8/9:20

Gentner
digital hybrid, 10/25:39
EFT-3000 digital frequency extender, 10/25:42
Phoenix audio processor, 6/28:39
VRC-2000 remote control, 10/25:52

GLW Enterprises
buys Harrison Systems Inc., 5/10:15

Great American Broadcasting
FCC grants waiver of one-to-a-market rule, 9/6:3

H

Haiti
Radio Liberte back on the air, 3/8:17

Ham radio. *See* Amateur radio policies

Harris Corp.
DX-50 solid state AM transmitter, 4/26:35
Harris-Allied sales under one banner, 4/12:9
HT series transmitters, 11/22:40
insight on AM, 4/26:42
XD-001 DAT deck, 9/27:43

Harrison Systems Inc.
bought by GLW Enterprises, 5/10:15

Henry Engineering
Fast Trac Dubbing System, 9/27:48
MixMinus Plus, 10/25:41
Utility Summing and Distribution Amplifier (USDA), 7/26:52

History, radio
border radio, 5/10:27, 8/9:32
call signs, 2/8:27, 3/8:26, 4/12:29, 5/10:27, 7/12:26, 9/6:42
college broadcasting, 11/8:26
Dr. Brinkley, radio legend, 7/12:26, 8/9:32
memories of towers and service areas, 10/11:41
Minnesota Airwaves, 1912 Through 1939, 1/1:18
NAB convention history, 6/14:47
National Museum of Communications, 10/11:46
WLW's real story, 3/8:26

Holaday Industries
HI-3002 broadband field strength meter, 1/15:39

Howe Technologies Corp.
HoweTech Series 10K, 8/23:41

Human resources management
becoming more of a people person, 8/9:43
communication between engineers and air staff, 5/24:19
creating a productive workplace, 2/22:22
don't be a know-it-all boss, 9/27:35
guest editorial on encouraging creative production "rats," 3/8:5
NAB engineers professional development session, 6/14:29
personality profiles, 8/23:20
Radio '89 session on communications skills, 10/25:26
rebounding from being fired, 1/15:19
staff communication, 4/26:27
successful management, 10/25:22
thoughts on audio production education, 5/24:17, 7/26:23, 9/27:28

Hurricane Hugo
knocks stations off the air, causes damage, 10/25:3
Myrtle Beach SC station rides out storm, 11/8:24
NAB-arranged equipment cooperative aids damaged stations, 11/8:12

I

Ice storms
prompt power cutbacks, 4/12:3

IEEE. *See* Institute of Electrical and Electronic Engineers

World Radio History

IGM
SC automation system, 2/22:36

Indecency
FCC acts on 95 complaints, 11/22:13
FCC cites three radio stations for indecency, 9/27:8
FCC reviews indecency filings, 10/11:3
top topic at FCC commissioner confirmation hearings, 9/6:8

Innovative Automation
Micro Di-Trol automation system, 2/22:36

Inspections
AM station deluged with penalties by FCC, 11/8:36
equipment performance measurement requirements, 5/10:37
FCC fines station for failure to know FM efficiency, 10/11:35
following the rules, learning from FCC citations, 12/13:24
paperwork requirements, 1/1:21

Institute of Electrical and Electronic Engineers (IEEE)
annual meeting to be held in Washington DC; Sikes address, sessions planned, 9/6:22
39th Symposium focuses on AM, FM transmission, 10/25:8

Integrated Media Systems (IMS)
Dyaxis manufacturer bought out by Studer Revox, 9/27:3
Studer Revox negotiating to buy, 8/23:13

Interference
AM interference rule may help coverage area, 9/27:34, 10/25:32
AM rule changes endorsed by most broadcasters, 2/8:1
FCC AM radio proposal would allow "negotiated interference," 3/22:1
FCC proposal to reduce AM interference favored by most broadcasters, 7/12:1
FCC proposed rules would reduce AM interference, 6/28:19
FCC tightening of Part 15 rules could reduce AM interference, 5/10:17
FM working group to study reducing interference from stereo transmission, 5/10:7
IF separation rule changes approved, 3/22:3
multipath testing on at WAEB-AM-FM, Allentown PA, 7/26:20
multipath tests show unpredictability, raise more questions, 10/25:7
multipath tests underway at WAEB-AM-FM, Allentown PA, 8/23:1
NRSC multipath field tests would yield data on FM interference, 3/22:1
Radio '89 session, 10/11:26
Radio Taino from Cuba blanks out US AMs, 4/26:3
receiver-induced third-order effects, 7/26:32
RSS calculations to include co- and adjacent channel interference, 8/9:22
single RSS that would take into account both co- and adjacent channel signals favored by Radio Advisory Committee, 11/8:3
solar flare activity, 4/26:12
"Voice of Venezuela" could cause interference for US stations, 2/22:9

International Cable Casting Technologies, Inc. (ICT)
CD/8 service offered via TV cable, 3/8:9

International Tapetronics Corporation (ITC)
Audio Switcher, 7/26:41

J

JBL
4406 studio monitors, 3/22:34

JVC
KS-RX5500 high-end tuner with FMX, 2/8:13

K

Klark Teknik
DN-500 dual compressor/limiter/expander/clipper, 7/26:43

L

Legislation
editorial supporting Rinaldo's radio improvements bill, 7/26:5
Emerging Telecommunications Technologies Act, 1989 (ETTA) would reallocate 200MHz of spectrum from government to private sector, 8/9:19, 12/13:16
hearings held on proposed legislation addressing radio design renewal, 11/22:1
legislation drafted to prevent state licensing of telecommunications engineers, 3/22:8
manufacturers oppose AM stereo bills, 12/13:1
NAB hopeful on getting radio legislation "by next year" despite low priority on Hill, 11/8:1
proposed legislation that would limit FM translators gets little industry reaction, 12/27:10
radio legislation low priority in Congress, 10/11:8
radio-only legislation's approval debated, 4/12:13
radio-only legislation supported by station and group owners to eliminate third-party payoffs during license renewal, 4/12:1
Rinaldo introduces Radio Quality Improvements Act, 7/26:7
state licensing of telecommunications engineers to be tackled by federal legislation, 1/1:1

License renewal
competing license filings on the rise, 1/15:1
FCC denies renewal of WBUZ-AM, Fredonia NY, license to Catoctin Broadcasting Corp., 3/22:8
FCC reform actions limit payoffs, require applicant information, 4/26:1
NAACP files complaints against license renewal for 22 North Carolina and South Carolina radio stations, 1/1:10
NAB Radio Board makes reform number one legislative priority, 2/22:10
radio-only legislation's approval debated, 4/12:13
Radio '89 workshop on reform, 10/11:28
simplified renewal supported, 12/27:8
station and group owners support radio-only legislation to eliminate third-party payoffs during license renewal, 4/12:1

Licensing
federal legislation to tackle issue of state licensing for telecommunications engineers, 1/1:1
historical view of state licensing of engineers, 1/1:27
legislation drafted to prevent state licensing of telecommunications engineers, 3/22:8
SBE position on licensing of broadcast engineers, 6/14:28
SBE session on state licensing of engineers, 11/8:21
state licensing of engineers focus of MAB convention panel, 3/8:3
thoughts on state licensing of engineers, 2/8:29

Lightning Eliminators and Consultants Inc. (LEC)
charges fire protection industry biased against innovative technology, 7/12:10

Lightning protection
companies offer different equipment, approaches, 10/11:7
Lightning Eliminators and Consultants charges fire protection industry biased against innovative technology, 7/12:10

Local stations
back to radio basics at WPCX-WMBO, Auburn NY, 8/23:14
local AM pleasures, 7/26:8
tapes versus local stations, 1/1:18

Los Angeles CA
DigiMod gives KIIS-FM its sound signature, 12/13:15
editorial on KFAC's switch from classical to rock, 9/27:5
FM loudness war feared with Westwood One's Pirate Radio on the air, 5/10:1
KJOI purchase breaks record, 12/13:14
KKBT-FM enters radio dogfight, 10/25:17
profile of Shannon's Pirate Radio, 12/13:13
record breaking prices for LA stations, less diversity, 9/27:1
Requiem for a Radio Station mourns loss of classical format KFAC, 10/25:17

LPB
Citation II console, 8/23:45
Signature console, 8/23:40
100 W low power transmitter, 4/26:36

Lyman, Jerry
Radio Ventures I potential powerhouse radio station group, 9/27:16

M

Madison Broadcasters Clinic
agenda for 35th year, 9/27:12

Manuals
good and bad, 2/22:19
manufacturers addressing user needs, 3/22:16
muffs and misprints, 9/6:31

Mark Antennas
P-9A96G-1 antenna, 5/24:36

Marshall, Sherrie
confirmed by Congress after tough confirmation hearing, 9/6:8
confirmed by Senate for FCC post, 8/23:2
FCC commissioner nominee, 7/12:3

Marti Electronics
audio companding system, 7/26:52

McMartin
FM modulation monitors, 1/15:40

Metropolitan Broadcasting
WNEW-AM New York to be shared with Westwood One, 5/10:18

Mexico
tests NRSC standards for AM, 4/12:9

Michigan Association of Broadcasters (MAB)
MAB/SBE Chapter 91 Mid-Winter Convention and Broadcast Exposition, 3/8:1
state licensing of engineers focus of MAB convention panel, 3/8:3

Microphones
Ariel Corp. debuts digital microphone, 10/11:10
instrument miking, 4/12:19
mixing schemes aid mic woes, 8/9:39
NAB convention offerings, 6/14:33
placement fundamentals, 3/8:23
recording basics for engineers, 1/1:22
stereo miking techniques, 11/8:33

Microprocessors
basics of, 12/27:45

MIDI. *See* Musical Instrument Digital Interface

Minnesota Public Radio
production team produces smooth *Prairie Home Companion*, 7/12:1

Minority issues
ethnic blend in newsrooms urged at RTNDA panel session, 1/1:1
NAACP files complaints against license renewal for 22 North Carolina and South Carolina radio stations, 1/1:10

Modulation
FCC letter OKs ModMinder, 12/27:1
ModMinder for more loudness, less processing, 6/28:43
ModMinder receives high marks, 8/23:10
modulation muting relays, 3/22:29
point-counterpoint on peak modulation monitoring, 9/27:5
quality and loudness, 11/8:25
reallocation of UHF and VHF TV bands is opportunity for digital modulation for radio over unused channels, 4/12:5

Modulation Sciences
asks EIA to review NRSC acceptance of paper critical of composite clipping, 8/23:1
composite clipping controversy continues, 9/27:3, 10/11:18
FCC letter OKs ModMinder, 12/27:1
ModMinder receives high marks, 8/23:10

Montoya, Paul
election results to be announced at SBE convention, 9/27:21
guest editorial on SBE future, 8/23:5
SBE presidency candidate, 8/9:1

Motorola
1400 AM stereo exciter, 4/26:41
asks for expedited ruling on patent infringement claims by Hazeltine and Kahn, 11/8:10
C-QUAM chips improvements, 10/11:12

World Radio History

develops analog-to-digital converter chip, 4/12:11
voluntary layoff order, 11/8:10

Mountain America Satellite Radio
Auto-Jock automation system, 2/22:45

Murphy Studio Furniture
Elite Series studio furniture, 12/27:46

Musical Instrument Digital Interface (MIDI)
adding drums to a MIDI studio, 8/9:26
assembling a MIDI studio, 5/10:22
multitimbral synthesizer tips, 9/6:28
recording original music for broadcast production, 7/12:27
recording your own music beds for spots, promos and other uses, 10/11:36
synthesized promos, 1/15:27

Music libraries
Airforce Broadcast Services, Inc., *The New Production Music Library*, 6/28:33

Music licensing
Sun music fee claim may be scam, 8/9:12

N

NAACP
files complaints against license renewal for 22 North Carolina and South Carolina radio stations, 1/1:10

NAB. *See* National Association of Broadcasters

NARTE. *See* National Association of Radio and Telecommunications Engineers

National Association of Broadcasters (NAB). *See also* Radio '89
AM certification mark push, 12/27:3
anti-skywave antenna project nears launch, 6/28:9
anti-skywave antenna project underway, 8/9:1
anti-skywave antenna ready for testing by April, 1/15:3
anti-skywave antenna test project behind schedule, 4/26:7
asks FCC to freeze non-applicant buyouts during comparative licensing process, 3/22:14
Class A members' resignations, withholding of dues, not a major issue, 1/1:1
convention history, 6/14:47
convention scheduling changes planned, 11/22:3
Crystal Awards, 10/11:32
editorial on NAB's interest in FMX, 3/22:5
editorial suggests support for NAB's Class A compromise, 1/1:7
Emergency Broadcasting System revisions sought, 11/8:3
executive committee aproves AM radio recommendations on transmission, interference, and reception, 4/26:11
filings on Class A FM power hike show divisiveness, 1/1:5
hopeful on getting radio legislation "by next year" despite low priority on Hill, 11/8:1
hotel room scramble for spring convention, 3/22:3
low-profile AM antenna study results to be presented at NAB convention, 1/15:3
membership split on whether there should be single annual convention exclusively for radio, 9/6:1
NAB opposes FCC noncommercial educational FM translator rule, 5/10:7
NAB-RAB ad campaign meets with some resistance, 6/14:28
opposes ANSI draft RF radiation standard, 9/27:17
press barred from NAB-EIA meeting on AM radio certification mark, 7/26:1
RAB-NAB ad campaign draws inconsistent, reluctant participation, 6/28:1
Radio Board meets, 2/22:7
Radio Board pushes license reform, 2/22:10
Seattle RF radiation emission standard fought by broadcasters, 7/12:1
show demographics numbers withheld from exhibitors, 12/27:7
test tone CD, 1/15:37
tries to prevent press coverage of NRSC composite group meeting, 12/13:3
ultimate radio can't find manufacturer, 10/25:20
ultimate radio prototype finished, 3/8:18
ultimate radio receiver due by 1990, 6/28:10
undecided position on FCC tightening of Part 15 rules, 5/10:17
urges FCC to hold talks on critical AM issues, 9/27:2

National Association of Broadcasters (NAB) convention, Atlanta GA
Atlanta convention squeezes radio exhibitors out of main exhibit hall, 6/14:1
gearing up for the 1990 show, 12/27:7

National Association of Broadcasters (NAB) convention, Las Vegas NV
audio processing offerings, 6/14:36
Class As discussed in convention session, 5/24:1
console products emphasize variety, 6/14:7
digital audio technology offerings, 6/14:8
digital interface debate, 6/14:10
editorial on exhibitors and innovation, 4/12:5
editorial on splitting radio from spring show, 6/14:5
engineers professional development session, 6/14:29
Fritts advocates radio reform, 6/14:29
interview with Gannett's Donahue, 6/14:14
NAB finalizes convention plans, 2/8:11
preview, 4/12:N1
accessory items, 4/12:N9
added depth in source products, 4/12:N6
agenda, 4/12:N5
an NAB view, 4/12:N14
console innovations, 4/12:N13
digital audio processors, 4/12:N10
exhibitor directory, 4/12:N22
interface gear, 4/12:N19
Las Vegas aims for convention business, 4/12:N15
Las Vegas night life, 4/12:N12
NRSC makes strides in AM, FM, 4/12:N1
radio frequency (RF) gear, 4/12:N8
room shortage, 4/12:N15
sessions span radio spectrum, 4/12:N2
test equipment, 4/12:N10
Quello says C-QUAM should be the standard, 6/14:20
radio industry lags in digital, 6/14:7
radio networks shun show, 6/14:1
record crowd attends convention, 5/24:1
SBE announces stand on licensing issue, 6/14:28
show stoppers, 6/14:18
solid state RF products proliferate, 6/14:23
stereo mics make debut, 6/14:33
STL/RPU gear, 6/14:26
tape, cartridge offerings, 6/14:24
test equipment sees product introductions, 6/14:32
was it such a circus?, 6/14:35

National Association of Radio and Telecommunications Engineers (NARTE)
opposes state licensing for telecommunications engineers, 1/1:1, 3/22:8

National Bureau of Standards
ohm and volt value changes in 1990, 1/15:9

National Institute of Standards and Technology (NIST)
radio time comes from WWV, Fort Collins CO, 12/13:33

National Museum of Communications
profile, 10/11:46

National Public Radio (NPR)
power outage hits NPR, 6/28:3

National Radio Quiet Zone (NRQZ)
FCC rejects petition to move NRQZ after dish collapse, 5/24:3

National Radio Systems Committee (NRSC). *See also* NRSC-1; NRSC-2
composite clipping controversy continues, 10/11:18
composite clipping debate, 8/23:1, 9/27:3
composite mask group meets to define goals, 12/13:3
editorial, 11/22:5
guest editorial praises NRSC, 12/27:5
meeting at CES, 2/8:13
meeting at CES discusses AM receivers, FM technical issues, 7/12:9
meets before NAB convention, 4/12:N2
meets on AM certification mark, 11/22:15
multipath field tests would yield data on FM interference, 3/22:1
multipath tests show unpredictability, raise more questions, 10/25:7
NRSC-2 ruling toasted, 5/24:7
NRSC tables FMX issue since only one side was represented, 3/22:1

National Religious Broadcasters (NRB)
Media Expo '89, Washington DC, 3/8:8

Nautel
insight on AM, 4/26:42
ND10 solid state AM transmitter, 4/26:38

NEC
suspends some US equipment sales, 12/27:1

Neumann
SM69 stereo microphone, 3/22:41

New England Digital
Synclavier Digital Music System, 1/15:12

New Jersey Class A FM Broadcasters Association
across-the-board hike sought, 1/1:5
Class A hike debate continues with latest FCC filings, 2/8:9
editorial suggests support for NAB's Class A compromise, 1/1:7
re-petitions FCC, 10/25:1

News broadcasting
Carolina AMs simulcast TV news at six, 6/28:13
industry groups ask FCC to liberalize policy on news broadcasting by amateur radio, 1/1:9
newsroom computers, 9/6:51

Noise blanking
IC cuts AM noise, 1/15:32
Sprague chip targets auto radios, 1/15:32

NRSC-1
conversion guide (part I), 6/28:44
conversion guide (part II), 7/26:46
Denon to build NRSC radios, 10/11:1
editorial, 5/10:5
FCC filings continue support, 2/8:12
implementation of NRSC-1 and NRSC-2 standards comments, 1/1:9
Mexico tests NRSC standard, 4/12:9
NRSC radios slated for unveiling in 1990, 2/8:13

NRSC-2
editorial, 5/10:5
FCC approves, 4/26:2
guide to compliance, 7/12:22
implementation of NRSC-1 and NRSC-2 standards comments, 1/1:9
NRSC toasts ruling, 5/24:7
reactions mixed on approval, 5/10:1

O

Ohms
value change in 1990, 1/15:9

Omnitronix
OMNI-1000 solid state AM transmitter, 4/26:37

Onkyo
T-9090 II tuner, 1/15:40

Orban
ACC-22 FM filter card for Optimod 81000 audio processor, 6/28:51
AKG Acoustics buys, 6/14:33
787A programmable mic processor, 3/22:36
Optimod-AM audio processor, 4/26:45

Orlando FL
WWNZ-AM tower construction halted by injunction, 12/13:16

Otari
MX-50 reel-to-reel recorder, 9/27:43

Ownership
FCC to allow group ownership of radio and TV stations in same market under certain conditions, 1/15:7

World Radio History

pitfalls of station ownership, 7/26:18

P

Pacific Recorders & Engineering
Radiomixer, 8/23:38
SDA8-A stereo distribution amplifier, 3/22:33

Panasonic
DAT editing controller, 9/27:54
SV 3500 DAT deck interface unit, 9/27:54

Parameter Current Antenna (PARAN)
PARAN system at heart of Washington state controversy, 1/15:10

Patrick, Dennis
editorial reassessment of FCC philosophy with Patrick resignation, 4/26:5
resignation from FCC, 4/26:1
sendoff parties, 9/6:8

PCBs
editorial, 3/8:5
EPA probes Universal Capacitor for allegedly selling new PCB-filled capacitors without a permit, 3/8:1
rules cause confusion, 3/8:7

Prairie Home Companion
production team produces smooth show, 7/12:1

Preemphasis standard. *See* NRSC-1

Press Broadcasting
Class A torchbearer sells Class A WJLK-FM, Asbury Park NJ, 1/1:5

Programming. *See also* Formats
AM answer?, 1/1:18

Public Radio Conference
digital audio highlighted, 7/12:15

Q

QEI
FMQ 20000B transmitter, 11/22:44
Model 400 CAT/Link digital T-1 STL, 10/25:37

Quello, James
C-QUAM would get Quello's vote, 6/14:20
criticizes talk radio at NAB convention, 7/26:17

R

Radio '89
agenda, 9/6:17
AM radio engineering session, 10/11:29
"AM Rebound" session, 10/11:19
communications skills session, 10/25:26
dial-up remote panel topic, 10/11:27
editorial, 9/6:5, 10/11:5
engineers discuss interference, 10/11:26
exhibitors, 9/6:14
FM technical advancements examined, 10/11:25
license reform workshop includes congressmen, 10/11:28
NAB Crystal Awards, 10/11:32
NAB's fall show has sold-out trade floor, increased registration, more sessions, 9/6:11
PCs in radio session, 10/25:26
preview, 7/26:10
products take show spotlight, 10/11:20
radio promotion gains momentum, 10/11:34
record attendance, hot products make show a success, 10/11:17
shortwave seminar, 10/11:33

Radio Advertising Bureau (RAB)
ad campaign draws inconsistent, reluctant participation, 6/28:1
ad campaign meets with some resistance, 6/14:28

Radio Data System (RDS)
ability to transmit extra data to radio receivers, 4/12:1

Radio Design Labs
ACM-1 AM noise monitor, 1/15:42

Radio drama
performers deliver *Satanic Verses* on radio, 4/12:7

Radio frequency (RF) radiation. *See also* NRSC-2
editorial on proposed Seattle RF radiation standard, 7/12:5
EPA halts work on formulating standards, 1/15:9
FCC-commissioned studies finds less land needed around antenna sites to meet RF requirements, 10/25:14
hot spots found less of a radiation hazard, 10/25:14
hot spot study may prompt RF reviews, 11/22:20
hot topic at EEPA conference, 4/12:3, 5/10:13
NAB opposes ANSI draft RF radiation standard, 9/27:17
NRSC members concerned over proposed rulemaking favoring NRSC-2 implementation rather than NRSC-1 standard, 2/8:13
proposed Seattle RF radiation emission standard fought by broadcasters, 7/12:1
Seattle mayor recommends less stringent RF standard than Office of Long Range Planning, 10/11:1

Radio industry
broadcasters seek phone alternatives, 10/25:38
drug bill extends to broadcasting, 1/1:3
editorial on innovation, 4/12:5
editorial on issues for the 1990s, 12/27:5
editorial on standard-setting and new technology, 2/22:5
editorial on trend toward mediocrity and professional use of consumer equipment, 1/15:5
examining T-1 phone circuits, 10/25:50
hot topic in film, TV, 3/8:10
lags in digital, 6/14:7
live assist automation is the next frontier, 2/22:38
promotion gains momentum with Phase II and III plans, 10/11:34
radio time comes from WWV, Fort Collins CO, 12/13:33
recruiting for careers in radio, 2/22:5
RTNDA focuses on minorities in broadcasting, 1/1:1
satellite use grows, 4/26:8

Radio networks
shun NAB show, 6/14:1

Radio Schleswig-Holstein (RSH)
profile of West Germany's first all-commercial radio operation, 4/26:15

Radio Systems
R-DAT controller, 9/27:46
RS Series console, 8/23:44

Radio Systems, Inc.
RS-1000 DAT automation system, 2/22:37

Radio Taino. *See* Cuba

Radio-Television News Directors Association (RTNDA)
annual convention offers basic radio fare, 1/1:11
International Conference hears manufacturers promise better equipment, 11/8:35
minorities in broadcasting is top convention issue, 1/1:1

Radio Ventures I
potential powerhouse radio station group, 9/27:16 *Radio World*
active device course to be offered through *Radio World*, NOVA, 3/8:16, 3/22:14
barred from NAB/EIA meeting on AM radio certification mark, 7/26:1
digital electronics course to be offered through *Radio World*, NOVA, 12/13:17
NAB tries to prevent press coverage of NRSC composite group meeting, 12/13:3
53 years ago, 1/1:18
57 years ago, 8/9:32, 12/13:44
58 years ago, 5/10:27, 9/6:42, 10/11:41
59 years ago, 7/12:26, 11/8:27

RAM/McCurdy
SX Series console, 8/23:41

Receivers
NAB ultimate radio receiver due by 1990, 6/28:10

Recording
basics for engineers, 1/1:22
multitracking with an in-house production studio, 2/8:18
resolution in digital recording, 1/1:26
switch for recorder upkeep, 4/26:20

Recording Industry Association of America (RIAA)
opposes recordable audio CDs, 2/8:1

Remote broadcasting
backpacking radio in Munich for WLUP, Chicago IL, 3/8:25
maximizing quality, 9/27:39
options for getting good audio from your remote site, 11/22:24
products and tips for improving remote broadcasting, 10/25:21
an RPU can back up your STL, 12/27:38

Remote control
building a remote control, 11/22:34
NAB convention offerings, 6/14:26
Radio '89 session, 10/11:27

Revox
C278 reel-to-reel recorder, 9/27:44

RF mask. *See* NRSC-2

RIAA. *See* Recording Industry Association of America

Richardson Electronics
Justice Department investigates possible antitrust violations in power grid tube industry, 10/11:1

Rinaldo, Matthew
editorial supporting radio improvements bill, 7/26:5
introduces Radio Quality Improvements Act, 7/26:7
Rep. Rinaldo shares radio views in interview, 4/12:12

Root, Thomas
DEA clears Root of drug allegations, 11/8:22
North Carolina probes Sonrise's alleged securities violations with help of Root, 9/27:8
plane crash of communications lawyer suspicious, 8/9:17

RTNDA. *See* Radio-Television News Directors Association

Rushdie, Salman
performers deliver *Satanic Verses* on radio, 4/12:7

S

Samplers
using samplers, 11/22:23

San Francisco CA
earthquake ravages area; radio service lost, 11/8:12
KABL-FM/AM stays on air despite earthquake, 11/22:1 *Satanic Verses*
performers deliver *Satanic Verses* on radio, 4/12:7

Satellites
CBS Radio will convert AM stations and Washington Bureau to a satellite network, 10/11:15
transmitter monitoring, 6/28:1
use grows in radio, 4/26:8
Virginia FMs, WPLZ-FM Petersburg and WYND-FM Spotsylvania Courthouse, go to satellite simulcast, 8/23:7

Seattle WA
editorial on proposed city RF radiation standard, 7/12:5
mayor recommends less stringent RF standard than Office of Long Range Planning, 10/11:1
proposed city RF radiation emission standard fought by broadcasters, 7/12:1

Shively Labs
FM combiner on Chicago's Hancock Center handles nine stations, 11/22:8
Model 6810 eight-bay antenna, 5/24:35

Short spacing
effect of FCC rules may be to hurt short spacing, 5/24:18
FCC review of FM directional antennas ruling sought, 5/10:3
FM short spacing allowed by FCC with use of directional antennas, 1/15:1
FM short spacing draws fire, 3/22:10
manufacturers assess directional antenna rule, 5/24:34

Shortwave radio
KUSW, Salt Lake City UT, broadcasts worldwide, 8/9:44
Radio '89 seminar, 10/11:33

Shure Brothers
Beta 58 dynamic microphone, 3/22:39
SmartAMP Amplifier, 10/25:44
Stereosurround system introduced, 8/9:21

Sikes, Alfred
confirmed by Congress after tough confirmation hearing, 9/6:8
confirmed by Senate for FCC post, 8/23:2
expected to be nominated for FCC chairman, 7/12:3
nominated for FCC chairman, 7/26:1
views on AM radio, 12/13:10

World Radio History

Sine Systems
News Director workstation, 7/26:55

Siting
antenna of KRLA-AM, Los Angeles CA, sits on landfill, 2/8:21
KBRD-FM, Tacoma WA, located on the Three Sisters mountain range, 4/12:21

Society of Broadcast Engineers (SBE)
asks FCC for type notification extension, 12/13:1
changes planned for 1989 show, 2/8:7
Dick, Montoya vie for presidency, 8/9:1
Dick elected president of SBE, 10/25:11
editorial on convention, 10/25:5
editorial on presidential race and SBE's future, 8/23:5
editorial on request for STL type notification extension, 12/13:5
election results to be announced at October convention, 9/27:21
exhibitors unhappy about SBE cut of exhibit hours by half, 8/23:3
guest editorial on future of SBE, 8/23:5
licensing issue stand, 6/14:28
MAB/SBE Chapter 91 Mid-Winter Convention and Broadcast Exposition, 3/8:1
schedule covers regulatory and technological topics, 9/27:10
show faces critics, 6/28:14
vendors gear up for show, 9/27:10

