Radio Guide

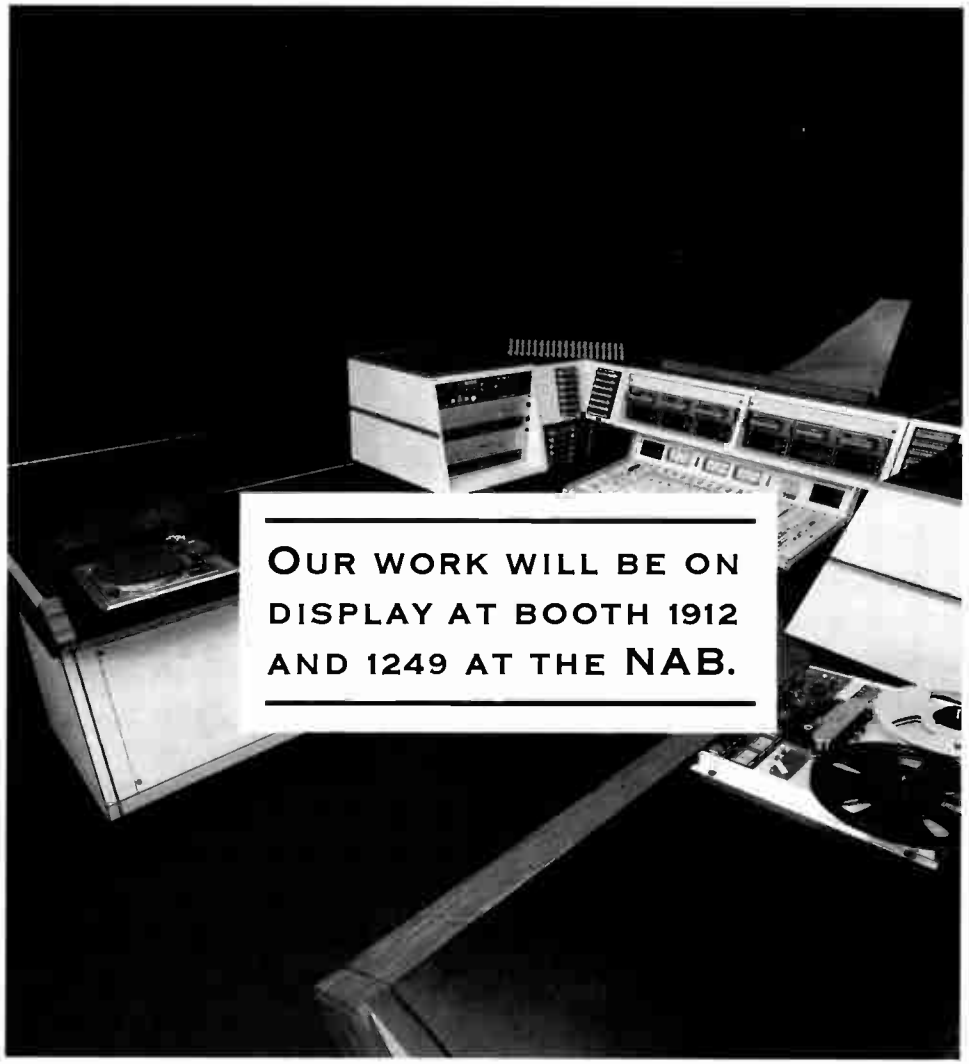
Radio's Technology Magazine

National Association of
NAB
BROADCASTERS

LAS VEGAS CONVENTION CENTER
LAS VEGAS, NV.

March-1991
NAB Issue

HEAD TURNING



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Radio Guide
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March - 1991
Volume 4 Issue 3

Cover Photo

Courtesy of
Arrakis Systems
-and-
Harris-Allied

See the new
Arrakis Digilink
at NAB '91 in Las Vegas

More After This!

Editorial Comments

Ray Topp - editor/publisher

You Say You're Safe ...?

This is the time of the year for transmitter site spring cleaning. You'll probably be getting into and touching a lot of equipment and circuits that you haven't seen or thought about for quite awhile.

We all talk about safety, but how many of us really practice it on the job? Most of us have specific maintenance or repair procedures that we have developed for ourselves, to guide us through the technical problems we face. Such procedures are designed to eliminate, as much as possible, the trial and error phase when resolving a problem. When repairing a battery powered mixer, there's not too much that can go wrong - at least nothing hazardous to life. At the transmitter site, it's a different story.

Suddenly the concept of trial and error takes on a whole new meaning. In fact, in many cases, an error could cost you your life. Think about it, have you set down specific safety procedures that you follow every time you work on your equipment? Are these procedures sufficiently developed so that they will work - even when you are dog-tired at 3:00 a.m.?

Let Them Know

Do you let the studio personnel know that you are working at the transmitter site? How many times have you just decided to go out and get some work done without so much as a phone call to anyone? Let them know where you are, what you are doing, and when you expect to complete the job. Better still, have that person give you a call every so often just to make sure that you're O.K.

Breaker-Breaker

Do you really ... I mean really ... know exactly what circuit is controlled by each breaker. Many transmitter sites have had extensive refurbishing. Some of the "old" wiring may still be live. Many sites have 120/220 VAC control leads going all over the place and into the phasor, ATU's, and transmitters. Just because the transmitter breaker is off, is no guarantee that there is no AC present from some other control circuit. Interlocks are a prime culprit. Many interlock circuits, at many sites, are still 120 AC - and you know how many devices that some interlock circuits can go through.

Numerous transmitters have separate breakers for exciters, drivers, etc. Even when the main transmitter breaker is off, there can still be exciter, control ladder and interlock AC present in the box. If you've been at your job for awhile, you probably know all about the quirks of your site. How about your replacement when you are on vacation? Is that person as well informed as you? Is there an up-to-date diagram or chart at the site, that can be referred to, if you're not there?

A 50-cent Lifesaver

While at the transmitter site, you should always carry one of those small neon AC testers. You can usually pick one up in the bargain-bin at your local hardware store, for less than 50 cents. Even when you think that the AC power is off, stick one lead of the tester on ground and touch the other lead to all the points you may be touching with your hands. *You* may be surprised at what you find in a "dead" transmitter. But at least no one *else* will be surprised at what they find at the transmitter site.

Ray Topp - editor

Radio Guide Forum

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

Tech Manuals Needed

Wanted: Otari MX5050 mini-pro, 2-SH series, tape deck technical manual and schematics.

Contact: Al Martin
HCR 1 Box 286-D
Merrifield, MN 56465
(218) 765-3333

Wanted: Bauer 707 AM transmitter service manual, or copy.

Contact: Roger Roth - WHNR
1505 Dundee Rd.
Winter Haven, FL 33884
(813) 682-8184

Wanted: Tektronix 535 'Scope schematic. Need original or copy.

Contact: Bob Gratham
RD #1 Box 1339
Carbondale, PA 18407
(717) 282-5831

Wanted: Gates Yard mixer and CCA FM-10-DS Exciter. Need schematics and service manuals for both. Photo copies OK.

Contact: Don Campbell - KALF
P.O. Box 7950
Chico, CA 95927
(916) 343-5253

Parts Needed

Wanted: McMartin TBM-4500A mod monitor. Need meter (400uA).

Contact: Bill Tidwell - WAFT
P.O. Box 338
Valdosta, GA 31603
(912) 244-5180

Wanted: Fairchild DART-384 satellite receiver. Need 7.5 kHz dual audio card.

Contact: Steve Raymond - WARE
P.O. Box 210
Ware, MA 01082
(413) 967-6231

Wanted: Scientific Atlanta 7300 satellite receiver. Need 7.5 kHz audio card. Will trade 15 kHz card.

Contact: Greg Kern - KEEY/WDGY
611 Frontenac Place
St. Paul, MN 55104
(612) 642-5211

Wanted: Harris 6550 satellite receiver. Need agile demod card for Harris or like receiver. Could use Microdyne PCDR5 outboard SCPC receiver.

Contact: Randal Miller - WRVI
815 W. Dean
Virden, IL 62690
(217) 965-3388

Wanted: Sigma Datacells. Need part #301R1-24. Need not work.

Contact: Tom Wilds - KODL
P.O. Box 741
The Dalles, OR 97058
(503) 296-2101

Wanted: Gatesway Console. Need Parts for this Gates Electronics console.

Contact: Ken Harmon - WBSC
One Radio Rd.
Bennettsville, SC 29512
(803) 479-7121

Wanted: Good used carts. Need used 4-1/2 and 5-1/2 (or longer) carts. Any brand. Possible trade for 40's, 70's, 100's, 2-1/2's and 3-1/2's.

Contact: Dave Richards - KKGD
P.O. Box 1210
Rifle, CO 81650
(303) 625-2299

Need three ITC cart I/O cards for Schafer 901/903 automation system.

Contact: Terry Jordan - WFNC
1009 Drayton Rd.
Fayetteville, NC 28303
(919) 864-5222

Equipment Wanted

Wanted: Wheatstone A-32 or A-50 console. ITC 3-deck stereo RP cart machine. ITC single deck P cart machine. Otari MX-50 reel deck.

Contact: Rod Chambers - KSUE
3015 Johnstonville Rd.
Susanville, CA 96130
(916) 257-2121

Wanted: 10kW FM transmitter on 94.1 mHz. 1980 model or later. Upgrading in Spring or Summer. Also need transmission line dehydrator unit.

Contact: Paul Salois - KPCR
P.O. Box 1 Highway 54E
Bowling Green, MO 63334
(314) 324-2283

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Sales Offices

Dale Tucker - sales manager
865 Hawthorne Dr.
Walnut Creek, CA 94596
(415) 935-1470

Cal Vandegrift - sales
33729 32nd Ave. SW
Federal Way, WA 98023
(206) 874-4976

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Radio Guide Forum

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

Wanted: Disc recording equipment. Presto, Fairchild, Rek-O-Kut, Neumann. Need manuals, needles, amps, limiters, blanks, etc. Would like advice or technical information that may help me to produce my own blanks (need chemical makeup for lacquer coatings).

Contact: Kim Gutzke
7134 15th Ave. S.
Minneapolis, MN 55423
(612) 866-6183

Wanted: 8100A Optimods in any condition.

Contact: Mike Cooney
Broadcast Management
Sioux Falls, SD 57104
(605) 336-2706

Wanted: On-Air sign, wall mount, in reasonable condition.

Contact: Tom Wilds - KODL
P.O. Box 741
The Dalles, OR 97058
(503) 2962101

Wanted: Gates ST-101 spot tape or cabinet for same, in any condition.

Contact: John Schnieder
RF Specialties
19237 Aurora Ave. N.
Seattle, WA 98133
(206) 546-6546

Wanted: Reel to reel for production room. Prefer stereo, solid state. Also need mobile studio unit or Big Boom Box type remote trailer.

Contact: WTGC Radio
101 Armory Blvd.
Lewisburg, PA 17837
(717) 523-3271

Need a Part?
Get it in The Guide!

Fairchild DART-384 or Scientific Atlanta 7300/7325 digital satellite receiver with 15kHz cards and voice/cue card for ABC network.

Contact: Joel Clawson - KPIE
P.O. Box 1160
Trumansburg, NY 14886
(607) 387-3184

Wanted: RCA BK-10 bi-gradient unaxial microphone. Principally used in TV and film as boom mike. Similar in design to RCA BK-5 model. Also seek RCA BK-14 and BK-16 dynamic units. Check your junk room! Will make acquisition(s) worth your while either directly or by referral.

Contact: James Steele - KXBX
P.O. Box 2525
Kingsland, GA 31548
(912) 729-6106

Wanted: Scientific Atlanta 7325 digital processing unit and a 7300 wideband BPSK receiver.

Contact: David Rockwell - WQIX
111 N. Main St.
Elmira, NY 14901
(607) 737-1314

Wanted: Old 250, 500 or 1kW AM broadcast transmitters to convert for use on 75 meter band. Prefer Gates BC-1G series. Could pick up in the Carolinas.

Contact: Terry Jordan - WFNC
1009 Drayton Rd.
Fayetteville, NC 28303
(919) 864-5222

Wanted: ABC Netcue II in good condition.

Contact: Steve Raymond - WARE
P.O. Box 210
Ware, MA 01082
(413) 967-6231

Wanted: Equipment donations needed to help place a new 50kW, non-profit FM on the air at 88.5 mHz. Need All types of broadcast equipment including antennas, towers, coax, STL, R/C, Audio proc and EQ, automation, tape and cart decks, TT's, CD's and mikes. Non-profit 501-C-3.

Contact: Wilbur Goforth - WBHY
P.O. Box 1328
Mobile, AL 36633
(205) 432-8484

Wanted: Orban 424 stereo compressor (or equal).

Contact: Ken Jones - KTLR-FM
105 W. Moore
Terrel, TX 75160
(214) 563-1071

Wanted: 10-1/2" reel to reel 2-track stand-alone tape deck.

Contact: Dick Warren - KGMG-AM
5735 Kearney Villa Rd.
San Diego, CA 92123
(619) 560-5464

Wanted: 4-track mixing board for production and training. KABR is licensed to the Alamo Navajo School Board, a non-profit organization. Your contribution is tax deductible. Thank you. Walk in beauty.

Colleen Keane - KABR
P.O. Box 907
Magdalema, NM 87825
(505) 854-2632

Jobs Wanted:

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Rochester, MN 55903

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State of the Art

By Chip Morgan - CMBE
Sacramento, California - (916) 983-9834

The New Look of Radio

Station's across the country are entering the 4th media with interactive voice mail systems. Callers can get a wide variety of audiotex including music information, traffic reports, jokes and insults, by calling a phone number and selecting the messages they want to hear by touchtone phone. Some stations are also introducing Frequent Listener Clubs where callers leave their names and addresses to join the club.

My Concerns About Digital Radio

I'm still concerned that broadcasters may not be able to implement digital technology soon enough. By the time we have agreed on the terrestrial broadcast systems, and they are licensed and built, the telcos and satellite companies will have completed digital and optical systems which will provide audio, video and data for personal communications devices. Once consumers find out that they can have a combination telephone, computer, radio, TV, fax, video and audio recorder in one box, broadcasting as we know it today may be as obsolete as telegraphy.

