March 1, 1986

Radio World

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S…chronous Xmtr Tes…

by David Hughes

Washington DC . . . The FCC has authorized a test of a synchronous AM transmitter in connection with its report on AM improvement, now expected to be released in mid-March.

On 17 January, the Commission granted an "experimental authorization" for a synchronous transmitter test in East Las Vegas, Nevada.

AM synchronous transmission involves using additional, strategically located, carefully synchronized transmitters that broadcast the same programming on a frequency identical to that of the primary transmitter.

Synchronous transmitters are widely used in Europe, where the problem of AM band congestion is far more severe than in the US. In England, for example, the BBC operates four transmitters operating between 50 and 150 kW, all on 1089 kHz, for its "Radio 1" domestic pop music service.

US stations, the FCC said, could utilize synchronous transmitters to fill gaps in coverage within an authorized service area, or to extend the station's actual service area.

However, the Commission maintained that synchronous operations must comply with the allocation procedures contained in the FCC rules for stand-alone stations.

Nevada test

Laughlin Roughrider Broadcasting, which has been awarded a construction permit to build a new AM station in Laughlin, Nevad… …e experiment, accordin… …hayer of the FCC's AM Bran…

Laughlin Roughrider said it wanted to construct "a second facility to provide uniform coverage in the primary service area" of the authorized Laughlin facility without requiring the use of a second radio frequency.

The proposed slave station would be located in East Las Vegas, about 60 miles away from the primary station in Laughlin.

Operating on 870 kHz, the slave station will have a power of 300 W omnidirectional daytime and 500 W directional nighttime. The main station, on the same frequency, is authorized to operate with 10 kW directional daytime and 1 kW directional nighttime.

The FCC asked Laughlin Roughrider to file regular reports on the operation.

Thayer said the Commission has not received any additional requests from stations wishing to perform tests with synchronous transmitters.

Technology advances

Because of technological advances, particularly in the areas of sophisticated new control circuits and highly stable frequency elements, two or more AM transmitters can be precisely locked on the same frequency and can "compensate for the program propagation delay between the primary and synchronous slave transmitters," the FCC said.

The experimental authorization will provide data "concerning the potential benefits and practicality" of allowing synchronous AM transmitters, the Com-

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Brazil Chooses C-QUAM

Brasilia, Brazil . . . The Brazilian government has established the Motorola C-QUAM system as the official national AM stereo standard, Motorola officials announced on 6 February.

According to Motorola AM Stereo Manager Chris Payne, the Brazilian government passed legislation ratifying the standard on 29 January. At press time, officials from the Brazilian Embassy were not available for comment.

Brazil is the third country to formally establish C-QUAM as its national standard. Australia adopted the C-QUAM standard in October 1984, and South African radio stations broadcast AM stereo with C-QUAM as the standard.

"This announcement should provide a leadership example to other South American countries to choose C-QUAM," Payne said.

Payne said that Motorola and Brazilian officials have been negotiating since the middle of 1985 over the "transfer of technology," which grants Brazilian manufacturers the right to Motorola's patent. In return, Brazil would establish C-QUAM as the official standard.

As a result of the agreement, Payne said Motorola will tur… over to the Brazilian government the technical "background and schematics" of the C-QUAM system.

In the meantime, US manufacturers (Motorola, Delta, Harris and Broadcast Electronics) will be allowed to sell their C-QUAM systems to Brazilian stations until Brazilian manufacturers possess C-QUAM production capabilities.

For more information, call Motorola at 202-862-1549.

RFR Vote Deferred

by Edward Wytkind

Portland OR . . . The Portland City Council met in January to consider adoption of new radio frequency radiation (RFR) human exposure standards that, as proposed, would be equal to 1/5 the federally recognized American National Standards Institute (ANSI) standard.

The council voted to defer implementation of new exposure levels until the US Environmental Protection Agency (EPA) conducts a site survey of a cluster of broadcast towers to determine RFR levels in areas adjacent to the antenna farm.

This cluster of towers, three of which are used by Portland radio and television stations, has fueled a battle between local citizens and city government officials over the question of what constitutes safe RFR exposure levels.

"For about 20 years, the city has seen fit to create an electrical jungle surrounded by residential properties," said Southwest Hills Residential League leader William Conley. This concentration of towers, he said, is a "nuisance" to the quality of life.

The controversy surfaced late last summer after the city's Bureau of Planning recommended RFR standards equal to 1/10 those of the ANSI standard. Portland Planning Commission policy officials disagreed with the recommended levels, and instead relaxed the recommendation to 1/5 of the ANSI standard's exposure limits.

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Funds OK'd for Two Florida AMs

by David Hughes

Washington DC . . . The FCC has approved that funds be released to two Florida stations as monetary compensation in the battle to override Cuban AM band interference.

On 16 January the Commission approved funds totalling $113,271.44 to be given to Sudbrink Broadcasting, the former owner of Miami AM station WNWS "for expenses incurred in modifying its transmitting facilities to offset the effects of Cuban interference to its service area."

On 5 February, the FCC approved $84,026.79 in funds to compensate WIOD/WAIA Inc., owner of Miami AM station WIOD.

The two funding recommendations bring the number of stations that have had their requests for compensation approved to three. In 1985, the Commission approved $12,265 in compensation for another Florida AM station, WSUN in St. Petersburg.

Six other Florida AM stations that have also filed for compensation await FCC rulings on their claims.

The compensation program, which is administered by the FCC, was adopted by Congress in October 1983 after Florida broadcasters complained that increasing Cuban interference forced them to make expensive improvements to their transmission systems.

The Radio Broadcasting to Cuba Act authorized compensatory payments to broadcasters, with the applications to be reviewed by the FCC. Rules regarding the compensation procedures were adopted in March 1984.

Even though the FCC has approved the compensation claims for WNWS, WIOD and WSUN, none has received any funds.

According to FCC Audio Services Division Asst. Chief Dennis Williams, the Commission's compensation recommendations are sent to the US Information Agency (USIA), which is then supposed to distribute the money.

"The FCC makes the findings," but does not award money, Williams said. He added that no funds have been appropriated by Congress to the USIA for the compensation program.

A USIA spokesman said that while Congress has "authorized" the agency to spend $5 million for Cuban interference compensation, no funds have actually been "appropriated" or "earmarked."

He said that USIA would wait until most of the Cuban interference claims are handled by the FCC before it asks Congress for the money. "We can't go to Congress every time we get a claim. We'll probably wait and ask for one lump sum," he added.

WNWS case

The Commission said that WNWS, which operates an English language news/talk format on 790 kHz with 25 kW, was given Special Temporary Authority in 1981 to increase power from 5 kW to counteract Cuban interference.

At the time the improvements were made, the station was owned by Sudbrink Broadcasting, which filed its application for compensation on 31 October 1984. However, Sudbrink has since sold WNWS to Jefferson-Pilot Broadcasting.

Williams said the compensation, when awarded, would go to Sudbrink, unless the transfer of ownership documents between Sudbrink and Jefferson-Pilot specified otherwise.

"The increased power and modified radiation patterns utilized by WNWS in its day and night STA facilities fall far short of recovering all the previously served areas lost to Cuban interference," the FCC said in the WNWS ruling.

"It is quite obvious, given the engineering constraints involved, that the modifications to both the daytime and nighttime transmitting facilities of WNWS were made for the sole purpose of mitigating the effects of severe interference from Cuba and not for the purpose of rendering service to previously unserved areas," the Commission added.

WIOD case

WIOD, 610 kHz, operates according to a STA issued in 1981 with 10 kW day and night using a directional antenna system, up from its previous 5 kW.