Society of Broadcast Engineers (SBE) convention, Kansas City MO
FM processing session, 11/8:18
products at a glance, 11/8:17
rescheduling of exhibit hours makes show a success, 10/25:11
RF equipment takes center stage at exhibition, 11/8:18
state licensing session, 11/8:21

Somich Engineering
DBE-1000 Dynamic Baseband Enhancer, 6/28:53

Sonrise Management Services
FCC directs an investigation for alleged application abuses, 9/6:27
North Carolina probes alleged securities violations with help of Root, 9/27:8
Root plane crash draws attention to company activities, 8/9:17

Sony
D-10 DAT deck, 9/27:51
PCM 2500 DAT deck, 9/27:53
Sony-Taiyo Yuden form partnership START Lab for recordable CDs, 7/26:20

Sound Technology
3000B Automated Test System, 1/15:35

Spectrum allocation
Emerging Telecommunications Technologies Act would reallocate 200MHz of spectrum from government to private sector, 8/9:19
FCC-FAA battle brews over spectrum allotment, 6/28:1
FCC-FAA seek compromise on towers, interference, 11/22:7
guest editorial on FAA-FCC spectrum allocation controversy, 6/28:5
Part 94 frequencies, 10/25:47
RSS calculations to include co- and adjacent channel interference, 8/9:22
single RSS that would take into account both co- and adjacent channel signals favored by Radio Advisory Committee, 11/8:3
station lottery plan opposed, 9/6:22

Sprague Electric
noise blankers, ULN-3845A, ULN-3846A, 1/15:32

Standard Broadcast Service
National Supervisory Network, 10/25:45
National Supervisory Network to monitor transmitters, 6/28:1

Station allocation. *See* Spectrum allocation

Station ownership. *See* Ownership

Stewart, Roy
new Mass Media Bureau Chief, 9/27:7

Structural Systems Technology (SST)
OSHA charges SST with safety violations regarding Colony MO antenna collapse, 1/15:1
OSHA drops citations against SST regarding Colony MO antenna collapse, 11/22:1

Studer Revox
acquires Dyaxis manufacturer Integrated Media Systems, 9/27:2
final negotiations to purchase Integrated Media Systems, 8/23:13

Studio-transmitter links (STLs)
editorial on SBE's request for type notification extension, 12/13:5
FCC STL deadline imminent, but broadcasters, manufacturers confused, 11/8:1
NAB convention offerings, 6/14:26
optimizing STL performance, 2/22:32
preamp alternative to a second STL site, 3/22:29
an RPU can back up your STL, 12/27:38
SBE asks FCC for type notification extension, 12/13:1
STL owners face upgrades, replacements, 12/13:18

Symetrix
501 Peak-RMS Compressor/Limiter, 8/23:18

Synthesizers. *See also* Musical Instrument Digital Interface
multitimbral synthesizer tips, 9/6:28
using samplers, 11/22:23

Systemation Corp.
Informer telephone system, 2/22:41

T

Talk radio
influence criticized, 7/26:17

Tape cartridges
NAB convention offerings, 6/14:24

Target Tuning
SCA receivers, 11/22:45

Tascam
CD-701, 12/27:47
DA-50 DAT recorder, 11/22:30
Model 238 Syncaset multitrack recorder, 7/26:51

Tax laws
taxes on station sales affected by change in tax laws, 1/15:2

Technics
SL-P1300 CD player, 12/27:45

Telcos
broadcasters seek phone alternatives, 10/25:38
equalization of telco remote lines, 2/22:16
examining T-1 phone circuits, 10/25:50
Integrated Services Digital Networks (ISDN) digital phone line under test, 8/9:20

Telos One
digital hybrid, 10/25:49

Test equipment
automation slow in test equipment, 1/15:35
a basic utility tone generator, 11/22:29
NAB convention offerings, 6/14:32
NAB convention preview, 4/12:N10
switch for recorder upkeep, 4/26:20

Towers
broadcasters fight new FAA tower rule, 10/25:1
collapse of WPAP-FM, Panama City FL, tower caused by air force jet crash, 6/14:3
FAA-FCC turf battle over spectrum allocation and tower placement, 6/28:1
FCC cracks down on tower light violations, fining KIQI-AM San Francisco CA, 8/23:9
FCC-FAA seek compromise on towers, interference, 11/22:7
FCC issues lighting reminder in wake of helicopter crash and near misses, 7/26:3
garbage truck knocks down WCEZ-FM, Columbia SC, tower, 2/8:3
guest editorial on FAA-FCC spectrum allocation controversy, 6/28:5
KGON-FM, Portland OR, readies new tower, 11/8:39
KLDD-AM antenna site includes bug blower, 7/12:29
KRLA-AM, Los Angeles CA, sits on landfill, 2/8:25
lighting and marking, 4/12:18
OSHA charges SST with safety violations regarding Colony MO antenna collapse, 1/15:1
OSHA drops citations against SST regarding Colony MO antenna collapse, 11/22:1
ranger falls from radio tower and survives, 5/24:1
WGMS-AM, Bethesda MD, tower knocked down by thunderstorm, 2/8:3
WWNZ-AM, Orlando FL, tower construction halted by injunction, 12/13:16

Transistors. *See* Active device course

Transmitters
FM solid state still on horizon, 11/22:43
guest editorial says solid state FM already a reality, 12/27:5
high voltage problems, 1/1:16
low power transmitters popular with AMs, 4/26:36
monitoring by satellite, 6/28:1
NAB convention offerings, 6/14:23
NAB convention preview, 4/12:N6
support tools and equipment to keep on hand, 11/8:46
treating cranky transmitters, 1/15:30
voltage switch idea, 1/15:17

TTC
AM 2500B transmitter, 4/26:4
FMS4000 transmitter, 11/22:4.

Turntables
on the decline, 3/22:33

U

Underground fuel tanks
EPA enacts new rules, 9/6:7

United Broadcast Co.
benefits from new duopoly rule, 1/1:3

United Class A Broadcasters Coalition
New Jersey Class A Broadcasters Association helps form broader coalition, 10/25:18

Universal Capacitor
EPA probes company for allegedly selling new PCB-filled capacitors without a permit, 3/8:1

UREI
809 Time Align monitor system, 3/22:35

V

Valley International
DDP-8 digital dynamics processor, 6/28:41

Varian Associates
Justice Department investigates possible antitrust violations in power grid tube industry, 10/11:1
US Navy lifts suspension of Continental Electronics Division imposed after Pentagon scandal allegations, 2/22:13

Venezuela
million-watt AM station would be most powerful in Western Hemisphere, 2/22:9

Verda
lightning deterrent system, 5/24:43

VOA. *See* Voice of America

Voice of America (VOA)
first phase of renovation complete, 1/1:13
Greenville NC relay station, 8/23:31, 11/22:21
Greenville NC relay station also serves training, education, and research purposes, 12/27:27
phase I complete, adjustments made for phase II, 8/9:15
reports of phase completion misleading, 2/8:1
visiting the Greenville NC transmitter sites, 9/27:41

Volts
value change in 1990, 1/15:9

W

West Germany
backpacking radio in Munich for WLUP, Chicago IL, 3/8:25
private radio takes Germany by storm, 4/26:15

Westwood One
Pirate Radio in Los Angeles may bring on loudness wars, 5/10:1
WNEW-AM New York to be shared with Metropolitan Broadcasting, 5/10:18

Wheatstone
A-20 console, 8/23:33
SDA-82B distribution amplifier, 7/26:41

Workstations
wish list, 11/8:37

World Radio History

AUTHOR INDEX

A

Ammons, William L.
Special Report
A Guide to NRSC-1 Conversion (part II), 7/26:46
Upgrading AM with NRSC-1 (part I), 6/28:44

Arsenault, Richard
Guest Editorial
FM Class A1 Architect Details His AM Concept, 5/24:5

B

Baker, Jeffrey
The Sliding Scale of Licensing, 2/8:29

Bartlett, Bruce
Adding Drums to a MIDI Studio, 8/9:26
Assembling Your MIDI Studio, 5/10:22
Getting Started Multitracking, 2/8:18
Making Music by Computer, 7/12:27
Mic Placement Fundamentals, 3/8:23
Musical Workstation Recording, 10/11:36
The Nitty Gritty of Instrument Miking, 4/12:19
Recording Tips for Multitimbral Synths, 9/6:28
Techniques for Stereo Miking, 11/8:33
Recording Basics for Engineers, 1/1:22

Beaulieu, Serge
Putting Radio Back on the Air in Haiti, 3/8:17

Beaulieu, Sondra Singer
Putting Radio Back on the Air in Haiti, 3/8:17

Beverage, Clarence M.
Special Report
Elevated Radials Pass Test, 5/24:38

Bissett, John
Special Report
Tips on Using Transfer Switches, 5/24:42

Blake, Ken
A Switch for Recorder Upkeep, 4/26:20

Brooks, Alan
Great Idea for a Voltage Switch, 1/15:17

C

Claterbaugh, Steven A.
Insight on AM
Stay Current, 4/26:42

Colligan, Frank
How to Set a Pass-Reject Trap, 4/12:27

Conn, Douglas
A Guide to Digital Cable Radio, 12/13:31

Crowley, Steve
FCC Plan May Help AM Coverage Area, 9/27:34, 10/25:32
Hot Spot Study May Prompt RF Reviews, 11/22:20
New Rules Aim to Help AMs, 6/28:19
Receiver-Induced Interference, 7/26:32
Repairing Ailing AM Sampling Systems, 8/23:22
Rules May Hurt Short Spacing, 5/24:18
Survival Manual for Class As, 12/27:30

Cummuta, John
Assessing Personality Profiles, 8/23:20
Basics of Database Marketing, 6/28:23
Collecting on Payment Owed, 7/26:21
Create a Productive Workplace, 2/22:22
Don't Be a Know-It-All Boss, 9/27:35
Good Marketing to the Letter, 5/24:13
Hiring You: What's In It For the Client?, 4/26:21
Rebounding from the Pink Slip, 1/15:19
See Your Way Clear to Success, 10/25:22
Selling Your Skills for a Profit, 3/22:26
Solve Problems by Networking, 12/27:32

D

Dalton, Terry
Singing the Bottom End Blues, 12/13:40

Darrig, Liz
Light at the End of AM's Tunnel, 10/11:19
Ten Stations Win Crystal Kudos, 10/11:32

Durso, Chris
PRC Highlights Digital Audio, 7/12:15

E

Elliott, Janet
What to Expect from Radio '89, 7/26:10

Ellis, Andrew
Interruptible Feedback Primer, 11/8:41

F

Finger, Robert A.
Guest Editorial
Users Can Help With AES Digital Interface, 7/26:5

Ford, Ty
1989 NAB Wrap-Up
Disc, DAT and D'Other, 6/14:8
Airforce Creates Music Beds, 6/28:33
Basics of Audio Equalization, 2/22:26
Delving In-Depth into R-DAT, 10/25:31
Last of a Dying Breed?, 5/24:17
Mental Disentrenchment, 3/22:25
Production Rat Discovers MIDI, 1/15:27
Road Testing the SV-3500 DAT, 12/27:24
A Road Test of the Tascam DA-50 DAT, 11/22:30
In Search of a More Thorough Education, 7/26:23
Seeking a Radio Curriculum, 9/27:28
Symetrix: Ear Candy and More, 8/23:18
Upgrading Production Values, 4/26:28

Foti, Frank
Processing in the Real World, 12/13:23

Frillman, Ronald C.
Insight on AM
AM Radio in an Era of Change, 4/26:42

G

Ganske, Dale
Guest Editorial
A Rock and a Hard Place, 6/28:5

Grace, David
Barriers to Quality, 4/26:42

Grosjean, Jon
The Secret of Noise Blanking, 1/15:32

H

Hadfield, Martin
Choosing an FM Booster Site, 10/11:42
Facts About Booster Synching, 9/27:26

Hallikainen, Harold
Annual "Proof" Requirements, 5/10:37
A Detailed Guide to NRSC-2 Compliance, 7/12:22
FCC Deluges Station with Stiff Penalties, 11/8:36
FCC Inspection by Moonlight, 12/13:24
Fined for Failure to Know FM Efficiency, 10/11:35
It Pays to Review the DCO Log, 9/6:34
Keeping A Non-Technical FCC File, 2/8:24
Leaving Paper Trails for the FCC, 1/1:21
A Review of Our Look at Rules, 3/8:21
Staying Free From FCC Fines, 4/12:18

Hebert, David
Becoming More of a "People" Person, 8/9:43
The Changing Face of Radio, 9/6:53
Getting Started in Consulting, 12/27:26
A Historical View of Licensing, 1/1:27
Life Support for Transmitters, 11/8:46
Optimizing STL Performance, 2/22:32
Springtime's Flights of Fancy, 3/22:28
Treating a Cranky Transmitter, 1/15:30

Hebert, Judith M.
My Life as a Contract Engineer's Wife, 11/22:27

Henderson, Don
Tech Tip
A Pressurized Line Saves Down-Time, 9/6:35

Hess, Philip
Great Idea
Home Brew Remote Control, 11/22:34

Higgs, Bill
Adding Mix-Minus to Consoles, 10/25:29
Analog Meters in a Digital Age, 1/15:15
A Basic Utility Tone Generator, 11/22:29
Chart for a Smart Cart Starter, 6/28:18
Creative Engineering Saves Time, Dollars, 2/22:18
Dealing with Hum in the Chain, 12/27:31
Designing a Demodulator, 4/26:27
Giving Old Consoles A New Lease on Life, 7/26:26
A Low-Cost Tunable Demodulator, 3/22:17
Revitalizing a Tired Console, 9/6:39
Reviving a Worn-Out Console, 9/27:24
Setting Up a Board For Special Effects, 5/24:16

Hunn, Peter
Corky Culver Swings on a Star, 8/9:37
Guest Editorial
FM Class "A1" May Help AM Daytimers, 3/22:5

J

Johnston, Steve
Utility Line Driver Amp Design, 5/24:20

K

Keirstead, Phillip O.
Computerizing Radio News, 9/6:51
RTNDA Brings Hope For Improved Gear, 11/8:35

Koury, Gigi
Tasting the Night Life in Vegas, 4/12:N12

L

Lambert, Mel
Advances in I/O Technologies, 12/13:27
A Bit of AES/EBU Interface Channel Status Data, 8/9:34
Catching Up on Digital Ideas, 10/11:37
DAT: After the Compromise, 9/6:29
DAT Breaks Timecode Barrier, 2/8:26
Defending DAT's Durability, 6/14:44
Making the Switch to Digital, 5/10:26
Resolution in Digital Recording, 1/1:26
Standards for Digital Interface, 3/8:30
Studying AES/EBU Interface, 7/12:23
A Tour Through Desktop Audio, 4/12:22
A Wish for Workstations, 11/8:37

Lane, Eric
Facts About Booster Synching, 9/27:26

Lewbel, Neil
Sprague Chip Targets Autos, 1/15:32

M

McCartney, Tim
The End of an SCA Tradition, 11/8:29
An RPU Can Back Up Your STL, 12/27:38

World Radio History

AUTHOR INDEX

McGinley, Thomas
Attention Focused on Dial-Up Remote, 10/11:27
A Clean Break From Processing, 1/1:25
FM Issues Under the Microscope, 10/11:25
1989 NAB Wrap-Up
Console Products Emphasize Variety, 6/14:7

McVicker, Dee
ABC Studios Take Fast Track (part II), 8/23:28
Alaska's Pipeline for News Gets a Facelift, 3/22:20
Fast Track Studios: Relocating WABC, WPLJ in the Big Apple (part I), 7/26:37
Jumping the Obstacles in WV, 11/22:31
KMNY's Studios Spell Money, 5/24:27
Moving Into Main Street Digs, 6/28:20
Networking Two New Studios, 1/15:21
Newcomers Shake Up Denver, 12/27:23
PC to CD: DAT's Programming!, 10/25:25
Renovating the Radio Ranch, 2/22:27
Top Ten Radio in a Small Town Market, 9/27:36
WXXK Gives Radio the Victorian Touch, 4/26:30
KGON Readies New Tower, 11/8:39
1989 NAB Wrap-Up
Solid State RF Products Proliferate, 6/14:23
Ambassadors of Shortwave, 8/9:44
Backpacking Radio in Munich, 3/8:25
Getting the Bugs Out of KLDD, 7/12:29
KBRD's Tale of Three Sisters, 4/12:21
KMOS Spoofs MTV's "Remote Control," 9/6:46
NAB Show: From the '20s to Today, 6/14:47
Radio on a Methane Gas Site, 2/8:21
Sightless CEs Share AM Vision, 5/10:23
Where Does Time Come From?, 12/13:33
Smoke Signals to Satellites, 10/11:46

Mishkind, Barry
The Best RPU Option May Be Wireless, 11/22:24
Get More Bang from Your Computer Buck, 12/27:33
How to Get More from RPUs, 10/25:21
Manual Muffs and Misprints, 9/6:31
Manuals: Good, Bad & Ugly, 2/22:19
Manuals: Things are Looking Up, 3/22:16
Maximizing Remote Quality, 9/27:39
Pitfalls in Owning a Piece of the Action, 7/26:18
Setting Standards for Quality, 1/15:23
Train Talent in Technical Topics, 4/26:27
Understanding the Other Side, 5/24:19
Engineers Discuss Interference, 10/11:26
How to Improve Your Communications Skills, 10/25:26
NAB Spotlights PCs in Radio, 10/25:26
New Ideas in AM Engineering, 10/11:29
1989 NAB Wrap-Up
Weapons Added to Arsenals of Processing, 6/14:36
Prospects for License Reform, 10/11:28
Radio Promo Gains Momentum, 10/11:34
SRO for FM Processing Session, 11/8:19

Montgomery, Ed
Analyzing Transistor Design (part V), 6/14:42
An Examination of Field Effect Devices (part VII), 7/12:30
An Integrated Circuit Primer (part XI), 9/6:36
Diode Use in Power Supplies (part IV), 5/24:22
How Semiconductors Are Made (part II), 4/26:22
Solid State Diode Operation (part III), 5/10:20
From Square One to Solid State (part I), 4/12:25
Transistor Circuit Connection (part IX), 8/9:24
Transistors in Typical Usage (part VIII), 7/26:28
Understanding Transistor Specs (part VI), 6/28:24
Using Transistors in Voltage Regulation (part X), 8/23:26
The Venerable Vacuum Tube (Part XII), 9/27:32

Montoya, Paul
Guest Editorial
Montoya Speaks for Stronger SBE Future, 8/23:5

Morgan, Charles T.
Guest Editorial
Praise for Ongoing Efforts of the NRSC, 12/27:5

Morgan, Chip
Guest Editorial
Digital Modulation Over the TV Band?, 4/12:5

Morrill, Geary
1989 NAB Wrap-Up
Advances Made in STL, RPU Gear, 6/14:26

N

Newman, H. Robert
Shedding Light on Shortwave, 10/11:33

O

Ogonowski, Greg J.
Guest Editorial
Modulation Debate, 9/27:5

Orban, Robert
Guest Editorial
Modulation Debate, 9/27:5
Guest Overview
Processing for Better or Worse, 6/28:40

Orr, Robert
Guest Editorial
Attracting New Blood to Radio, 2/22:5

Osenkowsky, Tom
A Generator Model Can Save You Time, 3/8:33
Phase, Matching and Other System Tuning, 1/15:22
State Licensing Elicits Debate, 11/8:21

P

Peterson, Alan
Guest Editorial
Encourage Creative Production "Rats", 3/8:5
From the Trenches, 7/26:8, 8/23:14
Another Fine Mess, 10/25:10
Hey, It's "Only" AM, 12/27:6
Sample One For Me, 11/22:23
Taming of the Shrew, 9/27:14

R

Rabinowitz, Harold
Guest Editorial
Solid State for FM is Already Reality, 12/27:5

Ramsey, Phillip
Modulation Muting Relays, 3/22:29

Rebmann, Paul
Injunction Stymies Florida AM, 12/13:16

Riggins, George
1989 NAB Wrap-Up
Familiar Faces Grace the Tape, Cartridge Arenas, 6/14:24
Old Timer
AM Stereo and Historic Calls, 4/12:29
Classic Calls and the Legend of Brinkley, 7/12:26
Dr. Brinkley's Story, 8/9:32
A Letter to Radio Management, 12/13:43
Memories of Towers and Service Areas, 10/11:41
Midwest Call Signs and Border Radio, 5/10:27
Processing, Formats, and Early-Day Calls, 1/1:18
Radio at the Old Alma Mater, 11/8:26
The Real Story on WLW's Long History, 3/8:26
Uncovering Radio's Call Sign Histories, 2/8:27
Wisconsin Willey & Rex of the Rockies, 9/6:42
Stalking the AM Stereo Car Radio, 9/6:43

Roycroft, Allan
Deflating an Overblown Ego, 11/8:28

S

Salek, Stan
What to Expect from Radio '89, 7/26:10

Scott, Chris
A New Look at the Ufer Ground System, 12/13:32

Shepler, John
Achieve Loudness with Quality, 11/8:25
AM Stereo Phasing Problems, 10/11:44
Digital Technology Comes of Age, 2/8:23
Double-Checking Connections, 7/12:20
Make Something From Nothing, 3/8:20
A Poor Man's Distribution Amp, 5/10:19
A Quick and Easy Studio Phone, 9/6:40
Spring Tonic for Tired Stations, 4/12:17
Tracking High Voltage Safety, 1/1:16
Why Some Circuit Boards Die, 8/9:30

Small, Eric
Guest Editorial
Modulation Debate, 9/27:5
Special Report
More Loudness—Less Processing, 6/28:42

Sorensen, James
Guest Editorial
Let's Get to the Truth in Audio Processing, 10/25:5

Springer, Chuck
Computer-Based Automation Memory, 7/26:24

Starling, Mike
1989 NAB Wrap-Up
Test Sets See Product Introductions, 6/14:32

T

Tyson, Laura
A Guide to Extra CD Mileage, 5/10:29

V

Vernon, Thomas
Hypermedia, 3/22:30
Paying a Visit to the VOA's Greenville Transmitter Sites, 9/27:41
Returning to VOA Greenville, 11/22:21
Digital Thermometer Design, 7/26:18
Equalizing Telco Remote Lines, 2/22:16
Hard Disk Editing On a Tight Budget, 4/26:24
Hypermedia for Broadcasters, 3/22:19
Odds and Ends in Engineering, 1/15:20
Putting Your PC to Work at the Station, 6/28:36
Reading a Topographic Map, 5/24:15
Touring VOA's Relay Station, 8/23:31
VOA Greenville: Beyond Relay, 12/27:27

W

Wachter, Gary
AM Antenna Monitor Interface, 2/22:20

Weirather, Robert R.
Insight on AM
AM Radio in an Era of Change, 4/26:42

Williams, Trenton
An NAB View, 4/12:N14

Womack, Buddy
Riding Out Hugo's Onslaught, 11/8:24

Woodruff, Sandra
Preamp Alternative to a Second STL Site, 3/22:29

World Radio History

BUYERS GUIDE INDEX

A

Absolute Broadcast Automation
Satellite System 100, User Report, 2/22:44

Aphex
Aural Exciter Type III, User Report, 6/28:47

ATI
DA10,000 distribution amplifier, User Report, 7/26:45

Audi-Cord
cart machine, User Report, 12/27:48

Audiometrics
AMCDS 1000A CD player, User Report, 2/22:43

Auditronics
400 Series console, User Report, 8/23:33

Autogram
Pacemaker console, User Report, 8/23:43

B

BAI
Live Assistant live assist control unit, User Report, 7/26:53

Beyer Dynamics
microphones, Technology Update, 3/22:40

Broadcast Audio
Series VI console, User Report, 8/23:42

Broadcast Electronics, Inc.
Dura Trak 90 cart machine, User Report, 12/27:39
FX-50 exciter, User Report, 11/22:38
Mix Trak 90 console, User Report, 8/23:39
MVDS remote control, Technology Update, 1/15:46
SAT 16 automation system, User Report, 2/22:44

C

Central Tower
1000' antenna tower, User Report, 5/24:40

Comrex
STLX console, User Report, 10/25:40

Concept Productions
CAPS I Automation System, User Report, 2/22:35

Continental
813A transmitter, User Report, 11/22:37
317C-2 solid state RF driver, User Report, 4/26:40

CTE
transmitters, Technology Update, 11/22:50

Cutting Edge Technologies
Vigilante FM multiband limiter, User Report, 6/28:43

D

Delta
ASE/ASM exciter/monitor, User Report, 4/26:45
SM-1 splatter monitor, User Report, 1/15:38

Denon
DN 950FA CD player, User Report, 12/27:49

Dolby
SR processing system, User Report, 12/27:48

Dorrough
610A discriminate audio processor, User Report, 6/28:50

E

ERI
panel and helix antennas, User Report, 5/24:33

F

Fidelipac
Dynamax CTR100 cart machine, User Report, 12/27:43

Fostex
6301 studio monitor, User Report, 3/22:34

G

Gentner
digital hybrid, User Report, 10/25:39
EFT-3000 digital frequency extender, User Report, 10/25:42
Phoenix audio processor, User Report, 6/28:39
VRC-2000 remote control, User Report, 10/25:52

H

Harris Corp.
DX-50 solid state AM transmitter, User Report, 4/26:35
HT series transmitters, User Report, 11/22:40
XD-001 DAT Deck, User Report, 9/27:43

Henry Engineering
Fast Trac Dubbing System, Technology Update, 9/27:48
MixMinus Plus, User Report, 10/25:41
Utility Summing and Distribution Amplifier (USDA), Technology Update, 7/26:52

Holaday Industries
HI-3002 broadband field strength meter, User Report, 1/15:39

Howe Technologies
HoweTech Series 10K console, Technology Update, 8/23:41

I

IGM
SC automation system, User Report, 2/22:36

Innovative Automation
Micro Di-Trol automation system, Technology Update, 2/22:36

International Tapetronics Corporation (ITC)
Audio Switcher, User Report, 7/26:41

INTRAPLEX, Inc.
T-1 phone circuits, Special Report, 10/25:50

J

JBL
4406 studio monitor, User Report, 3/22:34

K

Klark Teknik
DN-500 dual compressor/limiter/expander/clipper, User Report, 7/26:43

L

LPB
Citation II console, Technology Update, 8/23:45
Signature console, User Report, 8/23:40
100 W low power transmitter, User Report, 4/26:36

M

Mark Antennas
P-9A96G-1 antenna, User Report, 5/24:36

Marti Electronics
audio companding system, User Report, 7/26:52
Part 94 band, Special Report, 10/25:47

McMartin
FM modulation monitors, User Report, 1/15:40

Modulation Sciences, Inc.
ModMinder, Special Report, 6/28:42

Motorola
1400 AM stereo exciter, User Report, 4/26:41

Mountain America Satellite Radio
Auto-Jock automation unit, User Report, 2/22:45

Murphy Studio Furniture
Elite Series Studio Furniture, Special Report, 12/27:46

N

National Association of Broadcasters (NAB)
test tone CD, User Report, 1/15:37

Nautel
ND10 solid state AM transmitter, User Report, 4/26:38

Neumann
SM69 stereo microphone, User Report, 3/22:41

O

Omnitronix
OMNI-1000 solid state AM transmitter, Technology Update, 4/26:37

Onkyo
T-9090 II tuner, User Report, 1/15:40

Orban
ACC-22 FM filter card for Optimod 8100A audio processor, User Report, 6/28:51
787A programmable mic processor, User Report, 3/22:36
Optimod-AM audio processor, User Report, 4/26:45

Otari
MX-50 reel-to-reel recorder, User Report, 9/27:43

P

Pacific Recorders & Engineering
Radiomixer, Technology Update, 8/23:38
SDA8-A stereo distribution amplifier, User Report, 3/22:33

Panasonic
DAT editing controller, Technology Update, 9/27:54
SV 3500 DAT deck interface unit, Technology Update, 9/27:54

Q

QEI
FMQ 20000B transmitter, User Report, 11/22:44
Model 400 Digital T-1 STL, User Report, 10/25:37

R

Radio Design Labs
ACM-1 AM noise monitor, User Report, 1/15:42

Radio Systems, Inc.
RS-1000 DAT automation system, Technology Update, 2/22:37
RS-DAT controller, User Report, 9/27:46
RS Series consoles, User Report, 8/23:44

RAM/McCurdy
SX Series console, User Report, 8/23:41

Revox
C278 reel-to-reel recorder, User Report, 9/27:44

S

Shiveley Labs
Model 6810 eight-bay antenna, User Report, 5/24:35

Shure Brothers
Beta 58 microphone, Technology Update, 3/22:39
SmartAMP amplifier, User Report, 10/25:44

Sine Systems
News Director workstation, User Report, 7/26:55

Somich Engineering
DBE-1000 Dynamic Baseband Enhancer, User Report, 6/28:53

Sony
D-10 DAT deck, User Report, 9/27:51
PCM 2500 DAT deck, User Report, 9/27:53

Sound Technology
3000B automated test system, User Report, 1/15:35

Standard Broadcast Services
National Supervisory Network, Technology Update, 10/25:45

Systemation Corp.
Informer telephone system, User Report, 2/22:41

T

Target Tuning
SCA receivers, Technology Update, 11/22:45

Tascam
CD-701, Technology Update, 12/27:47
Model 238 Syncaset multitrack recorder, User Report, 7/26:51

Technics
SL-P1300 CD player, User Report, 12/27:45

Telos One
digital hybrid, User Report, 10/25:49

TTC
AM 2500B transmitter, User Report, 4/26:45
FMS4000 transmitter, User Report, 11/22:49

U

UREI
809 Time Align monitor system, User Report, 3/22:35

V

Valley International
DDP-8 digital dynamics processor, User Report, 6/28:41

Verda
lightning deterrent, User Report, 5/24:43

W

Wheatstone
A-20 console, User Report, 8/23:33
SDA-82B distribution amplifier, User Report, 7/26:41

World Radio History

BUYERS GUIDE

The following section represents reprints of selected articles, paid for by these companies:

3M	126—127
Absolute Broadcast Automation	127
Audio-Technica	128
Canare Cable, Inc.	129
Central Tower, Inc.	130
Circuit Research Labs, Inc.	131—132
Comrex Corporation	134—135
Delta Electronics, Inc.	136—140
Dorrough Electronics	141
Fidelipac Corporation	142
Gentner Electronics Corporation	143
Harris Corporation	144
Harrison (now GLW Enterprises)	145
Henry Engineering	146
International Broadcast Support Services	146
Inovonics, Inc.	147
LPB, Inc.	148—149
Murphy Studio Furniture	150
Orban Associates (division of AKG)	151—154
Otari Corporation	154
Potomac Instruments	155—156
QEI Corporation	157
Mark Antennas	158
Telos Systems	159
Verda	160
Wheatstone Corporation	161

Companies appear in alphabetical order.