What We Have To Offer That Nobody Else Has

Radio and TV stations provide 24-hour-a-day programming. We can produce live or recorded entertainment and information. Maybe we should decide whether we want to provide a service (programming) or a technical delivery system (transmitter systems). Is the method used to disseminate the programming the most important aspect of our business? If it is, the stakes just got a lot higher.

Skypix Offers An Alternative To Local Cable

A new 80-channel satellite service (received on dishes as small as 24 inches wide that can hang under the eves of your home) is expected to be available by mid summer. The receiver-antenna system will have a $699 suggested retail price. Many consumer electronics stores have already agreed to sell the receivers nationwide.

Video And Audio Distribution By Phone

When the phone companies' digital and optic networks are fully in place, TV networks and stations will send news and features by telephone; radio syndicators, newspersons and remote crews will make a phone call to send full quality audio - even Hollywood will be able to send movies to theaters by telephone. At home, listeners and viewers will program their phones to record audio and video, and it will recall it at the touch of their telephone dial (and later by voice). People will be able to call a station anywhere in the country and listen or watch by telephone.

AT&T Will Provide More Redundancy

By the end of 1991, AT&T is expected to have programmed central office switches to allow at least 100 possible paths for a call to take to reach its destination. Currently, calls have a choice of 21 paths, and this bottleneck has caused problems when major cables have been cut.

More On QSound... 3-Dimensional Music

Recording engineers at well-financed studios can use one of the ten QSound systems currently available to position sounds 3-dimensionally in a stereo soundscape. The results on playback reportedly contain better imaging. Listeners hear added depth and clarity in positions of the individual elements of the mix. You can sample the effects on Maddona's "The Immaculate Collection" and Sting's new "Soul Cages." This is not an in-line stereo enhancer, and the effects are not on all passages. QSound has been used mostly as a spice in the mix, rather than as a major effect on the whole recording industry.

Use One Phone For All Calls

CT2 telephones are personal digital phones designed to replace cellular and "regular" phones. The system is on-line in Europe and is being tested in the U.S. This system would allow you to have a personal phone that would replace your extension at work, your car phone, your home phone ... and it's wireless. At work, people would call you, not your desk. Costs are the same as regular phones.

Where's All The Spectrum Going To Come From?

In Canada, CT2 is going to be from 944 mHz to 948 mHz. In the U.S., these frequencies are used for STL links. Oh Boy! Test are being done to see if CT2 and cellular can co-exist on current cellular frequencies. Keep an eye on this one.

A Tapedeck On A Chip

A new "analog" input chip, which can record and playback audio, has been introduced. The chip can store up to 20 seconds of material, costs $20 wholesale, and multiple chips can be linked for longer storage times.

Future Wireless Systems

Apple Computers and a company called TV Answer are two of the latest petitioners to the FCC for low power wireless networks for the home. Consumers will be able to select Pay-per-view movies, shop and take polls with the TV Answer system. Apple has disclosed that it is developing a portable "companion" computer that will send data to a desktop by wireless communication. With technology currently available, radio stations could run talk shows completely wireless with the host and guests free to move about and spots started with a device like a TV remote control. This could even be done at remote broadcasts.

Chip Morgan has recently been seen trying to use twisted-pair telephone cables for transmission of food from point-to-point. You can reach Chip at CMBE by calling (916) 983-9834 ... editor

Double-Barreled Noise Patrol

The Noise Gremlins wage a constant battle to make your audio worse than your competition's. They sabotage your ratings by making your carts sound noisier than CD's...making your remote feeds sound remote...and making the audio sound many generations older than the video on your videotape.

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By W.C. Alexander - Crawford Broadcasting
Garland, Texas - (214) 445-1713

Spring Cleaning at the AM Site

Wintertime can be hard on antenna systems. Towers, foundations, antenna tuning units, sampling loops, and just about every other piece of directional antenna hardware exposed to the elements will suffer some deterioration. Now that the worst of the cold weather is behind us, we should take a good look at these items and make repairs as needed.

The Towers

Spring is an excellent time to have towers inspected. Employ a competent and bonded rigger to climb the towers. On the way up, he should inspect the following items: paint, welds, hardware, guy-wire attach points and preforms, guy insulators or fiberglass rods, conduit and junction boxes, and transmission lines. On the way down, he should replace all bulbs and inspect the light fixtures, sockets and wiring, red lenses, and gaskets/o-rings. If there are any deficiencies, correct them right away. Little things tend to pile up to the point that there are alligators snapping at one's backside!

Log this as one of your quarterly tower light inspections; use the inspection report or service invoice as part of the log documenting the inspection.

At the tower base, you should personally inspect the base insulator, the feedpoint connection, lighting chokes/transformers, photocells, spark-gaps, and isocouplers. Be sure that the RF excitation has been removed from the tower being inspected, and beware of RF energy induced by nearby operating towers. If the tower is not at DC ground potential, watch out for static electricity.

Check the base insulator for cracks or chips. Many base insulators are hollow and have drain holes inside; be sure these are not clogged by pouring in a small quantity of water and watching for it to run out. If the drain holes are clogged, try using a shop-vac adapted to a short length (3 or 4 feet) of 1/2-inch garden hose inserted into the hole in the tower baseplate to clear the blockage.

Visually inspect the feedpoint connection for mechanical and electrical integrity. If the tower is galvanized, the galvanization will have been filed away at the point the feed was brazed on; check this area carefully for corrosion. Treat with a cold-galvanizing compound if necessary.

Look carefully at all lighting equipment at the tower base. Check for electrical connections, corrosion, and foreign material (such as wasp nests). Test the photocell and flasher, checking the beacon-on current with a clamp-on ammeter. Note the current inside the flasher box for future reference; with this data, you can tell if all bulbs are working, even if you can't see the lights during the daytime. Austin-ring transformers should be checked for security, spacing, and corrosion. Feel of the rings to check for excessive resistive losses.

Check spark-gaps for spacing and good connections; a high resistance spark-gap is virtually useless for conducting lightning energy safely to ground. If you opened up the gap spacing to prevent ice-over during winter months, close them back up to the proper spacing now. Spring thunderstorms aren't far away, and these simple devices are your first (and best) line of defense.

Each isocoupler should be removed from the tower and inspected (if isocouplers are inspected while on the tower, you won't be able to see the back side, where problems from arcing are most likely to be). This should be done whether or not any deterioration in signal passing through the isocoupler is noted; I have seen these devices with quarter-size holes blasted in them working perfectly! Shake each isocoupler to see if there is any water inside. If there are any defects, replace the isocoupler.

All guy anchors should be visually checked for integrity and security. The rigger should perform this service as part of the formal inspection process; however, there is no substitute for seeing it for yourself. Pay particular attention to preforms, insulators, turnbuckles, and safety wires.

Tuning Units

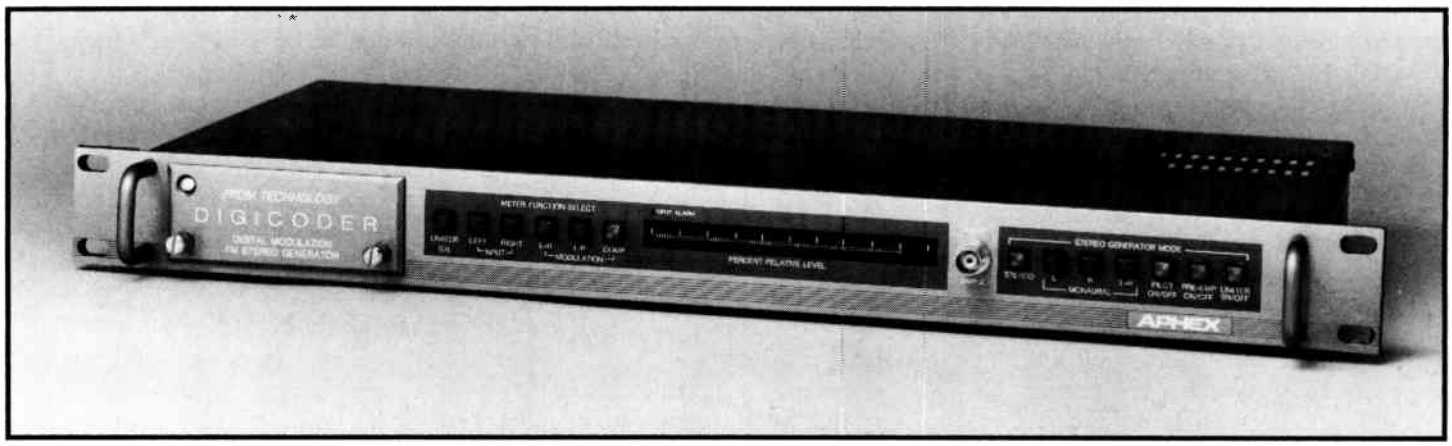
Unless they are located in insulated buildings equipped with heat/air conditioning systems (ha!), the antenna tuning units (ATU's) are exposed to the elements all the time. Even in so-called "weatherproof" enclosures, the temperatures within will range from the coldest winter low to well above the hottest summer high.

Temperature changes will result in a good deal of expansion and contraction in ATU components, cracking insulators and loosening hardware.

(continued on page-12)

NEW!

The Aphex Stereo Generator ... A Leap Beyond Digital



Under development for over six years, it's finally here. The Aphex Digicoder™ Stereo Generator ... the next link in the Aphex Audiophile Air Chain. The Digicoder provides unequaled sonic transparency of Class A analog with the separation and stability of digital ... and sustains maximum loudness. Plus it interfaces to your existing equipment with no A to D convertor.

This lab standard generator uses a proprietary PPDM™ (Parallel Path Digital Modulation*) circuit to provide a dynamic range better than 110dB. To achieve the same specs, a digital system would need 18 bit resolution sampled at 2.4 MHz.

Because of its sophisticated design, the Digicoder is easy to use and requires no maintenance. It is fully remote controllable and provides remote status output.

Broadcasters around the world have relied on the Aphex Audiophile Air Chain, a combination of the Aphex Compellor®, Aural Exciter® and Dominator™ to achieve *consistent high quality sound.* The Digicoder continues the tradition, providing the highest audiophile quality available at any price.

APHEX
SYSTEMS

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* Patent Pending

DA Systems

Continued . . .

Carefully inspect every ATU component, checking for secure mounting and tight connections. Any cracked or broken insulators should be replaced.

Look for and remove any foreign objects, such as insects, wasp nests, and the like. If the ATU's are housed in weatherproof enclosures, they will probably be equipped with screened openings on the underside that allow air to pass in and out. Make sure these openings are clear and unobstructed with the screens in place. If the ATU's are in "doghouses," check for deterioration of the wood and paint.

Bowl insulators should be secure and crack free. Look for evidence of water seepage around bowl insulators. If necessary, replace gaskets and cork washers.

I had a problem last winter at one of this company's antenna farms with a "hiccup" in the phase of one tower. This, of course, affected all the DA parameters, causing the phases to jump about 2 degrees for a second or so several times a minute. Once the offending tower was tracked down, it was discovered that the problem could be eliminated by applying pressure to one side of the ATU housing. As it turned out, a bolt securing the ATU housing to the supporting post was a little loose, and tightening it cured the problem. Why did a loose mounting bolt make a difference? It shouldn't have. But with RF currents returning to ground all over the skin of the ATU housing, a slight impedance change resulted from the loose bolt. The moral of this story - check all hardware for security.

Check mica capacitors for leaks, seepage, and dissipation. It is best to do this immediately after removing RF excitation. Physically touch every component, noting whether or not thecomponent is hot. Warm is okay, hot is not. If the item is hot near the connections but cool elsewhere, this is indicative of poor connections.

In the southwest, we have the particularly unpleasant problem of fire ants. Besides their painful and often dangerous stings, these insects are inexplicably drawn to sources of electrical energy. Many a homeowner has had the air conditioning repairman show him that his condenser start-relay is full of fire ant carcasses, thus preventing it from operating. Why these tiny but vicious ants seem compelled to commit suicide to get into electrical components is beyond me, but if their mounds in the vicinity of the tower bases are left untreated, they will get into the ATU's.

Treatment of the ground around the ATU's, and the ATU's themselves, with a good quality diazinon germ is absolutely necessary in this part of the country. These fire ants migrate a hundred or so miles north every year or two so, in a few years, it is likely that even the northeast will experience this delight. Be ready!

Ground System

Out of sight, out of mind. That's the general rule when it comes to ground systems. Yet this hidden portion of the antenna system is absolutely critical to the efficient and proper operation of the station.

There are several ways to check the integrity of the ground system, all of which are cumbersome and time consuming. Rather than trace out each radial individually, a better method would be to look for external signs of trouble.

Start with a good visual inspection. At the tower base, is the transverse strap that passes under the base insulator securely connected to the radials? In the antenna field, are there any radials visible above ground? Has the soil eroded away in drainage areas, leaving radials exposed?

Using data from the last proof of performance, check a few points in the main lobe. Has the field strength dropped considerably from the proof value? This is not an absolute indicator because of other environmental factors, but it is a good place to start.

How about driving point impedances (DPI's)? Using an operating impedance bridge (OIB), measure the DPI at each tower for any one mode of operation (be careful to tune out the insertion effect) and compare them with the previously measured values.

If there are any serious problems with the ground system, typically, some symptoms will appear. These symptoms can take the form of reduced coverage/low pattern RMS, altered base currents/DPI's, or surface observable damage. If problems are detected, then the individual radial checks should be made with a field strength meter, metal detector, or whatever.

Transmission Lines

Unless you are using air-dielectric lines which you keep pressurized, there really isn't much to check on the transmission and sample lines other than the security of the connections on both the phasor and ATU ends.

If a line does have a problem, the antenna system will usually show some symptom(s). A wet line will typically have a serious mismatch at the place

(continued on page-14)

EXPERIENCE COUNTS . . .

Continental Electronics Installations At Master Antenna Facilities.

