Radio Guide

Radio's Technology Magazine

Oct./Nov. 1990

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Radio Guide
- Contents -

Oct/Nov - 1990
Volume 3 Issue 10/11

Cover Photo
WQXR - New York
Courtesy of Pacific Recorders

More After This!

Editorial Comments

Reality or Perception?

Every so often, we are warned of an impending recession. Newsprint and air-time are spent moaning and groaning about tough times and slack sales. Just after everyone has come to believe that this perception may be true, up jumps Gomer. "Surprise, Surprise!"

Suddenly we read that (of course) it was all a big mistake, and that (of course) the financial figures don't support such a notion. But they tell us to watch out -- these figures are dated, and the new ones will most assuredly support the fact that we are in ... guess what ... another recession. What is key here, is perception. Even though perceptions have, many times, little to do with reality, people seem most willing to react to them. If we believe we are there, then we've taken the first step.

Perceptions Become Reality

The afternoon-drive jock had just spent two hours in the production room cleaning up a major client's spot and, the first thing that happens on his shift, the cart deck rolls through the tail end of the spot and ... Burp! ... the next cut is on the air before he can catch it. The client may perceive that your station is unprofessional.

The next thing you know, the GM is barking at your door, wondering what happened. You try, patiently, to explain that you've checked all head azimuths, cue frequencies, and phase-locked-loop cue sensors on every cart deck in the place. Now you've done it! Does the GM really understand about technical adjustments -- does he even care? Should he care? At this point, there may not even be an equipment problem. Yet he may perceive that you are more concerned with explanations than performance.

The GM has only one concern: The spots should run right at the right time. The jock may may have hit the wrong button, the cart deck may need adjustment, the cart may be bad, or the production studio recorder may be out of whack. Even so, he has hired his staff assuming that they will do what is necessary to solve problems as they occur.

So don't tell the GM what you've already done. It obviously didn't prevent the run-through on the air. Tell him what you are going to do -- and then do it!

After you have fixed the problem (or the jock), a nice touch would be to call the client and let him know that you are aware of the problem and are doing what it takes to prevent a reoccurrence.

The GM and the client both had perceptions of the situation. You have taken both of their perceptions and transformed them with solutions.

Solutions & Resolutions

After solving a difficult problem, resolve to learn from it, and adapt any new or different strategies you may have used, to the solution of the next. There is sometimes a strong tendency to revert to familiar ways, regardless of the effectiveness of an innovative approach to a problem.

How do you perceive yourself as an engineer? Just as important, how do you position yourself? If the answer is, "As a manager of one of the four departments in the station, who just happens to be the best at solving technical problems," you're in perfect "alignment."

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All letters and copy submitted to Radio Guide are assumed to be for publication, unless notified otherwise.

RADIOMIXER®
For everyone who thought a PR&E console was out of reach.

You've tried, but your console budget just can't accommodate a Pacific Recorders BMX—not this time. So you're probably thinking about settling for a copy, even though it won't have the standard-setting features, performance and long-term reliability that have made our BMX consoles so successful.

Fortunately, you don't have to settle. Radiomixer is genuine PR&E. All the way from its high quality components to its efficient BMX-style layout, comprehensive telephone mix system and unique Off Line Mix Matrix. Yet its manufacturer-direct price is no higher than the "clones."

How did the PR&E engineering team build a less expensive console without lowering our standards? Let's start with what we didn't do:

We didn't compromise on quality. Radiomixer uses the highest caliber components throughout, including our standard professional-spec meters, faders, and switches. Plus the best-sounding VCA technology in the industry. To keep Radiomixer's cost down, we've limited the number of different module types and mainframe sizes, and simplified the construction of the card frame, mainframe and modules.

The final result? In less than a year, Radiomixer has quietly become one of our most popular consoles. In fact, it's now one of the best-selling boards in broadcasting. Our color brochure will tell you more of the reasons why, and help you configure a Radiomixer for your particular application. To get your copy, call PR&E direct at 619-438-3911.

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Radio Guide Forum

Letters, Questions, Help & Parts Wanted From Radio Guide Readers

Letters to the Editor

CD Tips Comments

Editor:

I feel that some additional comments are due on Ed Sackley's CD tips in the September issue.

As Mr. Sackley points out, it is very important to keep the rails of the player clean and lubed. In most cases, this will cure the problematic behavior. But beware -- on many of the newer models, the "grease" has been replaced by a very thin oil. Applying grease to these CD players will cause all kinds of grief.

In my opinion, any station that expects to do CD direct on the air should invest in a service manual for the unit, and then order any materials for lubrication from the manufacturer.

Here at Power-96, we use two, Technics SLP-999 players and two three year old, beat up, SLP-720 decks that still work great. (we replaced them because of the auto-cue function on the SLP-999's) With the service manual, it has been possible to maintain all of these units in an "on-air" condition.

We even went one step further, by purchasing the Technics test fixture called "servo gain adjuster." It's a neat little box you can connect to any SLP model and check the alignment in a matter of minutes. The unit features three "idiot lights" that tell if the setting is to low, too high, or just right.

Maintaining CD players is not hard or complicated -- if you have the tools and information to do the job properly.

Robert LaFore
WQPW/WVLD - Valdosta, Georgia

Sony CD Jukebox Service

Editor:

A colleague of mine has just provided me with a copy of your August 1990 issue of Radio Guide. In that issue, under the "Signal Source" column, was an article by Art Reis entitled "Tips for the Sony CDK-006 CD Juke Box."

For your reader's information, although Seeburg has a great amount of experience with the CDK-006, they are not a service representative of Sony Corporation. We provide direct, well equipped, service for the CDK-006 in our Regional Service Center at 1200 North Arlington Heights Road in Itasca, Illinois 60143. They can be reached by phone at (708) 773-6037.

I would appreciate it if this information could be passed on to your readers.

Ron Remschel - Service Planning
Sony Customer Service
Teaneck, New Jersey

Help Wanted: Faders

Editor:

Does anyone know where to get parts to rebuild Penny & Giles faders? Auditronics sells the white nylon slide bearings, but I need the conductive plastic and wipers.

Contact: Don Payne, WZPL-FM, 1440 N. Meridian, Indianapolis, IN 46202. (317) 637-8000

Job Offering: Shamrock Communications

Editor:

Seeking Chief Engineer for Shamrock Communications, Maryland AM-FM. Applicants should have strong organizational skills. SBE Certification desired.

Send resume to Mark Timpany, WQFM, 606 West Wisconsin Ave., Milwaukee, WI 53203. EOE

Editor's Notes:

Classified Ads Separate

As you've probably noticed, the Equipment Guide classified ads section has been replaced with a new publication of the same name.

You've asked (more often than I care to remember) that we categorized the ads. So here it is, by category, the most effective "want-ads" in the industry. If you've ever used Equipment Guide to sell your used gear, you know what I mean. If you haven't, give it a try. It works!

Equipment Shorts

The "new" Equipment Guide will also be the place to have your short (paragraph or three) technical tips, hints and kinks published. Dust off your brain cells and your files. Jot down your quick fixes or technical tips and fax them to us at (507) 280-9143. We'll publish them all in Equipment Guide, and we'll pay you $15 for each one.

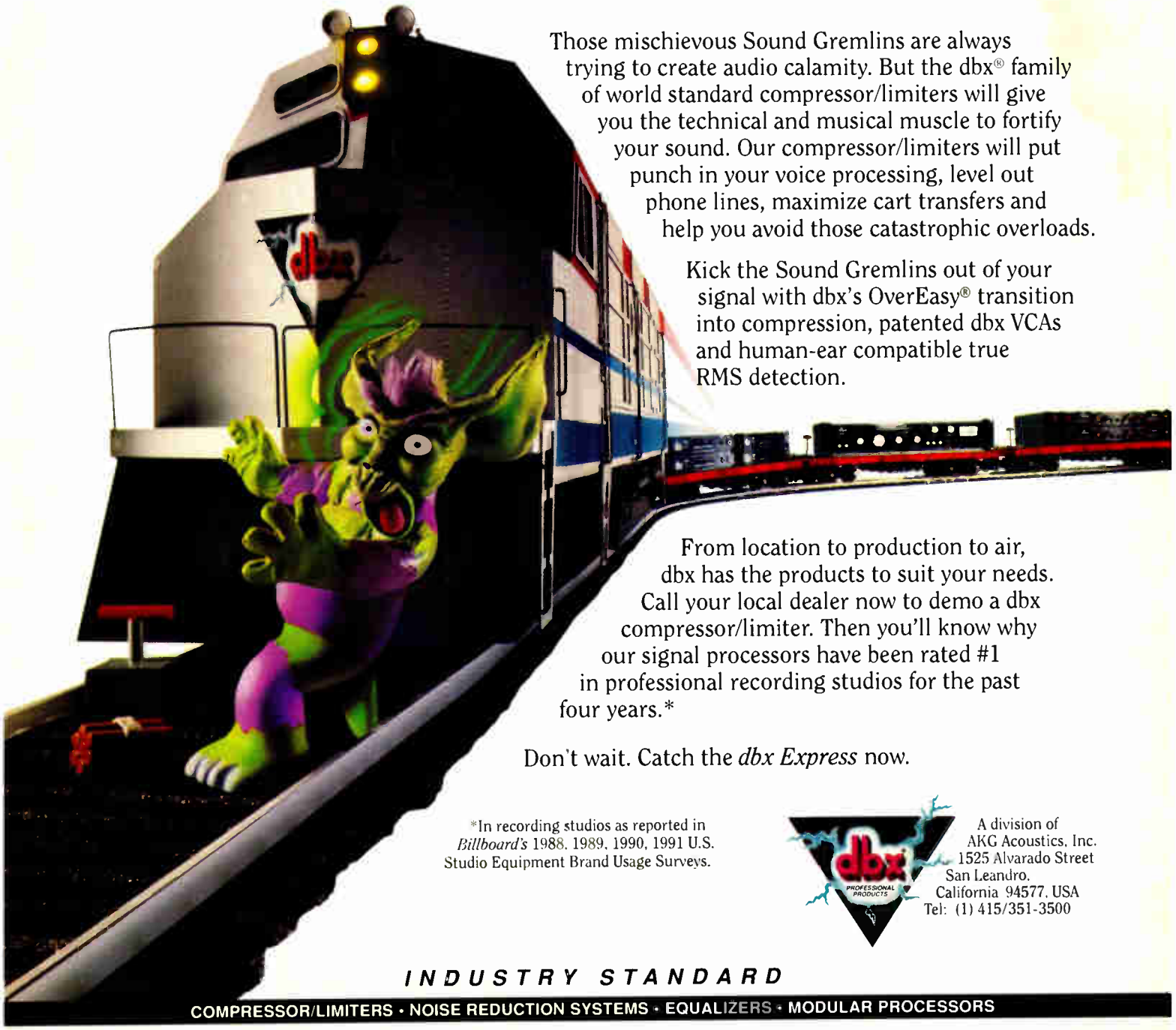
Product Guide Debut

Included in this month's packet of information is the new Product Guide. This new publication will mailed to you, along with the Radio Guide, from time to time.

In it's pages, you will find the latest new products and product information from the Radio broadcast industry.

Ray Topp
editor/publisher

Don't Let The Sound Gremlins Derail You.



Those mischievous Sound Gremlins are always trying to create audio calamity. But the dbx® family of world standard compressor/limiters will give you the technical and musical muscle to fortify your sound. Our compressor/limiters will put punch in your voice processing, level out phone lines, maximize cart transfers and help you avoid those catastrophic overloads.

Kick the Sound Gremlins out of your signal with dbx's OverEasy® transition into compression, patented dbx VCAs and human-ear compatible true RMS detection.

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*In recording studios as reported in *Billboard's* 1988, 1989, 1990, 1991 U.S. Studio Equipment Brand Usage Surveys.

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Equipment & Schematics Wanted

Wanted: Schematic SWTP P.S.

I need a schematic and XR-4194 for a Southwest Technical Products dual tracking power supply. I also need a schematic for a Cobra AN3100 answering machine.

Contact Mark Persons, M.W. Persons & Associates Inc, 402 Buffalo Hills Ln., Brainerd, MN 56401. (218) 829-1326

Wanted: Tech Manuals

Thanks to KAWC (John Gaboury-CE) and KGBT for the information on the Western Electric AM transmitter.

I could use service manuals for an Ampro model CT3548B record/play cart deck with splice finder, and also for a Gates/Harris FMR-88 tube-type AM/FM tuner (manufacturer CALBEST, model 9150).

Contact: Lewis Downy, KRCL, 208 W. 800 South, Salt Lake City, UT 84101. (801) 363-1818

Wanted: CSI Tech Manual

I'm in dire need of a complete schematic and instruction manual for a CSI model T-350F 350 watt FM power amp.

This unit is in operation at a small educational FM school station and is in need of service. Please contact me by letter or phone ASAP.

Contact: Bill Trivilino, WITX-FM, c/o 103 Shadeland Dr., Beaver, PA 15009. (412) 495-6333

Wanted: Broadcast Products Tech Manual

I'm looking for the manual for a Broadcast Products BDI-101DR, the clock for our AR-2000B automation system. I would like to know how to set the network to join.

I'm also looking for AR-52 and AR-72 cards and spare parts for the Broadcast Products AR-2000B system.

Contact: David Quinlan, KWSA, 1415 Lavern St., Klamath Falls, OR 97603. (503) 884-3257

Wanted: ITC Cart Deck

I'm looking for an ITC "Omega" R/P cart machine (mono) or "Omega" (mono) play-only cart deck. Must work.

Contact: James Steele, WKBX-FM, P.O. Box 2525, 20 North Grove Blvd., Kingsland, GA 31548. (912) 729-6106

Wanted: 10-bay Antenna

We need a 10-bay antenna that can be tuned to 105.5 mHz, approximately 500 feet of 3-1/8" or 2-1/4" coax, type accepted STL and Orban 8100A.

Contact: Charles Frodsham, KVSV, P.O. Box 7, Beloit, KS 67420. (913) 738-2206

Wanted: Sono-Mag DP-1

Need a Sono-Mag DP-1 input console and DP-1 brain unit. Must be operational. Will consider entire automation if Carousels are RS-252 models and priced right.

Contact: Truman Hamilton, KHBM, P.O. Box 445, Monticello, AR 71655. (501) 367-6854, Fax (501) 367-9564

Wanted: Ramko Switcher

Need a Ramko ARA-1612CP-1 slave switcher for audio routing.

Contact: Ron or Gene, WRJN/WHKQ, 4201 Victory Ave., Racine, WI 53405. (414) 634-3311

Wanted: Shortwave TX

We need a shortwave transmitter for our world-wide Christian Radio.

Contact: George McClintock, 4647 Old Hydes Ferry Park, Nashville, TN 37218. (615) 255-1300

Wanted: Military Gear

I need a BC-474A receiver/transmitter, an AVT-112 aircraft transmitter, an AVR-20 aircraft receiver, a BC-696/T-19/ARC-5 transmitter, and a Hewlett Packard 606B technical manual.

Contact: Mark Starin, WJYY-FM, 457 Varney St., Manchester, NH 03102. (603) 625-1165

Wanted: Used Studio Equip.

Broadcasting Arts Department in desperate need of used studio equipment donations (tax deductible). We need cart machines, splice finders, turntables, consoles, etc. In short -- all equipment. Please help us help our students.

Contact: Michael Issacs, Broadcast Arts Dept., College of San Mateo, 1700 W. Hillsdale Blvd., San Mateo, CA 94402. (415) 574-6297 or (415) 593-5631

Wanted: IGM Go-Cart

I need a used IGM Go-Cart 42-tray unit, either for spare parts or for use in service.

Contact: Paul Tinkle, WCMT, P.O. Box 318 North Lindell, Martin, TN 38237. (901) 587-9526

Wanted: Orban

I am in need of Orban Optimod 8000a's in any condition.

Contact: Mike Cooney, Broadcast Mngt., 610 N. Kiwanis, Sioux Falls, SD 57104. (605) 336-2706

Wanted: Sparta TX parts

These specific module parts are for use in reconditioning a backup Sparta FM transmitter 660 Exciter. Perhaps some of your readers can provide me with either the used parts by direct sale, or informational leads that might lead to purchase of these parts. The specific parts are:

1) 41-kHz SCA module (G/A part # 001-7563-01).

1) 67-kHz SCA module (G/A part # 001-7566-01) preferably with 5 kHz filter kit installed.

1) 5 kHz filter kit for above 67 kHz module (G/A part # 091-5971-01).

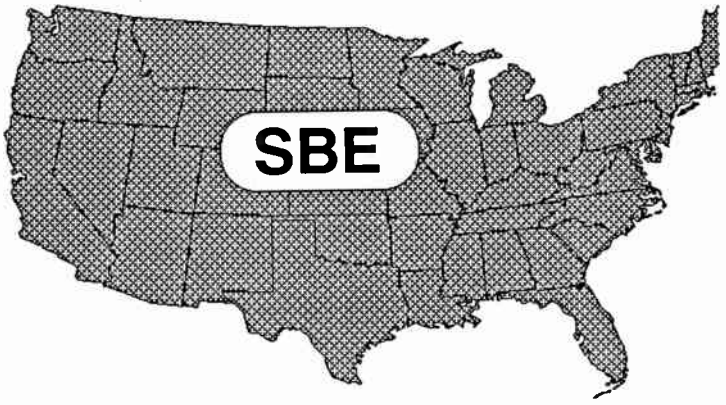
1) Module extender (G/A part # 001-7570-01).

1) DC probe (G/A part # 001-0015-01).

Contact: Melvin Kadle, P.O. Box 291, Fortuna, CA 95540

SBE National News

From the SBE National Office



SBE Supports FCC Position on Auxiliary Operation

The SBE has released information to its Volunteer Frequency Coordinators requesting that they be alert for improper operation of Auxiliary Broadcast Equipment in areas along the Mexican/United States border. The FCC has advised there have been reported cases of improper and illegal operation of such equipment by U.S. Broadcasters along this border.

The FCC further sates that, in addition to being illegal, such operation is also impeding bilateral discussions on spectrum planning and the resolution of cases involving harmful interference.

The SBE coordinators have been asked to advise their local FCC office if any such activity is noted.