World Radio History

ITC Assembles ScotchCart II

by Bill Parfitt
Bcst Prod. Supervisor, ITC/3M

Hutchinson MN Trying to match cart capabilities with FM fidelity became a great concern during the 1970s.

In a complete analysis of cartridge mechanical and electromagnetic functions equated to professional broadcast needs, 3M formed a completely new cartridge concept when it introduced its initial ScotchCart™ cartridge nationally in 1982.

TECHNOLOGY UPDATE

While compatible with all NAB standard cart players, its mechanical design was far beyond conventional. It featured a large-diametered stationary hub that was slotted to allow the tape to be pulled on a straight line out of the center.

A spring-loaded tape tension arm replaced the need for pressure pads and provided automatic tension control for all tape lengths.

Then, in 1985, 3M introduced a new product, the ScotchCart II™ broadcast cartridge, which offered even greater improvements in both tape performance and physical operation.

The most dramatic improvement noticeable with the ScotchCart II cartridge is its new Scotch™ 219 lubricated tape construction, visible as "black" rather than "brown" in color.

As with the cart's mechanics, the tape is designed to NAB specifications for complete broadcast compatibility, while also providing greater sensitivity and output, with a wide 62 dB S/N ratio that is of real value in achieving the performance levels of FM transmission.

Precision process

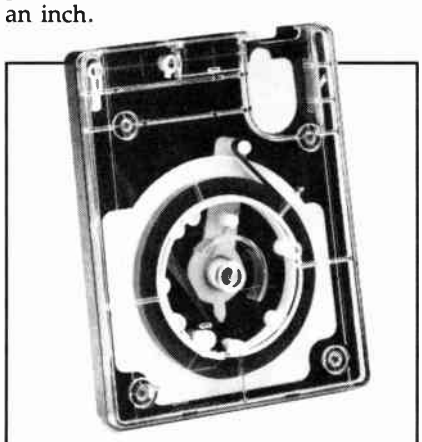
Watching the process of making high performance cart tape is an experience in high tech, precision manufacturing. The tape is produced in 3M's Hutchinson, MN magnetic tape plant, a hospital-clean, 370,000-square-foot facility for compounding, coating, slitting and assembly operations devoted exclusively to magnetic tape.

The company designs, tools and molds its own plastic components in order to maintain the same quality and supply assurance that it does for tape.

The tape manufacturing starts with dispersion compounding, where electromagnetically tailored, low noise oxide particles (individual magnetic needles so tiny that some 30,000 could fit inside the period that ends this sentence) are combined with the binder formulation.

The binders, matched to backing characteristics, are compounded with permanent lubricants to create a uniform liquid dispersion in which the billions of oxide particles are evenly suspended.

The 3M backing film, customized to the specific thickness for cart tape, is tough and tempered polyester that is produced in wide, splice-free jumbo rolls some three miles in length. The binder/oxide dispersion is applied in a precise layer calibrated to millionths of an inch.



ITC's Scotchcart II

The match of perfectly flat film and exact coating thickness is important. It prevents coating depth variations that would produce distortions in recorded signal response.

These are so carefully controlled that if a single tape strand was magnified to a mile width its surface level would vary hardly more than half an inch.

Coating and drying

The coated tape continues directly through huge drying ovens where the solvents are evaporated and captured for re-processing and the coating is cured. This coating and drying process, computer controlled to microscopic tolerances, is accomplished as the full-width film web travels at hundreds of feet per minute.

The finished tape jumbos are moved to slitting stations, where each roll is cut into quarter-inch strands. Here, 3M incorporates a sophisticated, laser-scanning, 100% surface inspection of every square inch of the tape that will pinpoint for rejection even minute specks or flaws too tiny for the human eye to detect.

This inspection assures the end user of a smoother, more uniform and defect-free tape. Precision mated rotary knives slice the tape to width, shearing the tape cleanly without edge distortion. This is another critical operation, because it is essential to have a truly straight-line tape for cartridge use.

A strand of Scotch 219 tape for the ScotchCart II cartridge, for example, is slit to a centerline tolerance of less than the thickness of a human hair in a mile length.

Tape installed

In modern, closely monitored assembly, tape in a specific metered length (10 seconds to 7.5 minutes) is put into the cartridge. Its operation is checked and the cartridge is completed for packaging.

During all the process steps from raw materials to completed ScotchCart II cartridge, in-plant quality assurance labs are checking the product constantly.

From wet-lab analysis of oxides and dispersion, to in-process coated tape testing with elaborate infrared spectrometry and X-ray fluoresence analysis, and actual recording performance of finished product, quality verification is maintained.

3M innovation has required a huge investment and dedication of its full resources to effect an advancement of cart technology. Other developing technologies may offer varying degrees of promise, but our cartridge technology is already delivering new generation performance.

■ ■ ■

Editor's note: For more information on ITC/3M tape products, contact the author at 612-736-5019, or circle Reader Service 73.

—Reprinted from **Radio World** *December 15, 1988.*

World Radio History

The Switch is On at FRN, with ITC Rout

by Brian Williston, CE
Florida Radio Network, Inc.

Orlando FL The Florida Radio Network recently decided it was time to plan a means of automation that would handle the complex problem of switching audio from the multitude of possible sources to each of our four modulators.

Internal audio distribution was desired as well. The system would have to be able to handle the large amount of audible traffic entering and leaving the building.

International Tapetronics Corporation (ITC) introduced us to its latest pet project, The Audio Switcher (A modest name, once you know what this computerized masterpiece can accomplish).

The Audio Switcher takes up only 28" of rack space, which includes the master control unit (this is where the programming is input and the metering is done) and two I/O modules (each is capable of providing 64 input or output terminations, made via screw terminals located on the rear panel).

TECHNOLOGY UPDATE

A matrix module (which is a real gem; this unit electronically connects inputs to outputs through the use of a revolutionary thick-film hybrid IC) and a machine control module are also available.

The machine control module can provide a variety of control options, such as momentary contact closures, latching contact closures and TTL logic control. A single module can accommodate up to 16 devices. A memory cartridge is provided to back up the memory periodically or as needed.

Our configuration is a 64 mono input x 32 mono output, fully programmed and automated audio switch. The setup was quite simple. We connected 64 audio sources to the 64 input terminals and connected the 32 output terminals to 32 audio inputs of various equipment including all four of our modulators, input channels in each studio and automated reel-to-reel recorders.

The next step was to assign a name to each input and output. That done, switches could now be made manually, using the master control unit. The remote controls were installed in each studio and in the engineering shop.

The remote controls are programmed separately to send any audio source to any of four locations. Each remote control unit (desktop version) has an LCD screen that allows the operator to view the names of the inputs he or she is selecting before that selection is made.

Once the selection has been made, the screen displays all four of the inputs that are connected to the four corresponding outputs. An included printer will then print a statement recording the event that just took place, including the time of day, what connection was made and what remote or "salvo" invoked it.

But you probably want to know more about salvos.

The Audio Switcher is programmable, with up to 99 separate programs, or "salvos." Each salvo can switch up to seven sources (more if you do not use all seven in each one) at one time and perform machine control if desired.

The use of salvos plays a key role in our daily network operation. We use them to automate our news channel almost exclusively. The switcher is programmed for every hour of the day. We even have some salvos programmed to switch several sources simultaneously, as in the example of our weekend talk programs.

Our telephone system is shared ... more than one studio. Therefore, at the beginning of a scheduled talk show from studio C, the output of studio C is matrixed to the MOH input of the telephone system.

Also, the mix-minus output from studio C is matrixed to the mix minus input of the telephone system. The caller audio is switched to a channel on the console in studio C and studio C is placed "on the air."

In retrospect, I do not see how we could have accomplished nearly as much as we did in the way of clean, crisp delivery of our product without this equipment.

We have received a level of technical support unequalled in the industry. I cannot think of enough good things to say about my experience with the ITC/3M switcher. There are always criticisms to make, but in this case it would be pointless, given the results that ITC/3M has demonstrated.

■ ■ ■

Editor's note: In addition to his radio work, Brian Williston enjoys boating, water skiing, and film production and editing. He may be reached at: 407-859-1100.

For more information on the ITC/3M Audio Switcher, contact Bill Parfitt at: 612-736-5019, or circle Reader Service 84.

—*Reprinted from* **Radio World** *July 26, 1989.*

System 100 "Localizes" Sound

by Peter E. Clark, GM
WLQM AM-FM

Franklin VA I recently applied for and was granted a new FM radio station to serve the community of Franklin. My biggest concern after obtaining the frequency was the overhead required to operate the FM during its early stages when there was little new income and a large debt to service.

Since we are only 45 miles from the Norfolk market and face competition from the large city stations for listeners, we felt that satellite programming, along with local news and programming, would give us a competitive edge.

Our decision to use satellite programming put us in the market for some kind of automation that would play our commercials and air the network.

We looked at many different systems and finally decided on Absolute Broadcast Automation's Satellite System 100, based on analog cassette technology.

We purchased the basic system including six cassette decks for playback and ➤

World Radio History

: for recording, and bought an addi-onal deck for music fill and as a spare.

We also bought the optional complete business system package, which permitted us to maintain all of the station business and scheduling of commercials from the same computer, using the same integrated software.

It took a week to install the system and get it running. There were no problems with the initial operation because the system had been "burned-in" during operations at the NAB's Radio '88 exhibit.

USER REPORT

The system is powerful, with many features not found in other systems. Its operation includes two main areas: input of commercials into the computer traffic and scheduling system, and recording of the commercials onto cassette tapes for airing by the system.

The commercials are entered in a manner similar to other computer traffic systems, the only difference being the addition of a location code which identifies the location of the commercial in the automation system.

This location code is found automatically by "asking" the automation computer where the commercial should be recorded. The automation computer will then reserve space for the commercial and generate a location code to be used by the scheduling software.

After the orders are entered, the operator runs the next day's schedule. This is easily done by pressing one key on the computer—the software then prepares the next day's schedule.

After the next day's schedule is completed, all commercials are scheduled. Commercial clusters are filled or ignored if no spots are indicated.

The schedule is simply copied to the automation system computer by carrying the schedule diskette over to the automation computer for automatic copying to the system. The next day's schedule is then ready to go, the entire operation taking about 30 minutes.

Commercials are usually recorded (first generation) on reel-to-reel tape. To record the spot to the system, the operator need only input the location code of the commercial and instruct the system to prepare for recording the commercial assigned to that location code.

The computer, which is controlling what is on the air, is instructed to cue up the location on the correct tape for recording. The computer instructs the operator to put the spot tape in the record deck and the correct location is then cued.

The actual recording is handled by the System 100 production processor, which features one-touch recording of commercials and music.

For example, to record a spot to a location already prepared for recording by the computer-assisted recording system, the operator cues up the original recording on the reel-to-reel and activates the source start switch (found on the production processor) for the reel-to-reel tape machine. The next step is to check the levels and press the production processor start button.

The processor starts the record deck, places the cue tone on the cassette tape and automatically starts the reel-to-reel source to transfer the recording to cassette tape.

At the end of the recording, the operator presses the stop button on the production processor and the operation is completed. The system then asks if there are more spots to be recorded to this tape and the process can begin again.

I highly recommend this system to any satellite user. I would also recommend that you make heavy use of the localized satellite liners if you decide to use this system. The System 100 does an excellent job of handling these liners and sure gives you a local sound.

The price of this computer system was very low, and its reliability has been top notch. The people at Absolute Broadcast Automation have been great to work with and gave us 90 days of free phone consultation, in case we had any questions. And we did have quite a few.

I would say, however, that the biggest endorsement of this new system comes from our advertisers.

Our business has more than doubled in just three months and for the first time in many years we are getting repeat advertising buys and a lot more satisfied customers. The system will save you money and give you a competitive sound at the same time.

■ ■ ■

Peter E. Clark is the owner of WLQM-AM/FM. He may be reached at: 804-562-3135.

For more information on Absolute Broadcast Automation's Satellite System 100, contact Jack Mullen at: 301-786-4661, or circle Reader Service 71.

—Reprinted from **Radio World** *February 22, 1989.*

AT836 Mic Comes Out on Top

by Rod Rogers, CE
KSKG-FM

Salina KS After upgrading our air chain three years ago the need for a change in studio microphones became obvious. In the search for replacements, I discovered the Audio-Technica AT836. Little did I know about the popularity it was soon to enjoy!

I considered the "standard" mics for this application, but was tired of the proverbial "Music/Voice" switches, broken plastic parts and having mics that, while excellent for other applications, were never intended for close-up work.

I also had the handicap of a small market budget.

Due to the standardization problems with mic specs, I decided to evaluate strictly by ear to see for myself what sounded good.

Our local distributer loaned me several armfuls of mics for evaluation, including some of the "standards." I went into the production room with my private stock of tape and compared mics for several hours.

In test after test, the Audio-Technica AT836 kept coming out on top. It had an open, natural sound and didn't get too muddy when worked close or off axis.

USER REPORT

It sounded best from about 5" back, on axis, but it never sounded bad no matter how I worked it. I was a little reluctant to believe that this very economical mic was winning!

Then I realized that there were no "Puberty Switches" on it (M/V), no plastic to break, and it had good internal suspension for hand-held use.

It wasn't a condenser model, so I avoided the powering hassles. And it had a price tag of around $130!

The PD and several jocks agreed that ➤

World Radio History

it was the best sounding mic.

I sold both of our $400 "standards" on the used market, bought three AT836s, and netted a profit! Needless to say, the GM was also pleased with this new mic.

Being a contract engineer for several other stations, I had them compare the AT836 against their mics. I never got one back!

The AT836 is a simple, cardioid dynamic mic. Output is 250 ohms, balanced, and contains no transformer. It has a very rugged metal housing and the metal screen is not easily bashed in.

I think the secret of this mic is its slight low-end rolloff and very gentle proximity effect. It keeps low frequency noise under control, but has a clean, flat sound when used close up.

The drawbacks of the AT836 are mainly psychological. If you like a large, fat mic, a nerf ball for a wind sock, or a lot of switches to play with, keep looking.

If, however, you want a very clean, natural sound at less then half the price, I seriously recommend the AT836.

There are better mics in the world, and you can spend a fortune if your budget allows. But for the majority of us, especially in smaller markets, good sound and good value are still big priorities.

■ ■ ■

For more information on the AT836, contact Greg Silsby at Audio-Technica: 216-686-2600, or circle Reader Service 92. The author may be reached at 913-825-4631.

—Reprinted from **Radio World** *March 15, 1988.*

Star Quad Cable Remedies Noise

by Barry Brenner, GM
Canare Cable, Inc.

Burbank CA . . . If you are in the process of specifying or installing new equipment or upgrading an existing studio, take a moment to consider an important, often overlooked link in your audio chain—cable.

Not all cable is created equal. Careful research and investigation will help you select the right cable for your installation.

TECHNOLOGY UPDATE

One of the most important features to look for in any audio cable is its ability to reject noise (EMI and electrostatic).

Let's assume that there is noticeable and annoying hum, buzz or RF garbage creeping into your mic lines. Unfortunately, it is clearly audible throughout your entire facility.

You've ruled out ground loops as the cause because all of your equipment was installed with a unified and well thought out grounding scheme.

The noise problem may be emanating from your transmitter, power lines, lighting dimmers, transformers or any number of things.

Canare offers a remedy to the problem, a microphone cable called Star Quad that can greatly reduce this type of induced noise.

Microphone cables typically carry 600Ω line level signals at +4 dB to +24 dB (1.23 V to 12.3 V). But when they are used to interface mics to mixers or preamps, the signal levels may be very low, on the order of −70 dB to −120 dB (0.3 mV to 1 μV).

Because such signals are subject to a large increase in level due to the high gain of microphone preamplifiers and subsequent amplifier stages, even the smallest noise signals entering the mic cable can become a significant factor.

Noise can "invade" the cable from external sources, by means of electrostatic coupling or electromagnetic induction (EMI)—sources that most engineers are well aware of.

The longer the cable, the greater its susceptibility to potential sources of noise. With runs of 100 m (328') or more, mic cable quality is critical.

Magnetic fields are radiated from power cables, motors and power transformers.

Often power line frequencies can become contaminated by a rich harmonic spectrum which is generated by saturated transformers, the reactive ballasts of fluorescent lights and most drastically, by the clipped waveforms emitted by SCR (Silicon Controlled Rectifier) dimmers.

The magnetic fields radiated by these sources cut across the conductors of a mic cable and induce a voltage that is heard as hum (or buzz at higher frequencies). The higher the frequency, the greater the induced voltage.

Twisting the inner conductors of a cable minimizes susceptibility to this electromagnetically induced noise.

Canare Star Quad mic cable obtains its name from a four-conductor, overall shielded style of construction. The main benefit of four-conductors (versus the common two-conductors found on ordinary mic cable) is to minimize the "loop area" between twists of the conductors.

This in turn reduces susceptibility to electromagnetically induced noise. The worst offender, SCR dimmer noise, is reduced to less than 1/10th the level found in good two-conductor cables.

Electrostatic hum may be present when the power line and mic cable act as two plates of a capacitor, causing the AC voltage to be electrostaticallly coupled into the cable.

This capacitive reactance more readily admits high frequencies, and the higher the impedance of the mic circuit, the greater the induced noise voltage.

A grounded, electrically conductive screen (shield) around the cable offers a low-resistance path to ground and can thus shunt the electrostatic hum.

However, the effectiveness depends upon the percent of coverage afforded by the shield.

Canare Star Quad mic cables are available in two different application (shield) types: Model L-4E6AT and Model L-4E6S.

Model L-4E6AT features a fully wrapped, aluminum tape shield with drain wire for 100% coverage. The outside jacket employs a tough PVC compound to resist tears and stretching.

Inside the quad bundle is KEVLAR 29, a fiber filler that is also used in bulletproof vests and jetfighter aircraft wing skins. The result is a pulling strength of more than 121 lbs.

This model is recommended for fixed installations and when pulling through conduit.

Model L-4E6S is used in places where flexibility, appearance and noise rejection is a consideration. A flexibile PVC jacket surrounds the quad conductors, overall braided shield and cotton pack fillers.

Canare does not use spiral or serve

➤

World Radio History

wrap shield because these can open up with use and degrade cable performance. Our high density braided shield offers good flexibility and excellent (96%) coverage.

In some wiring situations, using a multichannel audio snake in place of individual harness bundles can reduce labor time and material costs. Star Quad is available in a multichannel version. Both foil and braided shield styles can be ordered in 2- to 24-channel configurations.

■ ■ ■

Editor's note: For more information, contact the author at Canare, 818-840-0993, or circle Reader Service 77.

—*Reprinted from* **Radio World** *May 15, 1988.*

WKDQ Opts for Central Tower

by Shelby Wilkinson, CE
WKDQ-FM

Henderson KY Bristol Broadcasting was granted a CP for a 944' tower in early 1988. We had to find a tower and a crew for the job. Most importantly, we had to figure out ahead of time what problems we might encounter with a tall tower. Our land's terrain was rough and wooded.

Central Tower, located in Newburgh, IN, was fairly new to the tower building business, but looked like the perfect choice. We turned over a major part of the job to them and they went with it!

USER REPORT

The actual tower base was to be constructed approximately 1000' back from a main road, so clearing the land and building an access road were top priorities.

We also visited local TV stations with 1000' towers to find out about ice and wind, etc., and got a good look at their installations. That is when we discovered that this was not going to be easy.

Fortunately, Central Tower kept us up to date on all progress, supplied all the information we needed and answered any questions we had.

The building begins

Once the road was built, the tower sections started to arrive. Rigging rolled into position, the base was begun, and we were on our way, the actual construction beginning in early July.

The base was set and cured, and the first section went into place. It was only a 4' section, but the engineering was excellent, and the section was mounted on a special rocker plate to provide a pure pivot connection to the base.

On the taper, Central Tower used heavy channel to provide sheer plate resistance. The bracing was so close together that it provided a virtually solid taper section.

The anchor points were a problem since most of them were on the sides of small hills. And since all vegetation had been cleared, erosion was also a big concern. Central Tower used flexible rods, which were designed well in excess of load requirements.

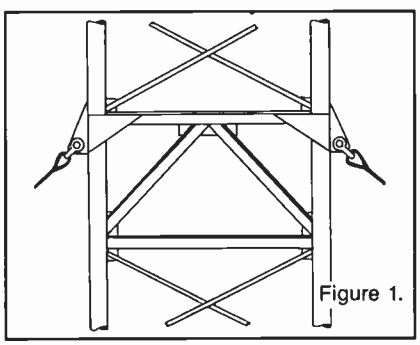


Figure 1.

These flexible rods also dampen cable vibrations. They are hot dipped, galvanized and coated with Bitumen for corrosion protection. We had to bury and mound the points until we could grow grass and protect them from erosion. We used strategically placed hay and straw bales to stop seed and earth from washing away.

As the tower went up, I noticed another curious point on some sections. Central Tower had designed into their sections extra bracing at the guy pull-offs. Upon investigation, I found what they call "double angle constructed K bracing" at all guy pull-offs.

This type of bracing strengthens the sections and also distributes dynamic loading at the cable connections. I believe this is an exclusive of Central Tower's weld-together construction, and, in my opinion, adds extra strength to the sections where it is really going to count: at the guy pull-offs. It results in a stronger overall tower.

At this point, we had to look at grounding for the tower. I decided I would go with what I call a "star ground system." It consists of eight 8' ground rods placed in a star shape, all tied together with 4" copper strap and buried one foot deep.

This 4" strap was welded to the tower taper section and further on into the building for transmitter grounding. The guy wires at the anchor points were also grounded by copper wire to an 8' ground rod ahead of the guy dampeners.

Alternate lighting devised

The tower began to reach high above the trees and temporary lighting became a concern. Having no AC on-site yet, I came up with a 12 V strobe with one-million candle power and a deep-cycle marine battery to raise up on the headache ball at the end of the day.

Later, after lighting was installed, we had to rent a 6 kW generator to run the lights until AC became available. We used a farmer's fuel tank to run the generator and only had to fill it up once. We got our 3-phase power five days later and the lighting was temporarily wired to the controller and tower lights.

Now we ran into our first big problem. The lighting system was drawing too much current, causing the controller relay contacts to burn and when it came time for the relay to drop out, it was stuck on. We also found that when it rained, the fuse for the top set of side markers would blow when the lights came on.

If I replaced the fuse while the lights were on, they would work until the next time the controller kicked on. Resistance measurements showed that all of the side marker sets looked the same. We knew then that it had to be moisture.

Solving a moisture problem

No water was found inside the conduit or light sockets, so we rewired the ➤

World Radio History

top side markers and that took care of our problem. I did find some water at the lowest junction box, but some extra waterproofing fixed that also.

Next came the antennas. We purchased an ERI 6-bay antenna for the main and a super power single-bay for back-up. Due to the height of the tower, we had −.5° of beam tilt built into the main antenna. Four-inch Andrew heliax was run to the main antenna, and 3 1/8" line to the back-up antenna. Due to wind loading, we did not use radomes.

The top set of guy wires has fiberglass rods, so the antenna pattern was not affected. The upper 80′ of tower tapers down to a 24" face. The antenna was mounted on the 24" face sections, and the back-up antenna was mounted, on the same face, at 400′.

We also put up a Mark 4′ open grid STL dish, mounting it at 200′ with 7/8" line running to it. We also mounted two Marti antennas for a repeater system. So we now have six antennas at various levels on the tower.

The dreaded ice bridges were the next concern. I had no idea of the damage ice falling from 1000′ can cause. I found out when I looked at ice bridges on some local TV towers and saw the damage that falling ice had caused.

Building bridges

We installed an ice bridge over the STL dish, as well as over the lines from the tower to the building. We had to install free-standing ice bridges over two air conditioner compressors located behind the building. The roof consists of poured concrete, reinforced with steel to protect our large investment inside. Ice bullets were also installed on the guy wires.

The importance of all of this became apparent when one of the largest ice storms we have seen in years hit about two months after completion of the tower. The force of ice when it hits things is almost beyond description.

I could not come within 300′ of the building when the ice started falling. Standing about 400′ away, I watched in total amazement for almost an hour. I saw large chunks of ice take down entire medium-sized trees in the woods!

The ice knocked huge craters in the ground all around the tower site. (The ice bridge we installed to protect the lines now bears serious battle scars!) We lost a beacon and a side marker to falling ice and the fence surrounding the building was also damaged. The tower, however, stood tall under this incredible load.

So, to recap: this tower is model #6024, manufactured in April, 1988 and is Central Tower project GT-59. Total height is 944′ above ground, with a 60′ face, tapering down to 24" at 864′. The top guys have fiberglass rods down past the antenna, so radiation is not affected. It is rated at 70 mph windload without ice and is 60% guyed with deadman anchors.

Amazingly, the tower took only 21 days to erect and that included a few days of bad weather. Once their work was done, Central Tower took me up via the tower rigging to let me inspect anything I wanted.

I went up three times and this is the sturdiest tower I have ever climbed. The people at Central Tower always take great care of us and if I have a problem, I just call, and they are on-site within 40 minutes.

Bristol Broadcasting has plans in the works for another 1000′ tower in Paducah, Kentucky. Central Tower will erect that one, too. If you are planning any kind of tower work, I highly recommend them.

■ ■ ■

Shelby Wilkinson has 17 years in broadcast engineering. He may be contacted at 502-827-8995.

For more information on Central Tower installations, contact Torrence Becht at 812-853-0595, or circle Reader Service 68.

—Reprinted from **Radio World** *May 24, 1989.*

Upgrading AM with NRSC-1

by William L. Ammons
Radio Products Marketing Mgr.
CRL Systems

Part I of II

Tempe AZ Converting your station to the NRSC-1 standard may be the best way to upgrade your signal quality.

In many cases the coverage area of the station is increased, with increased fidelity and reduced interference. Converting is easy and does not require a major reworking of the station. In some cases the conversion takes about an hour.

SPECIAL REPORT

While converting your audio processing to the NRSC-1 standard will not guarantee that you are in full compliance with the NRSC-2 RF mask, employing NRSC-1 processing, with a properly designed and maintained RF plant, will in many cases yield full RF mask compliance.

To help with your plans to convert to the NRSC-1 standard, let's discuss many of the common questions that are brought to our attention.

Two main methods can be used to convert to the NRSC standard. The first is to buy retrofit equipment—supplied either by the manufacturer of your peak limiter (modulation controller) or by an aftermarket retrofit.

The second method is to purchase new audio processing that includes NRSC compliant filtering and preemphasis.

Of the two options, adding a retrofit unit to your current peak limiter may be the least expensive method to comply with the standard. Most retrofits will be in the $500 to $800 range.

If the manufacturer of your current peak limiter offers a full retrofit kit (preemphasis and low-pass filtering), buying it for your unit would make the most sense.

If the manufacturer of your unit does not support the full NRSC standard (or is no longer in business), several aftermarket retrofit units have been introduced.