OLDSMAR TOWER PROJECT
Tampa, Florida
2 OF 2 STATIONS

WKRL 40 kW
WUSA 40 kW

TELETOWER PROJECT
Houston, Texas
2 OF 2 STATIONS

KLTR 27.5 kW / 21.5 kW (Aux)
KMJQ 50 kW

BRODIE LANE TOWER SITE
Austin, Texas
2 OF 2 STATIONS

KHFI 35 kW
KPEZ 21.5 kW

MILLER TOWER SITE
Dallas, Texas
6 OF 6 STATIONS

KKDA 40 kW
KLTY 40 kW
KLUV 40 kW
KOAI 45 kW
KZPS 40 kW
WRR 40 kW

LOXLEY TOWER SITE
Mobile, Alabama
3 OF 3 STATIONS

WBLX 27.5 kW
WGCX 27.5 kW
WJLQ 27.5 kW

LOADSTAR TOWER PROJECT
Ft. Lauderdale, Florida
2 OF 2 STATIONS

WJQY 40 kW
WKQS 50 kW

GANNETT TOWER PROJECT
Miami, Florida
8 OF 10 STATIONS

WEDR 50 kW
WHQT 25 kW
WLVE 25 kW (2)
WPOW 25 kW
WQBA 21.5 kW
WSHE 25 kW
WTMI 25 kW (2)
WZTA 25 kW (2)

BITLOW TOWER PROJECT
Orlando, Florida
3 OF 3 STATIONS

WHTQ 50 kW
WSSP 50 kW
WSTF 50 kW

LOADSTAR TOWER PROJECT
Orlando, Florida
3 OF 3 STATIONS

WJHM 25 kW
WJYO 55 kW
WOCL 55 kW

LOADSTAR TOWER PROJECT
Jacksonville, Florida
3 OF 4 STATIONS

WAIV 40 kW
WFYV 27.5 kW
WQIK 35 kW

SENIOR ROADS TOWER GROUP
Houston, Texas
7 OF 12 TRANSMITTERS

KFMK 27.5 kW (2)
KIKK 27.5 kW (2)
KKBQ 27.5 kW (2)
KLOL 27.5 kW

SUMMIT TOWER PROJECT
Atlanta, Georgia
2 OF 3 STATIONS /
4 OF 5 TRANSMITTERS

WSTR 35 kW (2)
WVEE 40 kW

LOADSTAR TOWER PROJECT
New Orleans, Louisiana
4 OF 4 STATIONS

WEZB 35 kW
WLNG 35 kW
WMXZ 35 kW
WQUE 35 kW

SHOREVIEW TOWER PROJECT
Minneapolis, Minnesota
6 OF 8 STATIONS

KDWB 25 kW
KEEY 25 kW
KLXK 25 kW
KQRS 25 kW
WLOL 25 kW
WLTE 25 kW (2)

MONTGOMERY TOWER PARTNERS
Montgomery, Alabama
4 OF 4 STATIONS

WBAM 35 kW
WHHY 35 kW
WLWI 35 kW
WSYA 35 kW

WEST TIGER MOUNTAIN TOWER SITE
Seattle, Washington
6 OF 9 TRANSMITTERS

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KMPS 50 kW
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Continued . . .

where the water is. This will cause a considerable phase shift and probably a power loss to that tower. This will, in turn, cause all the DA parameters to go whacko, so it may not be glaringly clear which tower's line is the culprit.

If a line problem is suspected, an oscillator and bridge can be used to check the electrical length (resonant frequency) and characteristic impedance of each line. Problems, if they exist, will show up here. The results of these measurements can be compared with results obtained during installation to find out what changes have occurred. Once any uncovered problems have been repaired, run these measurements again and record the results for future reference.

Transmitter Building

Varmints love warm transmitter buildings during the wintertime. Critters of all description will utilize any opening, no matter how small, to gain entry. Once inside, they will find a warm, dry spot in which to hibernate, lay eggs, or whatever critters do in the wintertime.

Every spring cleaning of the transmitter site should include a professional extermination, whether or not an insect or rodent problem is apparent. Because of the remote location of most transmitter sites, insects will abound and they will cause problems eventually. The best insurance is to exterminate regularly, paying particular attention to in-floor troughs, wireways, ducts, and other likely varmint hiding places.

A thorough check of the air conditioning unit(s) should top the list for building maintenance every spring. Have a service company check the system for head pressure, temperature differential, compressor leg current, and coil cleanliness. Cracked valves and other anomalies will often show up in such a check; Repairs can be made while the weather is still cool, thus heading off a failure in July when such a failure can put your transmitter off the air.

Clean or change all air filters, both in the HVAC system and in the transmitter's air system. A clean transmitter is a happy transmitter.

Look for evidence of roof leaks, cracked door seals, and other ways that water can get in. With thunderstorm season approaching, the building had better be high and dry.

Transmitter Equipment

Visually inspect every piece of equipment on the premises. Include transmitters, phasor, equipment racks, and your test equipment cabinet in this check. Look for evidence of insect infestation, moisture, corrosion, loose hardware, and the like. Clean the interior of equipment cabinets using a vacuum cleaner and brush. Be sure the primary power has been removed and that all capacitors have been discharged, and don't use a high-pressure air hose; these devices typically just move dust around and have sufficient pressure to actually damage fragile components.

Generator

With thunderstorm season approaching, the chances that the standby generator will be called upon are increased.

In addition to regular "exercising" of the unit, perform whatever regular preventive maintenance is recommended by the manufacturer. This would probably include changing the engine oil, oil filter, cleaning or replacing the air filter, draining or replacing the fuel filter, flushing the cooling system, and the like.

Check the full-load voltage output and frequency, adjusting the governor as necessary for proper operation (some transmitters won't operate properly if the frequency of the AC power supply is more than a cycle per second or two off of 60 Hz).

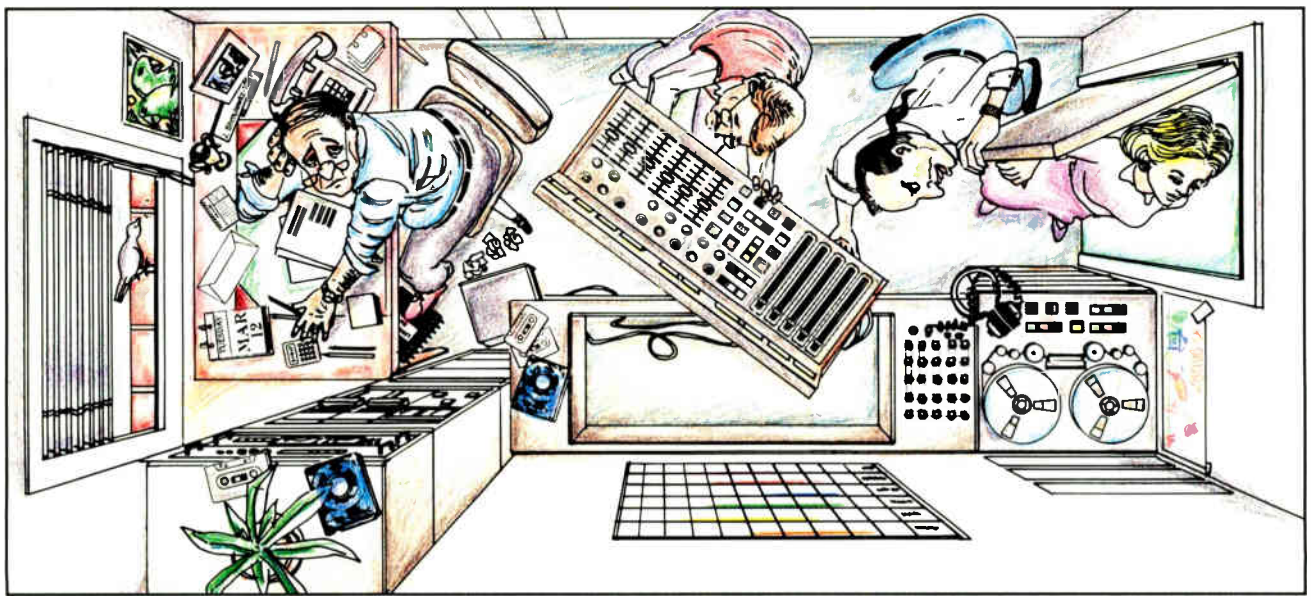
Review the exercise schedule to be sure it is adequate. Above all else, insure that when exercised, the generator runs long enough to reach its normal operating temperature. If the operating temperature is not reached, moisture will collect within the crankcase and corrosion will result; it would be better not to exercise the unit at all if the run time is too short.

Be on the lookout for bird/wasp nests in the generator housing. In addition to the "pest factor," such can impede the flow of cooling air and result in generator damage or auto shutdown under load.

Insurance

While you are looking everything over, note all model/serial numbers and other identifying marks on an inventory list. Then, use this list to determine whether the insurance policy covering the equipment, towers, and buildings on the property is adequate. The time to find out you are underinsured is before a claim must be filed, not after. On the other hand, over-insuring is costly and gains you nothing. An annual check of replacement costs is a good way to keep a handle on insurance coverage.

Most everyone, even the slobbiest slob, does some sort of spring cleaning - even if it is just taking out the garbage. Maybe it is some sort of genetic encoding that tells us to get brooming when the weather turns warm, or maybe it is simply a symptom of "cabin fever." Either way, engineers should channel some of this cleaning energy into their transmitter sites. Maintenance problems can be nipped in the bud (pun intended), and you can rest assured that everything at the transmitter plant is shipshape for the summer and fall.



How do you turn a multitrack production room into a *real* profit center? With fast, efficient operation and superb audio quality—a combination you won't get from "beefed up" recording studio boards or on-air boards with a few tacked-on features. Unfortunately, if your budget didn't have room for PR&E's ABX, you had to accept one of these compromises.

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By Richard Majestic - Engineering Consultant
Annapolis, Maryland - (202) 619-1228

An Unbalanced Audio Switching Design Applied to a 8X4 Mixing Switcher Circuit

The nucleus of this high performance (analog) audio routing switcher is the SSM-2402 dual audio switch IC. The design has negligible noise, low crosstalk, and very low distortion over the frequency range of 20Hz to 20kHz. The use of bipolar NE5534A and NE5532 IC(s) further enhance the performance, while making possible to drive 600 ohm loads at signal levels up to +28dBu (+/-18VDC power supplies).

The integrated circuit switch affords a much simplified electrical design and printed circuit board layout. The PMI-SSM-2402 makes it possible to improve performance when compared with discrete CMOS and J-FET switching circuits. The electrical performance of this design is vastly superior to CMOS switch designs, and is less prone to failure as result of electrical static discharge during fabrication or usage. The "T" switching configuration of the SSM-2402 switch provides excellent ON-OFF isolation. The part also features 7mS ramped turn on and 4mS ramped turn off for click free audio signal switching. Additionally, the switch has a break-before-make switching sequence. Both features are significant when many solid state switches are implemented in large switching system where a signal must pass through many electronic switching elements.

The application circuit design shown in figure-1 employs eight (8) balanced input amplifiers (U1 through U4). The input is bridging with an impedance greater than 40,000 ohms. The input circuit incorporates a single pole RFI filter too keep your RF out of the source audio. The input common mode rejection is greater than 70dB 20Hz to 20kHz. The signal drive level into the summing ports of each switch is -6dBu with a 0dBu input level. A +23dBu peak is well within ideal [operating] current range for the switching IC part. Good signal-to-noise is maintained, with generous head-room available by electing to use +/-18VDC power supply voltages.

The routing switcher buses are virtual ground [low impedance], which allows mixing of the input sources too. The SSM-2402 switch has a ON resistance that is typically 60 ohms. As result of the low bus source impedance (0 ohms), bus-to-bus cross-talk is exceptionally low, and with a little care taken in the layout stage, source to source signal cross-talk (isolation/separation) is greater than 80dB at audio frequencies.

The balanced output amplifiers includes the virtual ground amplifier while the other half of the NE5532A is a unity gain inverting stage. The balanced output circuit provides 6dB gain and will drive 600 ohm loads to +28dBm. Two independent NE5534 IC(s) could be used to increase IC amplifier heat dissipation under high ambient temperatures, helping keep IC package temperature well within safe operating limits when driving 600 ohm loads. The NE5532AN was chosen for its low noise, good frequency response, and output drive current capability.

The overall performance of the 8X4 audio switcher is noteworthy. Input to output frequency response, is 10Hz to 50kHz, well within +/-0.5dB. Total harmonic distortion plus noise is less than 0.03%, from 20Hz to 20kHz. SMPTE intermodulation distortion is less than 0.02%. The use of +/-18VDC power supplies, produces a +30dBm clip level while driving 600 ohm load(s).

The control ports of the SSM-2402 switch easily interface to conventional mechanical switches or 5 Volt TTL or CMOS logic control circuits. The simplified application shown in figure 1 utilizes a 5V control signal for illustration purposes only. Many diverse X/Y schemes, destination control, or computer interface designs can be developed. If you want design details of control circuit, please write the magazine editor.

While +/-15 volt power supplies will produces a +24dBm output clip level, all IC parts mentioned in this application will operate reliably at +/-18VDC or +/-20VDC, with approximately 2dB increase in clip level with each increased power supply voltage. If the extra headroom is desired, +/-20VDC power supply voltage is recommend, only if the ambient temperatures are held below 25 C. The noise increase, at the higher power supply voltage levels, will be indiscernible.

The source audio should be kept as close as possible to the summing resistors (10k) and the input side of the IC switches. Although, long runs from the audio buses to the virtual ground output circuits is OK, care should be taken not to introduce ground loops when shielding the audio buses by virtue of printed circuit board ground plain or other conductive shielding. The cross-talk figure can be improved further by isolating (shielding) the high impedance input circuits from the output circuits, again care should be taken not to introduce ground loops. Single point grounding will prevent ground loops and lower noise from external sources.