SBE Proposes Amendment to the Communications Act

At its October meeting, the SBE Board approved a proposal to undertake a lobbying effort to have Congress amend the Communications Act to require at least one FCC commissioner be an "Engineer." The term "Engineer" would be defined as one holding a "Senior" or "Fellow" status in any nationally recognized engineering society -- such as SBE, IEEE, SMPTE, NARTE, or SCTE, or possessing a four-year or higher engineering degree from an ABET accredited school of engineering, or registration as a Professional Engineer in any discipline in any State.

The SBE believes that an FCC with at least one Commissioner as an engineer would foster the regulatory goal of the most efficient use of the Radio Spectrum.

The SBE expects that its lobbying effort will receive widespread support from other national technical organizations.

Ennes Workshops Successful

The 1190 Ennes Workshops were well attended according to Ennes Executive Director, Jim Wulliman. The nine sessions were sponsored by several companies and the SBE.

Wulliman noted that Ennes attendance was about 20% higher that last year. One session was originally scheduled for 25 people. By the time the workshop began, a total of 67 people were registered. The session, sponsored by Harris/Allied, was the highest attended of all workshops.

SBE officials plan on video-taping at least part of the Ennes Workshops at the 1991 convention in Houston. The tapes will then be used as chapter programs, available from the SBE training library.

Send Your Tech-Tips
To Radio Guide
Fax (507) 280-9143

By Tim McCartney - McCartney Radio Eng.
Bemidji, MN - (218) 751-1680

Leveraged Ethics: Someone Else's Troubles?

The ongoing debate over leveraged radio station buyouts is increasingly being equated with basic business ethics. Specifically mentioned are ethical dilemmas created when repaying enormous debts. While the radio engineering community sometimes feels as if it has been singled out for irrational budget slashing in this environment, programmers and journalists argue the same case. In any case, radio engineering departments were certainly among the first to feel the impact of leveraged buyouts in the 1980's.

Fewer and fewer broadcasters view heavy debt as somebody else's trouble, but rather as a predicament impacting the entire industry. However, not all broadcasters agree that a debt-ridden existence is problematic.

Ethics Merged with Debt

During general discussions of ethics in broadcast management, the matter of leveraged buyouts is consistently appearing.

Radio Group Managers: At the NAB "Radio Only" conference in Boston this past September, a well attended session entitled Tough Calls! Making Ethical Business Decisions featured three radio group managers addressing a variety of ethical dilemmas.

The panel applauded the FCC decision to eliminate the three-year anti-trafficking rule (a decision frequently criticized by engineers). The feeling was that owners should not be forced to hold stations for any set period of time, noting that business ethics are not governed by time alone. A member of the audience challenged this assertion, complaining that station trafficking has degraded on-air programming by depleting funds available for program development.

One panelist responded by citing the two ways to service a debt: 1) reduce expenses (although not much room usually exists for significant cuts) and/or 2) increase funds for programming in order to increase income. He thus concluded that the resulting product from heavily leveraged radio stations is dramatically improved programming. The other two panelists agreed that the best broadcasters are the leveraged ones, citing high listener satisfaction as proof.

Educator: A contrasting point of view comes in "Ethics for Salespeople," by Charles Warner, University of Missouri School of Journalism. Those attending the NAB session were handed copies of the paper, scheduled for publication this November. Warner contends that, in the age of highly leveraged buyouts and takeovers, "ethical values sometimes took a back seat to bottom-line values. New, get-it-while-you-can owners often showed no loyalty to past employees, and employees returned the favor. This erosion of loyalty was often followed by a concomitant erosion of company values and ethics."

Journalist: Veteran journalist Daniel Schorr agrees in general with Warner. The former CBS-TV correspondent of 23 years, now a commentator for National Public Radio, said the impact on the major networks of being taken over by large corporations has not been good. In a July 1990 interview published in a San Jose newspaper, Schorr said "there's enormous pressure on the networks to work off the debt incurred by the corporate purchases of them; this affects the news divisions. Cost-cutting is rampant. Bureaus have been closed: CBS has no Paris bureau any more, never mind Bonn. There's an attitude of 'We can get by.' News coverage suffers as a result."

Business Advisors: Kenneth Blanchard and Norman Peale offer a checklist on ethics in their book "The Power of Ethical Management." 1. Is it legal? 2. Is it fair? 3. What does my conscience say?

Ethics Defined

Before getting back to ethics in relation to leveraged buyouts, more should be said about ethics in general. At the NAB ethics session, the panel focused on legalities and fairness, but did not explore the role one's conscience plays in the mix. However, a member of the audience asked the panel if they agreed that the actual definition of ethics is what it takes to avoid legal trouble rather than what is right. One manager contended that the industry should not do whatever is possible to expand ratings, even if it is legal. Another asserted that listeners are considered first, even ahead of advertisers and corporate ownership, but that profit remains a factor.

In response to the audience question "would you accept cigarette advertisements on an adult radio station if it were legal?" one panelist divulged that, if it were legal, he would do so. And, he added that he would also air beer spots on a youth-oriented station, if legal.

Saints Marched In

When audience research is conducted, there is always a concern that respondents are less than forthright. For instance, greater numbers of people claim to watch public TV than is indicated by actual, on-site electronic rating systems. Likewise, when panelists take the public high road on ethics, the audience may wonder about the differences between their words and actions. Also, curious questions emerge as to whether they are responding in ways designed to please the audience.

(continued on page-13)

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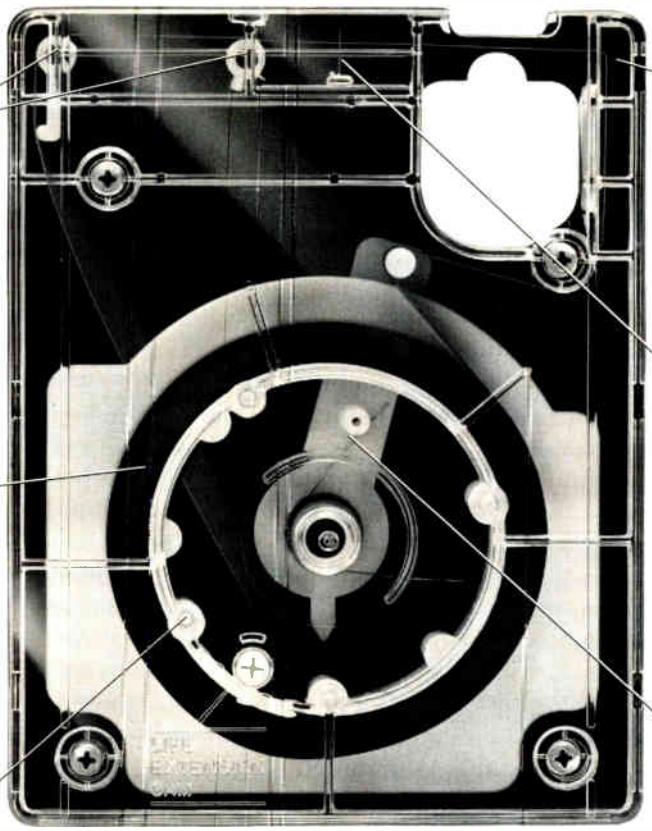

The ITC Cart II Cartridge, formerly ScotchCart®II

Less chance of the cartridge cracking or breaking, because the tough polycarbonate cover withstands repeated use and abuse.

Less head wear, tape steering and modulation noise, because there aren't any pressure pads to add friction.

Less chance of tape destruction, because our patented dynamic tension control system ensures proper tape-to-head contact, and provides constant tension to control looping and prevent twisting.

With broadcast cartridges, like everything else, you get what you pay for. With ITC Cart II cartridges, you get a revolutionary design that delivers trouble-free operation, superb sound quality and a life expectancy that's second to none.

We have renamed the cartridge due to trademark considerations, but only the name has changed, the cartridge and tape are the same. New name, same great cartridge and performance.

For a complete listing of ITC Cart II dealers, call ITC toll-free at 800-447-0414 (in Illinois, call collect 309-828-1381.) Or write to ITC at P.O. Box 241, Bloomington, IL 61702-0241.

Because a cheaper cartridge may be more trouble than you can afford.

ScotchCart®II is a registered trademark of 3M

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CHAIRMEN of the BOARDS

"It's amazing that you can offer a console of that quality for the low price tag that was on it."

"I would recommend the xL SERIES audio consoles to anyone with a small budget who is looking for 'big quality'."

"Congratulations! We believe you've built the most perfect audio console available to broadcast stations."

"We have found that noise and distortion are lower --much lower, in fact-- than audio consoles selling at three to four times the price of the RAMKO XL Series!"

Q92 KLQP-FM

P.O. BOX 70
MADISON, MINNESOTA 56256

January 5, 1990

Dear Sirs:

Just a note to let you know how much we like the Ramko xL62S stereo console we installed in our FM broadcast operation a few months ago.

The audio quality is excellent and our announcers like the ease of operation. It's amazing that you can offer a console of that quality for the low price tag that was on it.

I had one occasion to call your service department for an answer to a question I had on a minor problem and I received some friendly and accurate advice. Incidentally, the minor problem resulted from a severe lightning strike at our studios, the Ramko board survived it nicely!

I would recommend the xL SERIES audio consoles to anyone with a small budget who is looking for "big" quality.

Very Truly Yours,

Maynard R. Meyer
General Mgr/Chief Engineer

WBZM
94.3 FM
Peoria

Central Illinois' Pure Gold Station

April 24, 1990

RAMKO Research
3501 #4 Sunrise Blvd.
Rancho Cordova, CA 95670

Gentlemen:

Congratulations! We believe you've built the most perfect audio console available to broadcast stations.

We've been using an XL Series stereo console for four months with outstanding results. Indeed, your specifications for this console are quite conservative. We have found that noise and distortion are lower-- much lower, in fact-- than audio consoles selling at three to four times the price of the RAMKO XL Series!

Dollar-for-dollar and feature-for-feature, RAMKO consoles are the finest available in broadcast applications.

What sets RAMKO apart, however, is not simply the quality of the product. When problems develop (and with today's complex circuits, it's inevitable), your technicians have provided invaluable assistance over the telephone which has enabled us to make fast repairs.

It appears to us that your competitors spend a lot of money on slick four-color ads, while RAMKO puts its resources to good use quietly developing rugged, dependable consoles. So good, in fact, that our technicians refer to the RAMKO console as the "noise-free" board.

Yours truly,

Bill Bro
President

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RAMKO RESEARCH

Leveraged Ethics . . . (continued)

More specifically: 1. Are the panelists truly ethical people? 2. Do the panelists think of themselves as ethical people, but fall short in practice? 3. Are they just good actors? I found myself thinking about a few other managers in this regard. Had they been on the panel, would they have admitted to the significant ethics breaches for which they were guilty? Of course not. They would have portrayed themselves as true saints destined for martyrdom because of their valiant attempts to hold dragon-like corporate boards of directors at bay.

It is often effective public relations policy to blame someone else, especially an entity as devious as the unseen corporate board. Perhaps we need more Harry Truman-types, who expect the buck to stop with them.

Sainthood Confessed

It is very difficult to believe the suggestion that highly leveraged radio stations produce the best programming. Likewise, a manager who claims to consider what the audience wants, before the needs of corporate management and advertisers, is peddling a left-handed monkey wrench.

I spent seven years as manager of radio stations prior to "going straight" with a switch to engineering. Do you expect me, in this article today, to admit to any ethics indiscretions over the course of those years? Of course not. So, since you insist, my manager autobiography is provided in -- Fable One:

I was the best. -- I always considered the needs of my staff and audience ahead of all other concerns. -- What board? I was popular. -- I listened carefully to my engineers, and provided them the moral and financial resources to be the best in their field. -- I was revered. -- I was always formally introduced at staff meetings, only to be embarrassed by routine standing ovations. -- I was humble. -- I was sought by Ted Turner to manage CBS when he was trying to purchase a more real network. -- I was adored. -- I was asked to join an elite NAB panel making tough ethics calls. It was a perfect choice, since I had been born on high moral ground and had studied psych-oethicsology. -- I believed in love. -- I paid my engineers' SBE dues, out of my own pocket. -- I never met a radio person I didn't like. --

I was sensitive and new-age-ish, but not a yuppie. -- I did not "network." -- I liked old dogs named Shep. -- I thought the FCC and NAB consistently acted in my best interests. -- I believed in faster music, newer equipment, and older managers. -- I appeared presidential. -- I attended engineering conferences in order to learn everything necessary to support my engineers. --

I was a dreamer born and a hero bred. -- I babysat my staff's kids. -- I declined invitations to "power" lunches due to my community service schedule, but I was always invited nonetheless. -- I never appeared in public wearing clothes matching my wife's, to our credit. -- I worked with the SBE in an effort to improve relations between managers and engineers, firmly believing that other managers acted with anesthesia to the typical engineer's psyches. --

I was as sweet as I could be. -- I thought EBS was essential to our national security. -- I never missed visiting a weekend remote to personally thank my staff for giving up their day off. -- I insisted that my engineers be key components to my senior staff inner circle management style. -- I once posted a sign in the control room designed to improve staff morale: "No Dancing Control Room Only." -- I respected religions other than the real one. -- I never liked that joke about routinely increasing staff salaries every Feb. 29. --

I was hurt more than the employees I had to dismiss. -- I reduced broadcast hours on Christmas day. -- I was celebrated. -- I would never have allowed my station's earnings to be squandered on an ill-advised, enormous debt. -- I was a saint. -- In fact, I chaired the national board.

Fable One/McCartney's Manager Autobiography. What do the Easter Bunny and this self-eulogy have in common? There's no such thing as the Easter Bunny and there's no such thing as a manager who is this ethical! Despite the uneasy acceptance that ethical behavior is usually more desired than obtained, it is still worth striving towards.

Short Memories Remembered

Like it or not, short memories prevail. The human brain needs to be constantly reminded of important matters. It should not surprise us when a manager overlooks "little people" while spending much of his/her time negotiating major deals at business lunches. One of my former managers once confirmed just how much he had forgotten about his own past. He had experienced a limited form of poverty when eating macaroni and cheese for five years in order to put himself through college.

Several years later, when Congress was considering raising the minimum wage, he sought my agreement that most people earning so few dollars must actually be second wage earners in their households. He reasoned that since nobody could actually live on so little, another income source surely must have existed. I, on the other hand, had not forgotten as quickly, since I had more recently spent several years during which my wife and I both were in graduate school, broke and deep in debt. But, I too have the same problem remembering brushes with poverty over the long run.

Perhaps management circles have forgotten basic business strategy, which surely must include consideration to balanced budgeting. In a country with enormous government deficits, can these radio industry managers and owners realistically be expected to reach toward higher standards than our political leaders? Yes!

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Ethics . . (continued)

Ethics Stressed

The general discussion of ethics should continue, in the trade publications and at conferences (such as NAB's). Even though some fun is poked here at the dilemmas encountered when speaking in front of colleagues, the recent NAB ethics panelists are to be commended for taking such public risks for the greater good of the industry. It is unclear if the FCC anti-trafficking three-year ownership rule will ever be reinstated. While there is some truth to the argument that management ethics are not tied to the length of time a station is owned, the notion that a leveraged station is the best station belongs back in Fable One. Evidence overwhelmingly suggests that leveraged stations are choosing to cut expenses beyond the bone rather than boost program support.

Too many radio engineers have seen their physical plants reduced to pass-fail operations, supported by no preventative maintenance, and encouraging major breakdowns. It is clear that our programming and news colleagues concur with the level of damage caused by servicing large debts. Curiously, only managers appear to see advantages to co-existence with such debt.

Engineers can provide management with encouragement to do what is right by making ethical choices. The definition of ethics is certainly not just what is legal. Meanwhile, engineers must remain ethical themselves professionally and personally. Even when the system itself veers out of control, it remains appropriate to perform ethically. The risks being taken, in our industry, are frightening. A future economic downturn will be hardest on those with the greatest debts. The impact of large numbers of leveraged radio stations going under in a recession would be widely felt, increasing the likelihood that many engineers will lose employment and/or contract work. In any case, winners will be impossible to find.

Somebody Else's Troubles?

The final words are from the late Chicago songwriter Steve Goodman. "And I saw the boss come walking down along that factory line, and he said we all have to tighten up our belts. But he didn't look any thinner than he did a year ago, and I wondered just how hungry that man felt. But he knows it ain't too hard to get along with somebody else's troubles, they don't make you lose any sleep at night. Just as long as fate is out there busting somebody else's bubbles, everything's gonna be all right. Now I asked that undertaker what it took to make him laugh, when all he ever saw is people crying. First he hands me a bunch of flowers that he'd received on my behalf. 'Said, Steve, business just gets better all the time! Cause he knows it ain't too hard to get along with somebody else's troubles."

Tips From The Field

Equipment Technical Tips
From Radio Guide Readers

ITC Delta Series Lamp Modification

By James Sorenson - WJQY
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This is a modification to the ITC Delta Series cart machines for pre-EOM countdown flashes of the READY LAMP. This feature is activated by the presence of the TERT (8 kHz) tone and is fairly common in station whose formats require tight control of tape segue.

1. Remove relay K102, if it's loaded on the the REPRO card. Since this relay closes under TERT tone, it will just sit there and make noise if you leave it in. If you can stand the noise, don't pull it unless you want to.

It is possible, however, that the additional current drawn by this relay's coil will present some future problems with the collector current capability of the 8 kHz collector output, but I kind of doubt it.

2. Add strap W104 on the REPRO card.

3. Verify that the etched-in-place strap W502, shown on the card as WB, is in place. This is normally not cut except for modifications in which hi-speed cue is not needed. Cutting this will kill the hi-speed cue tone detection. Since this is an etched strap, it's probably intact -- but you should still check.

4. Add a jumper from J519-B to J518-13. These are the chassis connectors for the REPRO and LOGIC cards. J519 is the LOGIC card and J518 is the REPRO card. You can identify the pinning by looking at the overlay diagram in the manual. Be careful of this, as some of it is "backwards" -- you can easily become confused as to which end of the jack you are really on. This is not an error; the diagram is drawn so that the card and drawings appear as "transparent."

What you have accomplished, was to add a jumper between the 8 kHz collector output and the LAMP ENABLE position of the LOGIC card. There is not enough current drawn by the lamp to get this collector into trouble. In the event that you field-change lamps, use a low-current lamp in all those positions.

Follow good practice with your wiring and soldering, as there is not much room on the bottom of the mother-board in these machines. There is a real possibility of burning through the surface coating and shorting things out on adjacent traces.