True compliance

For true compliance with the NRSC standard, the retrofit unit must offer separate preemphasis and low-pass filter paths. Also, the low-pass filter section of the retrofit unit must be phase-compensated and overshoot-corrected for maximum modulation control.

Non-overshoot corrected filters can rob as much as 6 dB (or 50%) of peak ➤

World Radio History

modulation control from your station!

The NRSC-1 preemphasis curve boosts audio by 10 dB at 10 kHz. The proper place to insert preemphasis is directly preceding the multiband peak limiter circuitry.

Inserting preemphasis anywhere else in the signal path will render it either ineffective or cause excessive pumping and compression action to take place. In most cases the existing peak limiter will be able to handle the added preemphasis.

The main exception is with some older wideband limiter designs. Preemphasis causes some of these to compress excessively, which often causes a muddy or "pumped" sound. This results in the generation of excessive IMD and is a cause of the out-of-band "spitting" sounds often heard.

Buying a new peak limiter

The other method of conversion to the NRSC-1 standard is to buy a new compliant peak limiter. In any audio processing system the NRSC-1 compliance is done around the final peak limiting section of the processing. Preceding AGC and compression circuits have nothing to do with the NRSC-1 standard.

For example, assume you own a multiple unit system with AGC action in one unit, multiband compression in another and the peak limiter in the last unit.

To comply with the NRSC-1 standard, you would only need to replace the final peak limiter. If the AGC and multiband compressor units are in good working order, there is no need to replace them.

Advances improve audio

One of the advantages of buying a new NRSC-1 compliant peak limiter is that the circuitry has seen great advances in the last few years. Limiter designs are cleaner and much more accurate than in units designed more than three or four years ago.

Modern filter topology, combined with advanced patented clipper designs, can dramatically improve modulation density while allowing precise negative peak control.

Also, newer multiband limiter designs have faster control action and are specifically designed to handle dynamic preemphasized audio with ease. The cost of a new tri-band limiter is not that much more than an NRSC-1 retrofit. A modern tri-band limiter costs about $1700.

A few words should be said about stereo AM processing. Some stations are using two older mono processors, or have an older stereo unit which is not supported and have inquired about converting them to the NRSC-1 standard.

Since the predominant AM stereo system is a matrix system, the audio program material should also be processed in matrix form (L+R, L−R).

If the stereo program material is not processed matrix form, and some type of added mono gain support is used in the L+R channel, your mono signal will suffer.

A well designed matrix processor can add 6 dB of modulation density to your mono signal. Total stereo separation is dependent on the phase and amplitude matching of low-pass filtering in both the L+R and L−R channels.

Properly designed retrofit units are typically very close to one another with regard to phase and amplitude response, but will most likely degrade maximal stereo separation.

■ ■ ■

William Ammons may be reached at: 602-438-0888. For more information circle Reader Service 80.

—Reprinted from **Radio World** *June 28, 1989.*

A Guide to NRSC-1 Conversion

Editor's note: The following is Part II of the author's report on NRSC-1 conversion.

by William L. Ammons
Radio Products Marketing Mgr
CRL Systems

Tempe AZ Now that you are converting to the NRSC-1 standard, there are some often overlooked areas of the transmission system that can limit and degrade your signal.

Tuning up your transmission plant along with converting to the NRSC standard can significantly increase your coverage area and lengthen the life of your transmitter. Listed below are a few tips that we often give out.

SPECIAL REPORT

When converting to the NRSC standard, make sure that the various low-pass and high-pass filters that are often on the input of the transmitter's audio path are taken out of service.

A poor quality audio low-pass filter that is in the circuit after a NRSC-1 low-pass filter can ring and overshoot. This will result in reduced modulation control and hence lost coverage area. Most input low-pass filters are not overshoot corrected. High-pass filters are often used to protect the transmitter against subsonic material.

If the cutoff frequency of the transmitter's filter is too high, your program material can sound tinny, with a lack of punch. Furthermore, tilt correction will not work when third order or greater high-pass filtering is used.

Properly designed audio processor systems have high-pass filtering, which negates the need for an additional filter inside the transmitter.

If you are buying new processing, specify a system that has high-pass filtering built in, combined with low-frequency tilt correction capability.

Many owners of older transmitters have expressed concern that modern audio processing equipment and older transmitters do not mix. The primary concern seems to be that the transmitter can not handle the density and loudness that the newer processors provide.

The truth is that older transmitters and properly designed NRSC-1 compliant processors work very well together. There are two main reasons why this is true.

First, the audio frequency is cutoff at 9.5 kHz versus a much higher frequency (if any) in an older limiter. At higher modulating frequencies (above 10 kHz), the efficiency of a transmitter's modulator falls off rapidly, causing higher modulator currents (which usually cause greatly increased THD and IMD products) and more chance of damaging a marginally designed modulator transformer.

Many of the stations that have converted to the NRSC-1 standard have noticed sharply decreased modulator currents for the same peak modulation level.

➤

World Radio History

Preemphasis boost

Second, the NRSC-1 standard preemphasis is a modified boost with a first order roll-off introduced at (about 8700 Hz) 17 μsec. The net preemphasis peaks at 10 kHz and rolls off above that. The preemphasis circuits that many older limiters have is a straight 75 μsec. (or higher) boost that often continues out to 20 kHz.

With no low-pass filter, the high frequency audio is boosted over 17 dB at 15 kHz. This is why many stations have had problems with their transmitters when trying to use preemphasis. Therefore, many stations have elected not to use any preemphasis.

Since a compliant processor has a sharp cut-off low-pass filter working in conjunction with a modified preemphasis curve, a large difference in the amplitude of material above 10 kHz can be expected.

Hence, the transmitter never sees audio material above 10 kHz. The difference in amplitude response at 15 kHz between a new NRSC-1 and an older, non-compliant processor can be greater than 60 dB!

Converting to the NRSC-1 standard is easy. Some stations have been able to retrofit their audio path to the standard in about an hour. We have found several common pitfalls when implementing NRSC that can degrade your transmission.

Limiter placement important

When converting to the NRSC standard, it is important where your peak limiter is placed in your audio chain. The NRSC compliant retrofit or peak limiter should be connected directly to the transmitter.

Dynamically limited audio contains short duration audio peaks with fast rise times. Most audio equipment, including STLs, phone links and audio distribution amplifiers, are unable to handle preemphasized, limited audio.

Inserting other audio equipment between the peak limiter and transmitter can seriously degrade your signal and render the low-pass characteristics useless.

If you have a split studio/transmitter site, and wish to control audio level before entering a phone line or STL, an AGC or combination AGC/multiband compressor would work well.

An AGC that has program dependent attack times will do an excellent job of controlling (or levelling) your audio level at the studio. Audio that has had only AGC or light multiband compression applied to it will also interface well with an STL or telco system.

And do not use two limiters in series. Two are less effective than one good one at the transmitter site.

After converting, the most noticeable change is the greatly reduced splatter between 10 and 20 kHz away from either side of your carrier. Many stations now report that they can receive second adjacent channel stations at their transmitter site.

On analog tuned AM radios, you will find it easy to tune to the center of the signal. On these radios, the sound will be slightly brighter, depending on IF bandwidth and slope. On wider bandwidth radios you may notice a substantial improvement in fidelity.

Improved coverage

Some stations report that their coverage area has improved after conversion. Depending on the transmission system and the type of peak limiter being used, converting will, it is true, improve your coverage area.

The coverage area increase is due to the amount of sideband energy farther than ±10 kHz from your carrier being greatly reduced. The sideband energy more than 10 kHz removed does count as total modulation (but does not add to perceived loudness), however it is not usable energy for the listener's receiver.

Since most receiver IF bandpass responses are below 5 kHz, adding sideband energy closer to the carrier helps signal detection. A compliant peak limiter that employs a variable presence (1 to 4 kHz band) boost, for example, will further increase density (and improve vocal clarity), which helps increase detected signal loudness.

In cases where either the transmitter has limited modulation capability at high frequencies, or the antenna system has excessive amplitude roll off or asymmetrical response, your signal quality may sound cleaner also.

A cleaner signal

This cleaner signal is due to the reduction in IM products that often are produced by bandwidth deficiencies in the transmission system. Studies have shown that limiting the audio bandwidth to 10 kHz greatly lessens the higher frequency IM products of many popular transmitters.

In many cases this also greatly decreases in-band (below 10 kHz) IM products. Many stations have reported to us that they sound cleaner (with less dynamic distortion) after converting.

One concern that some stations have had after converting to the NRSC-1 standard is the sound quality that they hear out of wideband AM modulation monitors. Since the standard preemphasis boosts audio 10 dB at 10 kHz, a wideband modulation monitor will sound excessively bright.

If you use your modulation monitor for off the air monitoring, external deemphasis/low-pass filter units are available. The function of these units is to deemphasize the signal and low-pass filter it to emulate the sound quality of a properly produced AM radio.

The deemphasis units are fed from the audio output(s) of your modulation monitor. Converting to the NRSC-1 standard does not change the accuracy or calibration of your modulation monitor.

Tell your listeners

Once you have finished your conversion to NRSC-1 or have converted to AM stereo, let your listeners know about it. Tell them that you are on the cutting edge of technology and that the improvements have been made for their listening benefit.

Let them know that better quality AM (and AM stereo) receivers are coming soon to the marketplace. If you broadcast in stereo, identify your station as AM stereo. Many times a station has spent a small fortune converting to stereo and has never told its listeners.

Become a source of information to your listeners about AM. Since converting to the NRSC-1 often improves your coverage, drive around and see if some of your marginal areas (pre-NRSC) have improved. Let your listeners know that because of the improvements you have made you now clearly cover a wider area.

It's my hope that the information above answers many of your questions about conversion to the NRSC-1 standard. Feel free to write or call any of us at CRL about questions that you may have. We would be happy to hear from you.

■ ■ ■

For more information, William Ammons may be reached at CRL, 800-535-7648, or circle Reader Service 94

—Reprinted from **Radio World** *July 26, 1989.*

World Radio History

WASK Remotes with Comrex PLX

by George H. Williamson, CE
WASK-AM/FM

Lafayette IN . . . At WASK/K105 we are now using the Comrex PLX micro with a cellular telephone for many of our broadcast remotes.

For many years, our station used remote transmitters in the VHF band. For distance remotes such as sports, we used telephone lines.

USER REPORT

As time went on, problems came up in our area. The VHF band was getting congested, and we were beginning to experience a lot of interference. We were also starting to do more remotes which went beyond our remote transmitter range.

Because of the escalation of the installation fees, we were doing away with our dedicated lines and using more dial-up lines, sacrificing quality.

Clearly we needed an alternative for our remote broadcasting.

Cellular phones

With the cellular telephone system beginning to make its way into the industry, we thought it might be a good alternative. As we analyzed the cellular system, we asked ourselves: How could we obtain better quality from it? This is where the Comrex system came into the picture.

Since 1976 when Comrex equipment was introduced, stations across the country have been using it on their telephone lines. In the past we've had the opportunity to use Comrex equipment and were impressed with it. We began to wonder, could we interface the Comrex system through the cellular phone system?

We contacted Comrex Corporation. They informed us that they had been doing research and had just come out with the Comrex PLX micro for the cellular phone.

■ ■ ■

Editor's note: George H. Williamson has been in broadcasting for 33 years—28 years with WASK as CE. He may be reached at 317-447-2186.

For more information on the Comrex PLX micro, contact Lynn Distler at Comrex: 617-263-1800, or circle Reader Service 86.

Our goal was to interface the PLX micro with our cellular phones as simply as possible and with the least amount of equipment.

Interfacing the PLX

The cellular phones we purchased were Mitsubishi 555Ts, shown in Figure 1. Through the combined efforts of John Cheney of Comrex, Jim Miller of Access Communications and WASK, we started our project.

Since we were not using the hands-free module on the 555Ts, shown in Figure 2, John Cheney said that Comrex was willing to design a replacement module that would enable the Comrex PLX micro to plug directly into the cellular phone.

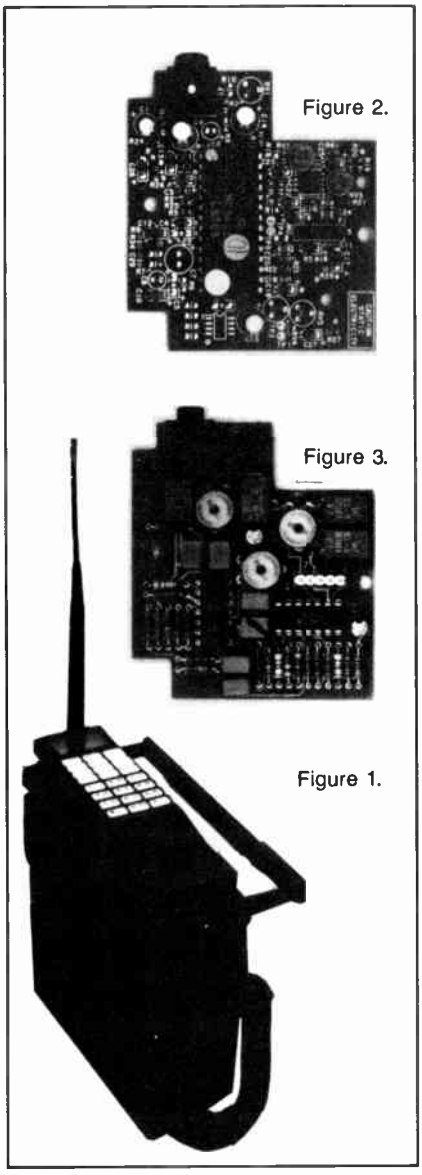


Figure 2.

Figure 3.

Figure 1.

With this module design, shown in Figure 3, we were able to interface the two units beautifully without another external interface box.

Our main objective of simplicity seemed to have been met. We were able to attach the Comrex PLX micro physically to the Mitsubishi by using velcro material. The complete system can be carried in the Comrex PLX road case.

We have purchased two complete Comrex systems. At the studio, we are using the TH-X Model. The TH-X is a complete telephone line management system containing all of the circuitry needed to interface a telephone line with your broadcast audio facilities.

Line management

The TH-X includes a telephone coupler which will connect to any PABX, an excellent hybrid, an auto-answer system which may be programmed to automatically pick up the telephone line only if the proper number of rings is received, an AGC that is designed to set levels only when the caller audio is present, a frequency extension encoder and decoder, and dual isolated "cart start" circuits which provide contact closures whenever the auto-answer system picks up the line.

A send limiter prevents excessive levels from getting to the line and band pass filters reject the extraneous noises often encountered on telephone lines. A tone generator and balance indicator will let you balance the hybrid without having to bring along anything more than a screwdriver.

Anytime we at WASK/K105 install new equipment, we first check to see if the equipment is free of RF interference. Our FM ERP is 50 kW, and a 20 kW transmitter is only a few feet from our control rooms. We were subsequently pleased to find the Comrex equipment completely free of any RF.

We are presently putting our Comrex/Cellular system to heavy use. We have already broadcast the Indiana and Kentucky Basketball High School Allstars and ➤

World Radio History

although we feared we might have some dropouts, everything was a success.

Repeated success

Our farm director broadcasts farm reports from all of the surrounding 4-H county fairs and the Indiana State Fair. And we are broadcasting high school football through the system. In all cases we have obtained excellent results.

We can also see a great expense reduction on remotes by the cellular system, especially when we are broadcasting a one-time event.

We can see many more possibilities in the future, and are planning to interface our news department computers to our farm director's computer via the cellular.

This way, the latest farm markets can then be fed to his computer before he goes on the air from his remote lo regardless of what city he will be long as a cellular system is locate that city.

We are pleased to be using the Cel lar/Comrex as an alternative in remote broadcasting. There is a great future for this method.

—Reprinted from **Radio World** *October 15, 1988.*

Comrex Gear Key to KPRC Remote Shows

by Jon Bennett, CE
KPRC-AM

Houston TX When our engineering department was asked if we could broadcast from various locations in London, the search was underway to find the most cost effective and economic means, consistent with good broadcast quality. The first thing everyone thought of was satellite. Right.

We would require a 7.5 kHz audio channel from a London uplink facility and equalized telecomm loops to each point of broadcast. The cost estimates began to resemble the national debt. There had to be a better way.

USER REPORT

Comrex came through in its traditional manner of excellence. Lynn Distler of the company described the new STLX four-channel console package.

It uses the Dual Line Comrex encoding system with a third line return for the IFB communication. The matrix headphone selector provides for up to four headsets, with individual headphone level control. It also provides selectable IFB for the talent and local audio for the guest, or whatever the local situation calls for.

The console has four mic level input channels, two that are selectable line/mic level. The system also provides auxiliary In and Out audio for feeding a local PA system. It was just what we needed: compact—220 V/117 VAC—and even offering a battery pack option if needed.

That covered the remote end of the operation. Now for the studio.

We used three TCB2A couplers. With the STLX console and the RTLX decoder, we chose the LX-L auto leveling option, which made the system auto answering and auto leveling at the studio.

The challenge was met. The system was cost effective, of good quality, equivalent to a 7 kHz loop, compact and easy enough to operate. It was completely automatic on the station end.

Comrex made prompt delivery on the equipment. Setup and checkout was completed in a matter of hours.

Before taking off to the other side of the world, we decided to do a few local broadcasts. The results were exceptional and the talent was pleased. Management was happy with the performance, *and* the *cost*.

We were off to London, England for 13 days! Three-hour broadcasts were scheduled for five different locations.

Upon arrival, I was met by a representative of British Telecomm, *the* telephone company of England. In no time, I was interfaced with three IFB circuits complete with dial tone. The telephone modular cables had been sent over in advance by British Telecomm. This enabled me to have our interface adapters ready for quick connection.

As you might expect, in a foreign country, the primary power was—oops!—220 VAC. Not to worry, a simple switch selection had my Comrex STLX on-line with the 220 VAC mains.

I was concerned about having the program producer set the balance of the two receive lines. The Dual Line Auto Leveling system by Comrex was so reliable that help was not required.

So with a list of broadcast locations in one hand, and a map in the other, the caravan was on the road.

The audio requirements were easily met with the four channels the STLX console provides. Using Electro-Voice RE11 microphones and Beyer headsets, setup was quick and without a hitch. Using the selectable line/mic level inputs on channels three and four, we were able to feed audio from the BBC and record interviews made earlier in the day. Management loved it.

In fact, with the exceptional success of the London broadcast, the promotion department announced a broadcast cruise through the inner passage of Alaska. Three of the five broadcast days would be at sea.

We had a little help from above on this project. Since the Comrex STLX has balanced 600 ohm line out audio, I simply used the console as an audio mixer and fed the satellite uplink equipment. With the headphone system so efficiently arranged, the IFB from the studio was a snap. Except for the delay on the return audio, which made a mix-minus return mandatory.

This summer, my assistant engineer, David Ainslie, experienced the flawless operation of the STLX system abroad. He enjoyed the rough duty of broadcasting for five days from Switzerland!

The quality of the broadcast was astounding to say the least. The quality rivaled that of some local 8 kHz loops. We now have GUS, The Incredible Broadcast Machine. A 31-foot custom broadcast bus.

It has a COMREX STLX system on board, in addition to the RF links. How else could GUS broadcast for five rough days from places such as Sea World, The River Walk and The Alamo in San Antonio?

So far this year, KPRC Radio has had over 70 remote broadcast events. With the savings realized by using dial-up circuits, we have more than paid for the cost of the STLX Comrex system.

Now, from the I-wish-I-had-it department. Comrex needs to provide a headphone connector so the engineer can monitor the return IFB line. When all

World Radio History

ur headsets are in use, you are in trouble. During station breaks, the producer is usually asking questions on the IFB line. The engineer, in this case, has to grab a mic to answer.

Maybe a PTT headset-mic connector would solve the problem. A built-in touch tone telset would be welcome, eliminating the telset we have to carry along.

We are very pleased with the equipment selection we made. Comrex builds a well engineered, quality product. The technical support is exceptional.

Who knows where we will go next. Maybe Down Under, or a cruise down the Amazon. I have to go now. GUS the bus is waiting for me.

■ ■ ■

For more information on the STLX, contact Lynn Distler at: 508-263-1800, or circle Reader Service 74.

—Reprinted from **Radio World** *October 25, 1989.*

Delta PRH-1 Finds Cable Faults

by John P. Bisset, Delta Electronics and John Diamantis, CE, WCPT/WCXR

Alexandria VA . . . Most broadcast engineers are familiar with the test instrumentation provided by Delta Electronics, Inc.

But few may realize that the company offers several products manufactured for HF communications that can be adapted to commercial broadcast applications.

TECHNOLOGY UPDATE

One such instrument is the model PRH-1 High Power Pulse Reflectometer. Designed to provide an oscilloscope picture of a station's transmission line system, the PRH-1 can be used to document buried transmission lines as well as determine the location of cable faults.

The primary advantage the PRH-1 has over other "time domain pulse reflectometers" is its ability to operate in high RF fields.

With the typical reflectometer, caution must be exercised to prevent high voltages from nearby radiating elements from entering and destroying the instrument's front end.

This drawback can wreak havoc when the line to be examined exists amidst other operating broadcast antennas or arrays.

Measurements conducted at Washington DC's WCPT/WCXR were made with a full power 5 kW AM transmitter and 13 kW TPO FM operating. No degradation of the display or damage to the PRH-1 was noted.

Operation of the PRH-1 is straightforward. A high voltage (5 kV) short duration pulse is applied to the transmission line. A time versus amplitude display of the echoes is then viewed on an oscilloscope.

Faults or discontinuities in the line, as well as the terminating load or antenna cause these echoes.

Although most engineers are introduced to a Pulse Reflectometer after damage to a transmission line has already occurred, the PRH-1 can provide a useful reference which can be consulted should future line damage occur.

The ability to convert these oscilloscope pulse distances allow accurate location of faults or line discontinuities in the field.

Figure 1 illustrates this fact. The photograph displays an expanded scale illustrating a coaxial transfer switch. A is the input of the switch, B is the output.

Figure 2 displays the input to two FM transmitter lines. C is the main reference pulse; D shows the input to the coaxial transfer switch; E is the input to a four-bay Jampro FM antenna.

The distance between C & D is a 100'

➤

Figure 1.

Expanded View - Coaxial Transfer Switch

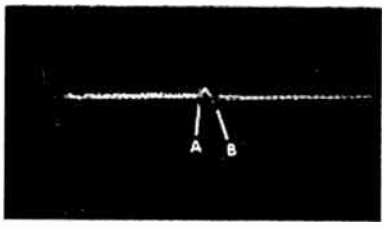
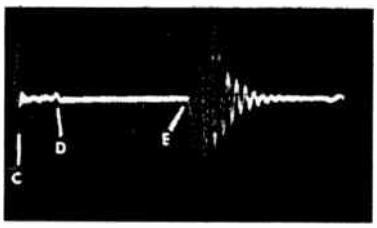


Figure 2.

Auxiliary FM System



Main FM System

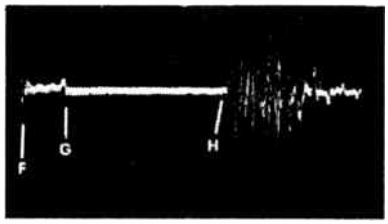
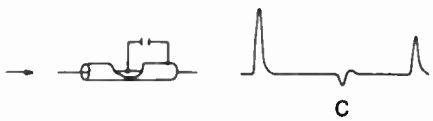


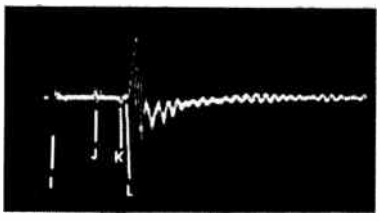
Figure 3.



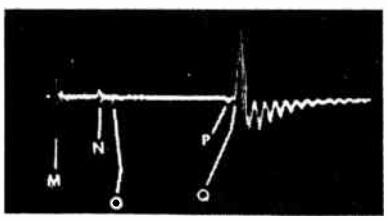
Shunt Capacitance
(Such as a dent in outer conductor)

Figure 4.

Tower 1 Sample Line



Tower 2 Sample Line



World Radio History

test cable which connects the PRH-1 to the coaxial transfer switch. The distance between D and E is the 400' run of heliax to the antenna.

Dents to the outer jacket of the coax would appear along this line as a small downward pip followed by a flattened upward pulse (see Figure 3).

The second photo in Figure 2 displays the main FM antenna. F illustrates the start pulse. G is the input to the coaxial transfer switch, followed by 500' of rigid line. H is the input to a four-bay ERI FM antenna.

The PRH-1 performs equally well in AM applications. Figure 4 demonstrates the station's two sampling lines. Measurements were taken while the AM operated under full power.

As you can see from the traces, there is no visual disturbance due to the 5 kW RF. I is the input reference pulse; J is the input to the sample line. Remember that the distance from I to J is the 100' reference cable which connects the PRH-1 to the sample line input.

K is the cable termination and L is the input to the sample loop. Since this is a folded unipole tower, the sample loop is mounted parallel to the skirt feed line. That explains the short distance between J and K.

M shows the reference pulse feeding the sample line for a tower; N is the input to the sample system for this tower. O is a splice in the sample line. P shows the cable termination and Q is the input to the sample loop.

Through measurement of a station's transmission lines, using the PRH-1, reference data can be gathered that is invaluable should a fault occur.

■ ■ ■

Editor's note: John Bisset spent seven years at WCPT/WXCR as CE before joining Delta. John Diamantis is now the station's CE.

For more information contact John Bisset at Delta, 703-354-3350, or circle Reader Service 82. John Diamantis may be reached at 703-683-3000.

—Reprinted from **Radio World** *January 15, 1988.*

Delta Monitors Splatter in AM

by Marty Sacks, CE
WGAY/WRC

Washington DC Over the last several years, a number of pieces of test gear specifically designed for use by radio engineers have been brought to market. The Delta SM-1 splatter monitor is such a device.

Splatter—the existence of undesired sidebands with the presence of modulation—interferes with the reception of stations adjacent to the station generating the excess splatter. Further, it raises the noise level in the AM band and wastes energy.

USER REPORT

Splatter can be caused by excessive preemphasis and/or clipping of the audio applied to the transmitter. Other causes might be overmodulation, transmitter or antenna problems.

As most of us know by now, the National Radio Systems Committee (NRSC) has established a suggested transmission standard for AM radio stations with respect to audio bandwidth and preemphasis characteristics.

To make a long story short, this standard has been suggested to encourage receiver manufacturers to build radios with wider bandwidths since the standard theoretically reduces second-adjacent channel interference.

To date over 800 stations have converted to the NRSC-1 standard.

Now the NRSC has released an RF mask, appropriately called NRSC-2. This standard specifies the minimum permissible attenuation of sideband energy versus frequency offset from carrier and should be attainable by a station in compliance with NRSC-1, assuming its transmitter and antenna are operating properly.

Realizing that it would be difficult for many AM engineers to confirm compliance with NRSC-2 without an RF spectrum analyzer, Delta has introduced the SM-1 splatter monitor.

The Delta splatter monitor is a basic spectrum occupancy analyzer that is easy to operate and can be used to observe sideband emissions which fall between 11 and 100 kHz away from the carrier.

Setup of the splatter monitor is easy. RF is applied to the unit from either an optional active antenna—for use away from the transmitter—or an RF feed from the point that normally feeds the station modulation monitor.

At WRC we used a toroidal current transformer mounted at the phasor common point. The SM-1 is equipped with a switchable attenuator to handle RF voltages from one to 20 V—a handy feature that should be duplicated by modulation monitor manufacturers.

To operate the SM-1, one dials in the station frequency, adjusts the carrier reference level and is then ready to take measurements.

Since the splatter monitor is equipped with dual synchronous detectors, there is a choice of measuring the in-phase conventionally generated splatter or the quadrature splatter due to incidental phase modulation of the transmitter. This feature is useful in properly adjusting the neutralization of a transmitter.

More detailed analysis can be obtained with the SM-1's offset mode.

This function allows the user to specify the frequency offset from the carrier (plus and minus) where the check is to be made, select the bandwidth of the measurement: 0.5 kHz, 3.0 kHz or NRSC deemphasized, and select one of two measurement ranges, 0 to −40 dB or −40 to −85 dB.

Any offset frequency from 11-99 kHz in one kHz steps can be chosen by a front panel thumbwheel switch. To test for compliance with the NRSC-2 "mask" one selects the NRSC position on the offset bandwidth switch.

In the 0.5 kHz position, the SM-1 responds like an RF spectrum analyzer. The 3.0 kHz selection will yield measurements that mimic a typical narrowband AM radio.

The unit was a breeze to use. We managed to check two transmitters from start to finish in less than an hour. The SM-1 is also equipped with a 12 V power option for mobile use.

➤

■ ■ ■

Editor's note: Marty Sacks has been CE at WGAY/WRC since 1985 and was previously a staff engineer at WPGC-FM. He may be reached at 703-587-4900.