The Commission said it conducted an interference study and found that WIOD "receives widespread Cuban interference throughout the northwestern, western and southwestern regions of its licensed daytime service area." The station suffers "severe interference" at night, the FCC added.

Williams said FCC compensation recommendations for the additional six AM stations could be announced by spring, but added that some of the remaining cases are "extremely complicated."

Incidentally, the new owners of WNWS, Jefferson-Pilot, recently sold another Miami station, WGBS, a 50 kW operation on 710 kHz that became WAQI and assumed a Spanish-language format. In October 1985, Cuba began broadcasting its Radio Rebelde program underneath WAQI, interfering not only with WAQI, but also with WOR in New York. That interference continues.

For more information, contact Dennis Williams at the FCC: 202-632-6485.

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Featured this issue

FCC Clips

Fines Raised

The Commission's Field Operations Bureau can now issue fines as high as $10,000 to stations that are found to be violating the FCC's technical rules. The previous fine limit was $2,000.

The FCC has emphasized that stations receiving a Notice of Apparent Liability (NAL) regarding a violation of technical rules are required to answer the notice within 30 days. Alleged violators are required to explain why the violation occurred and outline measures taken to prevent future occurrences.

As part of its crackdown on technical violators, the Commission also said it will impose monetary forfeitures on stations that fail to identify their call letters and/or to name the community specified in the station's license first when more than one community location is identified.

For more information, contact Mary Catherine Kilday at the FCC: 202-632-7551.

Engineering Tape

The FCC has produced a course on videotape that is designed to train nontechnical professionals in the basics of electronic communications systems. The "plain language" course includes basic electromagnetic principles and antenna theory.

The tape, titled "Engineering For Non-Engineers," features FCC Policy and Rules Division Assistant Chief Ralph Haller, who has also worked as a consulting engineer.

The four-hour session consists of two VHS video cassettes and a study field guide. A copy of the course can be obtained from Prism Corporation, 4545 42nd St. NW, Suite 109, Washington DC 20016. Phone 202-686-8250.

Offices Moved

The FCC has moved a number of offices that were previously located at 1200 19th St. NW, near its Washington headquarters at 1919 M St. NW.

The Common Carrier Bureau's Domestic Facilities Division is now located on the sixth floor of 2025 M St. NW, while the Mass Media Bureau's Auxiliary Service Branch is now in Room 7310 in the same building.

The Office of the Managing Director's Operations Support Division has been moved to the fourth floor at 1919 M St., while the Emergency Communications Division is now located in Room 840 and the Information Resources Branch at Room 416, both in the 1919 M St. NW building.

For more information on the move, contact the FCC's news media information office at 202-254-7674, or the administrative office of the particular bureau sought.

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'How-to' Carrier Current Guide

by Thomas L. Vernon

Harrisburg PA . . . In my last column, (RW, 1 January) we introduced AM broadcasting's strange cousin, carrier current radio.

Thomas Vernon, a regular RW columnist, divides his time among broadcast consulting, computers and instructional technology. His number is: 717-249-1230.

Carrier current is a world where the AC power distribution system of a building is the "antenna," and coverage depends on the induction field of the antenna to reach listeners.

While AM broadcasters strive to send their signal as far as possible, carrier current operations try to keep their radio waves within the confines of a limited area. Strange indeed.

With the fundamentals already explained, it's time to begin serious design, or redesign, work. If you're upgrading an existing system, it may be better to start from scratch, rather than to assume that those who went before you actually knew what they were doing.

Station Sketches

Installation of carrier-current transmitters and couplers in isolated dormitories is usually straightforward. When buildings are in a quadrangle, or spaced closer than a few hundred feet, things can get complicated (more on that later).

The first step is to feed RF into the power line. Since we want to distribute RF throughout the building as evenly as possible, the best feed point is the main AC distribution panel for the building.

Typically, a dedicated, 3-phase outlet is installed near the breaker panel, and the coupler output is connected to it with a mating 4-conductor plug. The coupler is connected to the transmitter via a short piece of 50 ohm cable with PL 259 connectors on each end.

Avoid the temptation to connect the coupler to a standard outlet plug just because it is easier. Poor coverage and/or carrier hum are virtually guaranteed.

With the transmitter and coupler installed and in place, it's impedance-match time. Newer carrier current couplers have a metering circuit built in to indicate peak output as impedance taps are changed. With older units, you'll probably have to make up a box with connectors and an RF ammeter, connect it between the transmitter and coupler, and adjust the transmitter and coupler for maximum RF output.

Remember that power line impedance at broadcast frequencies changes as a function of load. Impedance will be highest during daylight hours, and decrease in the evening as more lights are switched on. The best setting for the impedance tap is usually a compromise between the two extremes.

Determining how much power to feed into the building comes next. Too much power may cause beat notes with transmitters in nearby buildings, and bring your existence to the attention of the FCC. Too little power results in listeners in the far corners of the building losing your signal in the noise.

It's amazing how little RF power is needed to cover an average-sized dormitory once the impedance is optimized and the proper feed point is used. It's also important to remember that transmitters last longer, and have fewer component failures at reduced power.

"Too much power may cause beat notes with transmitters in nearby buildings, and bring your existence to the attention of the FCC."

Modulate the transmitter to 100% with either a signal generator or cassette recorder with music tapes. Bring along an oscilloscope for accurate measurements. Adjust the transmitter for full RF output.

Have someone go to the farthest corner of the building and plug in a radio. Reduce the RF level until reception begins to degrade. For an average dorm, you'll

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Readers' Forum

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trashy AM sections just like before.

Leonard Kahn shouldn't throw in the towel just because Motorola has better marketing. Kahn is an engineer (and a damn fine one), and his system is a very viable one that deserves more than a passing nod from an industry balanced between success and failure.

As for Mr. Walker's comment that "engineers who have kept the C-QUAM vs. Kahn battle going should be silenced by their management," all I can say is "sieg heil." Is there anybody out there with a first ticket and more than a year's experience that wants some front office exec telling him what to think and say about engineering?

C-QUAM has its merits and the Kahn system has its merits, but they each have their weaknesses. The biggest weakness for the Kahn system right now is the seeming dominance of C-QUAM receivers. But since there are a lot of AM mono receivers being manufactured, the market isn't going to be saturated any time soon. Multimode is feasible for the receiver makers, so let's not kill it tomorrow.

Before we jump on one system and let the receiver makers set our standards for us, we should remember that, as broadcasters, we'll have to live with this decision for a long time.

AM is in the bind it's in now because too many owners were happy to leave their stations alone with old boards, transmitters, short narrowband antennas, and deteriorating ground systems because it was the cheap way out. Receiver manufacturers followed with AM radios that had the audio quality of a dimestore telephone.

Let's hope the majority of AM owners listen to their engineers and programmers and not to Mr. Walker. If AM is ever to come back to its full potential, owners are going to have to stop giving us the impression that it is a throwaway band for simulcasting with FM, or that AM is someplace convenient to run news, public affairs, sports, and easy-sell religious programs.

Instead, owners should remind themselves that AM is first and foremost *Radio* and *Radio* is nothing more than potential waiting for creative people to make it happen. That creativity has to come from engineers who love their work, programmers who know how to do something other than "12 in a row," announcers who understand what an audience is, sales people who sell advertising instead of "spots," and managers and owners who remember why they got the license and hired those people in the first place.

George W. Gilpin, Ops Mgr
WAGR/WJSK
Lumberton, NC

Test for Sour Monitoring Point

by Frank S. Colligan

Washington DC ... I have found a new and precise technique for periodically testing monitoring points invaluable for isolating a monitoring point problem from an array or sampling system problem.