As long as the TERT tone is on, the READY lamp will be on as well. This change does not interfere with either the SEC or CUE functions and will not interfere with hi-speed operation.

Practical Theory

By W.C. Alexander - Crawford Broadcasting
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Unlocking the Secrets of the Phase-Locked Loop

I'm changing gears this month to shed some light on another technically mysterious topic, the phase-locked loop. In case you haven't noticed, these little marvels are everywhere; there are probably a dozen or more in the simplest radio station. Yet, many station engineers aren't familiar with them and are thus reluctant to tackle repairs to PLL circuits on their own. My intent in this article is to explain a common PLL frequency synthesizer circuit block by block and offer some troubleshooting tips.

The PLL circuit started becoming popular in the late 1970's and early 1980's. Some of the early designs were pretty crude. In fact, crystal controlled oscillators were a lot more stable and trouble-free than some of these early circuits. But beyond the growing pains and infant mortality, the PLL had a lot to offer the communications industry. Some of the advantages of the PLL over the older, quartz crystal oscillator are: frequency agility, low power consumption, stability on all frequencies without many complex temperature compensation components, much lower cost per frequency, digital control capability, and no need for traditional multiplier circuits.

It wasn't long before PLL circuitry started finding its way into broadcast equipment. Manufacturers of STL equipment, exciters, modulation monitors, EBS receivers, and many other items started jumping on the PLL bandwagon and haven't stopped. Many engineers find themselves staring at one of these circuits, scratching their heads, when something quits. How can you troubleshoot it? It's a loop! Trouble anywhere in the circuit shows up everywhere else! That's right, but the PLL can be broken down into discrete blocks, each performing a different function, that can be analyzed separately.

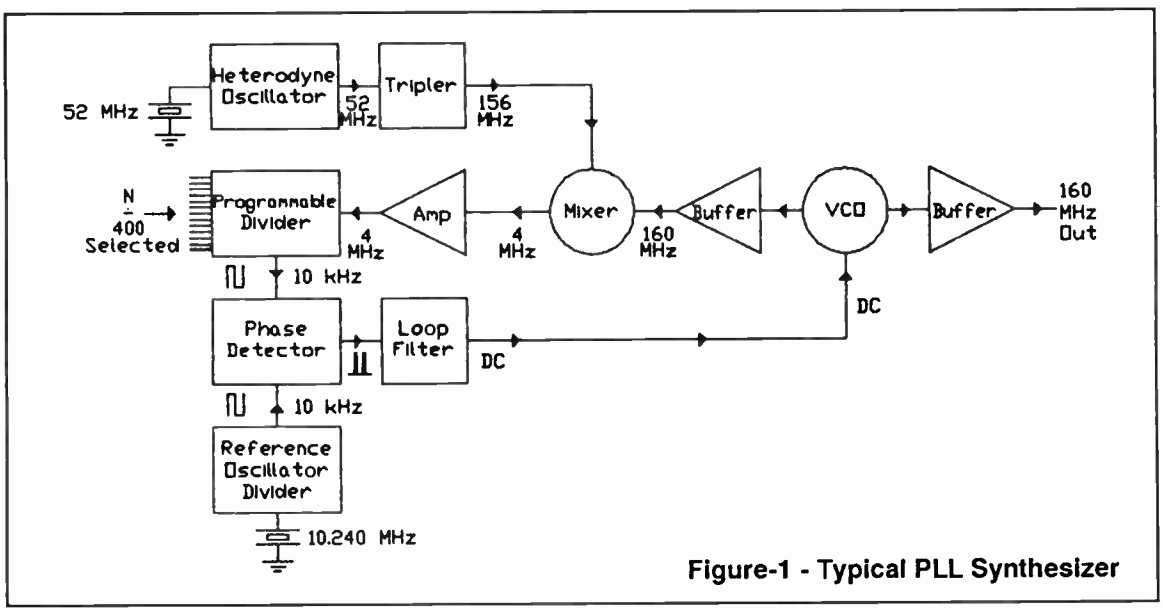

Figure-1 - Typical PLL Synthesizer

Figure-1 is a block diagram of a typical PLL synthesizer circuit for a VHF transmitter. The frequency range is 160 - 164 MHz.

Reference Oscillator and Divider

At the lowest level of the PLL is the reference oscillator. Figure 1 shows a typical reference oscillator/divider circuit. A crystal is placed in the loop between two inverters back-to-back and the result is a simple, but effective, crystal oscillator with a CMOS output level. The output of this oscillator, which typically runs at 10.240 MHz or a fraction thereof, is fed into a fixed divide-by-N divider.

The circuit shown uses a popular IC, the TC5082P. It features several different outputs, including N divide by 512, N divide by 1024, and N divide by 2048. The reference frequency appearing at pin 7 then is 10.240 MHz divided by 1024 = 10.0 kHz.

Using the same crystal, we could have used one of the other divide-by-N outputs to obtain a different reference frequency, such as 20 kHz or 5 kHz. By changing the crystal frequency to 12.800 MHz, references of 25 kHz, 12.5 kHz, and 6.25 kHz are possible.

The reference oscillator and divider set the step frequency for the synthesizer. If it is desired to have a synthesizer that moves in 10 kHz steps, the

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Phase Locked Loop . . . (continued)

reference will be 10 kHz. This is a common step frequency for VHF operations. 25 kHz is more popular for UHF and above.

If the reference frequency is incorrect, at the wrong level, or missing altogether, the entire PLL circuit will not operate properly. Any troubleshooting of a defective PLL circuit should begin at the reference oscillator.

Voltage Controlled Oscillator

The VCO is a free-running oscillator that uses a varactor diode to control the frequency. The circuit is designed to free run somewhat below the lower end of the desired output frequency range. As the DC voltage applied to the varactor increases, so does the frequency. When the voltage reaches the maximum, or "rail" voltage, the oscillator is running at its maximum frequency.

One of the real advantages of the PLL synthesizer is that the VCO can be made to run at the desired output frequency, this in contrast to the numerous multipliers needed to develop a carrier or LO signal from a crystal oscillator.

A VCO circuit will feature some method of adjusting the free running frequency. This is usually a variable inductor or capacitor in parallel with the varactor. The varactor presents a very high impedance to the DC feeding it; very little current is drawn. However, some method of isolating the DC from the RF in the oscillator circuit is necessary. This is usually done with a choke, a resistor, or a combination of the two along with RF bypass capacitors.

The output of the VCO circuit is a high impedance and thus is easily loaded. Therefore, one or more buffer stages are needed between the VCO and other circuits. Traditionally, FETs are preferred over bipolar transistors in VCO circuits, and it follows that a FET circuit buffering a VCO will present a desirable high impedance load.

Before we move on, I should point out that, because VCO circuits are unstable by design, they tend to be quite "microphonic". It is common practice to enclose the entire VCO circuit in a shielded "can" and coat the components therein with paraffin following final adjustments. This keeps the VCO free from stray RF and magnetic fields and keeps the components rigidly together to prevent microphonic effects. For service, it is easy to melt the wax with a heat gun or hair dryer and let it run out. When servicing is complete, let a candle drip wax back over the components.

Heterodyne Oscillator and Mixer

Since programmable dividers generally will accept input frequencies of only up to 20 MHz or so, it is necessary to use a heterodyne "local" oscillator to beat the VCO frequency down to some point within this range. The heterodyne oscillator is always crystal controlled, and a third or fifth overtone crystal is used to minimize the number

(continued on page-18)

Phase Locked Loop . . . (continued)

of multipliers needed. In the circuit shown in Figure 1, the programmable divider works with frequencies in the range of 4 to 8 MHz. With our VCO working in the 160 - 164 MHz range, a heterodyne oscillator running at 156 MHz is called for.

There is nothing special about the heterodyne local oscillator or mixer. Circuits used here are typically run as Class C so as to generate harmonics and multiply easily. The mixer can be any device, bipolar, FET, or diode balanced. However, the use of a dual-gate MOSFET in the mixer stage will present a high impedance to both LO and VCO circuits and thus not load them significantly.

The output of the mixer is a low frequency signal that is amplified and fed into the programmable divider. In the case of our example, this is 4 to 8 MHz.

Programmable Divider

The programmable divider does just what its title implies. The divider shown is a TC9122P, a very popular IC. It features a wide input frequency range and will divide by 1, 2, 4, 8, 10, 20, 40, 80, 100, 200, 400, 800, 1,000, and 2000. Any combination of these denominators can be selected by applying voltage to the appropriate pins. For instance, at our lowest frequency in the example circuit of 4 MHz, a division of 400 is needed. The 400 pin is tied permanently high, the 800, 1,000, and 2,000 pins are tied low. Then, any number from 400 to 799 can be selected with the remaining pins.

The only special requirement for the programmable divider is that its input signal be of sufficient amplitude at all frequencies for the device to operate properly. Generally 2 or 3 volts p-p is adequate. The output is CMOS level, and is fed to the phase detector.

Phase Detector

The phase detector receives two signals, compares their phase, and produces an output pulse width that corresponds to the phase difference. One of these signals is the reference frequency from the reference oscillator and divider; the other is the output of the programmable divider.

If the input from the divider is lower than the reference, the pulse will be wide; as the two signals approach the same frequency, the pulse narrows. A low pass filter is placed in this line on the output of the phase detector to develop a DC voltage corresponding to the frequency difference. This is called a "charge pump" or "loop filter".

A common PLL circuit problem is with the electrolytic capacitor used in this filter. If it dries up, the synthesizer develops a lot of FM noise typically referred to as "synthesizer whine". Early PLL synthesizers all seemed to exhibit high FM noise levels and this characteristic whine was prevalent (Remember the TFT 760 series of EBS receivers?). If the electrolytic becomes leaky, the circuit is loaded and will not function properly.

The output of this filter is applied to the varactor diode in the VCO, thus closing the Phase-Locked Loop.

The TC5081 phase detector IC features a lock detector output that can be used to inhibit transmit or otherwise indicate that the PLL is locked or not locked. This is a handy troubleshooting tool. Most phase detectors have this feature.

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Phase Locked Loop
. . . (continued)

Locking the Loop

When power is applied, the VCO will begin oscillating at its free running frequency, which in this case is 158 MHz. The 158 MHz is mixed with our 156 MHz heterodyne local oscillator and produces a difference of 2 MHz.

This 2 MHz signal is input to the programmable divider and divided by 400. The resulting output from the programmable divider is 5 kHz.

The phase detector receives both this 5 kHz output from the programmable divider and the 10 kHz reference. It compares the phase of the two and finds them to be far apart. A pulse appears at the output which corresponds to this phase difference. This pulse is filtered into a DC voltage of about 2 volts.

This 2 volt DC signal is applied to the varactor in the VCO through the RF filtering components. The capacitance of the varactor decreases proportionally to this voltage, increasing the free running frequency of the VCO.

On the next cycle, all this happens again, except the VCO frequency has now been adjusted by the varactor to the correct frequency of 160 MHz. This is mixed with the 156 MHz heterodyne oscillator and divided by 400 in the programmable divider. The resulting output is 10 kHz. This is compared with the 10 kHz reference in the phase detector and found to be in phase coincidence. At this point, the loop is "locked".

Suppose we change the number on the programmable divider pins to 500. Our 4 MHz will be divided by 500, resulting in an output frequency on the programmable divider of 8 kHz. The phase detector sees that this is lower than the 10 kHz reference and widens its output pulse, raising the DC voltage to the varactor. The capacitance of the varactor is decreased, and the VCO frequency comes up accordingly. By the second cycle following our change, the VCO frequency will have increased to 161 MHz. Subtract 156 and divide by 500 and you get -- you guessed it -- 10 kHz. The higher the number in the programmable divider, the higher the VCO must run in frequency for the difference frequency to divide to 10 kHz, the reference frequency.

Fixing It When It's Broken

As I stated earlier, when a PLL isn't working correctly, always start with the reference. You should see a clean, CMOS level square wave at the appropriate reference frequency.

Next, check the heterodyne oscillator for proper oscillation. A programmable scanner is a handy tool for this. In the case of our example circuit, punch up 156 MHz and you should hear a carrier. FM noise or instability in this signal will appear in the output. Use an RF detector probe to check for signals through the heterodyne oscillator chain if necessary.

With all that working, check to see if the VCO is running. If you don't have a spectrum analyzer handy, use a frequency counter and a "sniffer" probe. Place the probe near the VCO coil and see if the counter reads a frequency somewhere near the right frequency (for VHF VCOs, this can be within 10 or so MHz; double that for UHF VCOs). If the VCO is not running, fix it.

Now start looking from the mixer output toward the programmable divider with a scope. The input of the divider should be the difference frequency of the VCO and the heterodyne oscillator. Check the output of the programmable divider for a pulse train that is the input freq. divided by N, or the number loaded into the divider pins. This signal should appear at the input of the phase detector.

Look at the output of the phase detector with a scope. You should see a pulse train. Check the output of the loop filter with a high impedance voltmeter and scope. It should be a relatively clean DC signal somewhere between 1 or 2 volts and the rail voltage. Make sure that this voltage is getting all the way to the varactor.

Adjustment

There are so many combinations in PLL circuits that it is impossible for me to give a single adjustment procedure that works for every circuit. However, some broad guidelines are applicable to most circuits.

Start with the reference oscillator/divider. If there is a trimmer capacitor on the crystal, adjust it so that the output of the reference divider is the proper frequency to within a few Hz.

Next, go through the heterodyne oscillator chain. Peak all the multiplier coils so that the mixer receives maximum RF voltage from this circuit. Next, adjust the trimmer on the heterodyne oscillator crystal so that the multiplied frequency is correct to within a few hundred Hz.

Finally, monitor the loop filter DC voltage with a multimeter and adjust it per the manufacturer's recommendations. If there isn't any adjustment procedure given, with the highest intended operating frequency loaded into the divider, adjust the VCO coil (or trimmer capacitor) so that the varactor voltage is 10% - 20% below rail. Dial in the lowest frequency and check for a positive lock.

Variations

There are perhaps hundreds of variations on the PLL circuit. Many are microprocessor controlled and utilize large scale integration (LSI) ICs that combine the functions of reference oscillator/divider, programmable divider, and phase detector into one device. Some circuits have even done away with the heterodyne oscillator by using fixed dividers ahead of the programmable divider that work well into the VHF range. A number of PLL schemes operate the VCO at half the intended frequency and double it; these circuits must also operate the reference at half the desired step frequency.

Still, all PLL circuits contain the same basic set of elements. They are fascinating devices that are really quite easy to work on. If the PLL has gone bonkers, somewhere in the loop will be an element out of whack that you will recognize. When you find it, fix it. More than likely, no adjustment or other action will be necessary.

And in closing, don't be afraid to build one of these wonderful devices! I have built several and they all work great, saving the company a boatload on crystals. I don't know how the FCC would feel about you synthesizing your type accepted RPU transmitter, but if the resulting signal exhibits stability that meets specs for the type acceptance . . . .

Station Stories

By Frank Berry - WQYK AM/FM
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Paving the Lot - Bogus Orders - Vacationing in Equador

I will dedicate this months column to "Engineering Stories." Though I am a mere forty years old, I have been a Broadcast Engineer for about twenty-four years. Over that period of time and on a number of occasions, I have found myself in plights that you wouldn't wish on your worst enemy. Here is a synopsis of some of those awful situations.

"We're Paving the Parking Lot"

On a blistering, humid Florida August day in 1968 or 1969, a crew of workmen arrived at the station to pave the small parking lot in trade for several thousand thirty-second commercials.

The studios and transmitters for this station (actually two stations, an AM and an FM) were located in a "bowl" of low-lying, swampy, snake-infested land surrounded by hills on all sides. This location was great for the AM station, giving it a wonderful ground wave but was death to the FM signal. The transmitting tower, shared by both stations, was 130' in height ... The surrounding hills, about 85' in height, confined the majority of the FM signal to a one square mile area within the bowl.

After a long discussion with the foreman of the crew, I warned him about the very swampy land and suggested that he not take his paving equipment outside of the parking lot area or he would get stuck. I also advised him to post a man at the one tower anchor point which was located about ten feet from the edge of the parking lot so as to make sure that the heavy equipment didn't accidentally brush against the guy wires. I then left to take care of some studio problems at another area station.

No sooner had I arrived at the station down the road when the telephone rang. "We're off the air" were the first words out of the telephone receiver. "OK", I said ... "What's wrong?" I will never forget the reply, "The tower fell down and we can't keep the transmitters on!" I was stunned. I advised the jock to completely shut-down both transmitters and said, "I'll be there in a minute."

I gathered my tools, grabbed a roll of RG-58 coax for use as a temporary long-wire transmitting antenna if necessary and drove back to "The Bowl."

He was right. The top 100' of the tower was indeed down, leaving only the first 30' disfigured but standing. The men from the Paving Company had vanished. Only their heavy equipment remained -- parked directly over the anchor point.

I surveyed the situation and determined that with some help, I could get the AM station back on the air within minutes. I called a local steeplejack to help run a piece of RG-58 from the remaining tower stump to a tall pine tree about 150' south of the tower. I asked him to bring a ceramic insulator with him, for the purpose of insulating the horizontal long-wire antenna from the pine tree. He arrived and together we were able to put the AM station back on the air at low power.

We then began digging through the rubble in an attempt to find the remains of the FM antenna system and, hopefully, a single bay that was not too damaged to be used. It was a miracle -- one of the FM bays had sustained not a scratch! The steeplejack mounted it on the top of our 30' tower and the transmission line was connected to the isocoupler (about 40 turns of coax on a coil form) via an "adaptor" which was made from two standard coaxial connectors of different sizes, brazed and taped together.

We held our collective breaths as I pressed the PLATE button on the transmitter, putting a surge of nearly 500 watts into this makeshift antenna of unknown impedance. It worked and the FM station was again broadcasting it's Elevator Music for the entire "Bowl" to enjoy. The parking lot was never paved and the Paving Company crew never seen again.

The Emergency Transmitter

A couple of years after the tower fiasco, while still doing Contract Engineering for nearly every station in the county, lightning struck one of the stations and damaged the external crystal oscillators and buffer amplifier in "Bertha," one of the oldest 1 kW Gates transmitters I have ever had the "fortune" to service. Both crystals had been shattered, the transmitter's high voltage plate transformer was cooked, and the control ladder was smoked. The antiquated transmitter was ravaged beyond any possible hope of repair. The station did not have an auxiliary transmitter.