For more information on Delta's SM-1 splatter monitor, contact John Bisset at Delta: 703-354-3350, or circle Reader Service 72.

World Radio History

Delta also includes little extras that make things go smoothly such as a front panel speaker, a headphone jack, outputs for feeding a remote control and an alarm (with the contacts brought out for remote control uses) that can be used to warn of significant changes in splatter level.

There is also a provision for feeding external audio into the SM-1 to test NRSC compliance of an audio processor. The only thing missing from the unit that might be desirable would be a peak-hold function on the meter.

All in all, the Delta SM-1 will allow stations that are serious about NRSC to confirm compliance with a minimum of hassle and cost.

—Reprinted from **Radio World** *January 15, 1989.*

Delta Exciter a Solid Product

by John Diamantis, Dir Eng
WCPT-AM/WCXR-FM

Washington DC WCPT is located just down the road from Delta Electronics. Such close proximity to this manufacturer has given us the opportunity to see its AM stereo product's (C-QUAM) evolution.

From the early "carbon copy" of the Motorola boxes, each refinement provides more features for the engineer. Delta's latest offering, to be displayed at the NAB, is no exception.

USER REPORT

Delta's new ASE/ASM exciter/monitor combination has the same solid construction that is associated with the company's other products.

Although the front panels look like the early Motorola systems, that is where the similarity ends. Inside are high quality "mil-spec" pots and switches that make this exciter an investment.

The internal construction uses a top-accessed card cage and exciter and monitor functions are modularized on several different boards that fit into zero insertion force (ZIF) sockets.

This modular approach has been carried through from Delta's earliest systems and has several advantages. First, the boards can be easily accessed for testing or maintenance; an extender board with test hooks is provided.

This modular approach permits easy upgrades as state-of-the-art changes occur. The ability to plug in a new circuit board and improve system performance is definitely a quality worth considering. Few AMs would have the budget to purchase a brand new exciter every few years, just to take advantage of new circuitry.

A third feature is the mounting of critical delay and EQ adjustments—they are accessible from the top. By not being available from the front, tampering with these settings is reduced.

Setup and maintenance are no problem, as the exciter can be supplied with rack slides. You simply slide the exciter out for adjustment and slide it back into the rack afterwards—out of the way of those Junior Engineers' fingers!

A number of convenience features are found on this exciter/monitor. They include a rear-accessed carrier frequency trimmer, full dual transmitter/dual pattern interfacing circuitry and an updated tech manual that includes an expanded troubleshooting and service section.

This troubleshooting section was prepared after reviewing service information and field installation data from two hundred exciters presently in service.

Delta has added the little finishing touches that make the system easy to set up and maintain. An example is the top panel control silk-screened legends, which permit quick identification of a pot or switch.

A high angle flasher signals excessive phase modulation, caused by too much single channel information. In addition to warning the engineer of a system malfunction, the flasher can be used when setting up the matrix audio processing. It is set to trip at the point just before overload of your listener's C-QUAM stereo decoder ICs.

The companion monitor offers a selectable NRSC deemphasis on the balanced line outputs. Since it is selectable, stations not presently running NRSC will not be concerned with separate deemphasis networks when they make the conversion. They must simply move the jumper.

Perhaps the greatest improvements made in the new Delta exciter are those dealing with performance. Both exciter and monitor have improved frequency response, THD, separation and noise specifications. Delta has also incorporated true SMPTE Intermodulation tests as a part of the final system checkout.

Tilt as well as overshoot are greatly improved, while the exciter still employs the benefits of AC coupling. The AC coupled input prevents cumulative DC offsets from affecting the relative clipping level in aggressively processed stations.

Of these improvements, the most impressive is viewing the ASE audio output while feeding a 1 kHz square wave, low-pass filtered at 100 kHz. You will see no overshoot.

System performance specifications are also improved. A new Decoder II Assembly in the monitor has improved third order Bessell function response for better separation figures as well as overshoot. Again, the modular construction is carried through to the monitor, permitting field installation into existing systems.

Now to the bottom line—what do all these improvements cost? The system list price has not changed. It is still $12,500, which includes complete installation and a proof. Field mod kits to upgrade older systems are also available.

If you get to NAB, take a look at this product. You will not find a lot of flashiness and glitter—that is not Delta's style. What you will see is a solid product. And if past performance is any indication, the product will serve you well.

■ ■ ■

John Diamantis has been CE at WCXR/WCPT for the past two years. He may be reached at: 703-683-3000.

For more information on Delta's ASE/ASM exciter/monitor, contact John Bisset at: 703-354-3350, or circle Reader Service 91.

—Reprinted from **Radio World** *April 26, 1989.*

World Radio History

Tips on Using Transfer Switches

by John Bissett
Bdcst Product Sales Mgr
Delta Electronics

Alexandria VA As engineering staffs continue to shrink in size at most stations, the need for redundant systems becomes more important. At the transmitter plant, motorized coaxial transfer switches provide the engineer with a reliable, quick means of getting back on the air using either an auxiliary transmitter or the exciter.

SPECIAL REPORT

Motorized switches are also gaining popularity in AM applications, where the isolation provided by the switches reduces the crosstalk of AM Stereo signals.

Available in a variety of configurations for varying line sizes and power requirements, these motorized/manual switches have been designed to make the engineer's life easier. Unfortunately, it is not always that simple.

Things to consider

Improper installation can easily cause the engineer additional headaches, but these headaches can be avoided through some simple planning, and making sure the switch fits your requirements. A number of design and installation factors need to be considered.

Perhaps the most important consideration is location. Though good engineering practice dictates that you keep the number of elbows to a minimum, a compromise between a location with ease of maintenance characteristics and the fewest elbows may be best. The switch should not be located directly over the transmitter, in such a way that the PA exhaust air blows on the switch.

And although locations 15 feet in the air may be aesthetically pleasing, such locations can make maintenance and repair nearly impossible. At the same time, do not mount the switch too low where it can pose a safety threat to those bumping their heads on it—especially in a darkened transmitter room suffering from a power failure.

As you search for the ideal location, also consider the weight of the switch. Though the smaller 1 5/8" switches pose no great problem, the larger 3 1/8" switches typically weigh over 50 pounds.

Proper support

Such weight requires adequate structural support. Kindorf™ (a structural steel beam used by electricians) and threaded steel rods make an inexpensive support system. Since the switch is suspended on the threaded rods, mounting height and leveling of the switch is easily accomplished.

Leveling the switch to prevent binding of the feedline is another important consideration, another reason for not mounting the switch high in the air.

Orient the switch so that the RF ports will meet the required transmission line layout. As you determine the RF plumbing route, consider a means of patching around the switch, should it fail. The ability to remove the switch from service and easily plumb the transmitter output to the antenna will alleviate headaches later on.

As you decide on the mounting location, also keep in mind that you may need to operate the switch manually. Most motorized switches have a means of manually controlling their operation, but such features are worthless if they are inaccessible. If you mount your switch near a ceiling, provide at least a foot of clearance to permit removal of the motor housing for maintenance purposes.

Although most manufacturers impose no mounting criteria as to how the switch sits—that is, contact bullets pointing "up," "down" or "to the side," some engineers prefer mounting the switch with the bullets facing upward. Their rationale is that any contamination or dust would in that position fall away from the contact bullets.

While the installation is planned, a decision on interconnecting the control and interlock circuitry must also be made. AC power must be planned and routed to the switch location. Remember that your switch may use either 120 or 220 VAC; size your wiring accordingly.

Switch control functions are usually straightforward. And with the increased number of automatic transmitter changeover panels on the market, control interconnection should not be a problem.

The remote control of a transfer switch is usually dependent on the CE's level of trust in his air staff. In an off-air emergency, air talent can hurriedly rush through remote control functions and may cause more damage.

A middle ground can be reached by connecting the switch to a higher remote control channel and labelling it "Dummy Load." In this manner, the engineer has full remote control function, yet the labeling discourages tampering.

The dreaded interlocks

Coupled to the remote control question is that ugly word interlocks. Talk about a love/hate relationship! Properly interlocking the transmitters and the coax switch is a must—ask anyone who has paid for the repair of a smoked switch!

But good intentions—using proper switching procedures to avoid switching a transfer switch hot—have a habit of disappearing in the wee hours of the morning or in the middle of the morning drive.

Connecting the transfer switch interlocks is akin to going to the dentist; we know we are supposed to do it, but somehow never find the time. Save yourself the agony of a major toothache, connect the interlocks.

And while you are connecting the interlocks, check to see how they operate. Do they open before the RF path opens, or at the same time? How many interlock contacts are there? Not all switches are the same, and what works for one manufacturer may not for another. Check the instruction manual.

Coaxial transfer switches can greatly simplify the engineer's transmitter plant and proper installation and selection will assure years of reliable service.

■ ■ ■

Editor's Note: To assist engineers in planning the addition of transfer switches to their facility, Delta offers a free planning and installation guide. For a copy, contact Delta at: 703-354-3350. For more information, circle Reader Service 64.

John Bissett is a former CE and contract engineer. He can be reached at: 703-354-3350.

—Reprinted from **Radio World** *May 24, 1989.*

World Radio History

Repairing Ailing AM Sampling Systems

by Steve Crowley

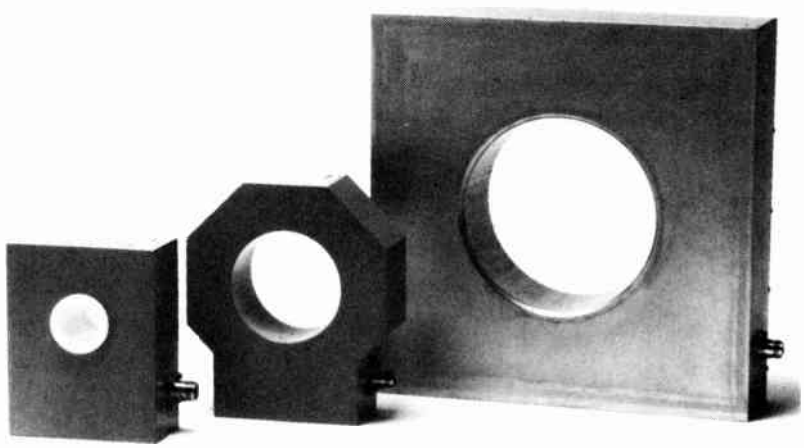
Washington DC AM directional array sampling systems eventually require repair or replacement due to damage or age. Sometimes, input components of the antenna monitor can be damaged by lightning or excessive RF voltage.

Old air-dielectric sampling lines can take on moisture, also causing unstable readings. Fluctuating antenna monitor readings, unaccompanied by corresponding fluctuations in base current or monitor point readings, are a sign of a defective sampling system.

Sometimes restoration is not possible. Perhaps a sampling loop was replaced with one of a different type, or the orientation of the loop is slightly different, resulting in changed current pickup from the tower. (Some older loops are designed so that they produce a current sample 180 degrees out of phase to those loops being sold today).

Replacement of transmission line to a loop can change the input impedance of that tower, also causing a change in parameters (and actual field radiated).

If parameters remain out of tolerance, a request must be made to the FCC for permission to operate with parameters at variance. Their response will likely be a telegram allowing such operation for ninety days. This can usually be extended upon request, especially if progress toward repair can be shown.



Delta Electronics offers three versions of its TCT Toroidal Current Transformers. Each of the transformers pictured can be supplied in sensitivities for a variety of power levels. For more information, contact Delta at 1-800-8-DELTA-8. Outside the continental US, dial 703-354-3350.

Because antenna monitor readings are a primary indicator of a properly functioning antenna system, several FCC rules apply when any sampling system modifications are to be made. Applicable rules differ depending on whether modifications or repairs are being made as a response to a breakdown, or if they are part of a planned construction project.

If your sampling system fails, you may operate for a period not to exceed 120 days without further authority from the FCC, if all other operating parameters and monitor point values are within the limits specified on the station license. During that time, if repairs result in antenna monitor parameters being restored to within licensed tolerances, no further action is necessary.

While you are operating under special authority, you can troubleshoot the antenna system to determine why the parameters have shifted. Field strength measurements should be performed to verify that the pattern is still within the standard pattern envelope. If not, the antenna must be adjusted.

Whether or not adjustments are made, a partial proof of performance must be made and filed with FCC Form 302 to support the new parameters. A modified license will then be issued.

If you are fortunate, you will be able to plan replacement or modification of your sampling system. The first step is to request permission from the FCC to operate with parameters at variance from licensed values.

In changes made off the tower (sampling transformer, antenna monitor, sampling lines not on the tower), you must record transmitter and antenna parameters, and the monitor point values before and after any such changes.

CONSULTANT'S CORNER

The monitor point and base current readings should remain within licensed tolerances after the changes. If changes are made on the towers, a partial proof must be made to verify radiation is within the limits authorized.

A request for modification of license (to reflect the new parameters) must be submitted within 30 days of the date of sampling system modification or replacement. If the changes were made off the tower, this request can be made in the form of an informal letter to the FCC. If the changes are on the tower, FCC Form 302 must be submitted with the partial proof.

Perhaps you are building a new station or have a construction permit to modify an existing directional array. You will have to install what the FCC refers to as an "approved" sampling system.

In 1985, the FCC eliminated construction requirements for sampling systems —the intent being to allow stations to use alternative technology to monitor directional arrays. You can still construct a sampling system according to rules in effect before 1 January 1986. If you do, it will be considered approved.

If you do not comply with the former rules, approval will come after submission of a year-long stability showing, consisting of a detailed description of the sampling system, monthly monitor point readings and other data.

Most engineers follow the guidelines of the former rules. They state, in part, that sampling lines must have a solid outer conductor. Sampling loops must be unshielded, of rigid construction, firmly positioned and mounted near the

➤

World Radio History

point of maximum tower current.

Shielded transformers at the tower base may be used in lieu of loops (a stability showing must be submitted if the tower is taller than 110 electrical degrees).

The former rules also state that all sampling lines for a critical array must be of the same electrical length. For other arrays, lines of different length may be used if the difference is not so great that predicted phase errors due to phase variation exceed 0.5 degree.

Following good engineering practice during sampling system installation will greatly reduce the chance of future problems. All lines on the tower should be electrically bonded at regular intervals. At the base of the tower, on the ground side of any isolation network, the outer conductor should be securely grounded.

Sampling loop hardware should be securely tightened to prevent loop movement by wind or climbers. Any extra transmission line at the base of the tower should be coiled and fastened down.

If you would like to review the FCC's sampling system rules, the applicable sections are 73.68 and 73.69.

■ ■ ■

Steve Crowley is an engineer with the Washington, DC-based firm of du Treil, Lundin & Rackley. He can be reached at 202-223-6700. For more information circle Reader Service 69.

—Reprinted from **Radio World** *August 23, 1989.*

Dorrough Maintains Integrity

by Ken Horton
Maintenance Eng
KFAC-FM

Los Angeles CA The Dorrough 610A discriminate audio processor is a vastly "new and improved" version of the company's original 610 box.

We have been A/B testing a pair of the 610As for two months in our FM audio chain. (This chain is from our studios in Hollywood to our transmitter site on Mt. Wilson via T-1 digital telephone lines.)

USER REPORT

In a test of any system, it is always a good to ask: "What are the criteria for evaluation?"

The first criteria is listening—it's the bottom line, the "proof in the pudding." Since we have a classical format, we are especially interested in extremely accurate reproduction of our program at the receiver—reproduction that is both transparent and dynamic, yet with an apparent loudness.

Second, interaction between our SCA channel and our main stereo channels could not be tolerated.

And third is the question of the unit's actual technical performance. Some very revealing but simple tests can be performed to evaluate this (see Figure 3).

There are so many boxes out there to choose from that it can get confusing trying to sort them out. What sets the 610A apart is its sound!

Dorrough's philosophy is that three-band processing in which minimum phase, gentle slope filters are incorporated is the only way to assure colorless limiting (see Figure 1).

The 610A is a tri-band limiter and special attention has been given to its phase integrity, under both static and dynamic conditions.

An important concept here is that the higher frequencies "ride" on the lower frequencies. One need only look at a scope to see that when you take away the low frequencies (150 Hz), the remaining higher frequencies "collapse" toward the base line.

Cutting off frequencies below 5 kHz causes another major collapse of the remaining information toward the base line: as frequencies increase, their amplitudes fall closer to the base line.

A common error, Dorrough says, is to use a sine wave generator to check performance. This does not work because the generator has constant amplitude over frequency, while music and speech get progressively lower in amplitude as frequency rises. This principle is illustrated in Figure 2.

After each of the three bands has been limited (if desired), they are summed together to achieve their original relative amplitudes.

This is why we experienced precise integrity in the decay of sustained piano and organ passages, right down into noise, without a timbre change.

Figure 1.

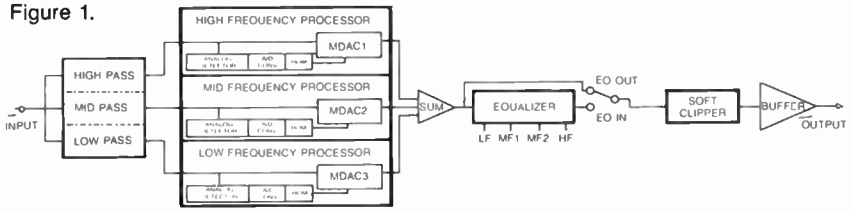


Figure 2.

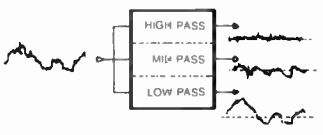
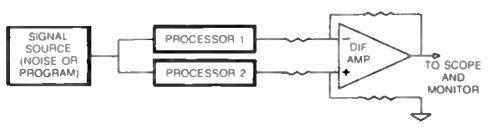


Figure 3.



Most other multiband boxes sum for flat amplitude response at this point, which means that on a decay the higher frequencies fall progressively out of limiting and their relative levels are no longer proportionate, resulting in excessive noise and unnatural sound.

The 610A is a minimum signal path device incorporating single pole (6 dB/octave) band splitters and digitally controlled analog attenuators.

The attenuators are followed by a four band equalizer, which may be hard-wire ➤

World Radio History

bypassed when desired. The side chains utilize proprietary ROM look-up tables to set attack, release and limiting characteristics.

A fast "soft" clipper is in place before the final output buffer amplifier to build power without degrading high frequency detail. Improvements in the 610A include higher speed, lower noise amplifiers, better ROM algorithms and simpler (more phase linear) filters.

Figure 3 shows a simple test set-up to check static and dynamic processor integrity. Two processors are required; one is operated below the limiting threshold while the second processor is operated as desired with processing activated.

All controls must be identically set up. When the outputs are summed out of phase with their amplitudes matched, the remaining artifacts may be observed and listened to, including frequency response discrepancies and intermodulation distortion products.

Included with each pair of 610As is the 80-B stereo generator. Balance compensation and pilot tone phase controls are brought out to the front panel to allow maximum separation under program conditions. All that is needed for calibration of the 80-B is an FM radio with mono mode capability and a balance control.

These 610As really sound good! And I believe they would be equally strong in any other format.

■ ■ ■

Ken Horton has worked in programming and technical installation for over 20 years with RKO, ABC, CBS, ARAMCO et al. He may be reached at: 213-466-9566.

For more information on the Dorrough 610A, contact Kay Dorrough at: 818-999-1132, or circle Reader Service 70.

—Reprinted from **Radio World** *June 28, 1989.*

Dynamax Gets Braiker Rolling

by Ernie Hopseker, VP Eng
Braiker Radio Services Co.

Bellvue WA A new satellite radio network, founded by Ivan Braiker, began operation in the fall of 1989. His Braiker Radio Services Company differs from other satellite networks in that it provides programming only, with no network commercials.

While the technical operation of most satellite radio networks is conceptually similar, Braiker Radio has added a new twist. As often happens in an engineering environment, we discovered a new use for an existing function, a use outside that originally intended by the equipment's designers.

USER REPORT

Braiker originally envisioned an operation whereby the network air personality could maintain simple yet total control of all affiliate programming. The programming would include local commercial spots, jingles, IDs, liners and other format functions. This would provide continuity and a "feel" that all material was originating from the local affiliate's studios.

The network studios had to be functional, simple to operate, foolproof and yet capable of network sophistication. In the early stages it was determined that we needed to be able to remote control up to 15 different cartridge-based affiliate events.

Some of the first ideas included our air personalities "playing a row of switches like a synthesizer" in addition to performing the traditional duties required. But, having considerable experience behind the microphone myself, I shuddered to imagine several different DJs pushing 15 different buttons while trying to produce results acceptable for network consumption.

The first part of the solution to this problem involved our decision to install a Wegener Tone Encoding System. Wegener utilizes a series of inaudible 25 Hz and 35 Hz tones encoded on each audio channel that can be distributed via satellite to each affiliate as part of our programming and used to remotely trigger a series of relays at affiliate sites designated by the network.

The system provides two encoded tones per channel, on each of two audio channels. Therefore we have four tones available, which form the basis of a BCD (Binary Coded Decimal) code, permitting control of up to 16 functions in theory (15 in reality; in our case the "0 0 0 0" function was discarded as being prone to triggering by loss of input).

Figure 1. Cartscan Function to Braiker Function Conversion Table

Normal Cartscan Function	Function Number	BCD Equivalent 2^3 2^2 2^1 2^0	Braiker Logic Function
Not Used	0	0 0 0 0	Not Used
Matrix	1	0 0 0 1	Legal ID
Elev. Level	2	0 0 1 0	Matched Call
Matrix & Elev. Level	3	0 0 1 1	Station Jingle
Aux	4	0 1 0 0	Image Liner
Matrix & Aux	5	0 1 0 1	Station Jingle
Elev. Level & Aux	6	0 1 1 0	Currently Unused *
Matrix, Elev. Level & Aux	7	0 1 1 1	Currently Unused *
Mono	8	1 0 0 0	Currently Unused *
Custom	9	1 0 0 1	Currently Unused *
Elev. Level & Mono	10	1 0 1 0	Commercial Cutaway—3:00 Minutes
Custom	11	1 0 1 1	Currently Unused *
Aux & Mono	12	1 1 0 0	Commercial Cutaway—3:30 Minutes
Custom	13	1 1 0 1	Currently Unused *
Elev. Level, Aux & Mono	14	1 1 1 0	Currently Unused *
Custom	15	1 1 1 1	Network Return

* Unused Codes permit later expansion

➤

World Radio History

Later, while at the NAB convention last spring, I was walking the show floor prospecting for a solution that was easier than using a bank of control switches. At the Fidelipac booth I noticed that its Dynamax CTR100 Series cartridge machine includes a "Cartscan" function.

Cartscan uses adhesive labels, with four optional reflective areas that are applied to the right side of each cartridge and corresponding optical sensors within the machine. Normally these sensors are used to control internal selection of Standard or Elevated operating levels, Stereo or Mono, Matrix or Auxiliary switching functions.

Four functions form the basis of a BCD encoding system. Fidelipac informed me that the Cartscan logic was available at an existing 50-pin "D" connector on the rear of the machine and that the machines could be easily modified to deactivate the normal internal Cartscan functions. We could then use the standard Cartscan labels, but for our own logic.

We immediately purchased our first Dynamax CTR100 Series machine and devised a truth table for the functions that we required. (See Figure 1.)

The puzzle was far from complete at this point. The Cartscan matrix in the CTR100 provides a BCD code output whenever a cartridge is loaded. The problem now was how to mix up to eight loaded cartridge sources, identify the correct one upon its initiation and route its BCD output to the input of the encoder.

We designed an interface box which uses the remote start tally output of the cartridge machine and permits only that machine's code to be passed through to the Wegener.

We currently have between six and eight Dynamax cartridge machines on-air in each network studio. Additional units are used in the production studio, dubbing and music library.

Operationally, our network air personalities load blank cartridges, with the appropriate Cartscan labels for the events that they wish to initiate, into any of our machines. The Cartscan matrix within each machine informs the Wegener system, via our interface, which function code is present on the cartridge currently initiated.

That BCD code is then transmitted over the satellite to each affiliate. Upon receipt of code at the local site, the appropriate relay, corresponding to functions 1 through 15, is closed and used to initiate designated equipment or events. We require that five cartridge machines be dedicated for this use at each affiliate studio.

The beauty of the system is that any cartridge can be loaded into any of our Dynamax machines. As implemented, the system merely supplies BCD codes for function initiations. This frees our network air personalities from undue concentration on cartridge loading and permits individual machines to be removed for maintenance without affecting the overall system.

There were a few initial glitches in setting up the system. For instance, we found that if our network personalities auditioned a cartridge, it initiated corresponding events at the affiliate end. So we now have a dedicated cartridge machine off-line from the Wegener system for audition purposes only.

We found too that the Cartscan labels are subject to wear and lose some reflectivity with use and handling. Therefore they need to be replaced occasionally. We also had the usual installation wiring errors, etc. But now everything works well, just as originally envisioned. Due to our volume of use, Fidelipac has made the unusual offer to provide machines factory-modified to our standards for our use.

Ingenuity has prevailed. Dynamax CTR100 units with Cartscan have given us a very simple and cost effective solution to what originally seemed to be an awkward and expensive task.

■ ■ ■

Editor's note: Ernie Hopseker may be reached at 206-562-3000.

For more information, contact Larry Lamoray at Fidelipac: 609-235-3900, or circle Reader Service 88.

—Reprinted from **Radio World** *December 27, 1989.*

Phoenix Rises at WOBT-AM

by Richard E. Hencley, GM and Lloyd C. Vollmar, CE WOBT-AM

Rhinelander WI There are no magic solutions for AM today. It is a combination of quality programming, professional attitude and a clean sound, stereo or mono that wins and keeps listeners on a long term basis.

Many AM stations maintain an AM attitude such as: "Oh well, we don't sound as good as FM, therefore we're inferior."

USER REPORT

To compete with FM these days, you need an FM attitude: "We sound as good or better than FM, therefore we are superior." It is a great thought.

But how do you do it? Your quality programming and professional attitude are only as valuable as the extent to which your listeners hear them.

In many stations, the missing link is a good audio processor. Combined with your programming and attitude, the three together become a hit. Our ace in the hole is the Phoenix processor from Gentner Electronics.

The Phoenix has our entire staff grinning from ear to ear and listeners are wondering if there is a new station in town. From a non-technical perspective, it has added 20% to our coverage area and made us the cleanest, brightest, clearest sounding station on the dial. To most people, that is indeed the bottom line.

But wait a minute: technically, the Phoenix, with its built-in Gentner Audio Prism, goes a lot further.

First of all, the Phoenix is a digital processor. This means that rather than experiencing the constant expansion and compression common among analog compressors, the Phoenix can do "nothing," or, in other words, "maintain present gain."

This greatly cuts down on listener fatigue, lessening that "busy" sound of increasing and decreasing gain. The Phoenix can be programmed to expand only when necessary.

So while the Phoenix maintains an equal or higher modulation level, its Audio Prism processor will make only one third to one half as many AGC voltage reversals as would an analog processor.

The benefits of the Phoenix continue, ➤

World Radio History

having greatly improved our sound density (a difference that was noticed immediately) as well as a offering a dynamic range that compliments digital programming sources such as music on compact disc.

The Phoenix is completely digitally controlled and all of its controls are mounted on the front panel. It is very user-friendly.

WOBT was at one point contemplating going stereo but found that with the Phoenix, we were able to offer an AM sound rivalling that of FM without having to go stereo. And, too, we knew that with the Phoenix and an additional Audio Prism we had the option of converting to stereo anytime in the future.

The Phoenix also adheres to the NRSC standard, solving the problem of how to maintain mandatory compliance. You will also find its internal pink noise generator extremely useful, especially during initial set-up, which is made simple with an easy-to-read and under stand manual.

The manual gives starting points and good suggestions for all formats and various types of equipment used in conjuction with the Phoenix.

The Phoenix unit itself is completely self-contained in a single 1¾" rack height enclosure and will operate in severely hostile electrical environments.

Featuring RFI filtering and three part lightning protection on all conductors, complete set-up of the Phoenix takes just a few minutes and requires no test equipment other than a simple VOM.

The Phoenix' front panel LED indicators offer a wealth of information and are arranged in typical bar graph fashion. Color coding displays expansion and compression.

The Phoenix from Gentner Electronics has delivered on every claim it has made. With the term "hot box" being thrown around by so many processor manufacturers, the Phoenix has shown that it sets the standards and does for AM what Orban did for FM.

The day after we installed the Phoenix, our phones lit up with comments like "I don't know what you did, but keep doing it" and "Did you increase your power?"

What did we want when it came time to choose an audio processor? Simple. Maximum modulation along with a clean, non-fatiguing sound.

The Phoenix has made WOBT-AM get up and dance. Our listeners are getting the necessities they require of any radio station, AM or FM. They are getting quality programming, a professional attitude and audio quality matching that of any other station.