Circuit Performance Specifications

Max Input Level = +30dBu
Input Impedance, Balanced = 40k Ohms
Common Mode Rejection >70dB 20-20kHz
Common Mode Voltage Limit = +/-20V peak
Max Output Level (+/-20VDC) = +30dBu/dBm
Output Impedance = 55 ohms
Output Voltage Slew Rate = 15V/uS
Frequency Response (+/-0.05dB) = 20-20kHz
Frequency Response (+/-0.5dB) = 10Hz-50kHz
THD + Noise (20-20kHz) = 0.005% @ +8dBu
THD + Noise (20-20kHz) = 0.03% @ +24dBu
IMD (SMPTE 60Hz & 4kHz, 4:1) = 0.02%
Cross-talk (20Hz to 20kHz) >80dB
ON/MUTE Isolation (20-20kHz) >80dB
S/N Ratio = 135dB

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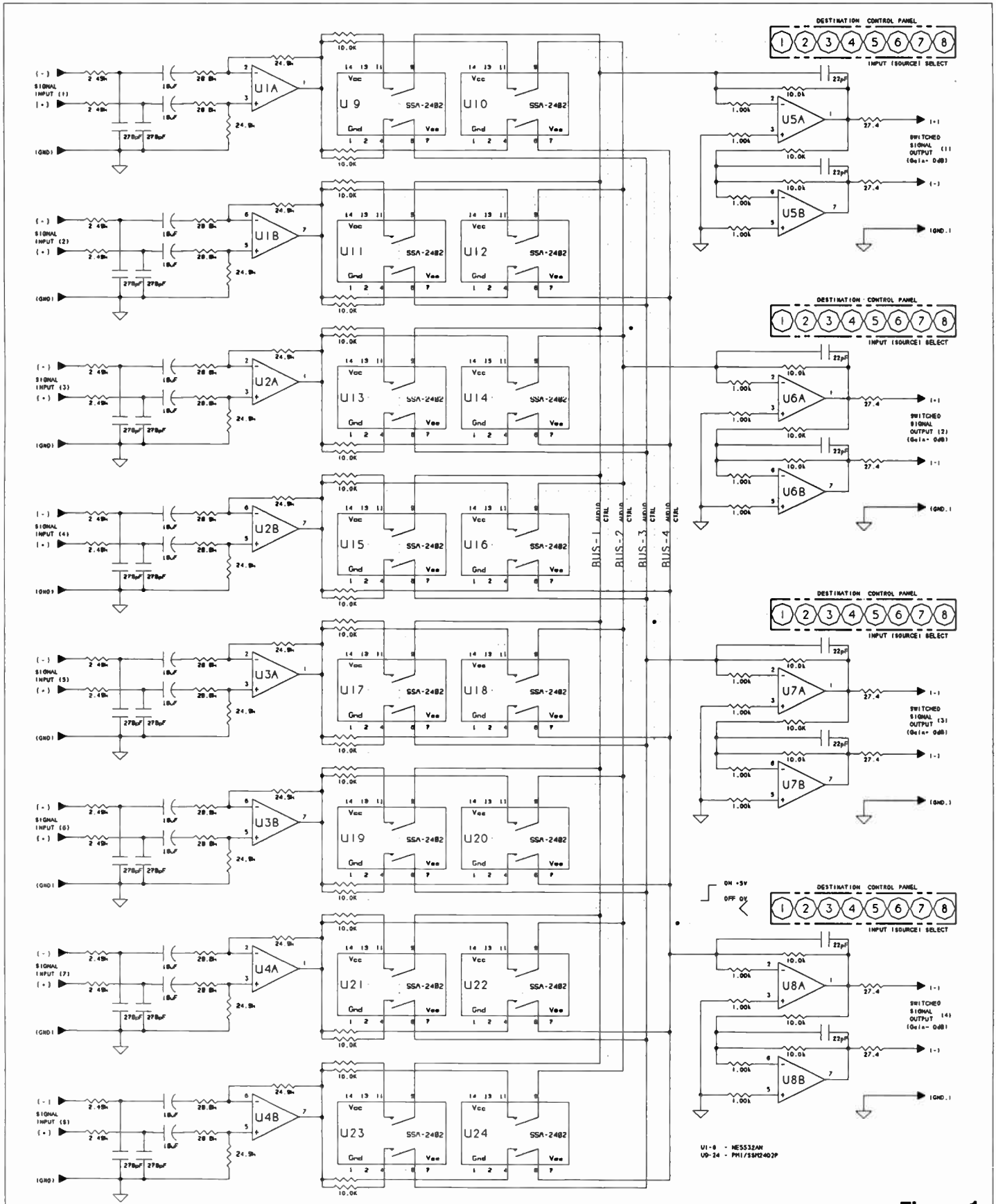

Figure-1

8(Input) X 4 (output) Mixing SWITCHER - Analog (Audio) Section

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By Gordon Carter - Pro Audio Services
Chicago, Illinois - (708) 482-4142

Analog Tape Recorder Maintenance

TIME	EVENT	SOURCE
1:25 p.m.	News feature (delayed from satellite feed)	Tape 1
1:29 p.m.	Spot	Cart 1
1:30 p.m.	Newscast (live with actualities)	Newsroom
1:33 p.m.	Spot	Cart 2
1:34 p.m.	Weather (recorded from weather service)	Cart 3
1:35 p.m.	Newscast sponsor close	Cart 1
1:36 p.m.	Return to music programming	Various

This segment of a typical program schedule shows how important analog tape is to the average radio station. In only ten minutes this station used at least four analog tape machines. In all probability the newscast contained actualities that were on carts and may have been taken from either a news service or recorded by the station's own news staff on cassette recorders. That being the case, this station probably used seven or eight analog tape machines in the preparation and presentation of this program segment.

Analog tape recorders play a major role in most modern radio stations. Some stations play almost all local programming from analog tape. Analog tape recorders include many familiar formats, such as reel-to-reel, cassette, and the very familiar NAB cart. While these formats are all considerably different, and not even compatible with one another, they all share the same principles of operation and problems. The procedures used for maintaining one are applicable, with slight modification, for another.

While a discussion of the principles of operation for analog tape is very interesting, we are going to concentrate on the maintenance of analog tape equipment in this article. For convenience in this discussion, we will use the word "tape" for any analog tape, completely ignoring the fact that digital tape exists. If we wish to differentiate between cassette, reel-to-reel, and cart, we will use those terms.

When discussing tape recorder problems and maintenance, we must look at the entire tape system. A machine in perfect working order will not seem to work properly if the tape is defective. You can find new tape that is bad as well as old tape. Some of the problems you may encounter with tape are bad slitting, oxide shedding, edge damage, and bad reels (reel-to-reel) or housings (cassette and carts). Before attempting to find a problem with a machine, make sure the tape you are using is good. On the other hand, using perfect tape on an improperly maintained recorder will not give satisfactory results, and the tape may be damaged by the machine.

Problems with tape machines may show up in a number of ways. Audio frequency response degradation may be caused on both the record and playback sides of the system by

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Continued . . .

dirty heads, incorrect azimuth, worn heads, poor tape guidance, and improper adjustment of the electronics. On the record side, simply using a tape type for which the machine is not adjusted can cause the same sort of problems.

Distortion of the audio signal can take a number of forms. The amount of total harmonic distortion (THD), the type of distortion most frequently measured in audio, may give you an idea that something is not right, especially if you know what the typical value of THD is for that type of machine. However, it is more useful to know the specific nature of the distortion. A high content of even harmonics (2, 4, 6, 8, etc. times the fundamental frequency) indicates a very different set of problems from a high content of odd harmonics (3, 5, 7, 9, etc. times the fundamental frequency).

However, harmonic distortion is difficult to measure on any tape machine without an analyzer capable of both automatic nulling and automatic level adjustment. The normal variations in the tape and its movement through the machine will tend to invalidate any manually adjusted harmonic distortion measurements. An audio spectrum analyzer, while not usually found at a radio station, can be another useful tool for such analysis.

Inter-modulation distortion (IMD) can also tell you a lot about the condition of your tape and machine. High values of IMD show excessive non-linearities in the tape system. This can indicate that the bias is not properly adjusted, but it can also be an indication of bad tape. Different types of tape can yield different amounts of IMD, so knowing typical performance is once again useful.

Another symptom frequently encountered is wow and flutter. Wow and flutter are variations in the speed of the tape over the heads. Wow is usually the term used for very low frequency (below about 50 Hz) variations, such as what you would have if you put your finger on the reel momentarily. Flutter refers to higher frequency (about 50 to 200 Hz) variations in the tape speed. Another type of flutter, commonly known as scrape flutter, is caused by the vibrations of the tape as it passes over a stationary or non-rotating element in the tape path. These variations are usually in the 2 to 3 kHz range.

A good flutter meter is the best way to identify these variations. (For a more thorough discussion of flutter, I would suggest a paper by Dale Manquen of Altair Electronics, 1694 Calle Zocalo, Thousand Oaks, CA, 91360, entitled

(continued on page-22)

Continued . . .

"A Wideband Tape and Transport Diagnostic System." This paper was presented in the 66th Convention of the Audio Engineering Society. Copies should be available from the AES or from Altair Electronics.) High wow or flutter is usually an indication of some sort of mechanical problem. However, a bad tape reel or housing can also cause wow or flutter. Anything that prevents the tape from moving freely over the heads will cause wow or flutter, so the possibilities are broad. Depending on the specific machine, wow and flutter can also be caused by electronic problems. If the capstan motor is electronically controlled, as is the case with most modern machines, any problems in the electronics may cause irregularities with the tape speed.

Audio is recorded by applying a magnetic field to the tape. The tape acquires this field and stores it so it can be reproduced at a later time. Any stray magnetic fields around the tape or the tape machines may cause problems. If the magnetic field is strong enough to change the magnetism on the tape, the recorded signal will be affected. If any elements of the tape recorder that come near the tape become magnetized, the performance will be degraded. Magnetization of something in the tape path (heads, guides, capstan) is usually indicated by either self-erasure of the tape (every pass of the tape through the machine further erases the signal on the tape) or by a high amount of second harmonic distortion or noise during recording.

Magnetization is generally not a problem in professional equipment manufactured within the last ten to twenty years, but it can occur if there is an electronic problem such as a leaky capacitor between one of the heads and the electronics. Routine demagnetization of your recorders is not recommended, since it is possible to do more harm than good if you are not careful. Errors in the demagnetization process can leave more magnetism on the recorder than you had when you started. Unless you strongly suspect a magnetization problem, don't try to fix a non-existent problem. If you would like more information on this subject, a good discussion is available from Magnetic Reference Laboratory, 229 Polaris Ave, Suite 4, Mountain View, CA, 94043. Their phone number is (415) 965-8187.

Frequency	What To Do
Daily*	Clean heads and tape path
Weekly	Clean heads and tape path Clean outside of machine Replace burned out lamps Check for signs of wear
Monthly	Do all weekly checks plus: Check for tight & rough bearings Check for excessive mechanical noise Check for proper operating level calibration Check for proper head azimuth*
Quarterly	Do all monthly checks plus: Check for proper record/play freq. response Check for proper flutter Check for proper signal-to-noise ratio

Items marked with (*) may have to be done more frequently depending upon usage and machine

Figure-1

In addition to the various problems already discussed, there are a few things that can be very elusive when trying to find them. For instance, the switches on the recorder can make poor contact, causing anything from poor frequency response to incorrect levels. Cassettes (and sometimes carts) may appear to need a new head alignment each time you use them. The lubricant on the tape in a cart may begin to dry out, causing any number of speed and stability related problems. The more completely you understand the tape recording process and your machines, the easier it will be to locate these problems.

Now that we know what some of the problems are that we may encounter with our tape machines, let's see what we can do to make them work better. Since tape machines are both electronic and mechanical devices, the best way to keep them in good working order is with a routine preventative maintenance program. The check list in **figure-1** can serve as a handy reminder of what to do and when to do it.

Keeping a tape machine clean is the simplest, yet most effective thing you can do to assure proper performance. The heads and tape path tend to get dirty rapidly due to the slight abrasion of the tape on the heads and guides. Small amounts of dirt and oxide from the tape will be left on all of these surfaces. These deposits may cause erratic movement of the tape over the heads. They may also clog the gaps on the heads or lift the tape slightly from the heads, causing very poor frequency response. Depending on the tape used, it may be necessary to clean this area each time the machine is used. For any critical work, such as a master recording, the heads should be cleaned before each tape pass. Do not rely on the deposits being visible before cleaning the heads. I have seen many cases of "clean" heads not working properly until they have been cleaned.

(continued on page-23)

Studio Site

Continued . . .

The heads should be cleaned with a good quality head cleaner or with alcohol. Use isopropyl alcohol or a good grade denatured alcohol for cleaning heads if you do not use a commercial head cleaner. Do not use rubbing alcohol as this contains oils which will leave a deposit on the heads. Use a new cotton swab to clean the heads, and only dip it in the cleaning agent once. A second dip may transfer contaminants to the cleaning agent, rendering the whole container useless. Tape guides, idlers, and the capstan may also be cleaned with this alcohol.

Unless you know it is safe, do not use the head cleaning agent on the pinch roller. There are special cleaners available that will not dry out the rubber used on pinch rollers. When cleaning the head and tape path area, be sure not to leave any fuzz from the cotton swab. Also, try not to use so much cleaner that you can squeeze it out of the swab, especially in the area of the capstan. The swab should just be moist enough to do the job. You may need to use a flashlight to see what you are doing with some machines.

While it may not seem very apparent, cleaning the outside of the tape machine periodically serves two very useful purposes. First, it prevents build-ups of dirt that may eventually get into the machine and cause mechanical problems. Second, it signals your co-workers and management that you care about the equipment. If you keep the equipment clean, it will be treated with more respect by those who use it. Most machines can be cleaned with a mild solution of dish detergent and water. Use a paper towel or cloth dampened with this solution and wipe machine clean. More stubborn dirt can be removed with a stronger cleaning agent and some elbow grease. Many owner's manuals suggest ways of cleaning the equipment. Follow these suggestions whenever possible. Be especially careful of strong solvents, such as alcohol, when cleaning machines. They may attack the plastic parts used on the machine.