I called several other area engineers for reinforcement and one of them suggested that we might be able to get the station back on the air if we could build an oscillator and buffer amplifier, and if the Power Company would loan us a pair of single phase high voltage transformers (Back in those days, utility companies were sometimes willing to extend a helping hand to someone in serious trouble). I called Chuck, a friend at the local Power Company and asked to borrow the transformers for a few days. Since Chuck was a Parts Supply supervisor and had previously been the contract engineer for the station, he didn't see any problem. He loaded the heavy Pole Pigs by himself and delivered them to our transmitter room.

Meanwhile, Bill, one of my engineering friends, was attempting to construct a tuneable Hartley oscillator and buffer amplifier to drive the IPA stage of the old transmitter. I asked Bill what I considered a reasonable question: "How are we supposed to keep this baby on frequency with an oscillator that is famous for it's inability to stay on frequency?" Bill suggested that we hire someone to keep their hand on the frequency knob and act as a "HUMAN AFC" while watching the station's frequency monitor.

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Station Stories . . . (continued)

While Bill was working on the oscillator, I began to strip the transmitter of the remains of it's control relays and associated wiring. The only hope of getting what remained of the transmitter back on the air was to bypass the entire control system and direct-wire all circuits to the AC power buss with a HEAVY DUTY switch between the AC supply and the HV plate transformers. By this time, it was nearly 3:00 a.m. The station was to sign-on at 6:00.

Clever work with clipleads, zipcord and anything else that was conductive resulted in a system that was not only homely but dangerous. Fortunately, this electrical hodgepodge was completely confined to the interior of the transmitter. Satisfied that the non-control ladder would conduct electrical power to every circuit within the transmitter, I turned my attention to the wiring of the HV plate supply transformers. It was after 5:00. Bill suddenly appeared from the workshop and pronounced his oscillator/buffer ready for it's maiden test. I suggested that he connect the makeshift circuit to the IPA grid, power it up and hope that the frequency would stabilize by sign-on.

At 5:50 a.m., having completed the high voltage wiring between the external plate transformers, HV switch and transmitter, we threw the circuit breaker to supply power to our creation. All filaments came on, RF drive appeared on the grid of the IPA stage and the audio driver deck began to draw current. After a warm-up of several minutes, I threw the switch supplying power to the HV transformers and the transmitter was on the air.

We made the 6:00 a.m. sign-on and at the advice of every engineer in the building, the station ordered a new 1kW transmitter.

Who Ordered This Equipment?

At one time, I was employed by a 5kW small-market AM station owned by one of the world's most bizarre individuals. The man could be an absolute saint when sober but, when he was drinking (as was often the case), he was totally unpredictable and vola-

Station Stories . . . (continued)

tile. On one occasion, while having "dinner" with him, I commented that our facility was in need of a complete overhaul. I further told him about some not-too-serious problems that I was having with the prehistoric RCA BTA-5G transmitter and suggested that it be replaced soon.

About a month later, an immense truck pulled into the station's parking lot with .. you guessed it .. a new 5kW transmitter, new cart machines, reel machines and various other major pieces of studio equipment. The driver asked where we wanted the "boxes" unloaded. I hadn't the vaguest idea what to do with them. We didn't have any building entrances that were large enough to accept the transmitter nor did we have any place to put it in the main building. The new studio equipment could be stored in a separate warehouse which was located on the property.

Since the station owner had not yet arrived for the day, I suggested that the transmitter be unloaded near a separate emergency power generator building, the only site which was large enough and empty enough to hold the new transmitter. I then started to calculate the number of concrete blocks that we'd need to knock-out before the transmitter would fit through the door.

About this time, the owner arrived. He was not in a good frame of mind. When told of the delivery of this new equipment, he was livid. He asked everyone present whether they had placed this $100,000 equipment order and pointed an accusing finger in my direction. I suggested that he call the manufacturer to find out who ordered this wonderful new gear and continued with my computations. Thirty minutes later, at the insistence of the station owner (who had, while on a binge, placed the order), a man arrived on an enormous forklift to move the transmitter into the generator building where it was installed and is, to this day, operating.

The "Vacation" In Ecuador

In the mid 70's, I had the opportunity to travel to Guayaquil, Ecuador for the purpose of installing an old and definitely used 50kW RCA Ampliphase transmitter. The archaic brute had recently been removed from service at a local station and I had garnered a respectable amount of knowledge in the operation of that particular unit so I agreed to make the trip and supervise the re-installation -- a two week job. The transmitter was carefully disassembled, packed for the overseas journey and was transported to the docks in Tampa for the first leg of its long trip to Ecuador via Miami, Mexico, etc., etc., etc.

A telephone conversation with the owner of the Guayaquil station gave me the first hint that perhaps I should fly down for the weekend to take a look at their transmitter site and help them prepare it for the upgrade to 50kW. I flew to Guayaquil, gave them RCA's suggested building layout and advised them to get the place ready for their new transmitter. I also placed an order for 4" transmission line and a 50kW antenna tuning unit to replace the existing 7/8" coax and a grossly underrated 10kW ATU and returned to the States to await word that the shipment had arrived in Guayaquil. I waited for nearly eighteen months.

I finally received confirmation of their receipt of 27 crates. Our local records indicated that we had shipped 29 crates ... not 27, but because they had already unpacked several boxes, we hadn't any idea which crates were missing. I agreed to return to Guayaquil and, with the help of another engineer from Tampa, begin the re-installation of the old Ampliphase in hopes that the missing crates would be located and forwarded to us. Very early one morning, loaded down with every conceivable tool and small electronic part, we caught a flight to Guayaquil, Ecuador.

We were met at the airport by the General Manager of the station, Sr. Cobos, and his entourage, conveyed to our hotel and then to the station's transmitter site, about 40 miles away, for our first glimpse of their "new" RCA transmitter.

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Station Stories . . . (continued)

Horror of horrors -- the Ampliphase was sitting un-covered in a grassy field beside the transmitter building. Chickens were roosting on the rectifier/control cabinet and an old hog was resting inside the open blower compartment! Not the first bit of work had been started to prepare the building for the transmitter and the necessary 480-volt power service had not been installed. It looked like it was going to rain. We covered the transmitter with plastic as best we could and returned to the hotel. Giving Sr. Cobos a directive to "get a good construction crew out there by 8 o'clock tomorrow morning or we leave," I bid him good-night, returned to my room, called the airline and purchased tickets for a return flight to Tampa on the first available plane -- the following afternoon.

Very early the next morning, Sr. Cobos met us at our hotel and presented us with a set of keys to a new Mercedes -- possibly the only one in the city, and gave us a map which showed the route to their transmitter. Clearly, he believed that we WOULD leave and wanted to make us comfortable. His ploy worked and shortly thereafter, we arrived at the transmitter site, ready for a full days work.

At 8 o'clock, a crew from a local construction company arrived with several truckloads of building materials. Minutes later, the local power company was on the job to provide us with the necessary three-phase power. We turned our attentions to checking out the condition of the transmitter. The condition was grim. Eighteen months of salt spray and several weeks of chicken-droppings had left the old hulk corroded and unfit for operation in it's present condition.

I called the owner of the station and asked his permission to order 2,000 gallons of distilled water and two high-pressure water pumps, delivered to the transmitter site for the purpose of giving the Ampliphase a bath. He agreed and early that afternoon the water trucks arrived. We began washing the transmitter, starting with the RF output connector on top and ending with the base plates. Everything was hosed-down and when we were finished, the transmitter was soaked but free from all salt and chicken deposits. With the help of the construction crew, the Ampliphase was moved into the old transmitter room where it was allowed to dry for the two weeks it would take to complete the new transmitter building.

During the construction, we busied ourselves by unpacking, cataloging and cleaning the contents of the remaining crates: tubes, coils, vacuum and mica capacitors and spare parts. We did not find two articles: The main inter-cabinet wiring harness and the installation manuals. The missing crates had contained these items!

Knowing that RCA was famous for their unnecessarily complex control ladders, I could imagine that the inter-cabinet harness must contain several hundred wires. It was fortunate for us that RCA had included in the transmitter's instruction manual, a wire-run chart from which we were able to build a new harness.

(continued on page-24)

Station Stories . . . (continued)

When the new transmitter building was completed, we moved the Ampliphase into it's new operating position and began the cyclopean chore of re-installation. Every circuit in the new wiring harness was checked and double-checked. Tubes and vacuum capacitors were installed. The filament regulators and power supplies were mounted on the back wall, adjusted and, finally, the high voltage transformers were positioned in their vault and wired into the system.

The time had come to install the new antenna tuning unit and begin the lengthy process of transmitter tune-up. So, with the blessings of the station owner, we shut the station down for a couple of days, moved the new ATU into position and mounted it to the vertical steel I-beams that had formerly supported the old 10kW termination equipment. As I was installing one of the huge 5000pf vacuum capacitors in the ATU ... CRACK ... the glass envelope shattered without any obvious reason, leaving the station with a worthless antenna tuning unit and without any hope of getting a replacement capacitor from Jennings for at least three months.

Careful measurement of the tower's base impedance with a signal generator of unknown accuracy and a General Radio "cold bridge," produced a figure of 54 ohms -J34. It was, in my opinion, conceivable to operate any normal transmitter directly into the tower, without the benefit of the ATU, until a new capacitor could be secured. The Ampliphase was not a normal transmitter but we connected the new 4" transmission line directly to the base of the tower and prayed that the transmitter would see some kind of acceptable termination impedance. Before attaching the transmission line to the transmitter's output, I measured the impedance at the input of the line. It measured 49 ohms -J15. The transmission line was connected to the output of the BTA-50G Ampliphase transmitter and we started the final tune-up at its new frequency.

Following a very complex and frustrating transmitter tune-up, we determined that the time had come to try the transmitter at its low power (13kW) level. We applied filament voltage and allowed the tubes to warm-up for about an hour before attempting to apply the reduced plate voltage to the PA tubes. When the HV was applied, the transmitter came up without a differential overload (a rare occurrence) and began supplying RF power to the tower. Preliminary readings on the phase meter showed that the RF on the PA grids was displaced by 135 degrees, the proper operating point for the Ampliphase system. So, at the suggestion of the station's General Manager, I put the high voltage supply into it's high power position, threw the PLATE switch, shut my eyes and covered my ears. I fully expected a saltwater arc and subsequent Plate or DC overload. It didn't happen!

The PA power supply came up to it's full operating voltage and the transmitter stabilized at a power output of 50kW without a single overload. Grid and plate samples, as read on the phase meter, were normal, and the plate current meter indicated 4.8 amperes which was an acceptable figure for this transmitter. I pronounced the Ampliphase fit for active duty and Sr. Cobos called the studios and instructed them to send us some programming.

The first thing that we heard was the National Anthem of the United States. We were dumbfounded. What followed was even more amazing: The announcer, in English, told of our hard work and dedicated the next twenty-four hours of American music to us. The Ampliphase didn't sound too bad, having been so desecrated by saltwater, chickens and an old hog.

That very afternoon, we boarded a return flight to Tampa via Quito, Bogata and Miami. When we reached Tampa, late that night, I punched up the Guayaquil station's frequency on the car radio and through the atmospheric noise, heard the same dedication announcement again. The ol' Ampliphase was indeed putting out RF.

State of the Art

By Chip Morgan - Morgan Broadcast Eng.
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Welcome to ***State of the Art***, a new monthly column here in Radio Guide. This is where you'll find a compendium of cutting edge technology ideas and developments. We'll be introducing information that's of interest to everybody in the radio business such as telephony, architecture, science, photonics, computers, health, other forms of communications and even gadgets.

What's Hot in Communications?

Color laptops, color photocopiers, color facsimile machines, color printers, LANs, and portable LANs, cellular modems, fax server cards for LANs, and DVI (digital video interface - sorting data, pictures, video and voice together).

HDTV Scheme #9, #9, #9

This is General Instruments Corp.'s new digital compression and transmission technology. The system is called DigiCipher and will be the only all-digital technology under consideration and is a simulcast system. The HDTV signal would be completely contained within the 6 mHz channels, consistent with current terrestrial and cable-television channelization. The NTSC signal would be transmitted on the assigned channel, providing continuous service to all current NTSC sets. The digiCipher HDTV signal would be transmitted on a second channel and could be received only by HDTV sets.

Mass Storage Medium

The Mitsubishi Co. has started mass production of magneto-optical disks. The company says world demand for such disks will reach 5 million units a year by 1993, despite the fact that they are significantly slower than conventional storage media. Mitsubishi says it will be manufacturing 1.2 million disks a year.

Transmitting Power Without Wires

A dream for years, now Army engineers have turned to lasers to shed light on the problem. Their invention uses a fiber cable to deliver laser light to photovoltaic cells that turn photons into electrical current. The unusual method for transmitting power is needed because using copper wires upsets sensitive electromagnetic fields. This new power delivery method takes advantage of all the properties of fiber optics, including use near flammable materials. So far, the system produces 28v AC.

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State of the Art . . . (continued)

CCD Neural Network That Can Think?

Researchers at the California Institute of Technology have developed an extremely sophisticated and flexible neural network computer chip based on charge-coupled device (CCD) technology. The new chip contains 256 fully interconnected processing elements, which means that each of the chip's simulated neurons makes connection with all of the other 255 neurons for a total of 65,536 analog connections. The update rate is at least 500 million connections a second. It's faster than currently available test equipment.

Convert Your E-Mail to Voice Mail

VoxLink Corporation has introduced a system which converts text messages into speech. Now you can call up your E-mail system and have your E-mail read to you over the telephone. The entire VoxMail system retails for $8,995...call (615) 331-0275.

Cellular's Next Generation

The difference between home and public CT2 is that both incoming and outgoing calling is available in your home, whereas only outgoing calling is available in a public phone area. The big advantage CT2 has over cordless and cellular is that it sounds much better.

ATV to be 31% of the Market in 2000?

A respected research group predicts that advanced TV (ATV) receivers will have 31 percent of the world market for color TVs by the year 2000, but HDTV will have only a sliver of that share, with IDTV (improved definition TV) and IDTV (improved definition TV) and EDTV (extended definition TV) making up nearly 98 percent of the world marked for advanced TV receivers. In its report, the research firm says, "this new decade will see HDTV essentially on a holding pattern".

MIT Has Developed a Laser-based Space Transmitter

And it works! The transmitter is a key part of the Laser Intersatellite Transmission Experiment (LITE) program. Although laboratory systems for optical space communication have been demonstrated for more than 20 years, this is the first successful complete coherent laser communications transmitter/receiver.

Here Come More Features From Your Phone

Pacific Bell is changing the way Californians use their home telephones. San Francisco Bay area residents can now use The Message Center, the first telephone answering and messaging service designed for home use in California. For $4.95 month, users use Pac Bell Voicemail with their tough-tone telephones. Before, consumers had to buy higher-priced business voice mail services. The Bay Area is the first California region to receive The Message Center.

Here's a Great Way to Preserve Important Photos

Eastman Kodak Company has a new way for you to show off your snapshots, by storing 35mm pictures on a compact disk. The new photo CD system, due in 1992, uses a special CD player that hooks up to your TV set. Customers who bring their exposed film to a Kodak-authorized photofinisher can order a Photo CD with or without slides or prints and negatives. The shop can also scan existing negatives and slides and convert them to digital form for disk use. Each CD holds up to 100 pictures. The player is expected to cost less than $500, and the disk less than $20.00.

Watch Out for Cellular Toll Fraud

Thieves use programmable security EPROMS and make free calls. This is just starting to happen, but check your cellular phone bills. It could happen to you. You can be ripped off even if your cellular phone is turned off.

The Perfect Christmas Gift

You can now buy a watch from Casio which displays the best times to go fishing. The watch automatically calculates moon movement, sunrise and sunset. It's about 40 fins.

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State of the Art . . . (continued)

Big Brother is Watching

A small company in Chicago has patented a pocket-sized device that silently monitors and logs the radio and TV programs a person listens to. Arbitron, Birch and Nielson methodology has come under attack in recent years. To address that issue, two engineers at Viewfacts Inc., which makes audience polling devices, have patented an invention that automatically identifies the station tuned in and logs the amount of time the person remains within earshot. The battery-powered device is based on "acoustic matching." As envisioned by the inventors, the users would place the monitoring devices on battery chargers when they go to bed. The battery charger would be connected to a telephone line, enabling the device to transmit the day's data to a central computer at the audience measurement company.

You've Heard of Smart Homes and Smart Cars

Now there's a smart toilet. Going to the hospital for routine health checks can be very costly and time consuming. Now the Japanese have developed a "Health Control Toilet System", allowing people to run simple tests in the privacy and convenience of their own homes. Test paper is attached to the toilet, and a sensor measures the amount of glucose, protein, urobilinogen, and blood in a urine sample. The intelligent toilet system also features a sphygmomanometer to measure blood pressure and pulse rate. The perfect control room chair!

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Soldering Tips

By Richard Majestic - Engineering Consultant
Annapolis, Maryland - (202) 485-6228

A Balanced Input High Level Amplifier

This topic deals with a Differential input amplifier with adjustable Gain, very Low Noise and High Common Mode Noise Rejection, with an unbalanced output (-10dBu level).

The balanced input amplifier shown in Fig. 1 utilizes the low noise IC PMI/SSM-2015. The circuit features adjustable gain and adjustable common mode noise rejection, and can accept audio signals from -27.5dBu to +0dBu with more than 30dB of head room when power supply rails of ±18VDC are used. The input terminals can tolerate common mode voltages up to 30 Volts peak to peak. Common mode noise rejection is greater than 100dB at 1,000Hz, while maintaining an EIN (Equivalent Input Noise) figure of -124dBu.

The IC1 amplifier circuit is gain adjustable, designed around a 12 position switch, that has 2.5dB gain steps. A variable resistor or other fixed value resistors can be calculated and used. Gain select resistor values below 5 ohms will cause slight output voltage offset.

IC1 is a true differential input IC amplifier. It's input circuit utilizes two identical low noise bipolar transistors, with access to the emitters, and they provide the gain adjustment. RG (R14 through R24) sets the amplifiers gain using the equation:

$$GdB = 20 \text{ Log } 3.5 + \frac{20 \times 10^3}{Rg}$$

The emitter feed back design exhibits both minimum noise, and maximum common mode rejection, while retaining a very high input impedance. The output circuit topology is complementary bipolar producing 6V/uS slew rate, and able to drive a minimum of a 2k unbalanced load. The circuit described can be directly coupled, eliminating the distortion associated with using an unpopular coupling capacitors. Circuitry following this amplifier could be AC (capacitor) coupled if input normal mode DC voltages are expected at the balanced input.