There are many managers and engineers who will give their testimonials to the success of the Phoenix. You can compare all you want, and there is no doubt that you will come to the same conclusion. Your AM will never sound better than it does with the "hottest box" in the industry.

■ ■ ■

Editor's note: Messrs. Hencley and Vollmar may be reached at: 715-362-6140.

For more information, contact Gary Crowder at Gentner: 801-972-7200, or circle Reader Service 96.

—Reprinted from **Radio World** *June 28, 1989.*

Sage Sold on Harris HT Series

by Gerald LeBow, Exec VP
Sage Broadcasting

Stamford CT This spring, with just weeks to go before the start of the ratings books, Sage Broadcasting put two new FMs on the air and completely revamped a third. Incredibly enough, everyone involved was still sane at the end of this major project. One of the main reasons was our choice of transmitter: Harris Broadcast.

We talked to several manufacturers about the three transmitters we needed: a 25 kW for WGNE in Daytona Beach, FL; a 30 kW for KSEZ in Sioux City, IA; and a 3.5 kW for WFHN in Fairhaven/ New Bedford, MA.

USER REPORT

Harris responded quickly with a very attractive proposal. The company's prices were more than competitive, its leasing plan was convenient and its delivery schedules were as good or better than anyone's.

More importantly, I had confidence that Harris could meet those schedules with transmitters that would work when they arrived. We had two new stations to put on the air, plus a third staring down the barrel of the year's only ratings book, so meeting delivery schedules was a very significant consideration.

Despite the problems that go hand in hand with the Christmas season, Harris came through on its January and February delivery dates as promised.

I was on hand for the installations at our two new stations, WGNE and WFHN, and I must admit I was nervous. With any device as complex as an FM transmitter, you have to expect problems once it has been shipped and installed.

But both the HT 25 FM in Daytona Beach and the HT 3.5 FM in Fairhaven worked right out of the box. There was a moment of confusion over the AC power wiring at the installation in Sioux City, but as soon as that was straightened out, the HT 30 FM was also fine.

I talk to the engineers at each of our 18 stations nearly every day. So whenever there is a problem, I hear about it. Our three Harris transmitters have been on the air for six months, and they have been as close to trouble-free as we could have wished for.

We have experienced no loss of air time, and the minor problems we have encountered were attended to with utmost dispatch by the Harris service department. All three stations have told me how pleased they are with the performance of their HT FM transmitters.

We took a big gamble installing these three transmitters so soon before the spring ratings books, but the performance of the people at Harris helped us make it pay off.

In fact, at KSEZ in Sioux City, we just had our biggest ratings book ever. I am convinced that the improved coverage from our new RF plant, including the Harris HT 20 FM transmitter, played a significant role in that increase.

Overall, you can say I am a sold customer: We certainly will look at Harris again when we need more transmitters.

■ ■ ■

Editor's note: Gerald LeBow is executive VP of Sage Broadcasting, and no stranger to the engineering side of the business. He may be reached at 203-357-1464.

For more information on the Harris HT Series transmitters, contact Ron Frillman at 217-222-8200, or circle Reader Service 97.

—Reprinted from **Radio World** *November 22, 1989.*

World Radio History

Z-93's Harrison Board Shines

Editor's note: Since the following article was first published, Harrison Systems has been acquired by GLW Enterprises, Inc. GLW continues to manufacture the Harrison lines of professional audio mixing consoles.

Dick Byrd, CE
WZGC-FM

Atlanta GA When we began to finalize plans last year to move the Z-93 studio facilities from midtown Atlanta to the suburbs engineering attention focused on the more expensive items that would be installed.

Since most of the tape machines, CD players, turntables and the like were to be reused it was obvious that consoles and cabinets would comprise most of the equipment budget.

USER REPORT

After seriously considering three manufacturers to build our consoles we chose Harrison. I became aware of Harrison's dedication to build a "broadcast console" through the efforts of Kandy Shute of Broadcast General Store.

Harrison's reputation throughout the recording industry has been impeccable for many years but broadcast applications present different hurdles to jump.

To familiarize myself with Harrison I spent a day at its Nashville plant finalizing the configurations of the three consoles we were to purchase. We saved a great deal of money in the process because each application was discussed and the most appropriate resolution for each was implemented.

To save money on shipping costs we sent our station promotions van on the four-hour trip to the factory to pick up the consoles.

Since Harrison had the consoles ready weeks ahead of schedule we were able to physically take them to the cabinet shop for custom fitting.

Harrison has a policy of sending the purchaser a pre-install kit soon after the order is placed. The kit includes the manual, a Molex tool (which doesn't work) and a few thousand crimp pins.

I personally like Molex connectors, so it suited me just fine that Harrison consoles utilize them for all the "goes-ins" and "goes-outtas." It makes installation and future changes a breeze.

The success of a Molex crimp, however, depends on the crimp tool used. The one shipped by Harrison is made by Waldom and is recognizable by its yellow grips. It doesn't crimp properly.

A previous Waldom model which looks the same except for its red grips works great. I've also had moderate success with a rather expensive ratchet-type tool made by Paladin.

External start and stop

Z-93 bought one model PRO-790 and two AIR-790 units—all three utilizing the same mainframe layout. The difference lies in the plug-in modules. We outfitted the PRO-790 mainframe primarily with modules that sport a few more knobs, switches and lights.

For the control room we chose the less expensive and less cluttered input modules. One of the first amenities that drew my attention to the Harrison was a little red switch on each module labeled "Next."

Proper utilization of this little fellow allows us to sequence our ITC model 99 playback cart decks without additional hardware. (Our old studio had a bank of switches external to the console that allowed the operator to select which machines should sequence.) A start pulse is provided when the channel is switched on for external equipment.

We hooked it directly to the cart machines, CD players and reel-to-reel machines. The old model SP-lO turntables required an interface adapter to provide a stronger tug on the line.

Designers also allow an external pulse to turn off the channel when the attached cart machine finishes. Yet another TTL connection prevents the channel from being turned on unless a cart is ready to go.

Personality programming of individual modules is accomplished with those little jumper connectors you see on a computer circuit board.

With jumpers you can elect to start the built-in digital timer at channel turn-on, activate any or all three mute and tally busses, vary the gain significantly, assign auxiliary buss feeds to either pre- or post-fader connection points and even cause the channel to turn on when the fader goes up.

Monitor modules include independent control of earphone and speaker level with line-level audio sufficient to drive external power amps. A companion module provides monitor audio and intercom for two other studios in the station.

The external power supply for the console is among the heftiest I've seen. The standard 30' cable allows installation in a rack where ventilation is adequate. I've heard folks say that the older model Harrison consoles and power supplies run pretty warm, but this model seems well within accepted temperature ranges.

A quick study

The learning curve for the DJs was very short. We first went on the air on a Saturday night and on Sunday required each jock to work an abbreviated shift. By Monday morning the only obvious difference on the radio was a better quality sound.

I burned up several ICs while installing the consoles because I frequently popped modules in and out while the power was on. I still remove and reinsert modules in the control room because it's too cumbersome to switch the show to another room, but I don't recommend doing it unless you are prepared to repair the module.

Insertion with the power on usually works, but not always. Luckily, one wayward module does not affect the rest.

The manual that Harrison provided was very confusing. I'd hate to see a novice try to install a console using only the information in those many pages.

While there are lots and lots of schematics and diagrams in the manual, it contains few words. Each time I called the factory, however, a knowledgeable technician answered my questions.

All of us here are extremely pleased with the performance, reliability and ease of operation of the consoles.

■ ■ ■

For more information on the PRO-790 and AIR-790 consoles, contact Martin Burns at GLW Enterprises, 615-331-8800, or circle reader Service 89

—Reprinted from **Radio World** *August 15, 1988.*

World Radio History

USDA A Prime Choice for a DA

by Hank Landsberg, Owner
Henry Engineering

Sierra Madre CA A few weeks ago Henry Engineering announced the USDA, which stands for "Utility Summing and Distribution Amplifier."

Since a distribution amplifier is probably the most mundane and uninteresting piece of equipment used at the average broadcast station, we wondered what could be done to make one a little differently, one more useable and able to solve more problems for the broadcaster.

TECHNOLOGY UPDATE

Our answer was to add a summing capability so that the DA could be used to *combine*—as well as split—audio signals for distribution.

Have you ever needed to add a mono output to a stereo console? How about combining the stereo output of a tuner to feed the (mono) house PA system? One way to do this is with resistive combining networks.

The drawbacks to passive summing are either a loss of level or a degradation in the stereo separation of the souce signal, or both. The only way to sum two audio signals without such pitfalls is to do it with an active summing amplifier. This is the summing feature built into USDA.

The USDA is a 2-input, 4-output distribution amplifier. The two input channels can operate independently, in parallel, or as a stereo pair. The 4-output channels can operate as four independent outputs, or as two stereo pairs.

The feature that makes USDA unique is the Stereo/Mono selector switch for each of the two stereo output pairs. Either or both stereo outputs can be switched to mono with no loss in level or separation of the other output, or of the source signal.

With the USDA, you can feed a stereo signal in and get two stereo outputs, four mono outputs, or a combination of one stereo *and* two mono outputs, simultaneously.

USDA has dozens of broadcast station applications. In addition to combining stereo to mono or splitting signals for distribution, it can be used to boost low level (−10 dBm), unbalanced "consumer" audio signals to +4 or +8 dBm balanced outputs.

Another use could be to convert Left and Right audio inputs to "matrix" Sum and Difference outputs. The reverse can also be done; feeding USDA with Sum and Difference inputs can produce Left and Right stereo outputs.

USDA's circuitry is active and direct coupled. The inputs and outputs can be wired either balanced or unbalanced. The input impedance is 20 kilohms (bridging), so the source is not loaded. This permits a source to feed a typical 600 ohm load and feed USDA simultaneously, with no adverse effects.

There are individual gain trim adjustments for each of USDA's four output channels. The gain may be set between −6 dB and +20 dB. The USDA will drive four 600 loads simultaneously to +24 dBm with typical distortion of .01% THD or IM.

Since the USDA is direct coupled, frequency response is from DC to over 50 kHz. The noise level (EIN) is −95 dBm. USDA is also compact (same size as a Matchbox) and has an internal bi-polar power supply.

Whenever a "new" DA comes to market, most folks respond with: "So what else is new?" The USDA is new, and should solve numerous audio-related problems at broadcast stations every day.

■ ■ ■

For more information on the USDA, contact Hank Landsberg at: 818-355-3656, or circle Reader Service 76.

—Reprinted from **Radio World** *July 26, 1989.*

CTE Products Move Into the US Market

by Rob Meuser, President
International Broadcast Support Services

Ontario CANADA Solid state transmitters are the dream of both engineers and general managers alike. The past decade has brought advances in both AM and television transmitters. Unlikely as it may seem, FM has lagged in this area.

Now, due to the worldwide explosion of FM stations, solid state power is coming to FM. One company in this area is the Italian manufacturer CTE. Originally designed for the home market, CTE's transmitters have gained worldwide acceptance.

TECHNOLOGY UPDATE

Despite this success, the American market is new turf for CTE. The company introduced its products to this market at the 1989 NAB.

The CTE line extends from its Model S-20 4 W to 30 W exciter/transmitters up to its Model VL 5000 solid state 5 kW transmitter. The forthcoming VL 10,000 and VL 20,000 will raise solid state FM to 20 kW capability. Other CTE power levels are 250 W, 500 W, 1000 W and 2000 W.

Technically speaking, CTE offers several features that make the line unique, including a PWM power control unit. All functions such as over temperature, VSWR and automatic power control are controlled via a constant feedback loop.

Ultimately, the voltage to the final amplifier transistors is regulated in response to various conditions. This feature makes the transmitter exceptionally tolerant of faults and allows for automatic power control at any level down to one-fifth power.

At a 2 to 1 VSWR, a typical unit will operate at 50% forward output power, with all spurious outputs down better than 85 dB. Because of the voltage reduction to the finals, the unit will stay cool and stable. The continuous power reduction upon fault is a feature that adds measurably to on-air reliability.

Loudness is always important in most operations. CTE has ➤

World Radio History

designed the S-20 exciter to be overshoot-free and nearly DC coupled, with a PLL corner frequency of .25 Hz. A 20 Hz square wave reproduction is easily possible. (According to recent studies, 1.5 dB of modulation is often lost due to low frequency problems in many modern exciters.)

The PLL circuit allows for lock-up to any FM frequency in four seconds via front panel controls. This performance is not without some penalty. The SNR is 85 dB referenced to 100% modulation, while distortion is .2%.

Other CTE products include STL links, STL receiver/excit and relay receivers. The net capability for CTE FM equipme. is therefore not limited to just transmitters: translators, repeaters, boosters and synchronous repeaters are all possible.

■ ■ ■

Editor's note: International Broadcast Support Services is currently marketing the CTE lineup in the United States. For more information, contact Barry Honel at 404-389-1966, or circle Reader Service 75.

—Reprinted from **Radio World** *November 22, 1989.*

Inovonics 222 Is "NRSC-Smart"

by James C. Parkinson, CE
KAMO-AM

Rogers AR . . . Last fall KAMO decided to implement the NRSC standard on its AM transmitter, a McMartin BA-1K. I had to come up with something cost effective, and quickly.

Checking the ads in **RW**, I found a few NRSC processors, all priced at about $500.

USER REPORT

Furthur investigation, however, revealed that one of these was a "wrap-around" unit: a preemphasis network to be installed ahead of an existing limiter such as our Gates Solid Statesman, and a 10 kHz rolloff filter on the output side.

The problem with this single band limiter being fed with preemphasized audio is familiar to anyone who has worked in FM radio engineering.

The enhanced high frequency peaks would cause deep limiting, which would tend to "punch holes" in the bass and midrange audio.

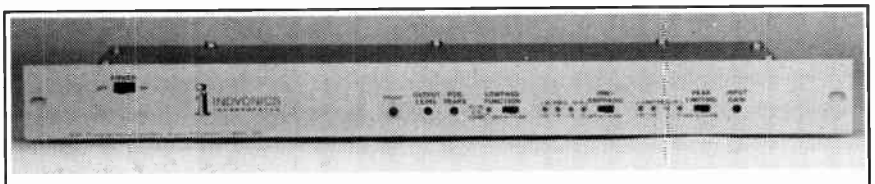
Placing the preemphasis at the output of the limiter would be even worse; in order to keep the highs from overmodulating the transmitter, the limiter output would have to be turned down to the point where the audio spectrum below 500 Hz would only be able to modulate 10% or less.

What we needed was a smart limiter which would allow independent additional limiting for the high frequencies only, based on the NRSC preemphasis curve.

Smart limiter

The Inovonics Model 222 NRSC AM Audio Processor was chosen because it does just that. It can be used as a standalone processor or in conjunction with additional processing as desired.

Front panel LEDs indicate gain reduction of 0, 2, 6 and 12 dB for both wideband limiting and preemphasis protection. There are switches to defeat the limiting, preemphasis and a 10 kHz low pass filter for test purposes.



Inovonics' 222 NRSC processor

A red LED reminds you to switch these functions back on when you're done with the proof.

Input and output levels are screwdriver adjustable from the front panel, which is 1¾" rack mountable. There is also an independent adjustment to allow for up to 130% positive modulation peaks. (Of course, to comply with current FCC rules, it must be set at 125% or below).

All limiting is controlled by pulse width modulation. The sharp 10 kHz rolloff is accomplished with active components.

Overshoot protection is a must for any post-limiter filter; a green LED lets you know this part of the circuit is functioning. Feedforward techniques are utilized for very tight control of transmitter modulation.

For stereo operation, two units can be operated in tandem, one for L+R, and one for L−R.

The well written manual is exceptionally detailed in theory of operation, setup and maintenance.

No RFI problems

I was at first dismayed to read the admonition against using the 222 near abnormally high RF fields. I had planned on installing it in a rack close to the transmitter, which is only 10' from the base of of our half-wave tower, and which supports six bays of FM at the top.

A glance at the schematic shows no RF bypassing at either the balanced input or output, both of which are DC coupled ICs (no transformers).

To be on the safe side, I installed outboard .0039 mfd mica capacitors on all input and output terminals. The 10 dB input pad we use supplies additional filtering there, and a couple of 100 μH chokes were added to the output port. I am happy to say no RFI problems were experienced whatsoever.

Inovonics recommends a maximum peak limiting of 12 dB on occasional peaks, with average gain reduction running at about 6 dB. For the more aggressive processing demanded by most stations they suggest a compressor (AGC) unit ahead of the 222.

So I modified our Gates limiter to obtain a slower recovery to make it act more like an AGC than a limiter, to smooth out the inevitable variations in level from the control room board.

Although the 222 has a separate control for positive modulation peaks, it will ➤

World Radio History

not do anything to accentuate those peaks if they are not already higher coming in.

But our good old Solid Statesman takes advantage of any asymmetry present in the audio waveform and automatically selects the correct polarity for greater positive peaks. The 222 passes this onto the transmitter, but limits it below the preset level—125% in our case.

The front panel LEDs make setup a breeze, and the unit has been operating flawlessly since last November. The sound on a typical AM radio has become brighter and more defined, even to the point where I can actually understand the lyrics of songs.

The GM noticed the improvement too, which made it all worthwhile. I know the filter is operating properly, since at four miles from the antenna I can tune in the second adjacent stations on either side without being bothered by splatter.

Recently, when our Solid Statesman limiter developed a problem and had to be removed for servicing, we had a chance to test the 222 as a standalone processor.

Although we didn't have as high an average level of modulation as with the two units together, the Inovonics gave a good performance by itself as long as the input level was reasonably controlled.

Considering the component count and sophistication of this processor, I consider it a "steal" at $500. Surely the manufacturer must be sacrificing higher profits in order to encourage more AM stations to convert to the NRSC standard.

Even stations using older vintage transmitters (with class AB transformer plate modulation) such as our McMartin, would do well to add this excellent NRSC processor to their audio chains.

I would advise any station wishing to upgrade to the NRSC standard to buy this unit now, before Inovonics wises up and raises the price.

■ ■ ■

Editor's note: James Parkinson received his FCC First Class Commercial Radiotelephone license in 1957 and has been in radio engineering since 1961. He currently maintains several AM and FM stations in the northwest Arkansas area.

For more information on the Model 222 NRSC AM Audio Processor, contact Jim Wood at Inovonics, 408-458-0552, or circle Reader Service 63. The author may be reached at 501-248-1108.

—Reprinted from **Radio World** *June 15, 1988.*

WTGC Switches to Nighttime with LPB

by Gary Magill, CE
WTGC-AM

Hollidaysburg PA . . . On 30 August 1985, WTGC in Lewisburg, PA was issued a show/cause order for night operations. The power issued was 13.6 W.

At first, we used our old RCA BTA250M, a 250 W AM transmitter with a dummy load and tapped coil to get 0.5 A on the base current. The transmitter was already set up for post sunset at different powers.

USER REPORT

We found the commercial power required to achieve 13.6 W was far more than efficiency prescribed. The audio quality of the old RCA at this low power was not very good, either.

What we needed was a low power transmitter.

I called Dick Crompton at LPB in Frazer, PA to see what he had in the way of equipment because I knew that LPB had a great deal of experience in lower power transmitters.

Dick suggested his LPB AM-30P solid state, 30 W AM transmitter.

We estimated that the savings from electric power costs would pay for the transmitter in one year.

Delivery time was quick/about two weeks. The instructions were very easy to follow, and we were able to install our new night transmitter in August of 1986.

The operating people at WTGC were amazed at the size of the new low power transmitter. It is approximately 12" high, 6" wide and 5" deep.

The unit has adjustable power control and audio input control. The output connector is an S0239 connector. The power input is a standard 120 V plug.

We made a modulation monitor sample connection with the circuit supplied in the book. We used a ceramic switch to switch between the RCA and the LPB units.

Our audio is driven with a Dorrough Model 310. The LPB AM-30P modulates positive peaks very well. The adjustable power control makes an easy transition from the power of post sunset into nighttime power.

The frequency stability is very good at about +10 Hz. The audio quality on the LPB is comparable to that of the main transmitter operating on daytime power.

The LPB operates low level modulation with linear amplifier push/pull. To supply power to the unit, there is a toggle switch inside the front door with an LED indicator on it.

One thing I would like to see is the main power and RF power adjustment mounted on the outside so the unit can be operated with the power on.

Also, the means of sample for the modulation monitor should be mounted inside of the unit with the jack on the side.

Overall, however, I highly recommend the LPB AM-30P to stations looking for economical night transmitters.

■ ■ ■

Editor's note: Gary Magill is CE of Cove Broadcasting stations WHPA and WKMC. He is also an engineering consultant for WTGC.

For more information on LPB solid state transmitters, contact John Tiedeck at 215-644-1123, or circle Reader Service 67. The author may be reached at 814-695-4441.

—Reprinted from **Radio World** *April 15, 1988.*

LPB: "Sleep Insurance" at WLSH

by William Lakatas, Jr., CE
HGF Media Group

Allentown PA "That breadbox on the wall is our new transmitter?" With that comment from a staff member, I threw the switch that turned on our new LPB low power transmitter and instituted 24-hour service on our most recently acquired AM station.

➤

World Radio History

When we purchased WLSH in Lansford, PA, it was a daytime-only operation. It had an overnight authorization of 59 W, but the former owner did not use it. I talked to Dick Crompton of LPB in Fraser, PA and he suggested the LPB 100 W low power transmitter for our application.

I now have a transmitter that can economically provide me with my overnight power and can provide an intermediate power level for Post Sunset Authorization. Also, as Dick calls it, I now have "sleep insurance" in the form of a backup for my main transmitter, an old Collins 21E.

USER REPORT

The installation of the LPB transmitter seemed at the outset to be as simple as mounting the unit on the wall, making a few connections and plugging it into the wall outlet.

It *is* that simple—and that is the problem! It took me longer to install the transfer relay in the phasor cabinet, and to plan and install the audio and modulation monitor switch over relays, than it did to install and fire up the new LPB transmitter.

Incidentally, in my installation, I tapped into one of the 28 V power supplies in the transmitter to automatically operate the audio and modulation monitor relays when the transmitter was turned on.

The transmitter is a very small package, which can be mounted anywhere that you have space on a wall at your transmitter site.

The LPB line of low power transmitters is modular in design. One module is the 30 W transmitter. Two modules connected together form the 60 W transmitter and the 100 W transmitter is composed of four modules.

Internal adjustments select a variable output level and adjust audio input. (I added a relay and a trimpot to select two power output levels.)

■ ■ ■

William Lakatas, Jr. is the technical director of the HGF Media Group in addition to being its CE. The group is based in Allentown, PA and owns and operates eight radio stations. Mr. Lakatas may be reached at: 215-434-9511.

For more information on LPB transmitters, contact John Tiedeck at LPB: 215-644-1123, or circle Reader Service 62.

The transmitter sounds great on the air and met or exceeded every single spec when I checked it out with our Delta splatter monitor.

As far as quality and reliability are concerned, I have 12 LPB boards among the eight stations in our group. These transmitters are designed and constructed just as well as their boards. If my track record with the LPB boards is any indication, I expect to see many years of reliable and trouble free service from our LPB transmitters.

Let me also mention that I am installing an LPB transmitter at our Mount Carmel, PA station, which operates with C-QUAM AM stereo. I expect to be just as pleased with this installation as I am with the one at WLSH.

The only changes I would like to see on future designs are external connections for modulation monitors and a door with an interlock rather than pop-on hatches. I am very pleased and impressed with this fine LPB line of transmitters. They were certainly worth our investment.

—Reprinted from **Radio World** *April 26, 1989.*

LPB's Signature Makes Its Mark

by Dave Schmidt, CE
WAMS-AM

Wilmington DE Searching for the words that best describe LPB Signature consoles, those that come to mind are: "No problems!"

We have been involved with LPB Signature consoles for many years. Our company has always made them our first choice for any station that asked for a good, dependable console.

Its selectable inputs for each of the channels make source selection easy, and gives the operator the pleasure of smooth operation. If a change has to be made, it can generally be done in a matter of minutes.

USER REPORT

How well do the Signature consoles hold up under tough operating conditions? We have installed them in private schools and universities, which we feel really puts any piece of equipment to its maximum test of durability. The results? No problems after years of hard use.

Smooth hook-ups possible

The layout inside the consoles is an engineering dream. The large barrier strip terminals, clearly marked, make for a smooth hook-up (unlike the very tough wedge-in-the-small-hole-and-screw-down terminals).

After you have done a few installations of the Signature consoles, you can generally do 75% of the hook-up without even looking at the detailed instruction book.

In the event of a problem, LPB has always given us full support with needed parts and has always answered our technical questions (as few as need to be asked).

If a pot needs to be changed or a switch needs servicing, there is plenty of room in which to work and the problem can usually be corrected in a few minutes.

Have they always worked when turned on for the first time? Yes. In most cases, the console is on for good from that moment.

Built to last

Construction of the console makes it look like it is built to last—we have not been let down in that department.

And in high RF fields we have found the console to be RF-free (even in the immediate area of a 10,000 W AM transmitter, RF is not present).

The movie guy gives "thumbs up" for a good movie review; we can do the same with the Signature consoles.

■ ■ ■

Dave Schmidt works as a contract engineer for Mid-Atlantic Radio Service. He may be reached at: 302-654-8881.

For more information on Signature Series consoles, contact John Tiedeck at LPB: 215-644-1123, or circle Reader Service 83.

—*Reprinted from* **Radio World** *August 23, 1989.*

World Radio History

Furniture Can Help Your Sound

by Dennis Murphy, President
Murphy Studio Furniture

Spring Valley CA "Will it make me sound better?" In any discussion of elegant studio furniture this question seems to come up. The answer, although harder to quantify than field strength or modulation measurements, is yes!

A refined, classy, well chosen style of studio furniture projects a positive visual everyday expression of your facility's commitment to a quality product. Station personnel "feel better" about their jobs and that will translate into more productivity and a better sound. Potential clients visiting your facility pick up this feeling of quality as well.

The Murphy Studio Furniture Elite Series attempts to address some of the more practical needs in a studio environment.

Sloped rack faces below the overhanging return countertops allow the best view angle to equipment or media located in these areas. The corner tower racks that sit on top of the console supports are at a 20° angle to the operator. This allows an easy three-quarter's arm reach to the rack face and a full view of a guest position shelf located on the back side of the console.

SPECIAL REPORT

Located above all knee spaces are aprons, which give strength to the counter and provide areas for mounting headphone jacks. Sit-down height is 30". Stand-up operation is 38".

There are three parallel wire passes in all returns. The bottom opening is for the AC and ground. The middle is for control and the top is for audio. There are 12" of separation between the top and bottom wire pass.

Wire can be laid into the passes eliminating the need for stringing wires through "D" rings. There is a wire management area located in the dead space of the corner tower racks and a wire trough under the console between the console supports.

We left the bottoms of all modules open to ensure maximum ventilation. Designed into the furniture just below the main counter wood trim is a quarter-inch reveal. This gap over a distance of 24" gives six square inches of vent area at the top of the module.

Passive ventilation eliminates the need for cooling fans, thereby reducing ambient noise and reducing the amount of dust blown into equipment.

Our design goal is to provide the most access possible while maintaining a sleek outer appearance. Removing the access panels leaves the entire perimeter open, allowing cables to be laid into the built-in wire ways. The jointed design of the panel on the back of the corner tower rack permits access to equipment even if placed in a corner.

The studio environment is often a 24-hour operation requiring furniture that must hold up to industrial use. No matter how high the quality of a product might be when built, if it has exposed laminate-to-laminate edges, it will show wear and tear immediately.

To solve this durability problem we have developed a curved base at the kick level and a unique overhanging counter. These act as "bumpers" to keep the backs and bases of chairs off valuable equipment mounted in the return rack faces. There is wood trim on all exposed corners in the base furniture and a 1½" thick smooth wood molding all around the counter level.

Murphy furniture comes with console supports and wire troughs. Each console support has a field relocatable, hidden 14" rack, covered with a removable smoked plexiglass panel. The panel protects the rack-mounted equipment from the operator's feet while allowing a view to the panel lights. Drawers can be added to supports. The center counter and wire trough can be expanded to accommodate larger consoles.

Sitting on top of the console support is the corner tower rack (CTR), which positions equipment such as cart machines at a 20° angle to the operator. The standard rack opening is 14".

A tower storage base raises up the CTR to provide storage for 10 hot carts or 15 CDs. This also allows the CTR to cantilever over the control console, thereby saving the addition of width to center when using an 18-input console.

A sloped rack return comes standard with a 21" rack. This space can be easily converted to media storage or pencil and file drawers.

Also provided is a single turntable return. Featuring an easy-to-see-over bifold dust cover, this return houses turntables, reel-to-reel machines and CD players. It comes standard with a 10½" rack. An optional sand-loaded isolator base can be ordered.