Replacing burned-out lamps on your tape machines (as well as other equipment) on a regular basis will prevent operator confusion, as well as letting your co-workers know you are doing your job. Check the equipment manuals for the proper lamps to use and the procedures to replace them. Many manufacturers offer special tools to assist in changing lamps on their machines. These tools can often mean the difference between doing the job efficiently and really messing up the machine.

(continued on page-24)

Studio Site

Continued . . .

While tape feels smooth on your fingers, it is really quite abrasive. As the tape moves over the heads and guides it acts like very fine sandpaper. Even though some tape types are more abrasive than others, all good tape should provide even wear. A quick visual inspection once a week of the heads and guides will let you know when a problem is brewing. If you see any signs of horizontal scoring, you have a problem that should be dealt with immediately. This usually indicates that you are using bad tape and may cause damage to any good tape you run over the machine. Whenever a head, guide, or idler becomes so worn that there is a groove in it, it should be replaced or otherwise repaired. A groove will cause the tape to be forced out of the proper path defined by the guides and may cause damage to the tape as well as degrade the recording. Many guides can be rotated to provide a fresh surface, thus prolonging their life. The heads can be quite a different problem.

Worn heads must be either replaced or relapped. Relapping is a process whereby the surface of the head is polished smooth. Over the years many people have suggested relapping your own heads. On most modern machines, especially those with more than one track, this is not a good idea. When the electronics of a tape machine are designed, they are matched to heads of a specific impedance. Remember that impedance includes both resistance and reactance, just like your antenna. If the head varies more than about 10% from this design specification, performance of the system will be degraded, perhaps significantly.

Any head that is to be relapped should be checked against the design impedance both before and after it is relapped. This *must* be done with an impedance bridge. (Do not use an ohmmeter to check a head at any time. This will almost certainly magnetize the head.) Not only must the impedance of the head be within the design specification, but all channels of the head should match fairly closely. If they do not it may be an indication of uneven wear on the head. When the head is relapped, it must be done in such a way that the surface is even and parallel with the original surface. This is almost impossible to do to tight tolerances, which are necessary for good channel matching on any multitrack (including stereo) head. Most people do not have the necessary equipment to do this job well, so it is best left for those who do. When a head is relapped or replaced, it must be properly aligned in the machine. We will discuss this a bit later.

As we mentioned earlier, tight or rough bearings will lead to wow and flutter problems. Remember that all rotating idlers in a machine have bearings, even though you may not notice them. A general rule of thumb is that if it rotates, it should do so freely and smoothly. However, some idlers may seem tighter than others. Knowing your machine will help you know when you have a problem.

Any unusual noises in a tape machine indicate a problem. They will usually appear at first in fast forward or rewind modes. Knowing normal operation of your machine is important here. Excessive noise usually indicates some sort of mechanical problem, such as a bad bearing, and may give you some advance notice before it causes any audio problems. However, carts and cassettes frequently make strange noises in the fast modes, so make sure you are using a good one for this test.

Proper level calibration is very important in any tape machine. When properly adjusted the operating level will be set at a point that will give the best compromise between noise and

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Continued . . .

overload with both the tape and the signal electronics. Tape users and manufacturers use a variety of standard operating levels, depending on the characteristics of the tape. This level has nothing to do with "0" level on the meters, but is instead a magnetic level (fluxivity) on the tape. Most broadcasters use 200 or 250 nanoWebers per meter (nWb/m) for their standard level for reel-to-reel tape. Cassettes and carts usually use 250 nWb/m and 160 nWb/m respectively for their reference levels. However, some users may wish to use a higher or lower level to give a lower noise floor or better headroom.

A calibrated reference level tape is necessary to set operating level for a recorder. The audio signal on this tape should be of a frequency that is not affected by the playback equalization. In this way errors in the equalization adjustment do not introduce errors in the level adjustment. If the reference tape available to you is not the same level you wish to use, **figure-2** on page-26 can be used to get to the right level.

Play the reference tape and adjust the reproduce level controls while looking at the output level with an audio level meter. For the moment, ignore the VU meters on the recorder. The level you are reading should be your desired output level (for instance, +4 dBu) with any necessary correction applied to compensate for differences in your tapes. For example, if your desired output level is +4 dBu and your desired tape reference fluxivity is 200 nWb/m and you are using a 250 nWb/m reference tape, you should adjust for a reading on the output of +6 dBu. Then adjust the VU meters on the recorder for the proper level. Using the same example, you would adjust the VU meters to read +2 VU.

After the reproduce level has been set, you can then set the record level calibration. Place a tape of the same type you normally use on the machine and feed a tone into the machine. This tone should be the same frequency as the tone on the level calibration tape, and should be at your system "0" level as measured before the tape machine. Adjust the record level controls (usually on the front panel) for a reading of "0" on the VU meters while looking at the input. Then adjust the record calibration controls (usually an internal adjustment) for a "0" reading on the VU meters while looking at playback. This procedure may take a bit longer if you can not look at playback while recording, but it is the same adjustment.

Head azimuth (perpendicularity relative to the tape) will affect many parts of the tape signal. Poor azimuth on either record or playback will result

(continued on page-26)

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in loss of high frequencies on both mono and multitrack machines, as well as poor mono compatibility on a multitrack machine. Perhaps you have heard a "swishy" sound when playing a stereo tape and listening to it in mono. The "swishiness" is not there when you listen in stereo. This is the result of poor azimuth adjustment on either the recording or reproducing machine. You are hearing the various frequencies of the signal as they cancel each other. Azimuth is easy to check, but you need a good alignment tape to do this. Most tapes have a section marked for azimuth adjustment but, if not, you can use any high frequency signal on the tape.

In order to check azimuth, you need a way to see the error. If you are setting a mono machine, you need only go after optimum high frequency response. If you are doing a multitrack machine, look at the two outer tracks, since this is where the error will be most noticeable. Depending on the type of test equipment you have available, you may have provision for looking at the relative phase of two input signals. If not, you can set up a scope to feed one signal into the vertical input and the other into the horizontal input. Another technique is to sum the two channels you are looking at, with the same gains out of phase, and look at this on a meter. Adjust the azimuth screw on the reproduce head (check the manual to see where this is) for minimum phase difference between the two channels.

If you are using the scope method, set the scope's gains for a line at 45 degrees with the same signal applied to both inputs. Then adjust the azimuth screw a nearly matching angle line. If you are using the summation method, adjust the azimuth screw for a null on the meter. Do not turn this screw far, especially if you are working on a previously adjusted machine. It is possible to adjust to a false point when only using a single frequency. After you have adjusted the azimuth, double check at other frequencies to make sure they all agree.

Desired Operating Level	Test Tape Reference Level	Meter Reading
185 nWb/m	185	0
	200	+1dB
	250	+3dB
	370	+6dB
200 nWb/m	185	-1dB
	200	0
	250	+2dB
	370	+5dB
250 nWb/m	185	-3dB
	200	-2dB
	250	0
	370	+3dB
370 nWb/m	185	-6dB
	200	-5dB
	250	-3dB
	370	0

Figure-2

After the reproduce azimuth is set, then feed a high frequency signal into the inputs of the machine. If you are using a speed lower than 15 IPS, reduce the level at least 10 dB from operating level. Record a tape with this tone, and then check the azimuth as above. If it is not correct, adjust the azimuth screw on the record head until you find the right point. This is easy to do with a machine that allows you to look at the reproduce signal while recording. Two head machines, like some cassette machines, will not need a record azimuth adjustment, since the same head is used for record and play.

If you are doing a complete check-out on a machine, the correct order of events is:

1. Check and adjust tape path mechanics and alignment
2. Check and adjust playback azimuth
3. Check and adjust playback frequency response
4. Check and adjust playback level
5. Check and adjust record azimuth
6. Check and adjust record bias
7. Check and adjust record frequency response
8. Check for proper flutter
9. Check for proper signal-to-noise ratio

(continued on page-27)

Studio Site

Continued . . .

Normally the tape path mechanics will need no adjustment unless something has been changed in the tape path. Check your manual for the correct procedures. You may need some special equipment to perform this procedure, and do not attempt to do it without the proper tools and equipment as you may make things worse. Be sure to check that the tape is not rubbing on the edges of any guides or reels as it passes through the machine, as this will cause tape edge damage.

If you have changed or worked on the heads, they need to be checked for proper height, zenith (front to back tilt), azimuth (side to side tilt), and wrap or penetration of the tape. Depending on the machine and the way the heads are made, you may need a gauge to adjust the head height. You can come close with a length of tape with the oxide removed (if you can see the heads with the tape in place). Put the tape in play mode and make sure the head is centered vertically. Be sure to allow for special track positions if they are used on your machine.

To check the other parameters, find a head position that is as near as you can tell to correct. Paint the face of the heads with Magic Marker and run some old tape through the machine. The tape will wear off the marker and show you a wear pattern. This pattern should have parallel and vertical sides and the head gap should be centered in the wear pattern. Non-parallel sides indicates improper zenith and non-centering of the gap indicates improper wrap or head rotation. Adjust the head and repeat the process until it is correct. Then adjust the playback azimuth as we described above.

Playback frequency response must be checked using a frequency response alignment tape. Depending on the type of test equipment you have available, you may wish to use either a swept-frequency tape or a multi-frequency tape. The swept-frequency tape should be used if you have a plotter or other automatic device to record the frequency response. Otherwise, you will need to use a multi-frequency tape. Play the tape and record the level at each frequency. Do not rely of the VU meters on the machine (or any other VU meter) to give accurate indications at all frequencies. While some meters will give accurate readings, don't assume that yours will.

Also, if you are using a digital multimeter for measuring audio, be sure it is accurate over the entire frequency range. Many of these only are accurate to about 2 to 5 kHz. This is greatly simplified if you have a meter that has a relative dB mode. Simply set your reference for the frequency response reference tone and record the readings. Otherwise you will have to do some math to come up with relative levels. If you have a computer and the right program, you can enter the raw data into the computer and come out with a frequency response curve. A response curve is the most useful, since it shows you at a glance what the machine is doing.

If the high frequency end of the range is not flat, adjust the reproduce equalization adjustments on the machine to compensate. Depending on the machine, this adjustment may or may not allow you to come up with a totally flat response. Remember that frequency response, especially for tape machines, is specified as a "plus or minus dB" term. Also, knowing your machine is important here. Don't try to make a machine ruler flat that is only capable of plus or minus 2 dB.

When you have adjusted all channels of the machine for proper playback frequency response, then set for proper playback level as described earlier. Then you can proceed to adjust record azimuth as well.

When record azimuth is set, you can set the bias. There are a number of techniques for setting bias that have appeared over the years, but the following one seems to be the most prevalent at the present time. Some machines, especially carts and cassettes which may not have great high frequency response, may suggest different techniques, so be sure to consult the manual. If no procedure is given, try the 10 kHz overbias technique. Depending on the machine's geometry, speed, and tape type, find the point

(continued on page-28)

Continued . . .

at which a 10 kHz signal peaks. Be sure to reduce the level to -10 or lower if you are using speeds below 15 IPS. For cassettes, use -20.

Then increase the bias until the audio level decreases the desired amount. If you do not have any recommendations, try 3 dB at 15 IPS, 5 dB at 7 1/2 IPS, 10 dB at 3 3/4 IPS, and 12 dB for cassettes. If you only have one bias adjustment for all speeds, set the machine for the speed you most frequently use. Then check the record frequency response by recording tones and looking at the playback level. Adjust the record equalization control for the best match to the playback response curve. If you cannot get satisfactory results, adjust the bias slightly and try again. If your high end rolls off too much, reduce the bias. If you have too much high end, increase the bias.

Some machines will require compromises to be made between bias and equalization, depending on the design of the machine. The most common compromise is not to have a full set of adjustments for all speeds. Again, if this is the case, optimize the machine on the most commonly used speed and under the most common conditions, and check to make sure the rest is in the ball park. Another common compromise is found with the low frequency response, especially on machines with narrow tracks.

You may encounter a problem known as "head bump" where the extreme low end of the range has a peak. This peak may be as much as 6 dB above the frequency response reference level, but will probably be below the specified frequency response range. There is little you can do to correct such a discrepancy. At one time there was a special equalizer available to deal with this error, but I do not know if it is still available. A severe head bump may give you a problem if you are using noise reduction. The frequency response error it introduces can cause noise reduction mistracking, especially on low frequency material such as kick drum.

Checking a machine for flutter requires a flutter meter. There are a number of these devices commercially available, some as part of a larger test equipment package. However, I only know of two such devices that can measure scrape flutter. When comparing flutter measurements to specifications, be sure you are using the same setup. There are a number of standard weighting curves for flutter measurement, and each will yield different results. Record the flutter test signal on your tape, and then rewind it. Play back the tape while measuring the flutter. You may have to do this a few times and should take the highest reading. If you try to record and play back at the same time, the errors could cancel themselves for the measurements. By making a number of passes with the tape, you eliminate the probability of such an error occurring.

Signal-to-noise ratio is a final check that everything is okay with your machine. Some machines have shields on the playback head that should be in place. When measuring signal-to-noise ratio, be sure to use a filter for your measurement. Failure to do so will give higher than expected readings due to bias leakage on the playback. Check the manual for your machine as to the proper conditions for this test. Many machines are specified with a higher than normal reference level for this measurement and with a restricted bandpass. You should be able to duplicate this measurement with a few dB to spare.

When you have finished working on a machine, you have to return it to service to be useful. When you do so, check the interface cables for any problems and do a quick listening test with the machine in the system. Listen for any signs of hum or buzz that may indicate an improper ground. Make sure the system levels match the levels you have set the machine for, or you will have discrepancies in your meter readings. This is especially true if you are using any sort of noise reduction (dBx, Dolby, etc.) with your tape machines. Level matching is important to the proper operation of some of these devices.

This has been a quick trip through the world of analog tape recorder maintenance. There are no great tricks to tape recorder maintenance, but you do have to be aware of the principles involved.