Frank Colligan is a telecommunications consultant specializing in AM directional arrays. He can be reached at 301-229-5577.

Simply stated, the monitoring points can be "bridged" as surely as the common point!

Did a monitoring point or two just go out on your directional array? Is the fault with the array itself? Is the problem in the sampling system? Is it a combination of the two possibilities plus problems with the monitoring points themselves?

Nagging questions, aren't they, and with the all-too-familiar "ring!"

A monitoring point problem could be just the seasonal effect that some stations experience as an increase in the fields in winter, most notably in eastern New York and on up through New England.

Is problem seasonal?

The obvious way to determine if the problem is purely seasonal is to switch to the nondirectional mode of operation and check the nondirectional fields at the monitoring points.

If the DA/NonDA ratio is the same as on the last complete proof, the seasonal effect is usually at work. This is why I insist on designing a phasing system to include a pushbutton switchover to nondirectional, with full detuning of idle towers. This establishes a calibration reference in terms of a DA/NonDA ratio at any point in the field.

If all DA monitoring points have increased by essentially the same percentage, there is a high probability that the seasonal effect has set in, and that the nondirectional values have gone up by the same percentage.

Precise new method

A new and more precise method of monitoring the monitoring points can save headaches now and later. The bearings of most monitoring points are at or very near the nulls in the pattern. This simple trick is invaluable in uncovering a monitoring point that has "gone sour."

When the DA proof of performance is finished, or as soon as possible thereafter, put a man with a field intensity meter and two-way radio gear at the monitoring point. To avoid possible co-channel interference, try to center these tests around noon.

The meter should be very carefully aimed at the array, with the loop parallel to the radial, *not* merely rotated for maximum reading! Make notes regarding local landmarks for easy repetition later.

Gradually adjust the phasing system controls to reduce the field to as close to zero as possible. When this condition is reached, carefully log the antenna monitor readings and the counter dials.

Reset them to the normal positions and repeat this procedure at the rest of the points.

In using this technique, you will have used null balancing in the same sense as impedance bridge balancing. The arms of the "bridge"in this case consist of the paths from each tower out to the monitoring point, plus the two arms of a classic impedance bridge within the field strength meter itself.

Later on, when one or more monitoring points go over the established limits, simply reset the phaser counter dials to the settings that had previously "zeroed" the point. Check to be sure the previous antenna monitor readings have been repeated. If necessary, trim the controls a

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Eliminating Transmitter Hum

by John "Q" Shepler

Rockford IL . . . The transmitter and its associated processing equipment are the final elements in the audio chain. While a narrow band directional array can add coloration to your sound, and could be called the "last audio processor," a finicky antenna probably won't be a source or amplifier of hum. Transmitter hum is what this month's column is all about.

The studio audio arrives at the transmitter site by phone line or STL. It has possibly been pre-processed to help override the noise sources along the way. The signal levels may be anywhere from −20 dBm to +8 dBm, depending on the transmission scheme.

John Shepler is a broadcast consultant, teacher, writer and former CE. He can be reached after 8 PM at 815-654-0145.

Low audio levels are not a good idea in a transmitter plant. It is best to get that signal into the first processor quickly or boost it to normal levels before you do anything else.

Q-Tips

Transmitter sites have something that studio sites are missing: lots and lots of RF energy. RF is no blessing until it is on its way to the listener. Any fields hanging around the audio circuits are just likely to cause trouble.

Figure 1 shows a typical transmitter plant and points out some potential trouble. The first problem area is outside the transmitter building. If a phone line is involved, it may be strung on poles within several hundred feet of a tower. The audio in that line will enter the terminating equalizer with a healthy, superimposed RF signal. The RF will most likely be bypassed right to ground or blocked by big inductors.

But, what if a connection becomes corroded? Now you have a nice oxide rectifier that demodulates the RF and adds its audio to the line audio. That's one way that AM and FM stations bleed into each other's audio.

If a single station is detecting its own RF, something else occurs. You can't hear the feedback in the form of reverberation, but the rectified audio component will add distortion and noise to your signal.

One effect of FM RFI is increased hum in the audio that varies in intensity as you move your hand around the equipment. There is no reverb effect because the time delay through the transmitter and audio path is too short.

Patch panel problems

The next danger spot is the patch panel. Patch bays are generally ignored until you rewire something or have an emergency. Few stations bother to do regular cleaning and exercising of every jack. After years of obscurity, dust and

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Figure 2. Filament Hum Balance

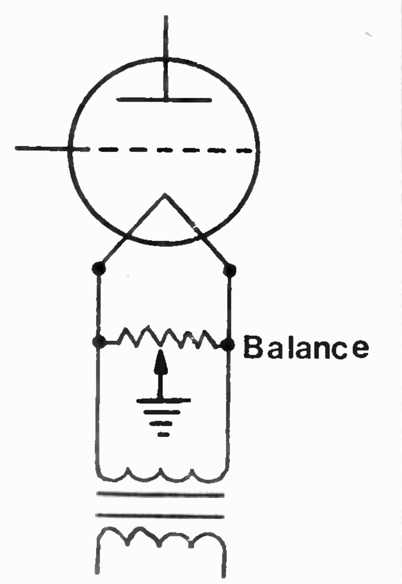
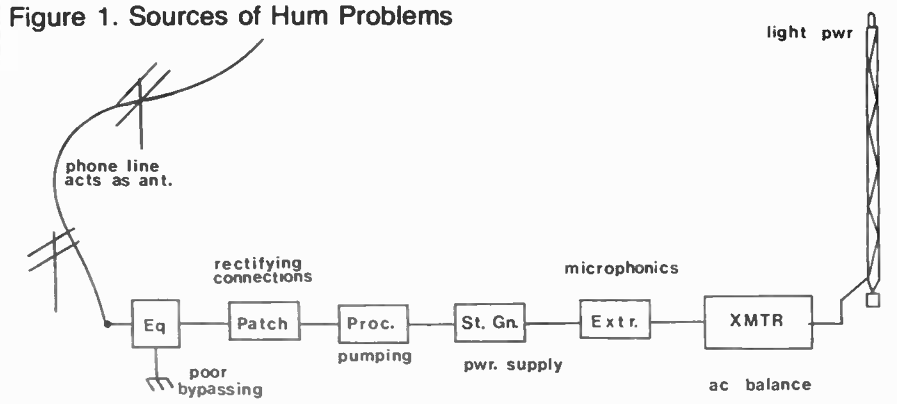
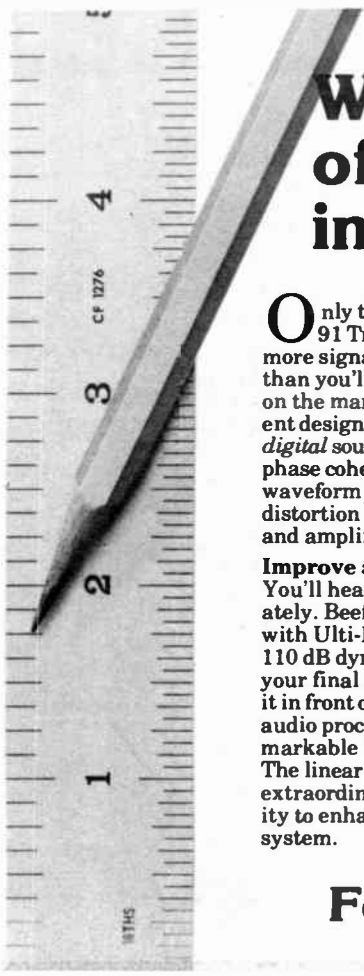


Figure 1. Sources of Hum Problems





Test for Sour Monitoring Point

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bit to get the exact values back on the monitor.