A work surface return module—used as a work surface for computers, keyboards and guest positions—can be built to custom widths. There is a built-in wire pass and it can be ordered with a pencil drawer.

A return completion panel is used to cover the unfinished end of a return. One panel is needed for each return. To provide multiple talent positions, a guest position shelf can be mounted anywhere and can be free standing. A sliding copy holder features a stick-on note surface.

Another system component is a raised rack overbridge, which provides rack space above the return modules or above transport mounted reel-to-reel machines.

A top sloped rack is used mainly to house reel-to-reel machines. This rack can be used for patch bays and any other gear that needs to be kept at a low profile on the countertop.

Attached to the top of the guest position shelf is the guest turret rack—a panel rack. Timers, cough buttons and headphone control can be mounted in the panel face. Finally, there are rack panel covers, which cover empty rack space and should be ordered after equipment installation.

We use void-free birch plywood in the vertical and horizontal support structure and poplar in rack supports. Poplar is also the backing for the non-chip material of our "bumper" base.

The countertop edge band is oak. This trim is 1½" thick and milled with a sloped double radius pattern. We use oak on all exposed corners and on the tops and bottoms of countertop modules. Because of its anti-resonate properties, high density particle board is the foundation of all top surfaces. We can use any national brand of plastic laminate.

Quarter-turn fasteners are standard on all access panels. This provides some security to gear such as processing equipment mounted in the hidden racks. If security is not a problem we can install hidden catch fasteners.

■ ■ ■

For more information, contact the author at: 619-698-4658, or circle Reader Service 65.

—Reprinted from **Radio World** *December 27, 1989.*

World Radio History

WNYR Gets Optimod NRSC Kit

by Randy Orbaker, CE
WNYR-AM

Rochester NY WNYR has been using an Orban Optimod 9100A/2 audio processor since 1985. We're very pleased with its performance, but I have observed some degree of second adjacent channel "splatter" when using Orban's recommended 17 dB of HF boost.

Reducing this boost from 17 dB to 8 dB helped somewhat, but did not eliminate it to my satisfaction. When I heard of the new NRSC preemphasis/10 kHz LP filter standard in early 1987, I felt that it would both solve our problem and make us compatible with the proposed new AM receivers.

USER REPORT

I called Orban and ordered one of its RET-042 NRSC conversion kits for our Optimod AM.

Since the kit was not then in production, there was some delay between placing the order and receiving it (four months in our case).

When it came, I found everything I needed—no missing parts, no wrong parts, everything correct.

Orban's manual is, like every one of its manuals, very detailed and well written.

Among the items included in the kit are: a new circuit board (#1S10) which plugs into the #1 card slot inside the Optimod and provides the 5/10/12 kHz LP filtering.

The NRSC uses 10 kHz, but the other curves are strappable to the Optimod's "DAY-NIGHT" mode switching to operate differently between day and night, if necessary.

New HF EQ modules are supplied, which replace the standard green, red or yellow modules supplied with the Optimod. They provide the modified 75 μs preemphasis curve required.

If your Optimod has a serial number below 700000, you must install sockets for the EQ modules before converting to the RET-042.

These sockets are available as Orban's RET-033 kits, and should be ordered if needed before attempting to put in the NRSC kit.

In our case, even though our unit's serial number was 680410, we had the sockets already on the #4 and #5 cards, so we avoided some extra work.

Check your unit first, install the sockets if you need them, then simply replace the existing modules with the new blue modules to provide the new HF curve.

To provide ±4.1 VDC for the clipper on the 1S10 card, I had to install two supplied jumper wires onto the back of the Optimod's motherboard. This requires removal of the Optimod's rear panel, following the instructions in the manual.

It's not difficult but must be done carefully to avoid breaking any of the ceramic feedthrough capacitors on the motherboard.

This particular step took the greatest amount of time, about 40 minutes. Once done, I reassembled the Optimod and reinstalled it.

Before plugging in the 1S10 card, compare the jumper settings with the diagrams in the manual.

This card has features used with Motorola C-QUAM AM stereo systems: a single channel limiter, a 200 Hz HP filter (for the L−R channel, when using low frequency SCA or telemetry), and a stereo enhance control, to improve subjective stereo separation.

WNYR is not operating in stereo at all, so I simply defeated these with the card's jumpers. Our LP filtering is hard-jumpered for 10 kHz both day and night.

After installing the card and powering up the Optimod, I made a manual frequency response sweep of the Optimod with our Potomac Instruments AG-51 oscillator. (First, though, I set the HF EQ control fully CW, to the "22 dB" position. This provides the correct HF curve.)

Overall response was flat to about 9.6 kHz, down better than 15 dB at 10 kHz, rolling off sharply above that. Orban's specs call for a 60 dB per octave rolloff—that's sharp!

After restoring normal programming, I listened and found that the second adjacent channel splatter we'd had before was now gone. This was confirmed on different radios at a distance from the transmitter site.

Audible HF response was down slightly, due to changes in the shape of the HF curve, but it wasn't what I would call "bad." It is a compromise we will live with until the new wideband, 75 μs de-emphasized radios are produced. (They *will* be produced, won't they?)

After more than six months of operation with the NRSC conversion kit, there have been no detectable failures or unusual operation.

Installing this kit required minimal effort, and a maximum of 1½ hours work time. The intention was that converting processors to the NRSC standard should be easy to accomplish, and that was the case here.

My opinion is that the NRSC retrofit for our Optimod 9100A/2 was well worth the $500 investment. We are now set to a standard that will eventually provide almost complete high fidelity sound from any AM station.

I say "almost" because it does not permit response out to 15 kHz, but in view of the drastic reduction in second adjacent channel interference, 15 kHz response must take a back seat.

Also, if your audio quality going into the transmitter is not the best it can be, you will sound bad even with the NRSC conversion. It isn't a cure-all for audio problems.

However, with a good audio chain, good source material, and a clean transmitter, the NRSC conversion will be of benefit.

Electrical interference will probably never go away on AM, but sometimes the "monkey chatter" from second adjacent channel signals is much more of a problem, and the NRSC kit *will* eliminate that.

Please consider converting your Optimod 9100A/2 if you haven't done so already. In fact, please consider it no matter what processing you have. It can only improve AM.

■ ■ ■

Editor's note: Randy Orbaker entered broadcasting in 1975 as a board operator and became assistant CE for WNYR in 1977. He was promoted to CE in 1981.

For more information on the RET-042 NRSC conversion kit, contact Howard Mullinack at Orban, 415-957-1067, or circle Reader Service 98. The author may be reached at 716-325-7260.

—Reprinted from **Radio World** *April 15, 1988.*

World Radio History

Orban Enhances Spatial Image

by Frank Foti, Field Spvsr
Malrite Communications

Cleveland OH *Audio processing: the mystical manipulation of audio signals in an electronic manner in order to enhance or reenforce the creative programming of a broadcast station.*

Many methods can be employed by a broadcast station in its efforts to create or control a dominant, distinctive and hopefully a quality sound over the air.

USER REPORT

Until recently, almost all audio processing concepts have revolved around the use of compression, limiting and controlled clipping within the individual stereo channels. Through the use of amplitude level control of the audio waveform for the discrete left and right channels, audio processing is achieved.

Another method of processing that can augment an audio processing system is the concept of "stereo" processing, or stereo enhancement.

This concept can be used to create a larger stereo image, an illusion that the "sound" is bigger than it actually is. Increased brightness, impact and definition of music can also be realized through this process.

Stereo processing is achieved through altering the difference signals that exist between the left and right channels.

As can be done with discrete audio signals, stereo information can be processed with compression, equalization, delay and reverb to create the enhanced stereo effect.

But it should be noted that when processing the stereo information of a signal, undesired results can occur. Within the realm of broadcasting these undesired effects can result in unnatural sounding program material and increased multipath distortion within a coverage area.

Natural sound

The Stereo Spatial Enhancer Model 222A from Orban can and does achieve stereo processing without creating any unnatural sounding program and also without affecting multipath possibilities.

It measures one rack unit high, 1¾", and is very easy to install and operate. Orban recommends that it be installed before any processing within a system.

The stereo enhancement method operates on transient information. For this reason, it should be installed at the output of the audio console.

The unit is configured with electronically balanced input and output stages. The output stage of each channel is an electrically balanced circuit that simulates a true transformer output.

This means that in installations where unbalanced equipment is used, one of the active balanced "sides" of the enhancer could be "tied" to ground with no adverse effect to operation. Connections are by means of a terminal strip, but the metal work has been done if XLR connectors are to be used.

The front panel features an LED enhancement level indicator, an enhancement control and a bypass switch. (There is a stereo ratio control that is located behind a capped recess in the front panel.)

The unit operates at unity gain, so there are no level matching problems to be dealt with.

Once installed, switching the bypass control in and out will activate the processing. Setting of the enhancement control should be done subjectively through listening over periods of time.

The theory used with this unit is that it will not create an exaggerated "echo-ey" sound which may be created when other forms of stereo enhancement are used.

What can be heard is a fuller, warmer sound with greater detail and depth to the overall mix. The stereo separation appears as if there is more "space" present.

On some musical material, certain instruments will actually stand out in the mix. You may even hear other instruments or sounds not heard before within the mix.

Acts on transient information

The technical theory behind the Stereo Spatial Enhancer is an interesting concept. Processing of the stereo information is achieved through the detection of "transient" information within the L+R signal.

This creates a control signal that operates a compressor that controls the level of the L−R or stereo information. Since only transient information is used to "trigger" the stereo enhancement, the added RMS level of L−R energy is kept to a minimum.

For this reason the effects on multipath distortion are either nonexistent or minimal in worst cases.

Actually the L−R level is only momentarily increased to achieve the effect, so multipath distortion is avoided.

It should be noted here that when added RMS levels of signals are present within the L−R channel, the chances or opportunities for multipath are greater.

Some forms of stereo processing utilize equalization or delay to achieve the enhancement process. This can create an unnatural sound due to the exaggeration of existing echo or reverb that exists already on the audio material.

Since the Spatial Enhancer is operating on transient information, existing echo or reverb is not enhanced because of the low transient content of echo and reverb signals.

In general, what has been created is an audio processing device that operates within another "realm" of processing technologies.

The Spatial Enhancer could be the needed edge to help complement an audio processing system. Here is a device that can "keep them guessing," along with an affordable price tag.

Through stereo processing, any audio chain can be augmented to further lock down or dominate your dial position. Now if we were to try and further define a detailed explanation of audio processing, we would all be mystified!

■ ■ ■

Editor's note: Frank Foti has been employed by Malrite Communications for almost ten years, and has been CE of WHTZ (Z-100) in New York, KSAN in San Francisco, and the Home of the Buzzard, WMMS in Cleveland. He has twisted the knobs of a few audio processors in other major markets as well.

For more information on the Spatial Enhancer, contact Sid Goldstein at Orban, 415-957-1063, or circle Reader Service 79. The author may be reached at 216-781-3010.

—Reprinted from **Radio World** *June 15, 1988.*

World Radio History

Orban 787A Tailors Mic Sound

by Chip Morgan, President
Chip Morgan Bdcst Engineering

Sacramento CA If there is one thing that sets a radio station apart from its competitors, it is the sound of its microphones. Almost every other audio source is pre-processed before it gets to the studio.

We all know how important live voice is, so we carefully purchase quality microphones, tune our rooms for "good acoustics," ensure low ambient noise levels and hire talent with "great pipes."

USER REPORT

Historically, outboard mic processing systems have been created from old processing gear that had been removed from the main air chain. After all, not too many stations had the money for state-of-the-art mic processing, much less a separate chain for each air talent.

Now there is a relatively inexpensive answer to the need for custom mic processing—the Orban 787A programmable mic processor, including almost everything you need for great mic audio.

When you think of Orban products, you naturally think of the Optimod (AM, FM and TV). You think of quality audio, attention to detail and good ideas. The 787A is no exception.

I first saw the 787A at its introduction at NAB in 1988. I had already ordered two units based on preliminary specs. The system was impressive with its three-band parametric equalizer, compressor, de-esser, noise and compressor gate including effects send and return ports—all in one 3.5" rack mount unit.

With the 787A, you just play with the controls until you get the sound you want, then store the control settings so you can recreate exactly the same sound tomorrow, next week or next year with just the push of a button.

The 787A will store up to 99 complete setups, eliminating the laborious "tweaking" of a rack full of processing units before each airshift or production session.

The unit consists of the following blocks: a balanced input buffer amplifier, an input attenuator, three peak/dip "constant-Q" parametric equalizer sections connected in series, a gated compressor with selectable noise-gating capability, a de-esser and a single-ended effects-send and balanced return loop with level adjustment.

The final section consists of a line-level balanced output and a separate mic-level output. Every function is completely adjustable on the front panel and all settings are stored in memory. You can even A/B your current setting with a stored one.

The unit provides two types of gating to maximize flexibility and utility. If attenuation of background noise (e.g., cart machine motors or other studio noise) is required, use the noise gate. If the ambient noise level is relatively low, use the compressor gate alone.

Both gating stages can be used simultaneously. The frequency can be adjusted in 10 step per octave increments in the coarse tuning mode. The fine tuning mode provides increments of 2.5 Hz in the low band, 30 Hz in the mid band and 60 Hz in the high band.

Sibilance is controlled with the 787A's built-in de-esser. It reduces sibilance without adversely affecting high frequency brightness. The de-esser follows the compressor and equalizer and corrects any sibilance caused by the prior processing. A threshold control determines the amount of de-essing required for each voice.

Finally, effects-send and effects-return loops allow external processing to be easily inserted, even if your console does not have send-and-return capability.

The 787A comes with standard line-level inputs, and an optional low-noise, low-distortion Jensen transformer mic preamp with 48 V phantom power provides a mic-level input through a rear panel XLR connector.

Other 787A options include MIDI and RS-232 interfaces, which enable programming and controlling of presets from an external source or downloading presets.

At KQPT we installed a 787A in the main production room and another in the main FM control room. The units are installed in the mic send and return circuit of Pacific Recorders & Engineering consoles, and they control the sound from AKG Acoustics 414 condenser mics.

Our units were some of the first out of the factory and were initially determined to be excessively noisy. We left the production room unit installed and bypassed the control room unit, awaiting help from Orban.

A quick response from the factory indicated that we needed to install some caps in the EQ section. During the time the processor was bypassed, the jocks thought it was still in line and continued to use their code numbers. At one point I removed the unit and they clamored for its return.

Each on-air person is assigned a permanent preset number for his or her voice, to be recalled just before air time. This works much better than the usual non-programmable units, which are "compromised" to sound acceptable on all voices but cannot be personalized to each.

Installing and setting up the equipment was no problem. We took each person into the production room and stored basic settings. Then final tweaking was made on the air to account for the main processing's effect on the mic sound. After each jock's settings had been recorded, we duplicated them in the production room for recording straight spots.

We set up the stored parameters in the order of the shifts so that the morning person is 01, midday is 02, etc. That way each person just advances the presets by one when he/she comes on.

KQPT uses the production room unit to set up and recall settings for outside voices as well as specific character voices. Each jock and production person has his/her standard setting as well as several alternates for effects.

The Orban 787A mic processor integrates a unique combination of quality processing functions in a fully programmable package. In one compact unit, the 787A combines all the functions you need to precisely define the sound of your mics.

■ ■ ■

Chip Morgan may be reached at: 916-973-9734. For more information on the Orban 787A programmable mic processor, contact David Roudebush at Orban: 415-957-1067, or circle Reader Service 66.

—Reprinted from **Radio World** *March 22, 1989.*

World Radio History

Adding Zero Improves Optimod

Don Hobson, Eng Mgr
KJQY-FM

San Diego CA A lot of good products do not receive much publicity. One such product is the Orban ACC-22 FM filter card for the Optimod 8100A audio processor.

This product was originally developed by Bob Orban to filter program-induced "trash" above 61 kHz in order to provide a cleaner baseband region for subcarrier use.

USER REPORT

Specifications *are* improved by about 25 dB, but real world conditions tend to negate much of this improvement.

Although crosstalk into the SCA channel is a problem, nonlinearities in SCA transmission and reception actually mask most any audible improvement in baseband crosstalk over a stock Optimod.

Thoughts on the spectrum

To quote from Bob Orban: "As anyone who has tried to do spectrum analysis of an FM station off the air (from a receiving antenna) can attest, the slightest multipath generally puts the 'grass' or 'grunge' level at anywhere from about −50 to −60 dB in the higher baseband frequencies.

"I would think that any improvements in spectrum cleanliness below −70 dB or so fall into the category of not only diminishing but vanishing returns."

Orban goes on to say: "One would think, given the generally lousy off-air measurements that usually result, that FM could not work at all! So much for science . . . "

However, some other, very worthwhile and audible improvements to the main and stereo sub-channel are achieved with this filter card (often referred to as the "slot zero card" because of its location inside the Optimod).

One of my basic complaints with a stock Optimod is that it does not "like" unprocessed live microphones and brass instruments—especially trumpets.

Card replaces safety clippers

Their asymmetrical waveforms produce audible distortion when clipped. The ACC-22 replaces the safety clippers in the Optimod with two cascaded, fifth-order, overshoot-compensated lowpass filters.

Because there is no hard clipping by the safety clippers (which often must be set at a compromise anyway) no annoying distortion products or overshoot are generated. Improvements in stereo channel quality were also noticed when these filters were installed.

So if you would like an inexpensive (less than $600) way to improve the sound of your station, consider the slot zero card. It may be ordered as a factory-installed option on the Optimod 8100A/1 or as a field retrofit kit for existing Optimods 8100A and 8100A/1.

Careful installation and testing should take about two hours. Installation consists of adding a pre-wired connector to the rear rails and soldering the additional wires. Card #0 is installed in the signal path at the output of card #8/9 and the input to the stereo generator.

An audio oscillator and digital voltmeter are needed for proper alignment and the 38 kHz null should be checked.

You will probably notice a slight change in your sound character after installation of the zero card and you may want to make a slight adjustment to your other processor controls. Sometimes you wonder what a dozen more ICs will do in your audio path . . .

But as those who work with FM audio processing know, it is somewhat of a miracle that the modulation needle can be sitting at 100% most of the time and the perception of the listener is that he is hearing high fidelity!

■ ■ ■

Editor's note: Don Hobson may be reached at: 619-238-1037.

For more information on the Orban ACC-22 FM filter card, contact David Roudebush at Orban: 800-227-4498, or circle Reader Service 81.

—Reprinted from **Radio World** *June 28, 1989.*

Otari's MX-50 is a Reliable Workhorse

by S. Parks Hall, CE
WDOD-AM/FM

Chattanooga TN In my almost 30 years as a broadcast engineer, there have been few constants. One, however, has been the presence of the venerable analog (how grand that the technology now has a name!) reel-to-reel tape machine.

It still stands as a versatile, if not indispensable, production tool both on and off the air. Truly nothing, and everything, has changed in the evolution of this blending of electronics and mechanics.

USER REPORT

New studios were completed in early August at WJTT-FM in Chattanooga, Tennessee. Centrally located on the ground floor of the downtown Sheraton hotel, the facility has been designed in its entirety to be one of the city's finest.

But when it came to equipment, this did not mean cost was no object. It meant we were to prudently purchase equipment of contemporary design from manufacturers with proven track records.

Enter the new Otari MX-50. It stands as a prime example of just how far the affordable workhorse reel-to-reel tape machine has come.

Otari's newest offering is built on an aluminum deck plate and is a single unit design. As supplied it is an upright standing machine, which does make the vertical front panel hard to work with. In the future, Otari will offer an optional cabinet to allow the front to be face up. ➤

World Radio History

I know of at least one major equipment supplier, Allied of Richmond, Ind., that offers very inexpensive wood side plates to accomplish the same thing. We used them at WJTT.

Another option would be to purchase a Tascam CS 607B roll-around stand and mount the MX-50, using Otari's ZA5 EK rack mount adapters.

Once the MX-50 was situated in a face-up position, station personnel gave it high marks for ease of use. Its push buttons are large, well marked and have a nice touch. Mechanical action is smooth and precise and there is good access to the tape path.

The MX-50 has a noteworthy list of standard features as well as some very worthwhile options that you do not have to pay for if you do not need.

Just about everything the machine does can be remote controlled via its 32-pin remote connector. Or, for $250, you can purchase Otari's remote control box and just plug it in.

Speed can be varied ±8% from the front panel or up to ±50% with an external sync source.

Welcome also is the real time tape timer, which displays hours, minutes and seconds. It incorporates a search-to-cue locator with one cue point memory, as well as a zero location memory. I am glad to see these "cassette deck" features in a professional reel machine.

Standard speeds are 7½ and 15 ips, although the machine is available with 3¼ ips as an option. Of course, you can select NAB or IEC equalization with a provided switch.

It is also interesting to note that two MX-50 machines are available, the MX-50N (NAB, two-track, two channel) and the MX-50D (DIN Stereo).

A feature exclusive to the MX-50D is its interfacing of the transport play control to switch contacts on the broadcast console fader or some other switching arrangement. Access to this function is through a separate "fader" port on the rear panel.

By far the most fascinating option available on these machines is the Voice Edit Mode (VEM). This requires the simple installation of a VEM-PCB inside the machine. Placing the machine in the VEM speed mode doubles the selected play speed (e.g., 15 ips becomes 30 ips).

However, the pitch of the recorded material during the VEM speed mode remains normal and constant. I see this as a real boon for those who edit lengthy lectures and similar material.

Three MX-50N machines were installed at WJTT—one in the control room and two in the production studio. As of this writing, all have performed flawlessly for several weeks.

A few fast performance checks, such as frequency response, noise, tracking error and the like, were made on all machines before placing them in service. All had survived shipping in good order, and I found that no adjustments to factory settings of heads or controls were needed.

As stated before, operating personnel are very vocal about how much they like these machines. This kind of unsolicited praise is not often forthcoming relative to a new piece of gear.

At a suggested list price of $2495, the MX-50 is a lot of reel-to-reel tape machine. I believe it will quickly become an oft-seen item in stations across the country.

■ ■ ■

Editor's note: S. Parks Hall, in addition to his duties as CE at WDOD, works as a contract construction engineer at several stations including the aforementioned WJTT. He is an SBE-certified senior broadcast engineer. He may be reached at: 615-265-9494.

For more information on the MX-50 recorder, contact John Carey at Otari: 415-341-5900, or circle Reader Service 99.

—Reprinted from **Radio World** *September 27, 1989.*

QA-100 Knows What You Hear

by John P. Bisset, CE
WCXR/WCPT

Alexandria VA The PD enters your office, and describes the appreciable difference between you and the competition. You listen, but can't place the effect you are hearing.

You take a sophisticated-looking instrument off the shelf, plug it in and, after several minutes, determine that the competitor has increased his presence band clipping. Then you set up a chart recorder for longterm analysis.

USER REPORT

A futuristic dream? Hardly. The year is 1986, and the instrument that allows you to peek inside your competition's processing is Potomac Instrument's QA-100 QuantAural Audio Program Analyzer.

There is no doubt that human evaluation of a station's "sound" is the ultimate decision maker; however, with the advent of the QA-100, such evaluations can be augmented with a quantified visual representation of the audio to be adjusted.

Although such a visual description of what a processor does to the audio is not new, Potomac Instruments is the first company to combine several types of audio signal measurement into one product.

In developing the QA-100, PI felt that there was a need for a more complete means of quantifying audio signals than what was presently available to the broadcaster. With today's emphasis on competitive audio processing, PI's QuantAural is right on the mark.

The QA-100 quantifies what the ear hears, and displays this analysis on two types of readouts—a meter and LED bar graphs.

The readouts allow the comparison of a number of different parameters, each of which make up what we know as "processed audio."

Meters and bar graphs

The front panel meter, calibrated in logarithmic voltage, is selectable to display audio based on Peak, Quasi-peak, VU, Average or Intensity levels. Although engineers are familiar with peak, average and VU time constants and sampling methods, the "quasi-peak" and "intensity" measurements may be new terms.

The human ear does not act like either a peak or an average detector. The Quasi-peak mode bases its sampling on ➤

World Radio History

years of psychoacoustical tests.

These tests have placed the integration time of the ear somewhere between 20 msec to 100 msec attack, and 200 msec to 500 msec decay. This Quasi-peak detector follows the reported time constants found in the CBS Loudness Meter (20 msec attack, 200 msec decay).

The Intensity mode is similar to Quasi-peak; however its frequency response is weighted to that of the human ear. The meter indications when operating in this mode would most closely approximate the listener's perception of intensity or loudness.

In addition to the selectable detection described above, the meter can be read in either the wideband or filter mode. A selection from high, presence, mid or low frequency filters can be made.

A series of four LED bar graphs augment the meter by displaying their own set of parameters. The DET (or detectors mode) displays quasi-peak, peak, average and VU levels of the signal being observed.

Although each of these detectors can be viewed independently on the meter, the simultaneous display of these parameters on the bar graphs allows the engineer to compare the average-to-peak ratios of his (and his competitor's) signal.

Audio processing to increase loudness reduces the separation between peak and average values. The net effect is a higher average-to-peak ratio. Unprocessed audio typically has an average-to-peak ratio of −20 dB, whereas some audio processors can tighten this ratio to −10 dB or better.

Peak density and filters

Another useful tool found on the QA-100 is the Peak Density measurement. When operating in this manner, the bar graphs display the percentage of time that the signal exceeds 60%, 70%, 80% and 90% of the peak value. The higher the peak density, the more often the waveform is pushed to higher values.

In order to accurately measure this characteristic, the QA-100 automatically ratios the instantaneous peak value to the wideband peak value over time. Use of this mode is broadened by selecting the insertion of one of four filters that will display where the peaks are occurring.

Like the filters for the meter, these filters are also front-panel-selectable, and provide center frequencies for the following bands: bass, 100 Hz; midrange, 450 Hz; presence, 2 kHz; highs, 9 kHz.

Since tonal enhancement is often used to make a radio station sound louder or brighter, analysis of each band of this "bar graph real time analyzer" is invaluable.

Simultaneous stereo display

Although "stereo" information is available on modulation monitors, the flexibility is not. The QA-100 displays L+R, L−R, and separate L and R simultaneously on the bar graphs.

Not only are cart machine azimuth problems easy to spot, but so are the stations that process their L−R separately.

By switching from the Peak, Quasi-peak, Average, and Peak Density modes while viewing the stereo bar graphs, a detailed picture of the processed signal develops. Perhaps the most useful data displayed by the QA-100 is "what you are buying" by twisting the processor's knob. With the QA-100, processing tradeoffs can now be seen as well as heard.

Simple operation

In spite of the multitude of functions the QA-100 can perform in a broadcast setting, its operation is simple and straightforward.

Selection of the modes of operation are reinforced by back-lit descriptors on both the meter and the bar graphs. The backlighting of the descriptors change as the particular function knob is changed. By reading the lighted descriptors under either the meter or the bar graphs, a quick determination of what one is viewing can be made.

Uses of the QA-100 are endless. It can be used not only in analyzing processed audio, but in troubleshooting problems in your own plant.

—Reprinted from **Radio World** *January 15, 1987.*

QA-100 Knows What You Hear, Part 2

Alexandria VA During the initial development of the QA-100 QuantAural Audio Program Analyzer, I was permitted to join the engineers at Potomac Instruments while they tested it. The purpose of these tests was to assess the usefulness of the device in analyzing commercial broadcast stations.

USER REPORT

Although many tests were conducted, perhaps one of the most interesting—and most appropriate for the instrument—was that of comparing the processing of various stations in the Washington, DC market.

Some of the results of these observations follow, as a followup to the last article which described the basic operation of the QA-100. I hope to share my experience that the QA-100 is a useful tool to keep one's own audio in shape and at the same time give the engineer a glimpse of what the competition is doing.

With the LED bargraphs in the wideband detector mode, a visual representation of peak to average programming can be obtained. A comparison of the three major Top-40 stations is displayed in Table A.

These readings were taken from the average of several measurements at different times (although, due to the large amounts of compression employed by each station, the results were nearly constant).

From the Table, station C has the tightest peak to average ratio. However, it is interesting to note that station A, with a little more dynamic range, was clearly the loudest (INT), and its peaks were "brick walled" at 0. Stations B and C displayed a little more range of peaks.

The compression levels (comparing the peak to average) are nearly the same, leading some in our group to speculate that all three were using the same type of processor, set up nearly identically.

When switching to the filters mode, an even more interesting picture developed. The real-time spectrum analyzer showed both low and presence boosting for station A. Station B displayed ➤

World Radio History

only high boost, and station C boosted only the presence band.

In the stereo mode, the L, R, L–R, and L+R signals were viewed. Station A demonstrated abnormally boosted highs in its L–R. Station C reflected a more even, "normal" frequency distribution, and station B displayed some presence boost in the L–R signal.

tune right past it.