Input components C1, C2, R1, and R2 form a single pole low-pass filter. It limits the input voltage slew rate, and will inhibit interface transient intermodulation distortion, it will also keep the amplifier from slewing. The input network has little effect on phase response within the pass band of 20Hz. to 20kHz. To maintain good high frequency common mode performance, capacitors C1, and C2 should be matched or 1% tolerance or better. Worst case THD measures less than 0.008% , and IMD less than 0.015% for the circuit described. For an output voltage of -10dBu; the balanced input amplifier circuit has input sensitivity range of 0.0dBu to -27.5dBu. The Common mode voltage trim is included for minimizing external common mode noise.

SW1	GdB	ein(dBu)	Rg	Value
1	10	0	R	INF
2	12.5	-2.5	R14	28.0K
3	15	-5	R15	9.53K
4	17.5	-7.5	R16	4.99K
5	20	-10	R17	3.09K
6	22.5	-12.5	R18	2.05K
7	25	-15	R19	1.40K
8	27.5	-17.5	R20	1.00K
9	30	-20	R21	715
10	32.5	-22.5	R22	511
11	35	-25	R23	374
12	37.5	-27.5	R24	280

Typical applications. This circuit is ideal for use as the input amplifier in audio distribution amplifiers, balanced input audio routing switchers, input buffer ahead of the A-to-D codecs in digital recording and mixer equipment, or the low noise high level input of a mixing consoles input channel.

TABLE 1:
CIRCUIT PERFORMANCE SPECIFICATIONS

Freq. Response (20-20kHz)= +/- 0.1 dB

S/N Ratio @ +23dBu = 103dB

THD+Noise (20-20kHz) @+23dBu = 0.008%

IMD (SMPTE 60Hz & 4kHz, 4:1) = 0.015%

CMRR (60Hz) = 100dB

Slew Rate = 6V/uS

Output Voltage (2k ohm load) = +23dBu or 11VRMS

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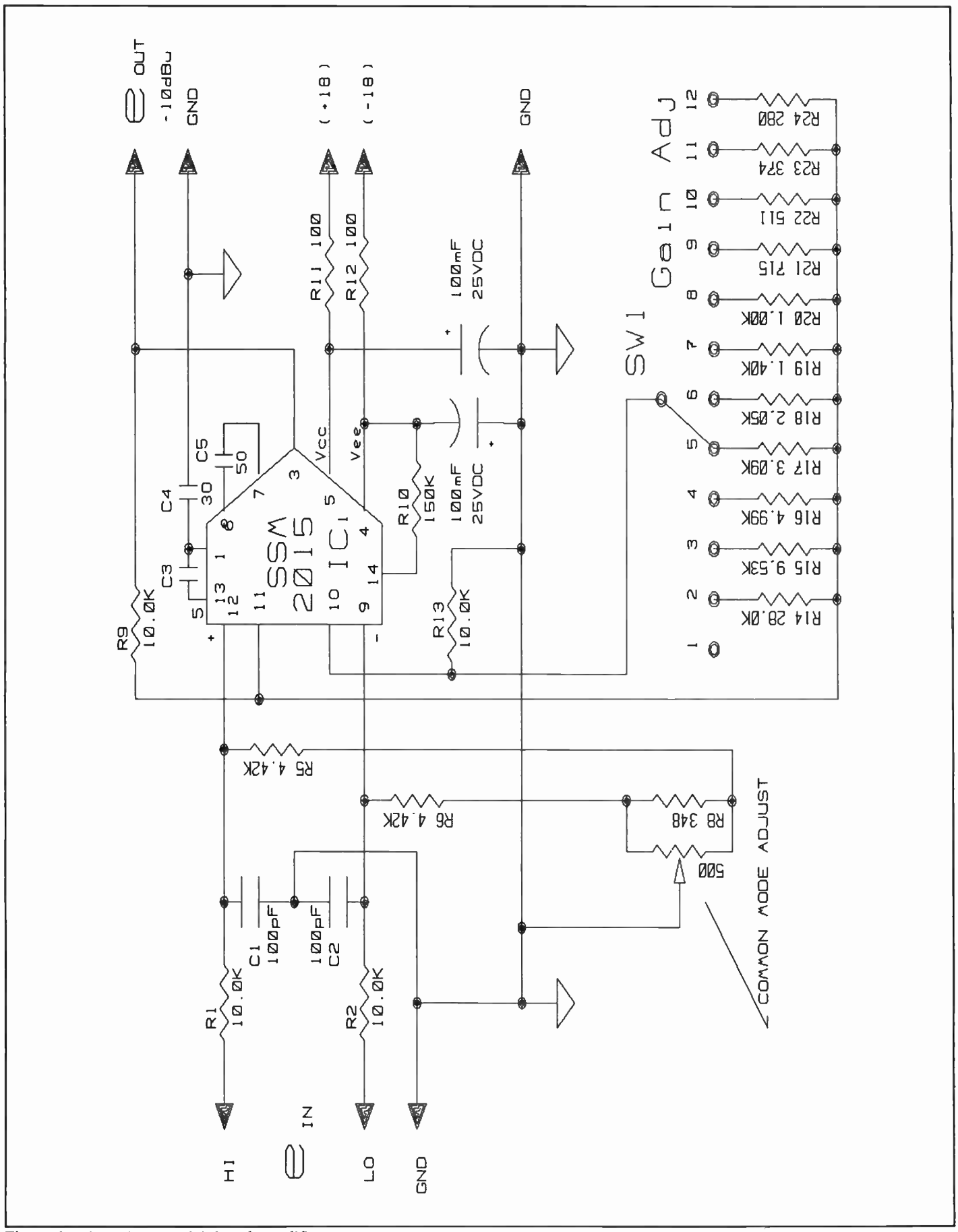

Figure 1 Balanced Input High Level Amplifier

Transmitter Site

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Mutual Impedance and Parasitic Radiators

These are subjects that may cause one to cringe in dread of a highly theoretical problem that can seem almost incomprehensible. However, since mutual impedance and its relationship with parasitic radiators affects everyone who is responsible for operating any kind of an antenna, this article will attempt to explain where and how they apply and try to make the subject as painless as possible. A basic understanding of them can help in solving some antenna problems that seem to fall into the realm of black magic.

Most articles on this subject seem to assume that you already have an understanding of what its all about and immediately launch into a series of math equations with little explanation of where it is all coming from. We will try to avoid the math and stick to the concepts of the subject. To lay a foundation, we will review a bit of basic antenna theory and then go from there.

Self Impedance

When each of us began to study antenna theory, we soon learned that a half-wave dipole has an input impedance of about 72 ohms. The dipole is a convenient place to start because it can easily be imagined to be out in free space where nothing will have any effect on its radiation. Also, as a matter of convenience, one half-wavelength is the shortest length at which the dipole is resonant. Resonance is defined as any length at which the reactance is zero, so the full definition of the impedance of a half-wave dipole is 72 ohms +j0. This value is defined its self impedance because there are no effects (reflections, absorption, etc.) from other objects in the vicinity.

Every antenna has a value of self impedance regardless of its resistance and reactance. That is, even if the antenna has reactance in this value, the entire complex number is its self impedance.

Free Space vs. Real World

The most important words from all the preceding are "free space". We don't live in free space, so anything and everything out there in the near field of an earth-bound antenna can get into the act. For example, if we go back to our dipole in free space and place another half-wave element parallel and near to it, we know that we can alter the effective field and make a directional antenna system from it. This is because the second element (known as a parasitic element) will transduce part of the energy from the field into an electric current within itself and then transduce the energy from this current back into electromagnetic radiation with a time delay to it. Much of this energy will be radiated out into space, but part of it will travel back to the first dipole at which time part of the energy will be transduced into a current in that element.

This is where it gets complicated. We were happily operating out there in free space with a generator (transmitter) feeding a sample current into the simple dipole. Knowing the dipole impedance and the transmitter power, we could easily calculate the current. But now we have brought in another current from the field of the other element which may, based on the timing of its arrival (called phase angle), add or subtract to the original current in the dipole. So now the resultant current is no longer what it was. See Fig. 2. The transmitter power is still the same, so what does it all mean? It means that the input impedance must have changed. It is no longer the 72 ohms +j0 that all the textbooks say. This effect is called mutual impedance and in the real world it happens frequently.

In general, the closer the second element is to the first dipole, the greater the change in the mutual impedance. When the space between the two elements is

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Transmitter Site - (continued)

more than about ten wavelengths, the effect can usually be considered negligible. See Fig. 1.

When elements that are resonant or nearly resonant are placed near a dipole for the purpose of directivity, they are called parasitic elements. A good example is the Yagi-Uda antenna, commonly used in broadcasting and communications. The dipole in such an antenna is called the driven element and its input impedance is greatly affected by the mutual impedance of the nearby parasitic elements. The field from each of the parasitics induces a small current back into the driven element. The designers of such antennas incorporate matching components at the input so that the desired impedance is seen by the transmission line.

Parasitic Elements in the Real World

Since we don't live out in space, but down here on earth, virtually every antenna is affected by parasitic radiators (elements) and their mutual impedance effects. The obvious application is in AM directional antenna systems, but FM antennas are always mounted on a metallic structure with metallic feedlines which all get in to the act. Fortunately, the engineers of the FM antenna manufacturers have designed in compensation to solve the problems. One general rule is to try to mount the FM antenna on a structure of small cross section to minimize the effect.

Also, FM antennas often have an input transformer for impedance matching purposes. In the process of matching the antenna, compensation must be provide for the reflective (or mutual impedance) effects of the structure on which the antenna is mounted. Anyone who has attended an engineering seminar on the problems of making an FM antenna pattern circular has been amazed at how the parasitic effects of the tower can put holes in an otherwise very good pattern.

The problem is compounded in that the vertical pattern is often very different from the horizontal pattern. This means that the vertical mutual impedance may be different from the horizontal mutual impedance, making for an interesting impedance value at the input terminals of an FM transmitting antenna.

Longer Wavelength Means Bigger Problems

For AM broadcasters, there is an entirely different set of problems to live with. Since the wavelength at AM frequencies is much longer, objects a mile or more away can get into the act. Other towers, power lines, smokestacks, large bridges and buildings can all re-radiate energy, distorting the pattern that should be transmitted. Omnidirectional stations may become directional and directional stations can have their patterns distorted. There is a fix for this though, which we will discuss later.

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Transmitter Site . . . (continued)

Mutual Impedance and AM Directional Antennas

Any AM directional system has multiple towers, each of which has an effect on all the other towers in the array. This must be taken into account by the consulting engineer designing the array. Otherwise one would be unable to determine the operating parameters of the system. This is where all the math equations come in, so be nice to your consulting engineer. Since this is covered in detail in several excellent books, we won't discuss it here.

Some stations are non-directional during daytime and directional at night. Only one tower functions as the antenna during daylight hours, while the other tower(s) just stand there doing nothing. However, what do we do to make sure that they are really doing nothing? If, for example, the other towers were to re-radiate part of the energy as described previously, they would have an unwanted effect on the desired radiation from the daytime tower. In other words, the system could become directional from this re-radiation from the other towers.

Possibly the most common method of accomplishing this in an array of conventional series fed antennas is to simply "float" or disconnect the unused towers at their bases. If they are no more than about a quarter wavelength high, re-radiation from them will be minimal. For towers that approach a half wavelength in height, this becomes a problem as a half wave tower may become a good parasitic element, and may re-radiate enough energy to cause problems.

It should be noted that a quarter wave tower, when grounded, also becomes an excellent parasitic element that will re-radiate and may distort the pattern. Communications and cellular telephone towers in the near vicinity are also grounded towers that can seriously disrupt or distort the field pattern of an AM transmitting antenna. Zoning authorities in many areas are now requiring new towers to be built near other existing towers without regard for the fact that some of the existing towers may be AM antennas. A problem then arises in trying to make these new towers effectively disappear and allow the AM pattern(s) to return to normal.

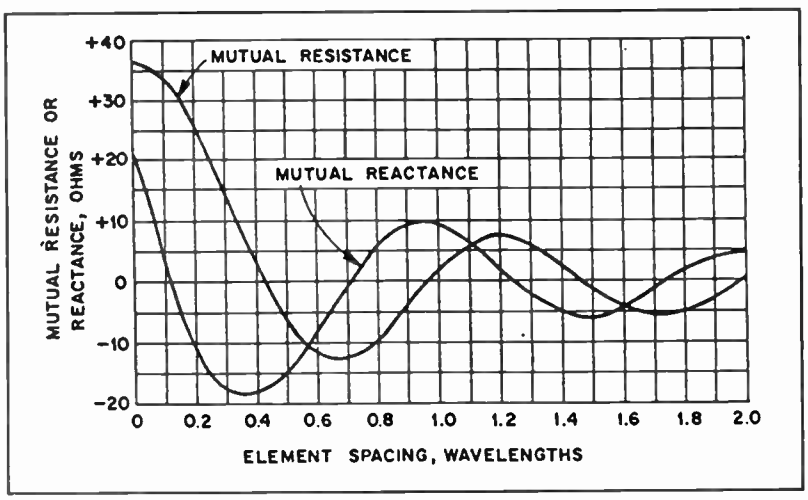

Figure-1. Mutual impedance between two parallel 1/4-wavelength vertical elements. Multiply the resistance and reactance by 2 for 1/2-wave dipoles.

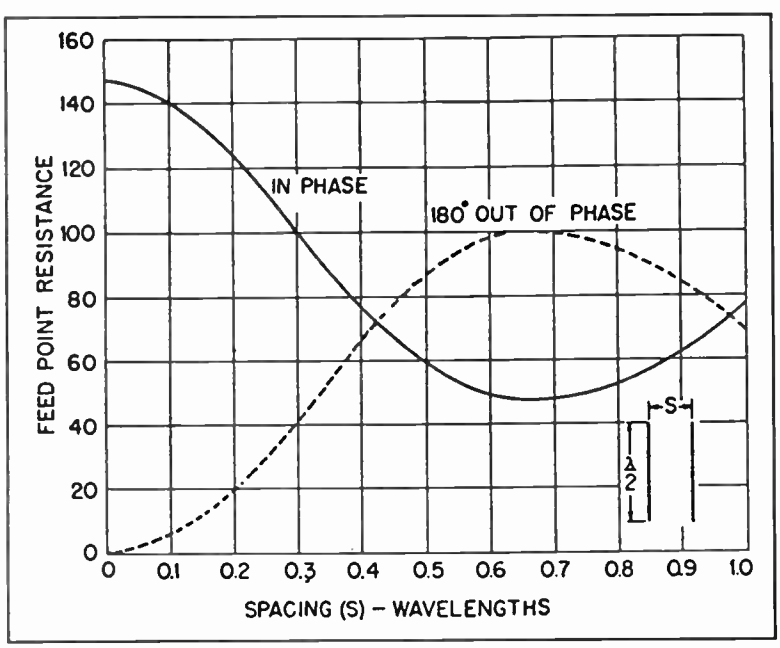

Figure-2. Feed point resistance measured at the center of one element, as a function of the spacing between two parallel 1/2-wave self-resonent antenna elements. For ground mounted 1/4-wave vert.elements, divide resistance by 2.

Detuning a Structure to Make it Disappear

The reason any structure re-radiates is a function of its mutual impedance with the antenna. This is determined primarily by the distance between the two and the physical dimensions of the structure(s). The worst case is where the structure is near natural resonance due to its dimensions and/or geometry, but re-radiation can occur from virtually any structure of any significant size. The key to making it disappear is to "tune it" to cause any current induced into it by the antenna to be extremely small or zero. This is commonly called detuning.

In studying basic electronics we learned that a parallel resonant circuit has minimum current flow in it, so lets apply that principle to this problem. A parallel resonant circuit consists of an inductance and a capacitance connected in parallel. The inductance doesn't have to be in the form of a coil, but can be distributed along a length of wire. If, for example we place a wire parallel to a tower and connect it to the

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tower at its top, a loop is formed which has a value of inductance. If, at the bottom of the wire, we connect a variable capacitor between the wire and the tower base and then tune the capacitor to the frequency of interest, we will have created a parallel resonant circuit.

Caution - High Voltage

Physically, its a very big circuit, but a circuit nonetheless. One characteristic of the parallel resonant circuit is that, while the current may be very small, the voltage can become very large, and this is indeed sometimes the case. In detuning a structure that is very near a high power transmitting station, this has been proven many times. Severe shocks and RF burns are possible if one becomes careless. Components and insulators must be adequate for the high voltages developed.

Summary

Every antenna has a mutual impedance between itself and any object in its near field, that may re-radiate a significant field. For FM broadcasters, it's of little practical concern, although the structure on which the antenna is mounted, transmission lines, adjacent antennas and guy wires cannot be ignored.

For the AM broadcaster, the problem is compounded by the fact that the antennas are right down on the ground so that anything of significant size must be considered. Directional antennas are normally composed of all driven elements, but each element in the array has a mutual impedance with all the other elements which must be taken into account in the design of a system. The current in each element can be affected by these mutual impedances which subsequently affects the individual field radiated by each element.

If you have ever heard engineers speak of a tower in a DA "going negative" It means that more current is coming back from that tower than is going into it. It appears that the tower is generating RF energy and putting it back in the system, but of course that can't really happen. What is happening is that the mutual impedances between the various elements are causing this curious performance.

Finally, if there is mutual impedance there is also the parasitic radiator effect whether you want it or not. Omni-directional stations with a single tower may have undesired effects from metal structures of any type in the vicinity. It is not an incurable problem, however. Any offending re-radiator can be detuned to get the antenna system back to normal. Towers have been built right in the middle of an AM directional antenna system and successfully detuned so that it effectively disappears from the system.

If you suspect you have such a problem, contact your consultant. Usually, it can be determined if there is a problem in a few hours, with the judicious use of a field intensity meter. After learning where the problem is, a plan can then be made to attack the problem. Should you think you have a problem or a question on the concepts of mutual impedance, please write or call the author of this article. He may not have the answer, but will steer you in the right direction.