Check the monitoring point to see if it is still essentially zero field. Then go to the next set of counter dial settings and monitor readings to check the next monitoring point, and so on.

If one monitoring point has "gone out of whack" while the others are fine, any one of several things may have happened. Carefully look at the vicinity around the bad point. Have any new buildings gone up? Have any new utility wires gone up?

If they have, is the point now just a little too close to a transformer pole ground wire? If so, you may be able to arrange to put in a special heavy duty RF choke in the vertical ground wire that will be found on the pole. Don't discount the possibility that newly installed underground utilities are affecting the monitoring point (they most definitely can, and usually do!).

During a proof of performance you have the opportunity to choose new monitoring points. While on nondirectional operation, make notes on field strength meter loop directional response.

Measure the points in the usual way, then rotate the meter for the deepest null indication. Log this minimum value as well.

Later on, calculate the ratio of the maximum to minimum indication at each point. The highest ratio will be a good monitoring point choice. This, in effect, is a use of the meter's direction finding capabilities (my FIM-41 is also the DF set on board my boat).

A very high ratio of maximum to minimum loop response indicates that the signal is arriving from the station with a minimum of reflections from nearby reradiators. Repeating this type of test later will also help you answer that same nagging question: "Has the array *really* drifted out of adjustment, or is it just the monitoring point?"

Installing C-C System

(continued from page 8)
probably end up using about 4-5 W of power.

And now a few thoughts on audio lines. The newer generations of carrier-current transmitters are high fidelity devices, and it is well worth the time, trouble, and expense to install 15 kHz equalized lines.

Older systems may have strange series/parallel audio feeds with poor fidelity. It's not usually worth the time to try to figure out what was done in the past. The best system usually consists of dedicated 15 kHz lines, each fed from a distribution amp in the studio.

Next month the real fun will begin as we'll discuss carrier current installations in groups of buildings and high rise towers, using splitters, RF amplifiers and miles of coax. 'Til then, watch out for J operators loitering on the Wheatstone Bridge!

System 'Zaps' Lightning, Static

by Ron Nott

Farmington NM . . . Lightning and static electricity have been costly nuisances to the broadcast industry since it began. Lightning arresters, ball gaps and lightning rods have all been installed with the assumption that, sooner or later, one will have to take a strike, and with the hope that these devices will somehow protect the station's equipment.

The study of atmospheric physics shows that it is not necessary that a station ever be struck by lightning. Proper application of scientific principles can prevent a strike altogether by discharging the high voltage electric field that occurs during thunderstorms and other atmospheric disturbances.

Although enormous voltages develop, often exceeding 100,000,000 V, they can be discharged below the point where lightning occurs, thereby providing protection for a broadcast or communications facility.

Unfortunately, a large amount of misinformation has accumulated over the years, much of it now accepted as fact by virtue of tradition. What follows is a simplified explanation both of what occurs during atmospheric disturbances, and of a method that has been proven to work.

Voltage gradient

Under what is described as "fine weather" conditions—i.e., blue sky, sunshine, either few or no clouds and no storms in the offing—the earth has a negative charge with reference to the atmosphere. The voltage gradient has been measured in hundreds, and sometimes thousands, of volts per meter of altitude. Surprising, yes, but it's there. Of primary importance is that, even though a large voltage gradient exists, it seldom reaches a value where lightning occurs.

Though conductive objects, such as broadcast and communications towers, disrupt the gradient, normally nothing occurs because the electric field is of such high impedance. The energy levels are not there to cause a large, sudden flow of current, as when lightning occurs.

On the other hand, storm conditions cause an inversion of the polarity. The earth, relative to the storm cloud bottom, becomes positive. An enormous, high energy field of many megavolts develops between cloud bottom (negative) and earth (positive).

Many factors affect this field. Wind, rain, the terrain, trees and manmade structures all have an effect, thus distorting the field and causing it to be more concentrated in some areas and less in others.

Figure 1 illustrates the field without distortion. The voltage gradient is represented by iso-electric (iso-E) lines illustrating that the gradient is uniform from the earth's surface to the cloud.

The earth is shown flat and devoid of structures, trees and terrain irregularities, each of which would have an effect, however large or small, on the E field. Such effects would be shown by irregularities in the iso-E lines.

Figure 2 shows a somewhat exaggerated example of the effect of a tall, conductive structure, such as a broadcast tower. The iso-E lines are closer together around the top of the structure. This illustrates a greatly increased vulnerability to a lightning strike, as the E field is much more concentrated in this area.

Figure 3 illustrates the conditions during a strike. For this short period of time, a portion of the cloud is short circuited to ground. For a time afterward, the field is discharged, but rapidly rebuilds from the energy contained in the storm cloud until normal gradient is restored.

What causes a lightning strike?

Under normal conditions, air is a good electrical insulator. However, it can be changed into a good conductor by applying enough voltage, either AC or DC, to cause it to ionize. At this point, the high voltage strips electrons from the gas atoms and molecules of the air, and a flow of electric current begins.

The shape of the points across which the high voltage is impressed has a definite effect on the voltage at which conduction by ionization begins.

It has long been known that rounded shapes increase the ionization voltage. When arcing is to be avoided, such as on high voltage transformers and RF components, great pains are taken to avoid sharp points and corners. Surfaces are polished and/or covered with insulating material. The electric charge is distributed over the rounded surfaces, and thus the air surrounding them requires much greater voltage to ionize.

The ultimate shape is apparently spherical. When high voltage experiments were in vogue about a century ago, the highest, most spectacular voltage discharges were between round balls. With other shapes, particularly sharp points, ionization occurs at much lower voltages, often in the form of a continuous current of very small value, discharging the voltage between the electrodes.

Conduction by low-voltage ionization

For minimum wind loading and economy of construction, most towers are of tubular construction, often with a dome-shaped beacon on top, and with few, if

(continued on page 14)

Ron Nott is president of Cortana Corporation, a manufacturer of dissipation devices for AM, FM and TV installations. He can be reached at 505-325-5336.

Figure 1.

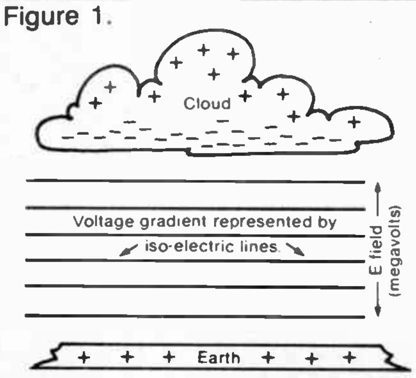


Figure 1 - Normal voltage gradient over flat earth. Irregular terrain, trees, structures and the shape of the cloud bottom will distort the iso-E lines.

Figure 2.

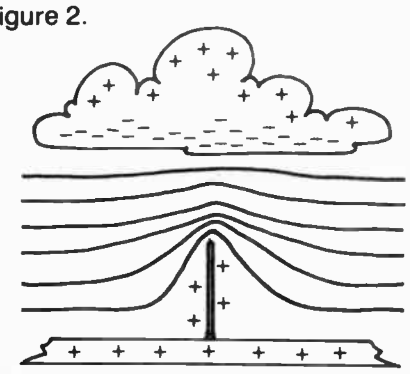


Figure 2 - Distortion of the E-field by a tall conductive structure. Maximum stress occurs where the iso-E lines are close together.