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BROADCAST EQUIPMENT

CLASS	TYPE	STK #	MAKE	MODEL	DESCRIPTION
CART MACHINE	MONO P/O	3117	SPAR	300CP	PLAY ONLY,MONO
CART MACHINE	MONO P/O	3160	HARR	994-7	BENCH .]
CART MACHINE	MONO P/O	3175	[illegible]	[illegible]	2 TONE
CART MACHINE	MONO P/O	3184	[illegible]	[illegible]	P/B, S/S, ABC MOUTH
CART MACHINE	MONO P/O	3196	[illegible]	[illegible]	PLAY MODIFIED
CART MACHINE	MONO P/O	3197	GATE	994-6	PLAY BENCH
CART MACHINE	MONO P/O	3198	SPAR	4515	PLAY BENCH
CART MACHINE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] PLAY ONLY 2 CUE , FF
CART MACHINE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] LAY ONLY , 2 CUE, FF
CART MACHINE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] LAY ONLY, 2 CUE, FF
CART MACHINE	MONO P/O	3520	RCA	RT-12	MONO, PLAY ONLY, 2 CUE, FF
CART MACHINE	MONO P/O	3629	GATE	CC 11	3 CUE CRITERION
CART MACHINE	MONO P/O	[illegible]	[illegible]	[illegible]	[illegible]T MACHINE (LOOKS GOOD),M
CART MACHINE	MONO P/O	[illegible]	[illegible]	[illegible]	[illegible] BACK ONLY, LOOKS GOOD,
CART MACHINE	MONO P/O	[illegible]	[illegible]	[illegible]	PLAY ONLY - SOLD AMER INSTIT
CART MACHINE	MONO P/O	4579	GATE	994-6	SOLID STATE/ BENCH TOP/ 3 CU
CART MACHINE	MONO P/O	4589	ITC	WP	3 CUES / VERY RUSTY
CART MACHINE	MONO P/O	4591	GATE	994-6	SOLID STATE / BENCH TOP / 3
CART MACHINE	MONO P/O	4764	SPAR		***MISSING CUE CARD***
CART MACHINE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] UNT
CART MACHINE	[illegible]	[illegible]	SPAR	[illegible]	MISSING TOP PANELS
CART MACHINE	MONO P/O	5184	HARR	994-7	BENCH TYPE CRITERION 80
CART MACHINE	MONO P/O	[illegible]	[illegible]	[illegible]	BENCH TYPE CRITERION 90
CART MACHINE	MONO P/O	5191	GATE	994-6	BENCH TYPE CRITERION COMPA
CART MACHINE	STEREO [illegible]	[illegible]	[illegible]	[illegible]	[illegible]/F, 3 CUES
CART MACHINE	STEREO R/P	[illegible]	[illegible]	[illegible]	R/P 3 CUE F/F
CART MACHINE	STEREO R/P	4546	GATE	CAR-2	RACKMOUNT CRITERION 80/REC
CART MACHINE	STEREO R/P	5162	GATE	994-6	HAS RECORD ELECTRONINCS BE
CART MACHINE	STEREO R/P	5162	GATE	994-6	RECORD ELECTRONICS 3 CUES
CART MACHINE	STEREO R/P	[illegible]	[illegible]	[illegible]	RACK MNT. BROKEN METER
CART MACHINE	STEREO R/P	[illegible]	[illegible]	RP	4 CUES W/ FAST FORWARD MOT
CART MACHINE	STEREO R/P	5368	ITC	RP	4 CUES WW/ FAST FORWARD MC
CART MACHINE	STEREO R/P	5369	ITC	RP	4 CUES W/ FAST FORWARD MOT
CART MACHINE	STEREO R/P	5370	ITC	RP	4 CUES W/ FAST FORWARD MOT
CART MACHINE	MONO R/P	[illegible]	RCA	[illegible]	ELECTRONICS WAS PART OF 31[illegible]
CART MACHINE	MONO R/P	[illegible]	GATE	[illegible]	R/P RACK MOUNT
CART MACHINE	MONO R/P	3580	SPOT	1070	RECORD/PLAY
CART MACHINE	MONO R/P	3830	SPAR	200 R	R/P "OLD"
CART MACHINE	MONO R/P	5134	GATE	994-6	RECORD 9134B
CART MACHINE	MONO R/P	5155	SPAR	[illegible]	HAS RECORD ELECTRONICS
CART MACHINE	MONO R/P	5155	SPAR	[illegible]	RECORD ELECTRONICS FOR SPART
CART [illegible]	[illegible] R/P	51[illegible]	SPAR	300 C	HAS RECORD ELECTRONICS
CART [illegible]	[illegible] R/P	51[illegible]	SPAR	300 C	RECORD ELECTRONICS FOR SPART
CART [illegible]	[illegible] R/P	51[illegible]	ITC	WRA	RECORD ELECTRONICS W/RACK M
CART [illegible]	[illegible]	[illegible]	GATE	994-6	BENCH TYPE CRITERION
REEL [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] REEL S.
REEL [illegible]	[illegible]	[illegible]	[illegible]	351	STEREO [illegible] TYPE
REEL [illegible]	[illegible]	[illegible]	[illegible]	A-77	STEREO, R/P
REEL [illegible]	[illegible]	[illegible]	[illegible]	A-77	STEREO, R/P
REEL [illegible]	[illegible]	[illegible]	[illegible]	SX-82	STEREO (4 TRACK STEREO) BOTH WAYS
REEL [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]OLE WITH ELECTRONICS 4 TRA
REEL [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]ECTRONICS
REEL [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	R/P, TUBE TYPE RACK MOUNT
REEL STEREO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] TY
REEL STEREO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
REEL STEREO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] D C
REEL STEREO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] TO
REEL STEREO	R/P	[illegible]	[illegible]	[illegible]	[illegible]
REEL STEREO	R/P	5092	TEA	[illegible]	[illegible] 1/
REEL STEREO	R/P	5122	REVOX	A-77	WOOD WRAP NEEDS PARTS
REEL STEREO	R/P	5130	REVOX	A-77	RACK MOUNT SELLS FOR $2450 NEW
REEL STEREO	R/P	5152	AKAI	[illegible]	WOOD FRAME/BAD SHAPE USING IT IN
REEL STEREO	R/P	5172	REVOX	A-77	RACK MOUNT 2 TRK 3 3/4 TO 7 1/2
REEL STEREO	R/P	5241	REVOX	A-77	2 CHANNEL STEREO
REEL STEREO	R/P	5259	REVOX	A-77	W/ RACKMOUNT, 3 3/4-7 1/2 IPS

Computer Connection

By Kelly Klaas - KEZJ
Twin Falls, Idaho - (203) 733-7512

In a previous article, I told you about the program from Motorola and how you could choose electronic parts by choosing the specifications you need. Well, come to find out, that program is available from Motorola, and also on BBS's around the country. Not only is the program available on MS-DOS machines, but also for the MacIntosh. If you are interested, you can contact Motorola Semi Conductor Products Sector, Data Disk Services, PO Box 20912, Phoenix, AZ 85036-0912. As I said in my previous article, it is a great program for you builders. To recap briefly, you can choose what type component you need, enter the specifications needed, and the program will give you the proper parts to use.

I have received several nice programs from a S.A. Walker in Hilo, Hawaii. At last report, his Coast Guard unit was being sent to the Persian Gulf. Sometime back, he sent me a disk full of programs he uses at the radio station he works at. One of the programs was a program to draw schematics. Some time back I wrote an article about ORCAD, an extremely powerful and complete schematic drawing program. Well, for those of you, like me, who have too much month left at the end of the money, yet you need something like that, Schematic Master may just fill the bill. It was written by S.A. Walker's friend in San Jose, CA. and is currently available on BBS's. You can get it by sending the $30 registration fee to Patrick O'Riva, 2726 Hofstetter Rd., San Jose, CA 95132. BBS phone number is 408-259-2223; 2400, 8, N, 1. Do NOT call the BBS from 12 midnight to 3 a..m. Pacific time. Schematic Master may be listed in the ZIP format as SCHEM200.ZIP. This is a rather complete program and will accomplish just about any kind of schematic drawing you want to do. If you like, you can even edit or construct symbols to your own liking. In fact, you can edit or change a component drawing easier than in Orcad.

S.A. also has a clever way of logging at his radio station. Most of us running automated stations usually have reams of paper from the logs after each broadcast day. This mounts up to quite a bit of paper if you keep your logs for a two year period. S.A.'s idea was to redirect the printer output to a disk. Then you can print the log out if you want, or simply store it in a zipped format for storing to retrieve it later if you need to. He uses the B: drive to redirect the printer output. The batch file to compact the log into the ZIP format is:

```
COPY B:\AM-LOG A:
REN AM-LOG %1
PKZIP %1 %1
DEL %1
```

The batch file to unzip the file is:

```
PKUNZIP -cm %1
```

These handy little files can literally cut down the "paperwork" at your station. You might want to consider putting them to use.

The saga of the 3.5 HIGH DENSITY floppy drive on an AT&T PC-6300 continues. I recently received some information from Geoff Mendenhall of Broadcast Electronics Inc. of Quincy, IL. Apparently AT&T said it couldn't be done. However, some investigation on the part of Geoff and his colleagues indicates it CAN be done, because they have done it. I have already gone over the steps to take to add a 720K 3.5 inch disk drive in the past. That is actually quite easy. But the 3.5 inch HIGH DENSITY is a different story. I'm not so sure it is that difficult, it's just that several steps and some addition hardware are required. A copy of the memo distributed at BE Inc. to install a HIGH DENSITY 3.5 inch floppy drive to a PC-6300 is as follows.

1. You must have version 1.43 BIOS with at least version 3.2 DOS.

2. You must remove the DMA Chip AMD-9517 and replace it with an NEC 8237-5. The DMA chip is soldered in so extreme care is advised. The replacement chip is available from JDR Micro-Devices for a few dollars.

3. You must purchase and install Micro-Solutions Compati-card package which includes the

Computer Connection

Continued . . .

Teac 3.5 inch, 1.44 Meg drive (FD-235HF-117), internal connection cable and the controller card (FD-235HF-240U) for $249. The address from Micro Solutions, Inc. is 132 West Lincoln Hwy., DeKalb, IL. 60115. The phone number is 815-756-3411.

It is also my understanding that to go this route, you must also disable the built-in primary floppy drive controller in the PC-6300. The 1.43 BIOS is available on the AT&T BBS as BIOSH143.ATT and BIOSL143.ATT. You will need both files. The AT&T BBS number is 201-769-6397. For those of you with the PC-6300, there's a gold mine of information here.

For those of you who like to use a spreadsheet program such as LOTUS 1-2-3 but can't afford it, here is a fantastic 1-2-3 clone. It's called AS-EASY-AS. You may have to excuse the play on words with the name, but frankly it is AS-EASY-AS 1-2-3 and is compatible with Version 2.X. Is it 100 percent compatible? No. But the incompatibilities are minor. The only thing I have found to be somewhat different are the macro commands. This stems from the fact that the first-letter commands of AS-EASY-AS are a little different than with 1-2-3. For instance, to QUIT in LOTUS 1-2-3, you press /QYEY for MENU, QUIT, YES, EXIT, YES. For AS-EASY-AS, the command to quit is "E" for Exit. This is one of several commands that can be changed in any macro. As far as the inner-workings, AS-EASY-AS is every bit the same. The program is available on many BBS's around the country. I have looked at version 4.0 and the registration is $50 plus $5 shipping and handling. You may want to contact the originators of the program to get the latest version. Contact Trius Inc., 231 Sutton St., Suite 2D-3, North Andover, MA., 01845. BBS number is 508-794-0762. For those of you who like to work with spreadsheets for making those complicated engineering formulas more manageable, this would be a must-have for your collection ... and the price is right.

Another fantastic spreadsheet, this one more pricey than AS-EASY-AS, is Quattro Pro from Borland Intl. Quattro has its own look and feel, and it also has a 1-2-3 mode. I have found it to be completely compatible with Lotus 1-2-3 including the macro's. If it is important for your situation, it has graphics that outshine 1-2-3 hands down, without the need to purchase an additional outside program. Just a couple of ideas in case you are looking for some spreadsheet programs.

Are you a member of the Society of Broadcast Engineers? Would you like to be? I have several of the tests on diskette that I plan to evaluate in the near future. I am not sure what is on the diskettes yet, but I intend to find out. I have seen a quick demonstration of one of the levels of the test. They are sample tests, of course, but they are indicative of the actual tests administered by SBE. They are multiple choice questions and I understand that about every level of exam is available. I hope to evaluate them by next issue.

I also want to thank many of you who have phoned me, faxed me and otherwise contacted me about information for this column. I might point out that if you have any programs you have written, that you don't mind sharing with the rest of us, please send them to me so I can take a look at them and tell others about them. This would be a perfect opportunity to spread some shareware around and make yourself a few extra bucks. I have a fax machine at KEZJ so if there is something you would like me to mention in this column, that you want to share, send it to me at 208-733- 7525. Writing a column like this is a lot easier if you have the help of your peers. Please don't be bashful ... send me any ideas you have. I don't mind taking phone calls while at work as long as they are somewhat short. If you have something to discuss at length, it might be more convenient to drop me a line at PO Box 346, Twin Falls, ID 83301, or send a fax. If you know of some good shareware, pass along the BBS on which it is available so I can let everyone know. Many times a good shareware is just as effective as a commercial programs. Since engineering is somewhat of a specialized field, it is difficult to find good commercial software dealing with any subjects of interest.

Station Automation

By Steve Walker - Broadcast Automation
Dallas, Texas - (214) 380-6800

Station Automation ... How "Live" is it?

You know, automation is a funny business. Yesterday I got a call from an old friend that had once vowed never to automate one of his radio stations- he said automation sounded too "automated." Now he wants to automate. It seems he's heard a few stations, lately, that know how to properly administer automation.