Looking Back

By George Whitaker - KSSA AM/FM
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FCC Rules Changes (For Better or Worse)

In the last column we were exploring some of the changes in the FCC rules since 1957. One thing that hasn't changed is the fact that "freezes" come along from time to time.

My 1957 copy of the rules contains an addenda that says, "Pending conclusion of the proceeding in Docket 6741, action will be withheld on the following: ... applications proposing new daytime or limited-time, ... existing stations proposing to change frequency to, ... or increase in power, ... or change in radiation pattern ... on any of the frequencies specified in paragraph 3.25 (a) and (b)."

The frequencies referred to are the clear channels. So, as of the latter part of 1957, you could not apply for a daytime station or daytime pattern change on any of the clear frequencies. At the moment, of course, you can't apply for anything proposing a change in any existing AM, or a new AM, regardless of the frequency.

Since many stations had requirements for a first class operator on duty at all times, a provision was made for operating with a lesser grade operator while you searched for a first class person to take the shift. However, it was considered serious business and you were expected to find someone quickly.

Section 1.334 says,"Applications for temporary permission to operate standard and FM broadcast stations with licensed operators of a lesser grade than normally required by the Commission's Rules shall be submitted to the Engineer in Charge of the Commission's district headquarters field office in the area where the station is located. Such permission will be granted for periods of not to exceed 120 days ... within 60 days of receiving an authorization for a longer period, a written report shall be submitted by the station setting forth what continuing efforts have been made to obtain licensed operators of a grade ... required."

And, you better believe they meant business. It goes on to say, "... the following information shall be furnished:

(1) Call letters of the station

(2) Name of licensee

(3) The number of persons holding radiotelephone first-class operator licenses that will be employed as full-time operators at the station, (this does not include part-time employees and persons only available on call in case of emergencies).

(4) A showing that at least one first-class operator will be employed full time at the station and will be available on call at all times in the event of equipment failure".

When I go to some of these stations that haven't seen a technical person since the last time the transmitter burned up -- as Carson says, "I hark back" to these days.

The strange sentence you may have noticed in the rules quote above is in my copy and I quoted it exactly as written, "... will be granted for periods of not to exceed 120 days ..." It makes me wonder if the rules actually said that, or if the person who typed my copy anticipated incorrectly and inserted the "of" because they expected it to be the next word. I say typed because that's what they are. And, on plain old standard typing paper.

Broadcast Service Bureau of Silver Spring, Md. produced the set of rules that I have been using for these articles and the pages are not type-set and printed. Instead they are typewritten and obviously run off on a mimeograph. No offset printing on slick stock here. No change in fonts for headings; if it's noteworthy, it's underlined. I guess there weren't enough stations back then to justify the expense of actual printing.

One of the interesting changes that came about in 1957 was the definition of "nighttime." Prior to 1957 "night-

Looking Back . . .
(continued)

time" was defined in the rules as "... that period of time between local sunset and 12 midnight local time." The rules were amended to read "... that period of time between local sunset and local sunrise."

"Broadcast day" was still defined as "... that period of time between local sunset and 12 midnight local standard time." After all, nobody in his right mind would operate a station 24 hours a day. Today the rules contain a definition for "Broadcast day" that says "... that period of time between the station's sign-on and it's sign-off."

Another definition that has gone by the wayside is "Standard Broadcast Station." Since AM had been the standard method for years, there were definitions for "Standard Broadcast Station," "Standard Broadcast Band," and "Standard Broadcast Channel." In later years we saw FM come into its own and then supplant AM as the dominant medium. With this occurrence we saw the term "Standard" deleted entirely and the rules simply define AM and FM without any prejudicial references.

Having an auxiliary transmitter was not just a matter of putting it in place by any means. The rules said, first of all, that you had to have a reason for wanting an aux. Sec.3.63 said, "Upon showing that a need exists for the use of an auxiliary transmitter ... a license may be issued ..." And, you had better be prepared to lose some sleep since you were required by subsection (d) to test the auxiliary at least once each week between midnight and 6 a.m.

In last month's article I mentioned that remote control was not allowed for stations employing directional arrays or stations of 10 kW or more. In doing some additional reading, I have found a proposed amendment that was to make it possible for these stations to be operated remotely. However, the requirements for being allowed to do so take up almost one full page. I don't know when the amendment was accepted, but, I do remember being associated with stations that had met the full page of requirements. So, I know that it was accepted.

Contract Guide

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BBS Listing

Broadcast Oriented BBS Listing

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201-769-1779	Visions Infoline II	Wildcat	300-1200-2400	Jeff Morgan
201-857-8880	Rockboard	Hermes (Mac)	300-1200-2400	Adam Curry
205-859-3030	Traveler	Phoenix	300-2400	Mike Bennet
206-443-6170	W. Washington Freq. Coord.	OPUS	300-1200-2400	Walt Jamison
206-566-1155	Amocat	Wildcat	300-9600 HST	Rich Langsford
212-415-3500	Hypercube Systems	PCBoard	300-1200-2400	Mike Oswald
212-645-8673	Communication Specialties	Searchlight	1200-9600 HST	Rich Brooks
214-647-0670	DFW Freq. Coord. Council	OPUS	300-9600 HST	Darryl Doss
215-364-3324	Satalink	PCBoard	1200-2400-9600	Ron Brandt
216-529-0121	Signal BBS	PCBoard	300-1200-2400	Lynn Laymon
219-256-2255	Radio Daze	Gap	300-1200-2400	Mike Shannon
301-725-1072	FCC Public Access	Custom	300-1200	Bob Weber
303-949-3253	Master Control	- - - -	300-9600	Lynn Osburn
315-474-5070	SBE Chapter 22	RBBS	300-1200-2400	Steve Hines
317-935-0531	Allied Radio World	Michtron	300-1200-2400	Bob Groome
402-289-2515	KFMQ 102 Connection	WWIV	1200-2400	Dan
404-320-6202	AV-Sync Atlanta	PCBoard	1200-9600 HST	Bill Tullis
404-982-0960	Rock & Roll Atlanta	PCBoard	1200-2400	Bob Helbush
407-239-2607	Producer's Circle	GT Power	300-1200-2400	Skeeter Durham
407-649-9834	Electronic Arts Info	QuickBBS	300-1200-2400	Jeff Alwin
408-985-8675	KOME Silent Side	Michtron	300-1200	Greg Argendell
412-981-3151	Mabel's Mansion	OPUS	1200-9600 HST	Charles Ring
414-771-3032	Second Opinion	Wildcat	1200-9600 HST	Mark Timpany
415-391-2657	NCFCC	RBBS	300-2400	Tim Pozar
415-571-6160	Production World	Red Ryder	300-1200-2400	Wes Dorman
415-641-4373	Information Radio	Wildcat	300-2400	Dave Evans
419-228-7236	Black Hole BBS	QuickBBS	300-1200-2400	Fred Vobbe
501-753-6536	N.L.R. 80	Spitfire	1200-2400	James Padgett
518-283-4067	Northeast Networks	PCBoard	1200-2400	John Nelson
601-373-0160	Net-Works	Galacticomm	1200-2400	Herb Jolly
602-438-0459	CRL	RBBS	1200-2400	Hank Langlinais
602-482-1001	Catalyst	TBBS	300-1200-2400	David Kidder
602-872-9148	Broadcaster's BBS	RemoteAccess	300-1200-2400	Mark Shander
608-274-7776	Communications Exchange	GT Power	1200-9600 HST	David Willow
614-766-2162	RadioLink!	QuickBBS	2400	Steve Craver
616-530-0821	Trillion	Wildcat	300-1200-2400	Dick Castanie
619-298-4027	Southern CA Medialine	PCBoard	1200-2400-9600 HST	Steve Tom
703-455-1873	VideoPro	PCBoard	300-1200-2400	Tom Hackett
703-538-6540	East Coast Pub Net	PCBoard	300-2400	Charlen Kyle
707-553-8452	KDA Message System	PICS	300-2400	Keith Davidson
713-782-5454	Ed Hopper's	PCBoard	300-1200-2400	Ed Hopper
713-855-4382	Cloud Nine	PCBoard	300-9600 HST	David Armstrong
713-974-3912	SBE Chapter 105	PCBoard	300-1200-2400	John Harvey
717-731-8966	Cat's Castle	Wildcat	200-1200-2400	Dale Fedorchik
719-634-5661	Colorado Springs Bdcst.	TBBS	300-1200-2400	John Anderson
801-967-9716	Planet Vulcan	Wildcat	300-14.2K HST	Chuck Condron
804-393-6390	Tidewater Medialink	PCBoard	1200-2400	George Randell
804-550-3338	Flamethrower	OPUS	300-1200-2400	Jeff Loughridge
804-973-8235	Broadcaster's BBS	PCBoard 12	300-1200-2400	Pat Wilson
806-352-2482	Radio On-line	PCBoard	1200-9600 HST	Ron Chase
813-527-5666	St. Pete Pgm Exchange	PCBoard	1200-9600 HST	Bill Bomgren
818-248-3088	Hot Tips	Wildcat	1200-2400	Mike Callaghan
818-363-3192	Call Sheet	TBBS	300-1200	Wayne Parsons
818-567-6564	Hotline	PCBoard	1200-19.2K HST	Jon Badeaux
916-338-5227	KBBS	QBBS	300-1200-2400	Mark Stennett
916-646-3600	FM102	QuickBBS	300-1200	Les Tracy
916-646-9358	Scratching Post	QuickBBS	300-1200-2400	Stacy Rothwell
916-728-5700	Entertain-Net	TBBS Multiline	300-1200-2400	Les Tracy
918-437-9004	The Radio BBS	QuickBBS	2400	Clark Dixon
919-481-2947	Recording Studio	WWIV	300-1200-2400	Greg Nowak

Broadcast BBS

By Mark Shander
Phoenix Arizona - (602) 392-0061

Add another toll-free broadcast-oriented BBS to your terminal program's dialing directory! "The Spin-Off" BBS, at 1-800-283-5313 is available to accept calls from broadcasters in the USA and Canada!

"The Spin-Off" is actually a BBS spin-off from the popular "Idiot Box BBS", which is also available toll-free. Michael White, the SysOp of both systems, explains that the creation of "The Spin-Off" was necessary after discovering that members of the Fifth Estate were unable to access broadcasters-only sections of "Idiot Box" due to the heavy volume of calls from all over the world.

Telecommunications News

Telecommunications technology has finally become affordable. At least that's what the manufacturer of a brand-new 9600 baud modem with send and receive FAX capability would have us believe!

Mike Callaghan from KIIS-FM in Los Angeles, who is also the SysOp of Hot Tips BBS (four nodes available at 1-818-248-3088), called the new modem/FAX card to our attention.

The new modem/FAX card combination promises better data transfer rates on noisy phone lines, and less garbage characters on-screen due to line noise. In addition to full 300/1200/2400 baud compatibility with existing modems, the modem features a new standard for 9600 baud data communications. The modem also allows the user to send and receive FAX transmissions at 9600 baud, with full group III FAX COMPATIBILITY and mouse support. The clincher that makes this new card a "wonder device" is the price; $279.

Next month's column will feature a review of the new modem/FAX card. If you can't wait for next month's column, or if you want more information on the 9600 baud modem/FAX card, please leave (F)eedback for me on The Broadcaster's BBS (1-602-872-9148), or contact me by voice, at 1-800-526-1342.

BBS Terminology

When you're interested in getting involved in something relatively new to you, sometimes the best way to get started is to jump right in feet-first! "BBS'ing", or "modemin' it" is no exception!

Sometimes , though, it's more comforting to be aware of the meaning of much of the technology involved in something you're not yet comfortable with. For those of you who are a little hesitant to dial up a local BBS and log right on as a new user, here is a list of terminology to study, which should help bring you up to speed with those folks for whom modem communication has become second-nature:

ACCESS: To log onto a system or to be able to use a particular area of a system, like the file transfer section or NETmail.

ASCII: American Standard Code for Information Interchange. This standard allows different brands of computers to communicate.

BBS: Bulletin Board System.

BPS: Bits per second. This is a measurement of how fast data is traveling between two modems. Eight bits is one single character or space. Typical speeds for modems using standard telephone lines are 300, 1200, and 2400 bps. This is also referred to as "baud rate", which is a misnomer.

BAUD RATE: Frequently used to represent the speed at which data is traveling. Actually refers to modem frequencies. See BPS.

BULLETIN: News and/or information provided by the System Operator (SysOp). Bulletins may be available to be selectively read from a menu (usually referred to as the "bulletin section" of a BBS), or they may appear automatically after log on.

CR,C/R [ENTER]: Carriage Return; the <Enter> key.

CARRIER: High-pitched tone generated by a modem. Similar to a carrier frequency in radio. Data is "modulated" over the modem's carrier frequency. A break in the carrier frequency may cause a modem to hang up or disconnect.

CHAT MODE: A feature of multiple-line BBS's that enables callers to communicate with one another "real-time" on the screen. On a single-line BBS, the SysOp and the user can "chat".

COM Port: Communications port through which the modem communicates with the computer.

COMMAND: Entering a selection from the current menu while connected to a BBS.

COMMENT: A private message to the System Operator.

CONNECT: A message from the modem to your terminal software indicating that communication has been established.

DATA LINE: A phone line dedicated to a BBS or to telecommunications use. Data lines for non-commercial (hobby) use are usually installed as a standard residential line. Businesses using data lines for commercial use often rent data-quality lines, or they simply pay for a voice-quality business line.

DEFAULT: The original factory settings or settings prior to customization.

DIRECTORY: A list of software available for downloading under a particular category.

DOWNLOAD: To receive a file from the BBS you're connected to.

ECHO: To print characters from your computer to the screen.

E-MAIL: Electronic Mail. A private (SysOp may be able to read E-Mail) message to another user of a BBS.

EXPERT MODE: Available on many BBS's. Shortens prompts for advanced users.

FEEDBACK: Same as COMMENT - a private, personal message to the SysOp.

FILE TRANSFER: Sending (uploading) or receiving (downloading) files.

FREEWARE: Software that may be freely distributed for non-commercial purposes. Usually copyrighted and sometimes accompanied by a request from the author that the user donate a small amount of money to him/her if the program turns out to be useful.

HOST: The BBS or computer system you're connected to.

Broadcast BBS

By Mark Shander
Phoenix Arizona - (602) 392-0061

LOG OFF: To end your telecommunications session. This command must be entered in order for your user account to be updated correctly. Failure to log off (by just dropping carrier) may result in a nasty letter from the SysOp.
LOG ON: To access a computer system via modem.
MAIL: Private, personal electronic mail not intended to be received by anyone other than the recipient. Most electronic mail can be read by the SysOp of the particular BBS you're on. Mail may also be considered messages that ARE intended to be read by the general public, but are addressed to you.
MENU: A complete list of commands available to you.
MODEM: MOdulator-DEModulator. A device that connects your computer to other computers across standard telephone lines. The remote computer must also be connected to its own modem.
ON-LINE: The state of being connected to a remote computer.
PAGE: Alert the System Operator that you wish to "chat".
PARITY: Eighth bit of a character with a value set to either 0 or 1; it makes the total number of 1's in the character even or odd. You must set your modem to communicate with the same parity as your host. Most BBS's communicate with no parity.
PASSWORD: Right out of WAR GAMES, this makes sure "you're you"!
PIRACY: The act of knowingly obtaining, sharing, trading or copying proprietary software to avoid having to pay for it.
PROMPT: A word or symbol indicating that the BBS is waiting for you to enter a command. The prompt may also tell you how much time you have remaining to complete your call.
PROTOCOLS: The rules that standards committees set forth in standard documents, and programmers and hardware manufacturers agree to follow, so that there can be compatibility between different sources of hardware and software.
PUBLIC DOMAIN: Software that is not copyrighted and which you may freely use share with other users. Often this term is incorrectly used to refer to ANY software that is distributed free or for a very small donation. (See "Freeware".)
RBBS: Remote Bulletin Board System. Also the name of a number of related bulletin board programs.
RDBS: Remote Data Base System. Though usually associated with systems that offer more features than a simple Bulletin Board System (BBS), the term encompasses all forms of non-commercial public and semi-public remote computer databases.
RS-232 or RS-232C: The standard computer hardware interface used for computer asynchronous communications connections.
START/STOP BITS: In serial, asynchronous transmission, start/stop bits indicate the beginning and end of each 7 or 8 bit data character. Most BBS's use an 8-bit word.
SYSOP: Common acronym for System Operator, the operator of a BBS.
UPLOAD: Transfer a file from your computer to a BBS.
USER: Anyone who establishes a user account on a BBS.
XMODEM: A protocol for transferring blocks of data via modem with a high degree of accuracy.
XON/XOFF: Protocol for controlling the flow of data. When the receiving device is about to overflow, it sends an XOFF character to the sending device. The XON character is sent when the receiving device is ready to receive data again.
ZMODEM: A fast and efficient protocol developed to enhance file transfer rates; extensive error-checking for accuracy.

Echoes and Networks

There are a variety of broadcast-oriented echoes, or linked message bases, available for broadcasters to use to exchange comments on broadcast information. RIME, FidoNet, MediaNet and SpectroNet, among others, feature several broadcast-related subboards that are available for SysOps to offer. If you log on to a BBS and notice that it's part of a network, leave (F)eedback or a (C)omment for the SysOp and let him or her know that you'd be interested in participating in any broadcast-related echoes that are available on the network.

Coming Attractions

Stay tuned to the "Broadcast BBS" column for a review of the new 9600 baud modem with FAX capability, and more telecommunications news!

Business Guide

Products and Services for the Broadcast Industry

Business Guide

Products and Services for the Broadcast Industry

Computer Connection

By Kelly Klaas
Twin Falls Idaho - (208) 733-7512

I want to thank those of you who answered my plea for help in a previous column concerning the addition of a 720k floppy drive on my vintage AT&T 6300 computer. Unfortunately, the amount of time from when I started receiving the help to the time this column was due at the publishers, I didn't have time to try the ideas. The 720k drive I was experimenting with was borrowed from a friend and I didn't have time to get it and try the different ideas.

The two methods, which became apparent after the dust settled, involved the DRIVPARM and DRIVER.SYS commands. I did try the DRIVER.SYS in my Config.sys file when I was experimenting, but I apparently didn't have the correct switches. Before I get too much into this, I want to experiment more with it. When I get it figured out, I will pass it along to those of you who may be going through the same thing. My next effort will be to get it to read and write 1.44meg, but I guess I'd better crawl before I run.