Figure 3.

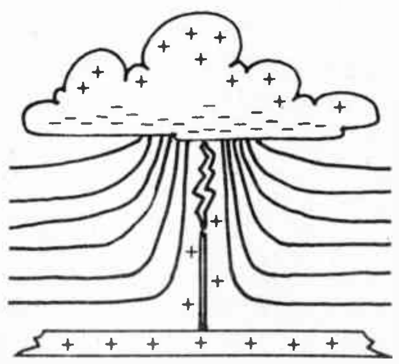


Figure 3 - When a lightning strike occurs, the iso-E lines move rapidly upward into the cloud. After the strike, the field is temporarily discharged, but it rapidly rebuilds, depending on the energy of the storm.

Figure 4.

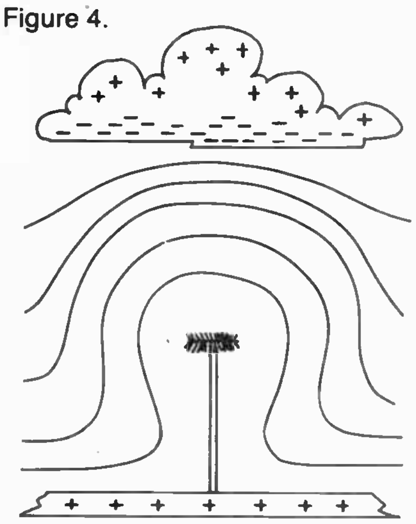


Figure 4 - With a Stati-Cat dissipator attached to the tower, conduction by ionized air discharges the near E-field and decreases the high voltage gradient as indicated by the increased distance between the iso-E lines.

Lightning 'Zapped'

(continued from page 13)

any, sharp corners or points to initiate low voltage ionization. FM, TV and microwave antennas are manufactured with rounded surfaces to avoid corona.

Blunt-tipped lightning rods are intended to intercept rather than to prevent lightning strikes. They are intentionally located at the point of maximum dielectric stress (see Figure 2).

While they may protect VHF and UHF antennas by diverting the lightning strike, blunt-tipped rods cause a large current pulse in the tower structure and its attachments. Welding of lighting conduit and coax hangers may occur. The pulse may be coupled into transmission lines, traveling into equipment and possibly damaging it or causing a tripoff.

The single sharp-tipped lightning rod precipitates low voltage ionization, but is limited to only a small amount of discharge current. It is analogous to placing a single resistor of large value across the terminals of an enormous capacitor. With time, it could do the job, provided that no additional charge were added to the capacitor.

Unfortunately, this is not the case with a storm. Formation of a storm cloud is a dynamic process, with its charge building at a rapid rate. While a single, sharp point does have a small discharge capacity, it takes many sharp points to discharge the energy of a potentially catastrophic storm.

Air ionization around a sharp point begins to occur at about 10 kV. This may sound like high voltage, but it is miniscule when compared with the millions of volts normally required for a lightning strike to occur.

While it is impossible to discharge all the energy in a storm, induced ionization can reduce the E-field in the vicinity of a tall structure to values far below those required for lightning to strike, provided that enough sharp points are present in the discharge area.

Dissipation devices

Figure 4 illustrates the increased spacing of the iso-E lines in the vicinity of the dissipation device(s). The spacing of the iso-E lines is, of course, affected by the number of points and their dispersal. However, the effect varies, depending on the energy in the storm and the atmospheric conditions in the immediate vicinity.

A high energy storm would require a larger number of points to keep the voltage gradient reduced below the point where lightning may strike. The goal of any dissipation system is to protect the structure by preventing the voltage differential between it and the storm system from reaching the catastrophic discharge point. The continuous low-voltage, low-current discharge does this.

Note in Figure 4 that the iso-E lines curve inward toward the structure below the dissipation device. Experience has shown, particularly with a tall tower, that even though the top is protected by a dissipation device, the voltage gradient can still get high enough to cause a strike on the side of the tower.

This has occurred on a tower of only 400'. Before dissipation devices were installed, it received many strikes on top, damaging the transmitter and causing tripoffs. The dissipation devices stopped this, but on at least one occasion, lightning hit the microwave STL antenna located at the mid-point (about 200'). Additional devices were furnished to solve this problem.

Depending on the weather history of the area, tall towers may need a system composed of devices installed at intervals, or even continuously, up the faces of the tower.

Guy wires

Another problem is insulated guy wires, such as those used by AM stations. They become charged to different values, depending on the voltage gradient, and can be triggered into discharging across the insulators by several

(continued on next page)

System 'Zaps' Lightning, Static

(continued from previous page)

things, including distant lightning flashes. The charges on the guys are dumped into the AM antenna, which may then cause a transmitter tripoff.

There are several solutions to this problem. Resistors are available that are placed across the insulators to drain off the charge.

Another method goes way back in time. When guy wires were installed using Crosby clips instead of "preforms," some tower installers would extend the guy wire 6-8" beyond the last clip and then flare out the strands. In effect, each guy wire had a dissipation device composed of the sharp wire tips at each end.

Once a tower has been installed, it is not convenient to go back and do this, but dissipation devices are available that accomplish the same thing.

Whether the guy is discharged by a resistor or low voltage ionization, the end result is the same. The flashover across the insulators is eliminated. Occasionally, guy wires receive direct strikes and have even been partly or completely burned in two. One or more of the above methods can resolve this problem.

Another problem eliminated by dissipation devices is the static electricity charge deposited on AM antennas by snowflakes or wind-blown dust. These particles become charged by their motion through the air but cannot discharge because dry air is such a good insulator. When they strike a metallic object, such as a tower, the charge is transferred to it.

Large voltages can accumulate on an insulated tower, to the point where it can arc across an insulator in the tuner or transmitter. The surge may damage components such as capacitors or may trip the transmitter off.

West Texas is known for its wind-blown dust and dry air. A station having its transmitter site near El Paso had many annoying tripoffs each day during the dust storm season. A dissipation device was installed on each of the four towers in the directional array, thus completely eliminating the tripoffs, as well as providing protection during thunderstorms.

The devices are physically small and have no effect on the impedance or directional pattern.

Receiving antennas

Many years ago receiving antennas with sharp tips or wire ends were plagued with static in the receiver. This static varied with atmospheric conditions, the season and even the time of day. The cause of the static was low voltage ionization of the air around the tips, which generates electrical noise. Insulating these sharp points eliminated or diminished the problem. Ultimately the corona ball that is found on the ends of most mobile antennas evolved.

Ionization discharge noise can sometimes be heard on car radios while in the vicinity of a storm or atmospheric disturbance. Depending on the size and shape of the corona ball, the ionization voltage can be moderately high. The sound from the radio may sound like the buzz from a relaxation oscillator, sometimes varying in pitch, depending on the storm intensity. Therefore, it is not appropriate to install dissipation devices directly on or in the very near field of receiving antennas. The devices should instead be mounted on the supporting structure, preferably above a receiving antenna.

During atmospheric disturbances, the continuous, low-voltage discharge will generate a low level electrical noise. However, if the signal-to-noise ratio is high enough, the effects should not be apparent in a receiver. If the static charge is not dissipated by low voltage ionization, sudden bursts of noise may be heard in the audio. This is the result of ionization occurring at higher voltage, which causes electrical noise of much greater energy levels.

Received signal quality and reliability can therefore be improved by utilizing low voltage ionization for static charge dissipation.