It takes more than a couple of racks of equipment and a few tapes, CD's, or a satellite hookup to make automation sound live. It takes human involvement. For example, how many automated stations run "live" contests during automated periods? Not many. But the most successful ones do. It's really simple. For example, you should have someone at the station at all times, anyway, so use him/her to record contest announcements for playback in the automation system during scheduled spot breaks. The same person mans the telephones when listeners start calling in. Record the winning call on cart and stick that in the automation for playback during the next scheduled break. Of course, you won't do this around the clock, just during your most listened-to times. If you're using announced tapes or satellite, some listeners will wonder why the guy on the air isn't doing the contest announcement. Evade this problem by having a well-trained voice proclaim "Now it's time for a special announcement from our Fun and Games department ... Here's John Smith..." or something along those lines. The same goes for weather announcements "...here's our staff meteorologist Jane Doe...", etc.

It's really incredible to drive cross-country listening to the radio and hear the exact same audio on AM radio from somewhere in Mississippi and on FM from Louisiana. What's even more incredible is listening for liner carts, custom promos, and spot breaks and finding out that one station sounds pitifully automated while the other sounds so live that even a seasoned radio person has trouble telling it's automated. Use the tools your format supplier provides you, and inject a little life into an otherwise average-sounding operation. If you make your own format, use liners, promos, and jingles to set your station off from all the rest. We're all engineers here, but we can tell our PD's a thing or two sometimes. After all, how many times have they told you how to set up your Optimod?

Another thing that greatly affects the on-air sound of automation is EOM tone placement. We talked about EOM tones, on an elementary level, a few months ago. Now let's talk about actual usage of the tones.

The EOM (End Of Message) tone is one of the most important tones you'll have to deal with in automation. EOM tones are 150 Hz for carts and 25 Hz for Reel-to-Reels. Don't confuse the tertiary tone on some cart machines with the EOM (also known as secondary or AUX) tone.

EOM tones tell the automation when to start the next scheduled event. Actual placement of the tone on the tape affects the "tightness" of your format. For laid-back formats that want a slight amount of dead air between spots or songs, placement should come just after the end of each cut. For tighter formats, place the tone on top of the final syllable of each spot, or the final downbeat of songs that end cold. For songs that fade, determine at what point in the fade you want to start the next event and consistently place tones at that point. Use the VU meter as an indication. Above all, be consistent. Consistency is the key to a great sounding automated format.

ITC-750 Info

In a previous column I wrote about some of the problems inherent in the ITC 750 reel-to-reel deck. Gordon Mackechnie of VIF International got wind of the column and gave me a call. As you probably know, Gordon manufactures pinch rollers and hold-down knobs for several reel-

(continued on page-33)

Station Automation

Continued . . .

to-reel decks. He's just bought ITC out of the reel-to-reel business. He has lots of spare parts that you may not have been able to get from ITC since October, including a few brake bands. However, he had not been aware of the problems with the 750 brakes. He's aware of them now, and has full intentions of redesigning the braking system to use a better brake band and perhaps a different brake roller. You can contact VIF at (408)739-9740.

In my first column I talked about using Procomm Plus or a similar PC communications program for terminal emulation to replace the Lear Seigler ADM-31 used with your Cetec 7000 Level II automation system. Several people called me and asked about replacing the old Beehive B100 terminal sold with Cetec 7000 Level I systems. The then-current version of Procomm wouldn't emulate a Beehive. I called Datastorm and inquired about this. I was told that they were writing several new emulations for the next release (v2.0) but none were for the Beehive. I would just have to wait until the new version came out and try the new emulations. Maybe one of them would work (after all, the emulation we used for the ADM-31 was actually written for a Televideo terminal).

The new version is being shipped as we speak, and I have a copy on order. I'll report back with my findings.

This month, I want to tell you a couple of secrets about the Harris System 90 automation controller. If you have one, you've probably had intermittent problems with it for a while. There are two things to look for when troubleshooting the System 90.

First, shut the system off. Open the door to the power supply chassis and check the back of the regulator board where several wires connect to terminal posts. Check each of these terminals for solid connections. Sometimes the solder joints connecting the posts to the board are broken due to excessive opening and closing of the door. The wires sometimes come loose, as well. Second, remove every socketed TI chip on every system board (not the source I/O boards) and clean its legs with silver cleaner. Harris used mostly TI chips with silver plating in the System 90. It may be a good conductor, but it tarnishes. These tarnished chips could easily be the whole problem with your System 90. Some people elect to remove the sockets and solder most of the chips to the boards.

While you're at it, get some red Cramolin and use as directed on the gold-plated fingers of all the boards. They will make better connections in the edge connectors of the backplane. If you can't get Cramolin locally, call me and I'll send you some. It'll be the best investment you make all year.

Thinking of Going Digital?

Timing is Everything!

No one can predict everything that will happen this April at NAB. But it's a safe bet that "digital" will be the most popular word in the Las Vegas Convention Center. Wander the exhibits, and you'll be confronted with a bewildering assortment of acronyms and new terms - *CD, DAT, DAB, DSP, SCSI, WORM, flopticals, waveform editing, digital satellite automation systems, removable media* ... It's obvious that digital technology is replacing analog equipment in many areas of the radio station. But which departments should go "digital" first and which can wait? Is it better to replace analog equipment that's reached the end of its useful life with digital equipment that may be in the early stages of product evolution? Which manufacturers in this new field are reliable? Radio engineers around the country will be asking these questions and others like them for years to come.

Clearing Up The Confusion

If you keep in mind a few simple benchmarks, your decisions about going digital will be made easier. The right time to "digitize" any area of operation is when digital products can *solve the problems* of your existing analog equipment, perform the same functions *more reliably*, and at *lower cost*. For example, most stations today do their accounting and traffic on computer (digital) rather than paper (analog). It became clear to managers several years ago that they could save money and reduce errors using the new technology in the engineer's domain, CD players have effectively replaced turntables. Both playback prerecorded audio, but a good pro CD player does it faster, with better quality and more reliability. Many CD players are less expensive than a broadcast-quality turntable, and the CD itself is arguably less expensive than vinyl since it has a much longer useful life span. In both instances, digital technology meets all three of our decision-making criteria.

Stay Open to New Ways of Doing Things

Whenever a new technology like digital audio meets a mature technology like analog, there are conflicts. There are also opportunities. To take advantage of them, it's essential not to try forcing the new technology into the exact roles and functions filled by the old. Digital audio not only solves existing problems, it brings *new functional capabilities* to the radio station. Intelligent computer control, instant random access to audio segments, digital signal processing and networking are the main ones. They can change the way your station works - for the better, if you let them.

Digital Satellite Automation The Timing is Perfect

For a number of reasons, automation systems, and satellite automation systems in particular, are the next operational area where digital audio is going to have a major impact. The technology has evolved to the point where you can now store 3 to 6 hours of stereo audio on a medium-capacity hard disk. One integral digital system can record, instantly cue and playback 350 to 700 thirty second segments - commercial spots, ID's, liners, promos, your station's entire non-music library. To do the same thing with analog equipment, you need several cart machines, cart carousels, reel-to-reels, and a complex controller. Carts must be loaded and unloaded manually on a regular basis. You also have to perform maintenance operations like head alignment and cleaning constantly to keep the cart machines in good working order. By contrast, the digital system requires no reloading or maintenance. It delivers better audio quality more reliably and is also easier to operate. The clincher is that digital satellite automation is less expensive than analog, with typical systems costing between $10,000 and $20,000.

Cart Machines Are The Next to Go

For live assist operations, digital automation offers the same key advantages over analog technology. You can replace several cart playback machines and a cart recorder with a single digital system that records, instantly cues and plays back all your spots, liners, ID's, promos, whatever. The digital system requires no maintenance, produces CD-quality audio, and can be pre-programmed for the on-air board shift. At $10,000 list price, digital systems are cost-competitive with cart machines. These digital systems are a clearly superior product that is available right now.

Digilink by Arrakis Systems Broadcast-Engineered Digital Audio

Digilink is designed to replace cart machines, cart carousels, cassette and reel-to-reel decks - any tape-based audio recorder-player in the radio studio. With CD-quality digital recording, powerful and flexible computer control and maintenance-free digital storage, **Digilink** is ideal for the radio environment. Yet with all its advantages, **Digilink** actually costs *less* than the analog equipment it replaces.

CD Audio Quality

Digilink records audio with CD quality in full stereo: THD is 0.008%, S/N is 85 dB and stereo phase error is unmeasurable. The system will store digital audio data on floppy disks, hard drives, removable (Bernoulli) hard disks, removable optical disks or any other SCSI (Small Computer Systems Interface) compatible medium. Because there's no tape to wear out, audio can be played back again and again with no loss in quality. Because there are no tape heads, there's no need for alignment, cleaning or other maintenance operations. Any audio segment on the storage device can be cued up instantaneously.

Versatile Computer Control With Five Operating Modes

Digilink is controlled by computer software, not hardware. That makes it easy to install any of the system's five basic operational modes - stereo production, on air, satellite automation, full automation or news.

For ***stereo production***, **Digilink** acts like an analog recorder, with an easy to learn and use graphical interface that provides fast, intuitive controls including Record, Rewind, Play, Fast Forward, Stop and Pause. Noise-free multiple recordings are possible in this mode, along with graphical waveform editing. Recording can begin automatically when audio starts.

In ***on-air*** mode, **Digilink** can be used instead of a bank of analog cart machines - it's also a remarkably simple and foolproof live assist system. Live assist sequences can be built up or modified while on air, or networked in from another **Digilink** in the production studio.

Tired of the expense and time required to maintain all the cart machines, carousels, reel-to-reels, switchers and controllers in your analog ***satellite automation*** system? **Digilink** replaces them all and gives you up to 14 days of walk-away time. That's real walk away time, too, because maintenance requirements are virtually eliminated. Operation is simpler, too - one system holds all your commercial spots plus liners, ID's jingles, promos, PSA's, sound effects, weather, news or any other audio segment. Schedules automatically adjust for jock schedules and network stopsets. Digilink's digital recording and playback will improve your audio quality, while features like automatic checking for scheduling errors and past-kill-date commercials plus "intelligent" audio insertion to cover network blunders. **Digilink** tracks actual on air play of commercials and network errors and prints out a log. In addition, **Digilink** is totally flexible - you can even change the scheduling during playback.

Digilink's ***automation mode*** gives you an automation source of unmatched flexibility. A single, simple to operate box can provide the entire commercial library to the automation system. You can expand the storage up to 70 hours using additional hard disks or removable optical disks to automate all your programs, including music, on **Digilink**.

Use ***news mode*** to record network news for later review. With its built-in mic mixer, Digilink's news mode can be used as a complete news production and live on air news workstation - no more cart machines.

Digilink's various operating modes are available as individual software packages (the production studio package is part of the standard Wavelink software included with every system, and there's also a business package available), all using the same "Macintosh-style" graphical user interface. The hardware to run all this consists of a rack-mounted Digilink Controller cabinet plus an IBM-compatible monitor, mouse and keyboard. The Digilink Controller contains the digital signal processing boards, an IBM-compatible industrial controller, a 5-1/4" floppy drive, a 40 Mega-byte hard drive for the system, and one or two SCSI hard drives for digital audio. Up to five more drives can be connected externally for total recording time of up to 70 hours. The keyboard, monitor and mouse can be located several hundred feet from the Controller cabinet, and a second monitor, keyboard and mouse can be paralleled to control the system from two studios.

What Will My Station Look Like in Ten Years?

It will probably look a lot like many small businesses today, because the direction of digital audio evolution is clearly following the same general path outlined by business computing over the last decade. Given the typical life span of analog equipment and digital technology's obvious superiority in terms of audio quality, trouble-free operation and programmability, there's little doubt that the station of the year 2000 will be almost entirely digital.

Of course, the price of digital storage will have to come down considerably to make this vision a reality, but that too is an obvious ongoing trend. In the meantime, you need to ask yourself if today's digital equipment can fit into the working environment you picture yourself. A modular system, designed to grow as more powerful hardware and more efficient storage media come on line, is the system most likely to be as useful ten years from now as it is today. In addition, the user interface should be capable of evolving without requiring extensive staff retraining. Digilink's modular architecture and graphical user interface meet both of these important criteria.

While you're evaluating digital audio systems, don't forget to take a look at the manufacturer and distributor. Long term support, service and technical expertise are going to be as important in the year 2000 as they are now - possibly more so. This is the reason **Arrakis** and **Harris-Allied** have entered into an exclusive marketing and support agreement to provide **Digilink** to broadcasters worldwide. **Digilink** is a natural extension of the Arrakis System's line of audio consoles, studio furniture and systems. **Harris-Allied** has built its reputation as a leading transmitter manufacturer and worldwide distributor of radio studio products on unmatched sales expertise and customer support. This is exactly what's needed to continue the evolution of a digital product line through this decade and beyond.

BBS Listing

Broadcast Oriented BBS Listings

Special thanks to Mark Leff of CNN/Atlanta for the original list.