I also want to thank those of you who gave me encouragement and ideas from your letters and phone calls. At the time I am writing this column, I am waiting for some information from a gentleman in Hawaii who also uses a Format Sentry FS12-C automation switcher as we do here at KEZJ. I will briefly describe what he did then, when I get his information, I will try to go into more detail.

First, let me say that we have had the Format Sentry FS12-C since February 1990. It replaced an archaic (but still effective) SMC DP-1 programmable switcher. The SMC was circa 1971. In its day, it was quite the machine, and was still working when we retired it. The biggest problem with it was the degree of difficulty of getting spare parts. The price of the isocouplers alone was $35 each and the supply was drying up fast. We found ourselves buying up other DP-1's from around the country just to have spare boards. Then you get into the problem of board revisions. It is quite difficult to explain to the boss why you have $5000 worth of used DP-1 parts and boards and the parts you have are NOT the same ones you need.

Anyway, our Format Sentry is a very nice switcher. We also purchased the 12 channel extender since the original 12-channel FS12-C was not quite large enough for our needs. The brain of the system is an MIT 8088 based computer with a mono monitor and one floppy drive. We did have to replace a floppy controller card shortly after we purchased the computer, but the dealer replaced it with no problem.

One nice thing about using an MS-DOS machine as the brain for the switcher is that MS-DOS machines are easily available and, if push comes to shove, you can always pull out the one you are using and replace it with another to get you going again.

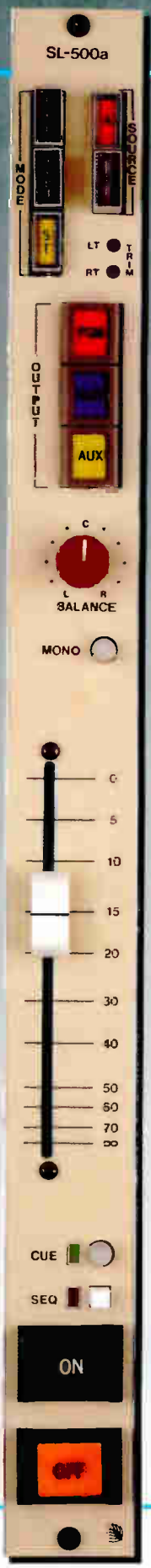
The software supplied with the FS12-C is fairly simple to use. The daily programming is easy once the basic programming skeleton is programmed. Some of the commands are a little mysterious but, if you know someone who has already fought that battle, it helps. I made a couple of phone calls to Paul Anderson at KZBQ in Pocatello before I got things running properly, and that helped tremendously. The manufacturer also helped.

The engineer from Hawaii called me recently and told me he had done some things with his Format Sentry which I thought were excellent ideas. First, he loads a TSR program which blanks the screen during extended periods of dis-use to prevent burn-in on the screen. EXCELLENT idea. He also installed a modem which allows him to control the programming and operations of the FS12 from his home. I have wished, more than once, that I had that feature, and I may do it soon.

He also installed a 12-position switch on the front of his unit to allow cuing on separate channels without interference from other sources. The way it is originally, if your network is sending feeds at the same time you want to listen to another source on cue, you can also hear the network feeds. This switch eliminates that. I hope to expand on these ideas as soon as I get his correspondence.

Keep the cards and letters coming folks, and we'll see you next time.

It's Handled!



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TELEPHONE/TALK SHOW: The MP-500 multiphone module offers a totally new way of handling telephone talkshow functions. Operation is simple: when the announcer wishes to do a phone segment he simply activates the MP-500 module and all mute, level, combining, and machine control functions are handled automatically. The MP-500 permits conferencing between 3 callers and 3 microphones, and provides separate multitrack tape feeds for various mic/caller signal combinations, permitting simple track punch-ins to replace razor and tape edits. This module eliminates complicated announcer set-ups, miscalls, and feedback problems.

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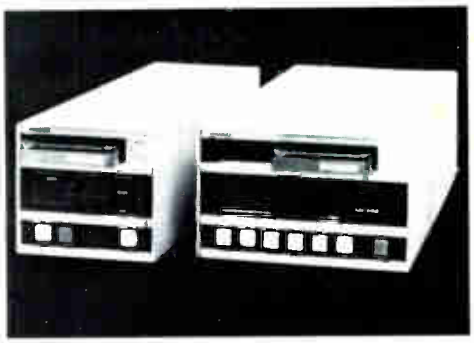

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Equipment Guide

Radio's Most Effective Classified Ads

October/November - 1990

Equipment Guide

Radio's Most Effective Classified Ads

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Equipment Guide

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Fax 912-739-0050

Phelps Dodge 2-bay CP antenna on 100.3 mHz. $1,200 in crate.
Alan McCarthy
KVIC - 600 East Main Suite K
Vacaville, CA 95688
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---

(4) Jampro FM antenna elements tuned to 99.9 mHz. Horizontally polarized, power divider included. Units do not include interconnections or heaters. Stored indoors since date taken out of service. $1,000 or best offer. You assume cost of shipping crate. Will ship freight collect only.
(3) Jampro JCP FM elements with heaters, tuned to 107.3 mHz. Manufactured in 1968. Stored indoors for past three years. Units include connecting cables but no power divider. $1,500 or best offer for all. You assume cost of shipping crate. Will ship freight collect only.
Aaron Wasilewski - KMWX/ KFFM
Yakima, WA 98907
509-248-1460 (8am-5pm)

Phelps Dodge CFM-2P CP 2-bay antenna on 107.1 mHz.
Phil Wells - KJQY
San Diego, CA
609-238-1037
Fax 609-238-6157

Rohn model 55 280 foot tower. Like new, complete w/ guys, lights and AM "Unipole" kit. On Ground, ready. $6,000
Roger Wright - WWLX/WLLX
P.O. Box 156
1208 North Locust Ave.
Lawrenceburg, TN 38464
615-762-2916

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(2) ERI FML-2 2-bay FM antennas. One on 96.7 mHz and one on 92.7 mHz.
Mike Ripley - KOZE
P.O. Box 936
Lewiston, ID 83501
208-743-2502

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(20) Phelps Dodge hangars for 3-1/8" rigid line.
Interbay lines and misc. parts for a Jampro JSCP antenna.
Parts off a FMH12AC miter cut antenna. Blocks, tees, interbays, arms, etc.
(2) Andrew 78ARF connectors for 3" Heliax.
(2) Cablewave 738350 connectors for 3" Coax.
WJAG/KXEL Radio
309 Braasch Ave.
Norfolk, NE 68701
402-371-0780 Fax 402-371-6303

Phelps Dodge HFM-LP5 antenna tuned to 89.5 mHz. Consists of (4) CP bays.
David Karns - KOPN
915 East Broadway
Columbia, MO 65201
314-874-5676

Cortana folded unipole - upper skirt.
1'-4" x 1'-8" tower bracket for Rohn 25 tower.
(2) tower brackets.
2600 feet of #10 soft-drawn un-insulated copper wire. (2) full reels of 1000 feet each and 3 partial reels.
74 feet 5/8" Heliax.
141 feet of 5/8" Heliax.
50 feet of RG-8/U coax.
Adolph Garza - KIXY-FM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext 20)

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600 feet of Andrew 4" Heliax with 3-1/8" flange gas-pass and gas-barrier installed. Line is approx. 4 years old and presently in use. We're putting up taller tower, line will be available around January-1991. $10,000
David Gernoske - WZYC
Route 4 Box 334
Newport, NC 28570
919-247-6343

---

275 feet Andrew 1-5/8" Heliax. Never more than 10 watts applied to it. Excellent condition. $1,500
Utility 496-foot, 42" face tower. Excellent condition, full lighting, standing in Texas. You move, make offer.
Patrick Parks - KYKR
27 Sawyer St.
Beaumont, TX 77702
409-838-3911 Fax 409-838-3233

Utility 450 foot tower. All but two sections in good condition. Included guy wires and insulators, base insulators, side lights and beacon, Stainless steel bolts and all other hardware. Part of this tower is only 5 years old. Tower on ground and ready for loading. No reasonable offer refused.
700 feet of 1-5/8" unjacketed line. Includes 3 end fittings. Cable in two pieces, approx. equal length. Make offer.
ERI 4-bay CP high power antenna, tuned to 105.3 mHz. Needs new bullets, but otherwise in good condition. tuning stub also included. Can be disassembled and shipped or can be picked up as-is.
D.C. Loughry - WFRB-AM/FM
P.O. Box 430
Frostburg, MD 21532
301-689-8871

Automation

BE SAT-16 automation unit with (6) reconditioned reels decks. Includes BE triple-deck, (3) SMC Carousels. Unit in great condition, 7 years old. Make offer, will deal.
Phil Noble - KLEN-FM
1416 Bradley Ave.
Cheyenne, WY 82001
307-637-5555

IGM Basic-A automation system. 12 years old, just taken out of service, working well. Includes (2) 42-tray Go-Carts; (1) ITC 3-deck; (1) ITC single deck; (1) ITC 750 reel deck. Input cards for 3 additional reel decks. A total of 12 input source cards including (2) live/network and

(continued)

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1975	Harris FM5H3, 5 kW FM
1983	Wilkenson 10000E, 10 kW FM
1972	CCA 20000DS, 20 kW FM
1976	RCA BTF-20E1, 20 kW FM
1983	Wilkinson 25000E, 25 kW FM
1986	Continental 314R1, 1 kW AM
1974	Harris BC1H, 1 kW AM
1981	McMartin BA-2.5K, 2.5 kW AM
1979	Harris MW5A, 5 kW AM
1966	Continental 315B, 5 kW AM
1980	Harris FM10K, 10 kW FM
1981	McMartin BA-5K, 5 kW AM
1972	CCA AM5000D, 5 kW AM
1976	CCA AM50000D, 50 kW AM
1972	Harris/Gates FM20H3, 20 kW FM
1967	Gates BC5PD, 5 kW AM
1972	RCA BTA-10U, 10 kW AM

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Jenkintown, PA 19046

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Fax No. 215-884-0738

(1) relay (for controlling external functions). Will demonstrate at Hutchinson, MN. $6,500
Darrel Gander - KKJR
Box 10
Hutchinson, MN 55350
612-587-2140

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(3) Automated Broadcast 25Hz sensors. Each run two decks. $85 each.
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San Diego, CA
619-238-1037

SMC automation system. SMC DP-1 controller in desk cabinet; SMC CCI-Carousel control interface; SMC DS-20-20 source audio switcher; (3) SMC 350 Carousels; (4) Otari ARS-1000 reel decks; (3) SMC 721 dual mono cart playback decks; AMC USI-1-universal satellite interface; Extel printer; SMC DT-1 logging package; SMC 790 mono cart R/P deck; SMC TG-25, 25Hz tone generator; (3) SMC equipment racks; (2) Gregg Labs series 2530 tri-band audio processing amps.; Rust RC-1000 remote control unit.
Ken Scott - WWQM-FM
5024 East Lacy Rd.
Madison, WI 53711
608-271-6611

SMC ESPI Automation System: (5) Otari reel decks; (4) SMC 350 Carousels; (4) SMC equipment racks; Video programming monitor; Time announce unit; (3) Audicord single play cart decks; SMC dual play cart deck; Audicord time delay R/P cart deck; DS-20A digital audio switcher; PD-4A superclock; logging encoder; logging printer; RAC-30 remote control; 4000-event memory. Includes all manuals.
Fred Jenkins - KMGO
402 North 12th
Centerville, IA 52544
515-856-3996

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(4) Otari ARS-1000 reel decks. With M.W. Persons Programmer 3A. Excellent condition, new Duracore heads. $5,000
Joe Jarjoura - WCIB
P.O. Box C
60 Spring Bars Rd.
Falmouth, MA 02541
508-548-3102

ABA System 100 automation system. Purchased new, used 6 months, then removed from service. Excellent condition, ready to deal.
Mark Skinner - WNFI-FM
801 West Granada Blvd.
Ormond Beach, FL 32174
904-672-9210

CCA A,S-1 Mini-Selector Automation System. $100
David Messing - KNCY
P.O. Box 278
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Absolute Broadcast Automation system: (8) Nakamichi MR-1 pro cassette decks. Perfect for in-house music or tie in with satellite program service. Purchased new, station now live. Used only one year. Great deal, let's talk. Production processor included.
Mr. Ed Sherlock - WBXQ-FM
4000 5th Ave.
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814-944-9350

Harris System 90 Automation System: (5) ITC 750 stereo reel decks; SMC 24-bin Carousel; (2) IGM 42-bin stereo Go-Carts; IGM 78-bin stereo Go-Cart; ITC 3D playback stereo cart deck;logging encoder; Texas Instruments 700 ASR data terminal; (4) AMCO equipment racks. Recently rebuilt and upgraded. Has been off air for over a year, but works great.
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Fax 517-972-1977

IGM model 382 time machine. Works good. $100
Extel model AH11R printer for parts or repair. $30
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402-371-0780

Extel Model 1AF11R printer with stand and book.
General Electric AP printer.
Smith Corona model 101 universal tractor feed.
Adolph Garza - KIXY-FM/ KAJY-AM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext.20)

SMC ESP2 Automation System: Will sell all or by the piece. (6) SMC/Otari ARS-1000 reel decks; (2) 452 bi-directional stereo Carrousels; (4) racks; control system, remote control with CRT; dual playback cart deck, printer. 2-1/2 years old, priced to sell.
Lyman James - KYQQ-FM
P.O. Box 650
100 East English Suite 480
Wichita, KS 67201
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(3) ITC SP stereo cart machines, $850 each.
ITC mono cart recorder. Also has time delay. $900 plus shipping.
Cart Winder. $125 plus shipping.
Bob Statham - WSTU
1000 Alice Ave.
Stuart, FL 34994
(407) 692-1000

Marantz PMD 200 cassette recorder. $75
Marantz C-206LP cassette recorder. $75
Service manual and carrying case for either of above.
(2) Fisher CR4016M cassette decks. $25 each.
ITC 750 record amplifier chassis (mono). $250
Tape-A-Thon programmer 4-reel background music system in rack. Make offer.
Marv Olson - KAUS-FM
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Tascam CD-701/RC-701 in good condition. $1700
Tascam CD-701. needs work. $300
All interconnection cables included.
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(2) Studer A727 compact disc players. Recently factory refurbished with latest software mods.
Bill Robinson - KLXX Radio
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(2) MCI/Sony JH110B reel recorders. Will trade for an Icom R9000 receiver.
David Solinske - WSUN #300
877 Executive Center Dr. W.
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813-576-1073

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(2) Teac X300 1/4-track stereo decks. $350 each.
UMC splice finder. $100
Ampex AG350 full-track mono reel deck. $150
Scully 270 1/2-track stereo playback. $150
Phillips Pro-12 1/2-track stereo deck. $50
John Franks - WHTH/WNKO
1000 N. 40th St.
Newark, OH 43055
614-522-8171

Spotmaster 2000 record/play cart deck. $500
Spotmaster 2000 playback cart deck. $400
Larry Filkins - KNGX-FM
Rogers State College
Claremore, OK 74017
918-341-7510 (ext 201)

BE 2000 playback cart machine. Mono with manual. $500
Spotmaster 500 rackmount R/P cart machine. Mono with bad motor. $200
(2) Electro-Voice DS35 microphones. $100 for Both.
ITC "Encore" R/P cart machine. Mono with bad motor. $200
(2) Revox A77's. One in portable case, the other for spare parts. Includes full service manual. $450 for all.
Jim McDonald - Wind River Institute
329 East 3rd St.
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ITC 750 2-track R/P reel deck. Works, in fair shape. $250
Sparta 400 R/P mono cart deck. $200
Alan McCarthy - KVIC
600 E. Main Suite K
Vacaville, CA 95688
707-446-0200

ITC 99B mono cart recorder. $1750
ITC RP mono cart recorder, 3-tones. $775
ITC SP mono cart player, 3-tones. $475
UMC 11-113 mono player, 3-tones. $375
Ampex 350 stereo recorder. $425
(4) Scully 285 playback decks. $250 each, all for $900
(2) Inovonics 370 R/P electronics. $425 for pair.
MCI JH-110B Full-track stereo reel, for 14" reels. $2500
Phil Wells - KJQY Radio
San Diego, CA
619-238-1037 Fax 619-238-6157

PDII record/play cart deck. Mono with manual.
Fred Jenkins - KMGO
402 N. 12th
Centerville, IA 52544
515-856-3996

Shure SC39EJ and **V15V-MR** phono cartridges. Unopened boxes. Best offer.
NAB test CD, unopened. $40
Bill Jones- 7748 Oldridge Rd.
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803-767-7880

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(10) Revox A-77 reel decks in various condition. $200 each or $1500 for all.
(4) Rek-O-Kut turntables and tonearms in various condition. $50 each.
(3) ITC RP stereo cart recorders with 3-tones. $750 each.
Telex RP-85 slow-speed logger tape deck. $1000
Gary Fullhart - WVKS-FM
4665 West Bancroft St.
Toledo, OH 43615
419-531-1681 Fax 419-536-9271

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(8) Spotmaster/BE 500-C mono R/P cart machines. $400 each or $2600 for all.
(2) Scully 280 Full-track record/play. $500 each or $800 for both.
Jim Linn - WHKS
62 North Main St.
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814-642-7004

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(8) ITC PDII mono cart play decks. Excellent condition. $400 each.
Spotmaster 500C mono cart recorder. $200
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218-829-1326

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ITC 750 reel deck record electronics.
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Saginaw, MI 48604
517-792-1063 Fax 517-792-1977

Scully 270 2-track stereo R/P reel deck. Works good. $500
SMC 590 R/P cart deck. $250
BE 2000 cart deck for parts.
16" turntable. $25
WJAG/KEXL Radio
309 Braasch Ave.
Norfolk, NE 68701
402-371-0780 Fax 402-371-6303

Sparta-Matic mono cart deck. Complete, good for parts. Best offer.
Mike Martindale - KVON
1124 Foster Rd.
Napa, CA 94558
707-252-1440

Neumann U-67 microphone with power supply. $750
Wayne Nauman - WLVJ-AM
400-J Royal Commerce Rd.
Royal Palm Beach, FL 33411
407-793-5555