In addition to "spying on the other guy" the QA-100 can be used to set up the stereo in the PD's office. Since multipath problems are heard first in the higher frequencies such as the SCA and the L–R information, orienting the FM antenna for the best L–R as displayed on the bargraphs will ensure a clean signal.

Table A.

Station	Peak	Average	Peak Range	QPK	INT
A	0	-15	0	-5	-8
B	0	-14	-1 to 0	-5	-9
C	0	-13	-1 to 0	-5	-10

Although the QPK (quasi-peak) values for the three stations were the same, the INT (Intensity) or way the ear perceives loudness clearly identified station A as the winner of the "loudness war."

Further analysis showed another station with commercials of a higher peak density than the music. The QPK (quasi-peak) level of the spots was consistently 3 dB higher than the music. Two other stations, obviously employing separate processing chains for the commercials and the music, demonstrated the opposite.

In another instance, a station was observed processing its L–R to the point that it exceeded the L+R most of the time. One of the easier listening stations also insured there was plenty of L–R, perhaps in an attempt to give the listener the broadest of stereo images.

Throughout the tests, peak to average ratios of –9 dB were found to be the point beyond which the audio was ripped to shreds. Two stations—both country—approached this level. Hot on their heels was another easy listening format which averaged –11 peak to average. This was interesting, given all the talk about listener fatigue.

Still another station chose to L–R process the mike only, with an interesting effect both on the air—and displayed by the QA-100.

Classical station A's stereo performance seemed to lag behind that of B. But one had to wonder, was the apparent lack of processing their attempt to attract the audiophile?

Two of Washington's urban stations were compared, and their differences were like night and day. Station L was a good 5 dB below station M in peak to average ratios. In addition, its peak density was such that at times, you could

When adjusting your own station's processing, the QA-100 can permit you to listen to clipping artifacts by switching to the high-pass filter mode. This ability to "slice up" the audio band is an engineer's dream.

Another unusual application of the QA-100 is that of grading your jocks' voices. Measuring the raw voice at the console output and observing the peak to average ratio will demonstrate the "gutsiness" of the talent. If a voice is very assymetrical, and its peak to average ratio is in excess of 25 dB, it will be more difficult to process.

It has long been known that by getting the average up through fast compression, density will be increased. A problem, however, has been the LF distortion.

Multiband processors have countered this by varying time constants in different frequency bands. The QA-100 can display the peak to average ratio of each of these bands, allowing the engineer to study the effects of different time constants on the peak to average ratio of that particular band.

In viewing the stations here in Washington, it was very apparent that there are as many different approaches to controlling modulation level and "sound" as there are stations in the market.

Just as apparent was the excellent "edge" the instrument gives—not only to supplant paranoia, but to evaluate the overall processing effectiveness of your station.

■ ■ ■

Editor's note: For more information, contact Dave Harry at Potomac Instruments, 301-589-2662, or circle Reader Service 61. The author may be reached at 703-683-3000.

—Reprinted from **Radio World** *February 15, 1987.*

QEI Produces Power at WAWZ

by Ron Habegger, CE
WAWZ-FM

Zarephath, NJ QEI Corporation has been in the low-power transmitter business for years, serving the Class A's while the Class Bs and Cs came to know QEI through its other products such as the Model 691 modulation test set and 675/695 exciters.

USER REPORT

Many of you may have upgraded your old Gates FM 10s and 20s with QEI exciters. Now QEI has decided to take on the big guys by offering a triode version of the 20 kW-30 kW transmitter.

WAWZ recently replaced its 20-year old, eight-bay antenna with a new four-bay ERI in order to better cover the hills of New Jersey and to penetrate the concrete jungle of New York. It required a new transmitter that would provide 20 kW.

WAWZ's GM decided to place an order for a QEI FMQ 20000B and no one has since questioned him on that choice.

Smooth Installation

Installation was so straightforward and logical that only a terminal number listing was needed in order for the remote control to be connected. The RF plumbing was bolted into place. Wagers were then placed as to which way the ➤

World Radio History

blower would turn when the three-phase was applied. That was the only guesswork needed.

For stations with very remote transmitter locations, QEI offers a single phase 30 kW version of the transmitter, an option many manufacturers will not even discuss.

The complete transmitter is built into only two 24"×30"×76" cabinets without internal crowding. The power supplies, mains connect and breakers are in one cabinet while all of the RF, audio/remote connections and control circuits are in the other.

Where's the beef

QEI has provided plenty of "beef" in every aspect, from a heavy gauge frame to handle the gross weight of the plate transformer to large gauge wiring to handle the years of stress and thermal fatigue.

Some wire runs were "triple wired" for added safety margins and reliability. We all like to see neat wire harnessing and shiny solder connections with no flux left behind, and this transmitter gives you a feeling of security just by looking at its interior workmanship.

We have been spoiled lately with lots of meters on the new transmitters, and we get nervous about any part of the machine that is *not* metered. QEI provides metering of powers (forward and reverse) between all amplifier blocks as well as metering of most currents and voltages. These meters are all clustered on the control panel and are certainly large enough to read.

There is also a fault display, updated by the processor, that holds an indication in memory even after a remote reset is initiated. This allows the engineer to take a look at the fault on a later visit to the remote site.

It is important to note that the QEI ARC-27 remote control package *will* allow remote displays of fault conditions. But because this station elected to keep its Moseley MRC-1600, and QEI provides no status outputs in its standard transmitter, we are out of luck on that point. It is the only compromise that must be lived with until QEI updates that area.

We chose the well-known 695 exciter, which has such wonderful specs that the QEI people named it "Transparent Plus." The term is not new to our industry, but it aptly describes the unit's modulation capability.

The station is feeding the 695 with 10% SCA injection at 57 kHz, with virtually no IM distortion and a 15 W output from the 695 feeds the IPA modules. To the relief of this CE, there are no trimmer caps to play with.

If all of the above were not enough, what really makes the FMQ 20000B unique is its grounded grid PA design. Most manufacturers in the past have shied away from this time-proven technique because they say it is less efficient. Our PA is running at this very moment at 68%. That's not too shabby.

Sacrificing 5% efficiency for a more wideband amplifier and using no tricky neutralization schemes make good sense. For example, there is no way one can mess up the cavity tuning when bumping around in there with the dust buster. Adjustments to the PA input and output (input via control knobs; output motor driven) tuning and loading are all that is needed to tune this transmitter.

We must credit QEI also for sending representation as promised for the initial turn-on after installation was complete. Some quick checks showed the synchronous AM noise to be −47 dB and asynchronous AM noise at −53 dB. The second harmonic was suppressed greater than 83 dB.

QEI's design engineers deserve much credit for providing a rock solid and very clean grounded-grid transmitter. They have convinced us that QEI can produce power!

■ ■ ■

Editor's note: Ron Habegger may be reached at: 201-469-0991.

For more information on the FMQ 20000B, contact Jeff Detweiller at QEI: 609-728-2020, or circle Reader Service 93.

—Reprinted from **Radio World** *November 22, 1989.*

Mark Tames Deer Point Terrain

by Tim McCartney, Dir Eng
KBSU-FM

Boise ID Use the eight-foot antennas and noise will not be a problem! Good advice for a new STL installation for which a smaller size might have been adequate. KBSU chose eight-foot, P-9A96G-1 Mark antennas to connect its 10.7 mile STL hop at 946.5 MHz in April, 1988. And noise has not been a problem.

USER REPORT

This design of grid parabolic antennas covers 940-960 MHz and is constructed of a hefty welded aluminum pipe. Its radiator's active element is protected by a teflon feed housing. VSWR is 1:3:1 or better on this model, although Mark provides a lower reflected rating as an option.

KBSU's Marks are non-pressurized and not equipped with de-icing elements, although such options exist. The receive antenna, located at an altitude of 7200', has yet to cause any signal degradation, despite many occasions this past winter when several inches of snow and ice had accumulated.

The system's STL path analysis, from the RF Specialties STL computer program, calculated 38.5 dB of fade margin, which is sufficient to guarantee a reliable signal. My experience over the past year has proven the prediction true.

For its part, antenna gain for the eight-foot Mark is +25 dBi. Since the six-foot antenna would not have provided as much fade margin, the next largest size was selected for maximum performance.

In fact, sufficient receive signal was not the concern. Rather, receiver attenuation may have been necessary to avoid front end overload. Certainly a receiver preamp was not needed! And, as it turned out, neither was an attenuator.

The two Mark antennas arrived packaged together in a wooden crate about two feet by eight feet. And, since both transmit and receive antennas are identical, there really was no selection process.

The receive antenna, to be placed atop Deer Point Mountain, was prepared for the journey to the top. It was fastened down to an eight-foot wooden spool containing three-inch transmission line.

On the mountain, the antenna was installed to a 4.5" outer diameter (od) mast, which contains plenty of wind loading capacity. For example, a 3.5" od ➤

World Radio History

pipe is rated at about 125 mph. The antenna itself is rated for 125 mph winds, with one inch of ice.

Besides, there must be at least 15 different eight-foot grid parabolic antennas on the mountain. So there was little concern about wind loading.

The receive dish was aimed down to Boise State University, and the transmit unit was installed on top of the four-story campus library building, with assistance from a crane hauling it to the rooftop. Mounting was to a two-inch mast fabricated by university personnel.

The FCC license called for 56.5° azimuth. The main lobe was easily located by aiming the transmit antenna for maximum received signal strength on the mountain.

The licensing for horizontal polarization determined the orientations of both transmit and receive antennas.

Since the system worked perfectly, we elected not to conduct one test that is normally advisable: that of reflected power at the receive antenna. This requires use of the STL transmitter feeding the receive antenna to check for VSWR. Such tests must be careful and brief in order to avoid interference, since the FCC only licenses one transmission location.

Other miscellaneous specs on the Mark product include: half power B/W of 8.7 degrees; F/B Ratio, 29; cross polarization discrimination response 40 dB; and impedance of 50 ohms.

The Des Plaines, Illinois company is no stranger to trade shows, so it is easy to learn more about their products. Mark Antenna's complete line is summarized in a bound booklet for RF users.

All in all, no problems and excellent performance have been the results on both transmit and receive sides. And KBSU is most pleased about a low noise floor, especially during classical music programming.

The crowded 950 MHz aural STL band in Boise is often a source of trouble, but not for KBSU. A good system and some planned "overkill" from the eight-foot Mark antennas make the difference.

■ ■ ■

Tim McCartney holds a Master's degree in Human Resources Management, is a former radio GM and is certified by the SBE as a Senior AM/FM engineer.

For more information, contact Mark Antennas at: 312-298-9420, or circle Reader Service 90.

—Reprinted from **Radio World** *May 24, 1989.*

WKSZ Takes Requests with Telos

by Douglas W. Fearn, CE
WKSZ-FM

Media PA For years our air studio had little need for a telephone interface—until, that is, an all-request oldies show was added to our weekend schedule. During this program virtually all of the audio was done live while the disc jockey was on the telephone with a caller.

At first we used a standard telephone interface unit, but it soon became apparent that something better was needed. The amount of DJ audio appearing in the telephone output was intolerably high and the adjustment of the hybrid null was a compromise, especially with the 800 lines we used for the show.

USER REPORT

To minimize the leakage in the hybrid, the level sent to the caller had to be kept quite low, which hindered communication because some callers could not hear the DJ clearly. Some calls were good, but others were unusable.

After a little research, I concluded that stations using Telos' digital hybrids were all pleased with the results. We arranged to have a Telos 100 delivered to us for evaluation.

Telos makes two digital hybrids: the Model 10, designed for multiline use, particularly with key sets; and the Model 100, for applications that had either a single line or an electronic phone system providing a single line output.

We chose the Model 100 for use with our AT&T Merlin telephone system. The 100 also had somewhat better specs than the older Model 10.

True digital audio

Many electronic devices boast of being "digital" these days, even home appliances. But the Telos 100 Digital Hybrid is truly a digital device.

The caller audio is converted to digital and processed as a digital signal before being converted back to analog. Automatic gain control, noise gating, equalization and the hybrid functions are all done in the digital domain. The audio is sampled at a 16 kHz rate, with a full 16 bits of resolution.

And, as in most better digital audio devices, 2× oversampling is used in the D-to-A conversion to make the filtering side effects less obvious.

As each call is picked up, a 400 msec burst of white noise is sent down the phone line. The burst is used by the Telos circuitry to analyze the impedance of the phone line in use and to null the hybrid for that line.

During this time, the audio output to the studio equipment is muted, which will also mute any pops or clicks generated by phone system switching.

This burst of noise is not very obvious to the caller, and when I listened to it I didn't find it at all distracting or annoying. In addition, the unit analyzes the line during the conversation and continues to fine-tune the hybrid.

The results are amazing. With a decent telephone, a caller can sound nearly "studio-mic" in quality, while the announcer's microphone feed to the caller is quite loud and easy for them to hear. The amount of DJ feedthrough in the caller's audio is also very low—over 40 dB down, according to the Telos specs.

Installation was fairly simple. The basic connections are easy: XLR connectors are provided for the send and caller audio. Two caller audio outputs are provided, each with a level control.

The telephone line connects to a standard modular jack (with another jack for a telephone instrument loop-through, if desired). We use one output to feed a reel-to-reel machine; the other goes to a console input.

Remote switching

Remote on/off switching was more complicated, however. The Telos requires ➤

World Radio History

a momentary closure at the beginning of each call to tell the unit to re-adapt. In our situation, all phone calls are taped, so a console on/off button isn't necessary.

I have tried to find a reliable pulse in the Merlin telephone (or in the AT&T General Purpose Adapter we use to extract an output of the phone line selected), but have had no luck so far.

So for the time being, a small push-button in a box next to the telephone must be pressed at the beginning of each call, an inconvenience that I hope to remedy soon.

But even when a call is picked up without the noise pulse being sent, the Telos adapts to the new line adequately within a few words.

Since only a portion of most of the calls are actually aired, this works out pretty well. In counterpoint, however, when no line is selected, the Telos "hunts" for an adjustment and is way off by the time a line is finally present.

Setup adjustments are few and simple. A coarse null, the desired amount of caller expansion (which reduces the caller level when he or she is not talking) and the degree of override (caller ducking) are all set.

These last two adjustments are made with front panel knobs and are so easy to understand and use that we have encouraged the operators to experiment with the settings.

Three LED meters on the front panel indicate the audio input level, the amount of gain reduction on input or output and the audio output levels (switchable between the two outputs).

Clear instructions

The Telos manual is excellent. In these days, when "unscrew when remove cover" is typical of the language used even in manuals for professional equipment, it is refreshing to find a book that is not only written in standard English but is also entertaining and highly informative.

A very comprehensive section on telephone systems theory is included in the manual, which is the first such explanation that I have ever read that actually made sense.

The Telos 100 has vastly improved the sound of our all-request oldies show—not only on the air but also in the callers' minds, since they can now hear the DJ on the phone much better.

■ ■ ■

Editor's note: Doug Fearn is a frequent contributor to **RW**. *He may be reached at 215-565-8900.*

For more information on the Telos 100, contact Steve Church at Telos, 216-241-7225, or circle Reader Service 95.

—Reprinted from **Radio World** *October 15, 1988.*

Verda Zaps Lightning Strikes

by Rob Meuser, Pres
Int'l Bdcst Support Services

Hamilton Ontario CANADA It is difficult to attribute a lack of lightning hits to technology when it may well be simple good luck. Only time reveals the real truth in such matters. But if stations with a history of lightning damage install lightning deterrent systems and the damage is suddenly reduced, then the system apparently must work.

Lightning protection systems, like the one manufactured by Verda, all work on a similar principle: namely that a continuous "draining" of static electricity must take place before the charge is big enough to become a lightning bolt.

USER REPORT

Such systems depend upon a large number of small points, which, being both quite sharp and at the top of the tower, cause static discharges to begin at voltages much lower than the normal amount required of a lightning bolt.

Tower charge equal to cloud

It is not too unlike having thousands of little lightning rods at the tower top. This draining process eventually causes the tower to assume a charge that is the same as a threatening cloud, thus repelling further discharges.

Any serious company marketing lightning protection has a file of case histories where there have been great improvements at a certain client's installation. The difference betweeen them, in my opinion, comes with the physical form the various systems employ to perform their functions. On this criteria Verda ranks highly.

The Verda lightning protection system takes the form of a ring of spikes of approximately the same diameter as the tower's cross section. The primary virtue of such a system is that it greatly reduces tower loading and installation costs. Compared to some other systems, Verda can provide the same protection with much less mechanical loading.

Some pointers for dealing with such lightning protection systems: remember that static electricity is being drawn to the tower when the system is working, so a good static drain is essential; guy wires should be treated separately for static draining and arc gaps should be properly set.

(An interesting aside about arc gaps: there are vacuum devices available that more sharply define arc over voltage than an ordinary air gap does, and they are worth adding to any system.)

The real question

But the real question is: does the Verda, or similar systems, work? Having dealt with such systems in new installations, I can only say at this point that several 50,000 W installations with up to 9450' towers have operated for over five years without any hits.

These stations are in exposed locations where one would expect some lightning strikes. But, as I indicated at the beginning, only those stations that have a history of lightning damage and then go on to install such systems can claim with any certainty that system's effectiveness.

In the case of Verda, the overall economy of installing their system makes it a must on any tower installation.

■ ■ ■

Rob Meuser may be reached at: 416-526-8200.

For more information on the Verda lightning deterrent, contact Richard Tarney at: 414-961-2185, or circle Reader Service 78.

—Reprinted from **Radio World** *May 24, 1989.*

World Radio History

Wheatstone DA Wins Kudos

by Dave Edwards, CE
WNDR-AM/WNTQ-FM

Syracuse NY When **Radio World** asked me to review the Wheatstone SDA-82B distribution amplifier, my first reaction was to wonder what anybody could say about a distribution amp that has not already been said. You put a signal in and get a lot of signals out. Surely there was not much of a story there.

But walking over to our equipment racks and gazing at the stack of SDA-82 B distribution amps bolted in place refreshed my memory as to why I liked this DA so much. So there really was something to write about after all.

USER REPORT

The first thing that gets your attention when looking at these DAs in the rack is their sleek appearance. The color scheme is a refreshing gray and gray-blue instead of the black or beige so common with other amps. The box fits into a single rack space and is about nine inches deep.

What is most appealing is that an active DA will blink at you with green rectangular LEDs. This is part of an innovative level setting and audio presence indicator scheme that I'll describe more fully in a moment.

Across the face plate, just below the individual gain controls, is a write-on strip. This is a very handy feature, for it enables you to label the inputs and outputs of your DA where they can be seen.

After all, we do this for patch bays, why not for DAs? I still have scraps of paper with input/output designations on them taped to my other brands of DAs.

The rear of the unit sports a departure from barrier strips with the use of amp connectors and gold-plated pins. This gives the back of the unit a neat and finished look when it is wired up, and there is a real advantage to being able to move inputs and outputs around with an amp connector as opposed to unscrewing barrier strip terminals when wiring changes have to be made.

As I mentioned earlier, the DA has input and output LEDs on its face plate for the purposes of level setting and of indicating audio presence. When setting up the DA the input LEDs will light up when the input signal is at +4 dB.

Likewise, the LEDs located next to the output controls will light when the output level is at +4 dB. This makes level setting a snap. The LED threshold setting for both inputs and outputs is field changeable, with trim pots for various OVU references if values other than +4 dB are desired.

The ability to check for the presence of audio at a single glance is an excellent feature of this DA. The LED indicators derive their signal directly from the input and output ports, making them true indicators of what is going on in the outside world.

I once had a situation where in one DA all of the LEDs were active except for one associated with the left channel of one of the outputs. The reason for this turned out to be a short at the input plug of a piece of equipment in a studio. In this case the DA turned into a trouble-shooting tool as it alerted me to a problem.

Another time during a remote broadcast over an equalized phone line where the phone line had gone dead (of course, when else would it die?), I was able to confirm the line trouble while still at the remote location by having the board operator back at the studio observe the darkened LEDs of the appropriate DA.

The SDA-82B output controls for each channel feature multiturn pots. If you have set levels with trim pots, where the slightest twist can mean a change of a couple of dB, these multiturn pots are for you.

The smooth operation of the multi-turn pots allows precise level setting to within fractions of a dB. They also are immune to changes of level due to vibraton—tweaking production room levels is no longer a hassle with this DA.

While eight outputs are ample for most applications, sometimes more are needed. Wheatstone has provided an auxiliary input port that is in parallel with the normal input port. This allows you to daisy-chain the input signal to additional DAs if needed.

It is also an elegant way to split a signal without splicing or doubling up on connector pins. The feature can be jumpered in or out.

The electrical characteristics of the SDA-82B are impressive and innovative. The input signal passes through state-of-the-art 5532 amplifiers, yielding a high slew rate and harmonic distortion of only .002%. All inputs and outputs are actively balanced and transformerless, with an input impedance of 10 K.

The common mode rejection is 85 dB at 1 kHz and 70 dB at 20 K with a +4 dB reference. All inputs have a CMMR trim pot for field adjustments should they become necessary. There is plenty of headroom. Clipping occurs at +28 dB and this DA boasts a 110 dB dynamic range. CD anyone?

The frequency response will suprise you. It is rated at ±.5 dB from 20 Hz to 50 kHz. Why the extended range? Wheatstone believes that to have an audio chain in the station that is flat to 20 kHz each piece of equipment in the chain should be flat to beyond 20 kHz to prevent a cumulative roll-off effect, which can occur when each unit in the chain contributes a deficient response curve.

Extended frequency response could be a problem if proper RF filtering were not employed. But Wheatstone uses individual RF isolator networks and common mode RF rejection coils are on every input and output port of the DA.

The bipolar power supply is rugged and straightforward featuring plenty of filtering, trimpots to balance the supplies and a toroidal transformer for hum-field free operation.

Should the SDA-82B ever need servicing, the mother board is easily accessible by removing the top and bottom covers of the box. This exposes both sides of the board and internal parts without having to remove or disconnect anything. There are no stand-offs to wrestle with and no circuit boards to extricate.

The Wheatstone SDA-82B is a DA worth having in the audio chain. Its thoughtful engineering and high quality construcion make it a must.

■ ■ ■

Dave Edwards may be reached at: 315-446-9090.

For more information on the Wheatstone SDA-82B, contact Pattye Bagshaw at 315-455-7740, or circle Reader Service 87.

—Reprinted from **Radio World** *July 26, 1989.*

World Radio History

ADVERTISERS INDEX

Page	Advertiser	Reader Service
21	3M	22
47	AKG Acoustics	—
26	Allied Broadcast	36
57	Altronic	39
49	ATI	45
98	ATI	1
33	Audiopak	8
63	Belar	20
45	Bext	56
99	Broadcast Services	3
100	Broadcast Automation	42
39	BSW	14
101	BSW	27
19	CCA	17
102	CCA Corp.	23
103	Central Tower, Inc.	53
5	Comtech Systems	38
23	Conex	41
22	Continental Electronics	52
62	Cortana	51
43	Current Technology	50
11	Delta Electronics	10
104	Delta Electronics	25
30	Di-Tech	43
9	Dolby	26
7	Eventide	55
44	Eventide	40
2	Fidelipac/Dynamax	37
102	Gentner	35
18	Gorman Redlich	46
46	Gorman Redlich	16
53	Gorman Redlich	60
13	Graham-Patten Systems	33
61	Halland Inc (Henry Eng)	24
29	Hallikainen & Friends	30
105	Hallikainen & Friends	54
3	Harris	28
106	Henry Engineering	13
58	Hnat Hindes	59
58	Hnat Hindes	2
58	Hnat Hindes	34
31	Inovonics	18
107	J.N.S. Electronics, Inc.	19
99	JRF Magnetic Sciences	21
35	McCurdy Radio	58
37	McCurdy Radio	44
106	Moseley Associates	49
55	Motorola	48
111	Multiphase Consulting	29
51	Myat	15
40	Nautel	4
14	Pacific Recorders & Engineering	11
25	QEI	32
108	QEI	7
163	Radio Systems	47
110	SCA Data Systems	31
109	Spencer Broadcast	5
17	Tennaplex	6
52	Titus	12
164	Wheatstone	57

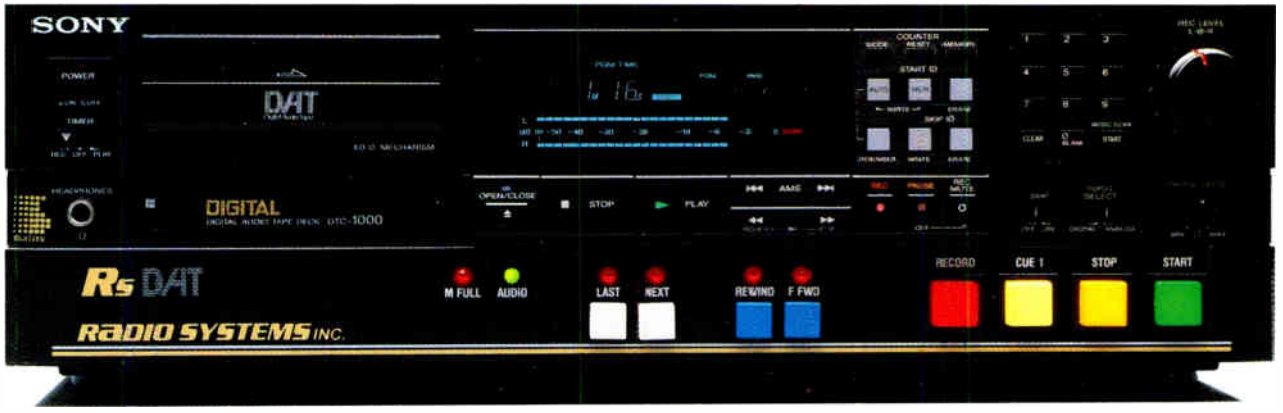
Advertising Sales Representatives:

East Coast, Arthur Constantine: **800-336-3045** FAX: **703-998-2966**

Midwest, Michael Dahle: **914-762-3572** FAX: **914-762-3107**

West Coast, Pat Macsata: **415-786-2198** FAX: **415-786-2754**

World Radio History



DAT was invented for your home. Rs DAT is for your studio.

Other DAT machines only take you halfway.

You need more in your studio than just a DAT machine. You need a DAT machine that can interface to your console and automation equipment. You need a machine with remote control and status information. And you need it to perform like a cart machine - - reliably and quickly.

Meet the RS-1000 from Radio Systems.

The RS-1000 is an integration of the Sony DTC-1000 and a special microprocessor-based controller from Radio Systems. Its features include: □ Full *broadcast* remote control (not a hard-wired remote, like most other machines). □ Rear-panel ports for automation and serial interface. □ Thirty cut, random access memory. □ EOM signals and relay closures. □ Automatic cue-to-cut. □ Cart machine style buttons and dubbing. □ Sampling rates for recording at 44.1 *and* 48 kHz. □ Balanced audio inputs and outputs. □ "Next" and "Last" functions for quick cut re-cue. □ Industrial-grade head life. □ 16-bit linear D/A conversion. □ Logging data. □ Total harmonic distortion < .0055%. □ Optional rack mount.

Imagine recordable digital audio in your automation system or as a live source in your air studio. And with DAT archiving, your entire music library can fit into a briefcase.

Call today for more information on radio's hottest DAT machine, the RS-1000 from Radio Systems.

RADIO SYSTEMS INC.

110 High Hill Road • P.O. Box 458 • Bridgeport, NJ 08014-0458
609/467-8000 • **800/523-2133** • FAX 609/467-3044

Circle 47 On Reader Service Card

World Radio History

"Many of the headaches associated with building a new studio were eliminated with the WHEATSTONE pre-wire package. Set up and wiring of WAZU was a breeze. The furniture is solid and good looking, quick and easy to assemble—many hours were saved. Our jocks love the easy straight-forward layout of the new A-500 air console .. and, after a quick and easy production room installation, little time was needed teaching the staff how to use the new multi-track studio; operators familiar with an on-air console adapt themselves easily to the SP-6 stereo console and the easy ways to insert special effects and audio processing—operation is so simple!"

John Soller, chief engineer at WAZU

Radio is Starting to Experience a Shortage:

Technical Experts

Let our experts supply your prewired studio, consoles, studio furniture and audio system engineering. We'll help with your design, then build, wire, test and document your whole studio furniture installation—all at our factory. This takes a *major* load off your technical people and ensures project completion on time.

When Osborn Communications decided to upgrade member station WAZU in Dayton, Ohio, they chose WHEATSTONE for the job. With 12 rooms of Wheatstone consoles already installed, the Osborn people are well qualified to vouch for our commitment to client satisfaction.

Draw on our experience and reputation. Get a great looking studio with cutting edge performance. Contact WHEATSTONE—the experts!

Wheatstone® Corporation

6720 V.I.P. Parkway, Syracuse, NY. 13211 (TEL 315-455-7740 /FAX 315-454-8104)

Circle 57 On Reader Service Card

World Radio History