There is no apparent effect on transmitting antennas, since the discharge currents are very small in relation to the normal antenna current. If the device is mounted directly on an antenna, such as an AM broadcast tower, it must be physically small enough to have no effect on the antenna field or impedance.

Fortunately, devices have been developed which provide effective lightning

(continued on page 23)

Circle Reader Service 34 on Page 24

Grounding Systems Complex

by Roy B.Carpenter, Jr.
Pt. I

Santa Fe Springs CA . . . In opposition to conventional thinking, the requirement for achieving a satisfactory grounding system is governed by several, somewhat divergent criteria. These criteria are, in turn, created by the system and/or the application. They include:

- Personnel safety;
- The establishment of a grounding reference point;
- The establishment of an earth interface; and/or
- Lightning protection.

Although these would seem to be similar criteria, they may not be, as a detailed analysis of each of these criteria will show.

Personnel safety

The personnel safety criterion stems from the need to protect people who normally interface with the system from being harmed by it, due to differences of potential between components of that system that are supposed to be of equal potential (or at "ground potential").

To satisfy this criterion, every component in the system must be referenced to whatever common grounding is available, regardless of the earthing resistance achievable. For this, a low resistance ground (earthing interface) is not necessary as long as every component is referenced to a given point, including the actual grounding point itself.

Common point ground

Establishing a grounding reference is simply the process of selecting some point of the earth to which every potential in the system is referenced, for AC, DC, low and high frequency potentials.

Separate runs to that point prevent circulating current from causing interference, destruction and disruption. It is often referred to as the "common point ground" (CPG).

Note that the "surge impedance" of the paths to that point must also be considered. Again, the resistance to earth is of secondary importance, unless it is used as one conductor in the system, or as part of one.

Earth interface

Establishing an earth interface is a criterion which mandates an electrical connection to earth. The connection, in turn, is used as one electrode of the system. This obviously infers a very low-resistance interface connection to true earth.

A typical illustration would be the way local power and telephone companies interface with consumers. A grounded conductor can create high "fault currents" across its earthing resistance, which can appear across its ground wire and true earth elsewhere in the power network as an unsafe voltage.

"Charge neutralization"

Lightning protection grounding system requirements have conventionally been thought to be similar to those described above. A more accurate title, however, would be "Lightning Charge Neutralization System," because of the nature of atmospheric electricity and the lightning stroke mechanism.

As illustrated in Figure 1, storm clouds induce an image charge of equal but opposite potential on the surface of the earth, beneath the cloud.

When a lightning channel terminates on an earthed object, that channel forms a conductive path between the two bodies to permit equalization of the charge between them.

Since the charge was on the surface of the earth, it follows that every bit of that charge must move from where it was induced to the stroke channel. If a pad of a facility was part of the charged body, and was the terminus of the strike, its grounding system must provide

(continued on next page)

Many Factors Affect Grounding

(continued from previous page)
an adequate, low-resistance, low-surge impedance path from any point in that system to any other point in that system.

Therefore, the grounding requirement for lightning protection is not just a low (DC) resistance to ground per se, but an interconnecting grounding network that electrically interconnects every component of the plant or system.

Other requirements of a universal grounding system include:

- Negligible resistance to true earth;
- A conductive path (low resistance) between every point in the system;
- A low-surge impedance path between every point in the system;
- A common point reference for every electrical device in that system; and
- Separate short runs to each system "ground" connection to eliminate the potential for "circulating currents."

Conventional grounding concepts

Conventional grounding concepts involve the use of various forms of wire, rods, straps, plates and, in some cases, any other conducting medium that is both readily available and in contact with local earth. The use of water, sewer or gas pipes, though common, is not normally considered or allowed for commercial systems, and is not recommended for any application. The proliferation of plastic pipe, the presence of which may be unknown to the user, makes this form of ground a dangerous practice.

Achieving a low resistance interface with true earth is a complex challenge, as all of the local soil characteristics must be considered. These include:

- Soil type and uniformity
- Moisture content
- Compactness
- Granularity
- Temperature
- Mineral content
- Stratification
- Manual conditioning

Obviously, these cannot all be considered in concert; some, such as temperature and moisture content, change constantly. These factors also cannot always be assessed, even individually, since soils are seldom uniform.

A review of the individual factors affecting earth resistivity will help define the problems and give an estimate of the possibilities.

Soil resistivity

Soil resistivity is the most significant parameter influencing grounding resistance; the higher it is, the higher the grounding resistance will be for a given grounding concept.

Soil resistivity is usually defined as the DC resistance of the path between two opposite faces of a cube of that soil, 1 meter on a side (for ohms per meter) or 1 centimeter on a side (for ohms per cm). Some typical soil resistivities are listed in Table 1. The ohms per meter value is equal to the ohms per centimeter value when the latter is multiplied by 10.

Grounding resistance

Grounding resistance is the interface resistance, measured in ohms, between the grounding electrode and true earth. A low resistance "ground" must facilitate a highly conductive interface between local earth and the grounding system electrode(s). Obviously, the higher the local soil conductivity, the lower the measured interface resistance to earth.

Following is an assessment of each of the parameters that influence achieving a "good" conventional ground.

A single driven rod or other form of conductor is the most common grounding electrode. Its usefulness as a grounding interface is illustrated in Figure 2. The actual interface is described as an "equivalent hemisphere."

A certain amount of soil is required to establish contact with the local soil. The soil surrounding the rod may be considered as a series of concentric shells, each adding some resistance (dr) to the overall grounding resistance.

As the number of shells increases, the resistance of the subsequent (dr) shells have less and less effect on the overall resistance to ground.

A rod finally reaches about 90% of its interfacing soil at a distance of approximately 2.2 times its length. Simply stated, a rod requires a clear hemisphere diameter of 2.2 × the physical length of the rod in the soil to achieve reasonable use (90%) of its ground interfacing capability.

As an example, a 6' rod driven fully into the earth requires a hemisphere of a little over 22' diameter for a 90% effectiveness. It would take 44' to achieve 95% effectiveness, and 224' for 99% effectiveness.

Typical resistance achieved through use of a single rod is illustrated in Figure

(continued on page 22)

Roy Carpenter, Jr. is president of Lightning Eliminators and Consultants, Inc. He can be reached at 213-946-6886.

Table 1.

Soil	Average	Resistivity, ohms per cm Minimum	Maximum
Fills:			
Ashes, cinders & salt marsh	2,370	590	7,000
Clay, shale gumbo loam	4,060	340	16,300
Hybrid Soil	15,800	1,020	135,000
Gravel, sand with stones	94,000	59,000	458,000

Figure 1. Charged Cloud Influence on Surface Facilities

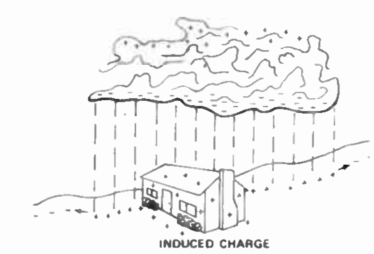


Figure 2. Earth resistance Shells Surrounding a Vertical Ground Rod.