SMC 792 stereo R/P cart deck.
Marantz turntable.
Auditronics model 132 multi-track, multi-head large reel tape duplicator. Mobile carrying case included.
(2) Ampex model 351 tube type reel decks.
QRK 12C turntable. No arm.
Russco Cue-Master turntable. No tone arm.
(2) Revox A77 R/P reel decks (for parts).
Marantz PMD-220 cassette (for parts).
Technics SP-15 turntable (for parts).
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2824 Sherwood Way
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915-949-2112 (ext 20)

Consoles & Mixers

Harris Gatesway-80 console.
Jay Bromley
8805 S. 28th
Apartment #6
Fort Smith, AR 72903
501-648-9138

Shure M675 broadcast master, with manual. $75
Jim McDonald - Wind River Institute
329 East 3rd St.
Loveland, CO 80537
303-669-3442

LPB C-10S Citation 10x3 stereo console. $2500
Phil Wells - KJQY
San Diego, CA
619-238-1037 Fax 619-238-6157

McMartin B-5000 5-channel stereo console. Needs work. $200 or best offer.
Gary Fullhart - WVKS-FM
4665 West Bancroft St.
Toledo, OH 43615
419-531-1681

Gatesway 8-channel tube-type audio console. No power supply, has been re-painted, looks good. Operational status unknown. No manual.
Les Vaughn - WMCL
McLeansboro, IL 62859
618-6432311
618-643-5201 eves

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(2) Audio Interface Systems 8-pot dual output consoles. Similar to Broadcast Electronics 150 Series consoles. One is in great shape, the other good for parts or re-building.
Jim Linn - WHKS
62 North Main St.
Port Allegany, PA 16743
814-642-7004

Bauer 910 8-channel mono console. $400
Bauer 912 5-channel stereo console. $400
WJAG/KEXL Radio
309 Braasch Ave.
Norfolk, NE 68701
402-371-0780

Ramko DC-12 11-channel mono console. Needs wiring harness, otherwise works good (needs TLC). $1000 or best offer.
BE 4M50 console. $700
Sparta 4-channel board. Unknown condition, needs power supply. $50
Mike Martindale - KVON
1124 Foster Rd.
Napa, CA 94558
707-252-1440

Gates "Yard" Console. Power supply needs repair, good production board, just removed from service.
Jat Amburn - KTUE Radio
Tulia, TX
806-995-3531

Peavy Mark III series 12-channel stereo mixer with case. $750
Wayne Nauman - WLVJ-AM
400-J Royal Commerce Rd.
Royal Palm Beach, FL 33411
407-793-5555

Gates mono "Yard" console. Taken out of service 1 year ago. No manual. $225 plus shipping.
David Oseland - WCFC-TV
20 N. Wacker Dr.
Chicago, IL 60606
312-977-3838 Fax 312-977-9947

Broadcast Electronics 4BEM-50 4-pot mono console.
Ramko SC-5M 5-pot mono console.
Ramko DC-8M 8-pot stereo console.
Collins 212F-2 6-pot mono tube type console.
Gates M-5136 2-pot tube-type mixer.
Ampex 4-pot tube-type mike mixer.
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Royal Palm Beach, FL 33411
407-793-5555

ADC Sound Shaper Two equalizer. $45
ADC SA-1 Sound Shaper analyzer. $45
Marv Olson - KAUS-FM
Highway 105 South
Austin, MN 55912
507-437-7666 Fax 507-437-7669

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(2) CRL SEP-400's and PMC-300's in good condition. $600 each.
George Arroyo - WONQ-AM
Orlando, FL
407-293-0000

Inovonics 2222 NRSC processor. Like new. $400
Gregg Labs 2530. $350
Phil Patton - WAPO
29 West Main St.
Jasper, TN 37347
615-942-5611

Harris Solidstatesman AGC.
Harris Solidstatesman limiter.
Jay Bromley
8805 South 28th Apt. #6
Fort Smith, AR 72903
501-648-9138

Howe Audio 2100 Phasechaser. $1,200
(2) Shure SR-107 equalizers (single channel units). $75 each.
Gary Fullhart - WVKS-FM
4665 West Bancroft St.
Toledo, OH 43615
419-531-1681 Fax 419-536-9271

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(2) CBS model 411 FM Volumax peak limiters. $200 each.
David Messing
P.O. Box 278
Nebraska City, NE 68410
402-873-3348

Harris MSP-90 dual channel AGC/compressor. Excellent condition. $800 or best offer.
Jim Linn - WHKS
62 North Main St.
Port Allegany, PA 16743
814-642-7004

Sound Technology AN-1 stereo simulator. $350
(2) UREI BL-40 Modulimiters. Excellent condition. $300 each.
Mark Persons
218-829-1326 Fax 218-829-2026

Sound Craftsman TG-2209, 600 ohm balanced in/out equalizer (not working).
CBS Laboratories Audimax stereo limiter. One channel not working.
UREI BL-40 Modulimiter.
Dorrough model 310 audio processor.
Adolph Garza - KIXY-FM/ KAYJ-AM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext 20)

STL, RPU, R/C

Marti RMC-2AXT(10) remote control system. $250
Marv Olson - KAUS AM/FM
Highway 105 South
Austin, MN 55912
507-437-7666 Fax 507-437-7669

Micro-Controls DLC-9/DLT-9 remote control. $800 or best offer.
Larry Filkins - KNGX-FM
Rogers State College
Claremore, OK 74017
918-341-7510 (ext 201)

Marti 1500 digital remote control with manuals. 15-channel, LED readout, easily calibrated at TX site, 67kHz generator for studio STL interface, FSK for return telco loop. Includes interface relays, failsafe. Excellent condition. $1,500
Fred Jenkins - KMGO
402 North 12th
Centerville, IA 52544
515-856-3996

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(2) Marti STL-8 transmitters and receivers. On 946.850 and 947.150 mHz. $2,500 for pair.
Rod Chambers - KSUE
3015 Johnstonville Rd.
Susanville, CA 96130
916-257-2121

QEI 7775 ATS system. Excellent condition. $500
Micro-Controls PTS-10C composite STL system on 949.0 mHz. Excellent condition. $2,000
Mark Persons
218-829-1326 Fax 218-829-2026

Marti STL-8 STL transmitter and receiver.
WGER-FM
6165 Bay Rd.
Saginaw, MI 48604
517-792-1063 Fax 517-792-1977

Rust remote control system, studio and transmitter units. One telemetry encoder model 108-1C and one remote telemetry model 08-00.
Adolph Garza - KIXY-FM/ KAYJ-AM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext 20)

Moseley MRC-1600 remote control system. Set up for phone line but can be updated to wireless system, as well as being upgradeable to 1620 level. Great condition, must sell. $2,500
Bud Williamson - WALL
One Broadcast Plaza
Middletown, NY 10940
914-343-7400

Marti MRA950, 900 mHz preamp. About 12dB gain. $100
Alan McCarthy - KVIC
600 East Main Suite K
Vacaville, CA 95688
707-446-0200

AM Transmitters

Collins 20V AM transmitter in good condition. Tuned to 1090 kHz. $2,000
George Arroyo - WONQ-AM
Orlando, FL
407-293-0000

Harris/Gates BC-1H AM transmitter. 250/500/1000 watts. In excellent condition, has been well maintained. Presently being used until facility is upgraded.
Collins model 550A-1 AM transmitter. 250/500 watts. In use at present time as aux.
Arnold Terry - WODY
P.O. Box 545
Bassett, VA 24055
703-629-2509

AM/FM Exciters, Stereo and SCA

Kahn AM stereo exciter with Power-Side. Tuned to 1140 kHz. $2,800
George M. Arroyo - WONQ
Orlando, FL
407-293-0000

CCA FM-10DS exciter on 107.1 mHz. Well Maintained with manual. $400
Don Sports - WCLA-AM/FM
P.O. Box 427
Claxton, GA 30417
912-739-3035

Harris STX-1B C-Quam exciter; BE AS-10 C-Quam monitor; Harris STM-1 Harris and ISB monitor. All currently working and on-air. $6,500 or trade for Khan system with or without Powerside.
Phil Patton - WAPO
29 West Main St.
Jasper, TN 37347
615-942-5611

CCA SG-1D "solid state" stereo generator. $50
McMartin B-910 FM exciter with stereo generator. Good condition. $900
David Messing - KNCY Radio
P.O. Box 278
Nebraska City, NE 68410
402-873-3348

Gates M-6095 10-watt exciter. $200 or make offer.
Jim Linn - WHKS
62 North Main St.
Port Allengany, PA 16743
814-642-7004

Collins 310Z-2 exciter on 94.3 mHz. Excellent condition. $2,000
Mark Persons
218-829-1326 Fax 218-829-2026

Test and Monitor

B&W Oscillator and B&W distortion meter. $200 for the pair.
Bob Statham - WSTU/WHLG
1000 Alice Ave.
Stuart, FL 34994
407-692-1000

McMartin TBM-3000 freq. monitor on 99.9 mHz. $50
Marv Olson - KAUS-AM/FM
Highway 105 S.
Austin, MN 55912
507-437-7666

Audio Proof Set. B&W model 210 audio oscillator; Gates (Harris) stereo gain set; B&W model 410 distortion meter. All manuals complete. $1000 for all three.
Don Sports - WCLA-AM/FM
P.O. Box 427
Claxton, GA 30417
912-739-3035

McMartin TBM-8500B AM modulation monitor.
McMcartin TBM-3700 FM modulation monitor on 100.9 mHz.
McMartin TR-660 FM SCA pickup receiver.
Best offer on all pieces.
Bill Priest - WBNO/WQCT
P.O. Box 603
S.R. 34 West
Bryan, OH 43506
419-636-4577

Norlan model SR-2091 surveillance receiver. 20-500 mHz with DU-2090 spectrum display. Good condition. $1200
Tektronix model 115 pulse generator in good condition. $150
Michael P. Murphy
11621 Valle Vista Rd.
Lakeside, CA 92040
619-561-2726

McMartin TBM-3000A frequency monitor on 92.5 mHz. $50
Gary Fullhart - WVKS-FM
4665 West Bancroft St.
Toledo, OH 43615
419-531-1618 Fax 419-536-9271

Marconi TF-791D deviation meter. Works but could use re-calibration. With manuals but no probes.
Marconi TF-1066A signal generator. Works but could use re-calibration. With manuals but no probes.
Les Vaughn - WMCL
McLeansboro, IL 62859
618-643-2311
618-643-5201 eves and weekends

General Radio model 916A RF bridge. Excellent condition with cables connectors and ,manuals. Asking $350
B&W model 210 audio oscillator and model 410 audio distortion analyzer. Look good but need a little work. Includes manuals. $100 for the pair.
David Messing - KNCY Radio
P.O. Box 278
Nebraska City, NE 68410
402-873-3348

Nems-Clarke type 120E field intensity meter.
Mike Ripley - KOZE
P.O. 936
Lewiston, ID 83501
208-743-2502

RCA Senior Voltohmyst type WV-98C, without probe. $35 plus shipping.
David Oseland - WCFC-TV
20 N. Wacker Dr.
Chicago, IL 60606
312-977-3838 Fax 312-977-9947

Tubes

(1) New and (1) used OK 4CX250B tubes. $200 for all three.
Jim Mcdonald - Wind River Institute
329 East Third St.
Loveland, CO 80537
(303) 669-3442

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(3) 8122 tubes and (3) 8122 tube sockets, 1 new and all wired.
Danny Tabor - WVLE Radio
(502) 237-3148

Satellite

USS model 380 3.8 meter dish. Polar mount, complete with (2) 85-degree LNA's, mount, Houston "Tracker IV" satellite locator and drive. Perfect for radio stations with multi-network "talk" formats. Complete system $3,444 or best offer, freight, FOB, **LaCrosse, WI.**
Mark Burg - WLAX-TV
1305 Interchange Place
P.O. Box 2529
LaCrosse, WI 54602
608-781-0025

Microdyne model 1100-FFC, SCPC downconverter. $600
David Messing - KNCY Radio
P.O. Box 278
Nebraska City, NE 68401
402-873-3348

LAUX satellite system includes: (2) model 8705 audio terminals, (1) LAUX LNA LC0106, (1) 70 mHz LAUX downconverter, (2) runs of 25-30 feet each of RG-59/u coax, (1) 9-foot parabolic dish for 4 gHz. Books included.
Adolph Garza - KIXY-FM/ KAYJ-AM
2824 Sherwood Ave.
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext 20)

TV, Video

Sony 5600 3/4" video recorder. $795
Panasonic NV9100A 3/4" video player. $250
Panasonic CCDWVCL304 video camera. $695
Quickset video studio tripod. $350
HP 10753A Laser tripod. $250
Wild inspection microscopes. 60 to 500 power. $345
B&L stereo-microscope. 100, 430, 970 power. $350
Bruce Cooke
125 Birch St.
Blountville, TN 37617
605-323-2976

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(2) Emcee TTS-20, 2 gHz television transmitters with RCA color TV modulators. Excellent condition. Make offer.
Patrick Parks - KLVI
27 Sawyer
Beaumont, TX 77702
409-838-3911 Fax 409-838-3233

Misc. RF

(6) New Johnson grid capacitors. Part #124-0113-001.
(10) New type MA4899 diodes used in line element.
Microwave Devices 3kW incident & reflected line element.
Danny Tabor - WVLE Radio
(502) 237-3148.

McMartin TBM-2500C FM RF amplifier.
Adolph Garza - KIXY-FM/ KAJY-AM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext. 20)

Hygain Scanner, works good. $30
WJAG/KEXL Radio
309 Braasch Ave.
Norfolk, NE 68701
402-371-0780 Fax 402-371-6303

McMartin TR-66A SCA receiver.
WGER-FM
6165 Bay Rd.
Saginaw, MI 48604
517-792-1063 Fax 517-792-1977

Misc. Audio

Technics SV-100 with AC power supply. Records digital audio on any NTSC VCR. $500
Phil Patton - WAPO
29 West Main St.
Jasper, TN 37347
615-942-5611

Marti PGM-20 line amp. $50
Spotmaster 1x5 mono DA. $50
Phil Wells - KJQY
San Diego, CA
619-238-1037 Fax 619-238-6157

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(2) McIntosh MC-60's. Good condition. $750
Phil Patton - WAPO
29 West Main St.
Jasper, TN 37347
615-942-5611

ITC ESL-IV splicefinder with manual.
Fred Jenkins - KMGO
402 North 12th
Centerville, IA 52544
515-856-3996

ITC ESL-IV bulk eraser/splice finder. $500
Hewnry Engineering Mix-Minus Plus. $100
(2) Radio Systems PA-1 phono pre-amps. $125 each.
Gary Fullhart - WVKS-FM
4665 West Bancroft St.
Toledo, OH 43615
419-531-1681 Fax 419-536-9271

RCA BA-44 monitor amp.
RCA BA-48 line amp.
Bopth items never used/new. $100 each.
Roy Humphrey - WLTJ
7 Prkway Center
Pittsburgh, PA 15220
412-922-9290

Dsktop miniature patch panel. 6 bays x 26 jacks. $100
Misc racks mixers and tape decks.
David Messing - KNCY Radio
P.O. Box 278
Nebraska City, NE 68410
402-873-3348

Collins 212Y remote amplifier.
Broadcast Electornics cart rewinder.
Adolph Garza - KIXY-FM/ KAYJ-AM
2824 Sherwood Way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext 20)

Misc. Equipment

(3) ABCO wire cart racks on floor stands, holding 500 carts each. $225 each or $600 for all.
(342) Capitol A-2 carts in fair to good shape. $1.20 each.
(1178) Scotchcart II's with Easy Listening/Lite jazz Library. Well recorded in stereo. $2.00 each or $2,100 for all.
1 set LEL alignment ga. for Ampro carts. $15
Phil Wells - KJQU
San Diego, CA
619-238-1037

Lazy Susan cart rack with 500 cart capacity. You pick up. $400
Cart winder. $125 plus shipping.
Bob Statham - WSTU/ WHLG
1000 Alice Ave.
Stuart, FL 34994
407-692-1000

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(2) Phasemaster T-10,000-A2-AS. Fro 3-phase conversion. Usable with 20kW FM or 25kW AM transmitters. $2,800 each.
George Arroyo - WONQ
Orlando, FL
407-293-0000

Videomedia model Z6000 control panel. Good condition. $175
Michael Murphy
11621 Valle Vista Rd.
Lakeside, CA 92040
619-561-2726

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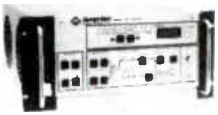
(3) Ruslang reel deck push-carts. Adjustable deck, center base, wood grain finish with black facing. $450 each or best offer. You assume cost of shipping, will ship freight collect only.
Aaron Wasilewski - KMWX/ KFFM Radio
Yakima, WA 98907
509-248-1460 (8am-5pm)

2'8" x 3'10" x 2'5" steel desk.
(5) Beige Formica and wood reel stands for Revox PR99's.
(5) Directors chairs. Steel & vinyl construction.
Carrier 16,000 BTU air conditioner. 220 volt.
Various runs of 27-pair multi-cable shielded. All runs under 30 feet.

Punch blocks, jack panels and Panduit.
Fisher Audio component system MC-708.
Transmitter breaker box, 200 VAC, 200 amp.
(6) Formica and wood turntable cut-outs for Technics SP-15 turntables. Outside perimeter is square (4 beige and 4 dark brown).
Adolph Garza - KIXY-FM/ KAJY-AM
2824 Sherwood way
P.O. Box 2191
San Angelo, TX 76901
915-949-2112 (ext. 20)

FM BROADCASTERS!!

We can meet all your FM transmitter needs!!



SOLID STATE - LOW POWER

Amplifiers and transmitters are available at the popular levels of 30W, 100W, 300W, 500W, and 1KW. All units are solid state, broadband, and designed for both local and remote operation.

ONE AND TWO TUBE HIGH POWER

Medium transmitters with broadband solid state drivers and one zero bias grounded grid triode in their PA are available at 1.5KW, 3.5KW, 5.5KW, 7.5KW, and 12KW. Higher power transmitter utilizing two grounded grid triodes (one as a driver) are available at standard outputs of 15KW, 22KW, 25KW, 30KW, 40KW, and 50KW.

Energy-Onix

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(518) 828-1690 FAX (518) 828-8476

A Wise Enterprise