201 769-1779
Visions Infoline II
Sysop(s): Jeff Morgan
Plainfield, NJ
BBS Type: Wildcat - Speed: 3/12/24
PC-Pursuit Code: NJNEW

201 857-8880
Rockboard
Sysop(s): Adam Curry
Verona, NJ
BBS Type: Hermes (Mac) - Speed: 3/12/2400
PC-Pursuit Code: NJNEW

203-438-9908
Orion's Nebula
SysOp: Ward Carpenter
Ridgefield, CT
BBS Type: OPUS - Speed: 1200/2400

205 859-3030
Traveler
Sysop(s): Mike Bennett
Huntsville, AL - Company: WAHR-FM
BBS Type: Phoenix - Speed: 3-2400

206 443-6170
W. Wash. Freq Coord
Sysop(s): Walt Jamison
Seattle, WA
BBS Type: OPUS - Speed: 3/12/24
PC-Pursuit Code: WASEA

206 566-1155
AmoCat
Sysop(s): Rich Langsford
Tacoma, WA
BBS Type: Wildcat - Speed: 3-9600 HST

212 415-3500
HyperCube Systems
Sysop(s): Mike Oswald
New York, NY
BBS Type: PCBoard - Speed: 3/12/24
PC-Pursuit Code: NYNYO

212 645-8673
Communication Specialties
Sysop(s): Rich Brooks
New York, NY
BBS Type: Searchlight - Speed: 12-9600HST
PC-Pursuit Code: NYNYO

214 647-0670
DFW Freq Coord Counc
Sysop(s): Darryl Doss
Allen, TX - Company: SBE Chapter 67
BBS Type: OPUS - Speed: 3-96 HST
PC-Pursuit Code: TXDAL

215 364-3324
Satalink
Sysop(s): Ron Brandt
Huntingdon Vly, PA
BBS Type: PCBoard - Speed: 12/24/9600

216 529-0121
Signal BBS
Sysop(s): Lynn Laymon
Rocky River, OH
BBS Type: PCBoard - Speed: 3/12/2400
PC-Pursuit Code: OHCLE

219 256-2255
Radio Daze
Sysop(s): Mike Shannon
Mishawaka, IN
BBS Type: GAP - Speed: 3/12/2400

301 725-1072
FCC Public Access
Sysop(s): Bob Weber
Suburban DC, MD - Company: FCC
BBS Type: custom - Speed: 300/1200
PC-Pursuit Code: DCWAS

303-341-0129
Colorado Broadcast Frequency Coordinating Committee (CBFCC)
SysOp: Jeff Brothers
Aurora, CO
BBS Type: OPUS - Speed: 2400 Baud

303-949-3253
Master Control
SysOp(s): Lynn Osburn
Avon, CO
BBS Type: OPUS - Speed: 300-9600v.42

305-828-7909
Telcom Central
SysOp: Ray Vaughn
Miami Lakes, FL
BBS Type: OPUS - Speed: 300/1200/2400/9600HST

315 474-5070
SBE Chapter 22
Sysop(s): Steve Hines
Syracuse, NY - Company: SBE
BBS Type: RBBS - Speed: 3/12/2400

317 935-0531
Harris-Allied Bulletin Board
Sysop(s): Bob Groome
Richmond, IN - Company: Harris-Allied
BBS Type: Michtron - Speed: 3/12/2400

402 289-2515
KFMQ 102 Connection
Sysop(s): Dan ?
Lincoln, NE - Company: KFMQ Radio
BBS Type: WWIV - Speed: 1200/2400

404 320-6202
AV-Sync Atlanta (tm)
Sysop(s): Bill Tullis
Atlanta, GA
BBS Type: PCBoard - Speed: 12-9600HST
PC-Pursuit Code: GAATL

404 982-0960
Rock & Roll Atlanta
Sysop(s): Bob Helbush
Atlanta, GA
BBS Type: PCBoard - Speed: 1200-2400
PC-Pursuit Code: GAATL

407 239-2607
Producer's Circle
Sysop(s): Skeeter Durham
Orlando, FL
BBS Type: GT Power - Speed: 3/12/2400

407 649-9834
Electronic Arts Info
Sysop(s): Jeff Alwin
Orlando, FL
BBS Type: QuickBBS - Speed: 3/12/24

408 985-8675
KOME Silent Side
Sysop(s): Greg Argendeli
San Jose, CA - Company: KOME-FM
BBS Type: Michtron(Atari) - Speed: 300/1200
PC-Pursuit Code: CASJO

412 981-3151
Mabel's Mansion
Sysop(s): Charles Ring
Sharon, PA
BBS Type: OPUS - Speed: 12-9600HST

414 873-7807
Second Opinion
Sysop(s): Mark Timpany
Milwaukee, WI
BBS Type: Wildcat - Speed: 12-96HST
PC-Pursuit Code: WIMIL

415 391-2657
NCFCC
Sysop(s): Tim Pozar
San Francisco, CA - Company: Northern Calif. Freq. Coord. Cmte.
BBS Type: RBBS - Speed: 3-2400
PC-Pursuit Code: CASFA

415 571-6160
Production World
Sysop(s): Wes Dorman
San Mateo, CA - Company: Film/Tape World Magazine
BBS Type: Red Ryder Host - Speed: 3/12/24
PC-Pursuit Code: CAPAL

415 641-4373
Information Radio
Sysop(s): Dave Evans
San Francisco, CA
BBS Type: Wildcat - Speed: 3-2400 v42
PC-Pursuit Code: CASFA

419 228-7236
Black Hole BBS
Sysop(s): Fred Vobbe
Lima, OH
BBS Type: TBBS 2.1 Multiline (8 Lines) - Speed: 3-14.4

501 753-6536
N.L.R.-80
Sysop(s): James Padgett
Little Rock, AR
BBS Type: Spitfire - Speed: 12-2400

518 283-4067
Northeast Networks
Sysop(s): John Nelsen
Albany, NY
BBS Type: PCBoard - Speed: 12/24

601 373-0160
Net-Works
Sysop(s): Herb Jolly
Jackson, MS - Company: Myers Bdcst Svcs/J&J Software
BBS Type: Galacticomm - Speed: 1/24

602 438-0459
CRL
Sysop(s): Hank Langlinais
Phoenix, AZ - Company: CRL
BBS Type: Wildcat - Speed: 12-2400
PC-Pursuit Code: AZPHO

BBS Listing

Broadcast Oriented BBS Listings

602 482-1001
Catalyst
Sysop(s): David Kidder
Phoenix, AZ - Company: Take 3 Inc.
BBS Type: TBBS - Speed: 3/12/24
PC-Pursuit Code: AZPHO

602 872-9148
Broadcasters BBS
Sysop(s): Mark Shander
Phoenix, AZ
BBS Type: RemoteAccess - Speed: 3/12/2400
PC-Pursuit Code: AZPHO

608 274-7776
Communications Exch
Sysop(s): David Willow
Madison, WI
BBS Type: GT Power - Speed: 12-9600HST

614-766-2162
Radio Link
Sysop(s): Steve Craver
Columbus, OH
BBS Type: Quick BBS - Speed: 300-2400
FidoNet: 1:226/140

616 530-0821
Trillion
Sysop(s): Dick Castanie
Grand Rapids, MI
BBS Type: Wildcat - Speed: 3/12/24

617 439-5699
Boston CitiNet
Sysop(s): JAE/Koch
Boston, MA - Company: Applied Videotex
BBS Type: Yellow - Speed: 300/1200
PC-Pursuit Code: MABOS

619-268-9625
Radio-Active BBS
Sysop(s): Steve Asaro
San Diego, CA
BBS Type: WW4 - Speed: 300/1200/2400

619 298-4027
So. Calif. MediaLine
Sysop(s): Steve Tom
La Jolla, CA
BBS Type: PCBoard - Speed: 12/24/96H
PC-Pursuit Code: CASDI

703 455-1873
VideoPro
Sysop(s): Tom Hackett
Burke, VA
BBS Type: PCBoard - Speed: 3/12/24
PC-Pursuit Code: DCWAS

703 538-6540
East Coast Pub Net
Sysop(s): Charlen Kyle
Suburban DC, VA
BBS Type: PCBoard - Speed: 3-2400
PC-Pursuit Code: DCWAS

707 553-8452
KDA Message System
Sysop(s): Keith Davidson
Vallejo, CA
BBS Type: PICS - Speed: 3-2400

713 997-7575
Ed Hopper's
Sysop(s): Ed Hopper
Houston, TX
BBS Type: PCBoard - Speed: 3/12/24
PC-Pursuit Code: TXHOU

713 855-4382
Cloud Nine
Sysop(s): David Armstrong
Houston, TX
BBS Type: PCBoard - Speed: 3-96HST
PC-Pursuit Code: TXHOU
Second node at 859-8195.

713 284-1090
SBE Chapter 105
Sysop(s): Frank Rainey
Houston, TX - Company: SBE
BBS Type: PCBoard - Speed: 3-12-2400
PC-Pursuit Code: TXHOU

717 731-8966
Cat's Castle
Sysop(s): Dale Fedorchik
Harrisburg, PA
BBS Type: Wildcat - Speed: 3/12/2400

719 634-5661
ColoSprgs Broadcast
Sysop(s): John Anderson
ColoradoSprings, CO
BBS Type: TBBS - Speed: 3/12/2400

800-766-1720
Idiot Box BBS
SysOp: Michael White
Hemet, California
BBS Type: RBBS - Speed: 1200/2400

800-283-5313
The Spin-Off BBS
SysOp: Michael White
Hemet, California
BBS Type: RBBS - Speed: 1200/2400

801 266-2426
Planet Vulcan
Sysop(s): Chuck Condron
Salt Lake City, UT
BBS Type: Paragon - Speed: 3-14.2KHST
PC-Pursuit Code: UTSLC

804 393-6390
Tidewater Media Link
Sysop(s): George Randell
Portsmouth, VA
BBS Type: PCBoard - Speed: 12/2400

804 550-3338
Flamethrower
Sysop(s): Jeff Loughridge
Richmond, VA
BBS Type: Binkley/OPUS - Speed: 3/12/24

804 973-8235
Broadcasters BBS
Sysop(s): Pat Wilson
Charlottesville, VA
BBS Type: PCBoard 12 - Speed: 3/12/24

806 352-2482
Radio Online
Sysop(s): Ron Chase
Amarillo, TX
BBS Type: PCBoard - Speed: 12-96HST
Second node at (806) 352-9365.

813 527-5666
St Pete Pgm Exchange
Sysop(s): Bill Blomgren
St Petersburg, FL
BBS Type: PCBoard - Speed: 12-96HST

818 248-3088
Hot Tips
Sysop(s): Mike Callaghan
Glendale, CA
BBS Type: Wildcat - Speed: 1200/2400
PC-Pursuit Code: CAGLE

818 363-3192
Call Sheet
Sysop(s): Wayne Parsons
Los Angeles, CA
BBS Type: TBBS - Speed: 300/1200
PC-Pursuit Code: CAGLE

818 567-6564
Hotline
Sysop(s): Jon Badeaux
Glendale, CA
BBS Type: PCBoard - Speed: 12-19.2HST
PC-Pursuit Code: CAGLE

916 338-5227
KBBS
Sysop(s): Mark Stennett
Sacramento, CA
BBS Type: QBBS - Speed: 3/12/24
PC-Pursuit Code: CASAC

916 646-3600
FM102
Sysop(s): Les Tracy
Sacramento, CA - Company: KFSM Radio
BBS Type: QuickBBS - Speed: 300/1200
PC-Pursuit Code: CASAC

916 646-9358
Scratching Post
Sysop(s): Stacy Rothwell
Sacramento, CA
BBS Type: QuickBBS - Speed: 3/12/24
PC-Pursuit Code: CASAC

916 728-5700
Entertain-Net
Sysop(s): Les Tracy
Citrus Heights, CA
BBS Type: TBBS multiline - Speed: 3/12/24
PC-Pursuit Code: CASAC

918 437-9004
The Radio BBS
Sysop(s): Clark Dixon
Tulsa, OK
BBS Type: QuickBBS - Speed: 2400

919 481-2947
Recording Studio
Sysop(s): Greg Nowak
Cary, NC
BBS Type: WWIV - Speed: 3/12/24
PC-Pursuit Code: NCRTP

If you have a BBS, and it's not listed here, call Radio Guide at (507) 280-9668 and we'll get it on the list.

By Steve Walker
Hilo, Hawaii

A Shareware Schematic Drawing Program

Ever been crouched down behind a rack with your head in a hole just big enough for it and the flashlight? Looking for the end of a mysterious wire that looks as though it was run in the 1940's? Only to find it terminated in a box that has six sides, four screws and a rivet visible on the outside, and a mystery on the inside ...?

I can't begin to remember how many times I opened up one of those black boxes only to wonder what in the world it was supposed to do and when it was put there. A quick examination of the station's engineering files shows no indications that anything was ever there ... but then ... the GM says "Oh, Frank built that a couple of years ago to ..." You get the idea I'm sure. At best, you will find a little "something" drawn on a restaurant napkin that Frank sketched out while he was out to lunch "a couple of years ago."

I have a friend whom I have never met but with whom I have had a few interesting phone conversations. He too had this problem. His name is Patrick O'Riva and he runs a computer BBS in San Jose, CA. It is called O'rivations (of course).

Pat and his son David wrote a little program. It is called Schematic Master. Since I had expressed some interest in it, they asked me to do some of the pre-release Beta testing of the new version. I did and let me tell you ... when David rewrote the program he enhanced it very nicely. The new version, v2.00 was made available for download on the 21st of November 1990.

The program is available in Area 6 (programs by an O'Riva), and is called SCHEM200.ZIP. It is stored in PK-ZIP format v1.10 and is only about 35k in its zipped form so at 2400 baud takes only 2-3 minutes to download depending on your telephone line quality. The program is written in assembly language and so runs very quickly, especially on AT class machines. Pat has Z-Modem, X-Modem CRC and SEALink protocols available, as well as others, for downloads.

Do not call the BBS between 12 midnight and 3 a.m. Pacific time as it is involved in echo-mail transfers and will kick you off.

Schematic Master is a program designed expressly for drawing schematic diagrams. It operates similarly to an electronic Etch-A-Sketch (with credit to Ohio Arts) and is just about as simple to use. Play with it for ten minutes, and you're an expert. You can design your own components on a 16x16 pixel matrix and save them. All of the most commonly used electronic symbols are already in place and so are about 100 IC chips. In the most recent version you can add your own IC chips as well as components to the library.

You can print the schematic to any Epson compatible dot matrix printer. At the moment there is no support for laser jet printers but there are shareware utilities available to convert from DMP to HPLJ. The print quality is very good.

David, indicated that the new version is complete except for some minor changes in the documentation files. Anyone who sends a new .DOC file to him will get a free registered version. He also said that registered users will have access to a special area of his BBS for support.

David requests a registration fee for the program if you continue to use it after a reasonable trial period. The fee is $30 which is easier to handle than some of the more pricey stuff like AutoCad or OrCad.

Give Pat and David a call on their BBS or drop them a note. The address is:

Pat or David O'Riva
2726 Hostetter Road
San Jose, CA 95132
BBS - (408) 259-2223
2400,8,n,1

If you have trouble, send me a card and I'll arrange a modem transfer or floppy.

S A Walker
P.O. Box 162
Hilo, HI 96721-0162