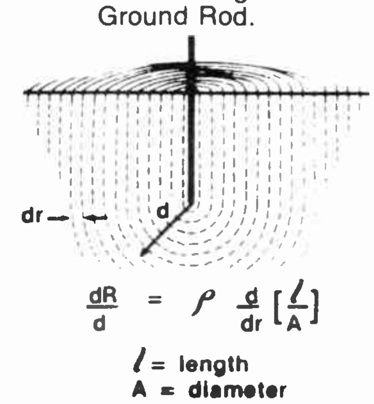


Figure 3. The Influence of Ground Rod Physical Parameters

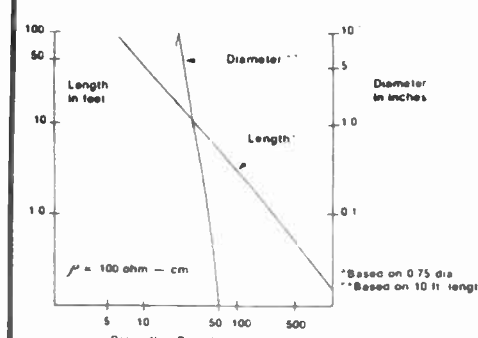


Figure 4. Interference Phenomenon Rods too Close

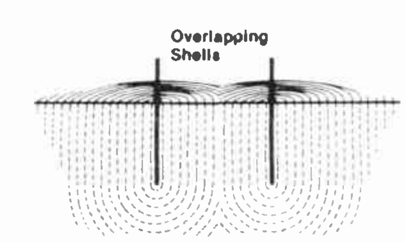


Figure 5. Number of Rods Required vs. Soil Resistivity

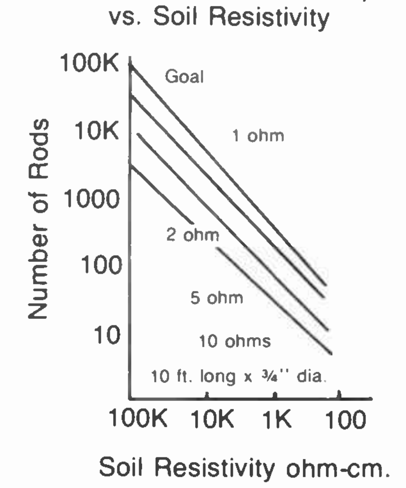


Figure 6. Minimum Resistance Obtainable with Parallel Rods in a Square of Given Area.

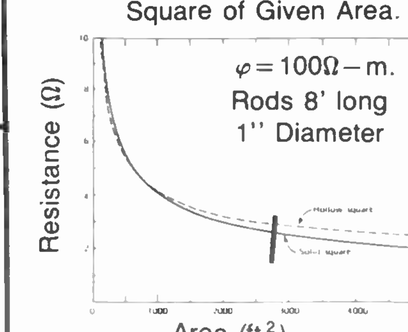


Figure 7. Rods in a Circle of 20' Radius

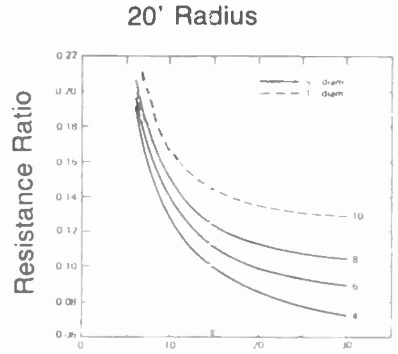


Figure 8. Resistance of Buried Wires

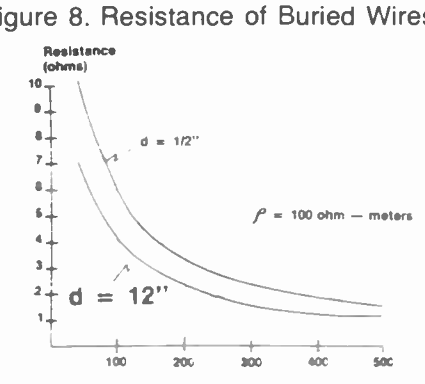


Figure 9. Depth factor for buried wires arranged in six patterns:

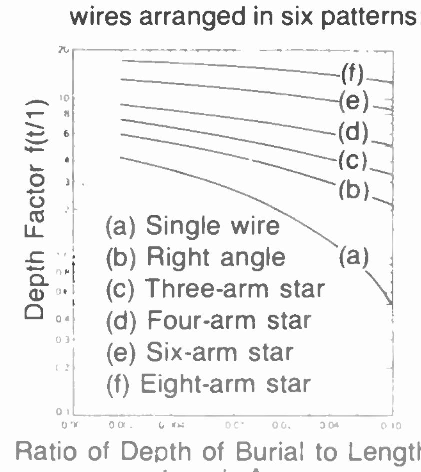
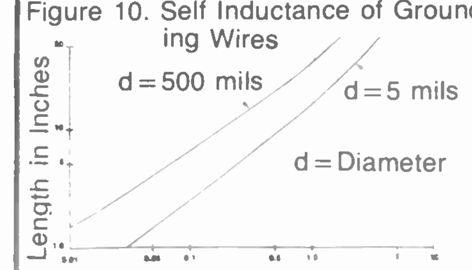


Figure 10. Self Inductance of Grounding Wires



FM Begins With Radio Basics

Editor's note: The following is the first of seven lessons in a for-credit class, "Fundamentals of Frequency Modulation."

by Ed Montgomery
Lesson 1

Annandale VA . . . This series of articles is designed to give the reader basic knowledge of how FM broadcast systems function. It is impossible in the space available to present all of the physics necessary to fully understand the concepts that underlie what will be discussed. I hope that this series, which will provide a general overview of the subject, will stimulate further study by the reader.

Induction

The basis for all wireless communication is the relationship between electron flow and magnetism. When electrons flow through a wire conductor, a magnetic field is produced around that conductor.

This magnetic field contains energy that can be transferred from one conductor to another through an electrical principle known as induction. Simply stated, this means that when electrons flow through a conductor (electric current), a magnetic field is produced around the conductor.

If a conductor is not connected to any source of electrical energy, but is passed through a magnetic field, an electron flow will then be generated within the conductor. This is the principle by which transformers and antennas function.

In order to transfer energy using a magnetic field, a varying or alternating current must be employed. Thus, in order to produce an electron flow in a conductor that is not connected to any electrical source, the magnetic field across it must be constantly changing.

Antennas

In radio transmission, the conductor connected to the electrical source can be considered the transmitting antenna, while the conductor that is not connected to a voltage source can be considered the receiving antenna.

An antenna is made of a material that

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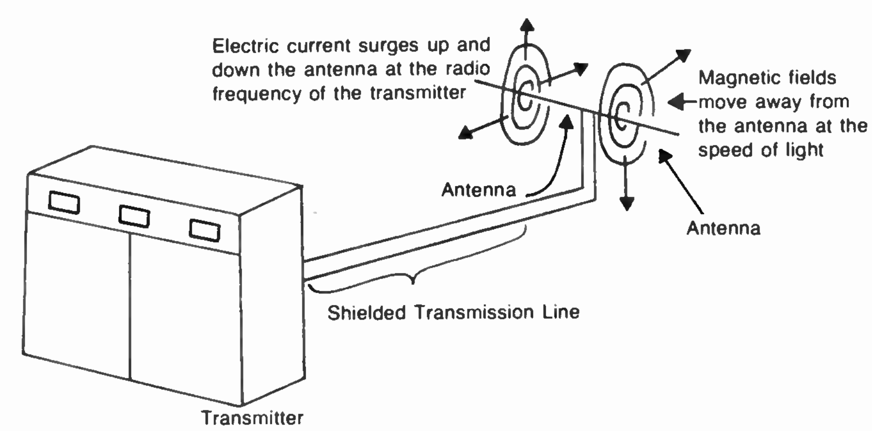
Figure 1.



FM Begins With Radio Basics

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will conduct electricity. It is specifically designed to radiate the magnetic wave away from the transmitter (shown in Figure 1). The antenna is a specific length of what could be considered unshielded wire that is connected to the transmitter through a shielded transmission line.

Transmitter principles

The transmitter produces the alternating current that is delivered to the antenna. All transmitters produce electromagnetic waves, or alternating electrical current, with an associated magnetic field.

The only difference between various transmitters is the frequency or variations in rate of alternating current produced. A broadcast transmitter operating at 93.1 MHz is producing alternating current at the rate of 93,100,000 cycles or alternations per second, while a transmitter operating at 105.5 MHz is producing alternating current at the rate of 105,500,000 cycles or alternations per second.

A receiver uses a tuned circuit to select the frequency one desires to receive, and rejects all others.

The strength of the radio signal, or magnetic field, traveling through the air is directly related to the power, or electrical energy, produced by the transmitter. If the electrical current is increased, the magnetic field will also increase.

The transmitter employs tuned, or resonant frequency, circuits that confine the energy radiated from the antenna to the frequency that the transmitter is licensed to. The energy is produced in the form of a sinusoidal wave, which is illustrated in Figure 2.

This wave is actually a display of constant circular motion versus time. Its length is measured in degrees in the same manner that angles in a circle are measured.

This waveform is produced in the resonant or tuned circuits of the transmitter. The magnetic field is constantly changing in intensity and polarity as the current in the antenna changes direction.

The varying magnetic field traveling through free space is the key to sending information from one place to another without any transmission.

> *"The only difference between various transmitters is the frequency or variations in rate of alternating current produced."*

Radio waves are very similar to light in the way they travel from one point to another. The theory surrounding their transmission was first proposed in 1873 by British physicist James Clerke-Maxwell.

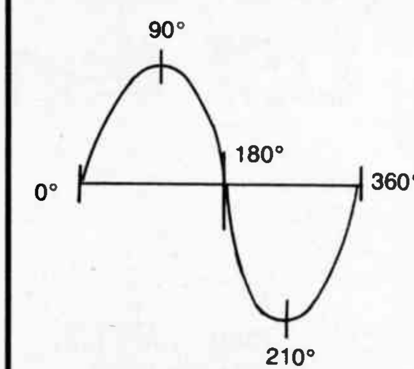
The first experiment in which radio waves were transmitted and detected was in 1888 by Heinrich Hertz. He performed his work only to prove Clerke-Maxwell's theory. Hertz did not pursue radio transmission because he believed that the medium had no future.

Additional information for this course can be found in a series of articles on direct and alternating current that appeared in RW from October 1984 to May 1985. If you would like reprints of these articles, send $6 to Northern Virginia Community College, Broadcast Engineering Technology, 8333 Little River Turnpike, Annandale VA 22003. Make checks payable to: E.T. Montgomery.

To register for "Fundamentals of Frequency Modulation," send a check for $15, payable to Northern Virginia Community College, along with the registration form below.

Ed Montgomery is professor of Broadcast Engineering Technology at Northern Virginia Community College. He is available to answer any questions at 703-323-3248.

Figure 2.



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Broadcast Computing

DA Program Eliminates Sweat

by George and Glen Frese

Wenatchee WA . . . We have recently completed a microcomputer software program to aid in the calculation of AM directional antenna (DA) systems. The time necessary to calculate a complete standard pattern has been reduced from six hours to under two minutes.

The program can format and print tabulations of the full standard pattern, a requirement for inclusion in an FCC 301 application. This is accomplished in the time it takes for your printer to crank out seven pages of tabulations.

Our software is guided by a flow chart that is graphically shown on the computer screen. That flow chart is reproduced in Figure 1. Throughout the program you can refer to the flow chart to review your options for further experimentation.

Another feature is the ability to alter any of the five tower parameters from two to five towers, and then recalculate the resulting pattern in a matter of minutes. This enables trial and error experimentation that replaces the old process of making intuitive guesses and extrapolations from existing patterns.

To further assist design work, you can display tabulations of sections of the pattern in English or in metric units.

One of the most interesting features of the program is its ability to graph the pattern on the monitor at any scale and with any interval between the points. While the points of a graph are being calculated and plotted, each value is sorted and compared to the other points in order to select the smallest values of E standard (the nulls of the pattern.

These E standard values of the nulls are then displayed on the monitor, paired with their corresponding horizontal angle. This enables you to immediately know the direction and the magnitude of the nulls for any pattern.

The speed and the ease of operating this program eliminate the need to know the complex math and electromagnetic relationships of a DA pattern, thus opening the door for non-engineers to dabble in the world of DAs.

A chief operator or a station manager can explore the pattern used by their station and can simulate it to facilitate minor tuning.

The manner in which patterns can be revised and plotted makes this a useful tool for the college level engineering classroom. A student becomes self-taught while exploring the system.

This software runs on IBM compatible computers with a minimum of one disk drive and 64K RAM. For the graphics features to work properly, your computer needs to have a standard IBM graphics or compatible video board.

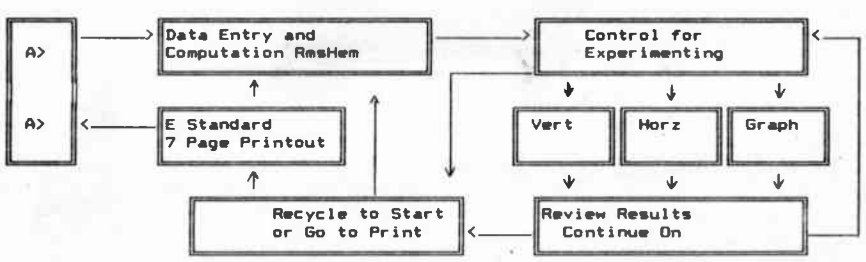
If you have an optional 8087 coprocessor installed, there is a separate set of programs that will do all the calculations 10 times faster.

When using an 8087 coprocessor, a value for Rms hemisphere can be calculated in 10 seconds.

George Frese is a veteran broadcast consulting engineer. For more program information, call Glen Frese at 509-663-0326.

Figure 1.

```
This flow chart will appear when you have a major decision to make.
The cursor will blink in the box that represents where you currently are.
A prompt will accompany the flow chart to explain what to enter.
Entering something else will direct the flow on an alternate path.
 * CAUTION * If you enter anything besides a number when a number
            is needed the program will crash !!
Enter a RETURN to continue.
```



Automate Technically

by P. Michael Zeiman

Camden NJ . . . While many radio stations use computer-based program automation systems to control the continuity and flow of their programming, few stations have integrated a technical control system into their operation.

Such a control system has many inherent advantages, not the least of which is an unattended operation for part of the broadcast day.

The cost of some dedicated, packaged systems is prohibitive for some stations. But with the advent of inexpensive personal computers and a "real world" interface, WKDN has developed a complete control package for under $900.

The system was designed around the Commodore 64 computer and its related equipment (printer, disk drive, monitor and phone modem). In addition, the C-64 was interfaced to an existing transmitter remote control system (TFT) using the Innovative Technology 1020 interface board. A block diagram illustrating the relationship of all components is shown in Figure 1.

(continued on next page)

Mike Zeimann is station manager of WKDN-FM in Camden, NJ. You can set up an on-line demonstration of his system by calling Mike at 609-854-5300.

Find dBs

Belgrade MT . . . This month's program allows you to enter either the voltage, current or power ratio for purposes of conversion to dB. Lines 13020 to 13110 are designed to tell the computer which of these variables you are considering.

The program listing in Figure 1 also shows which of the computational sections applies to each choice. Results are then printed in lines 13180 to 13200. Note that line 13175 is one conventional method of rounding the final results.

Short programs from Dale's toolbox appear each month. You can call him at 406-388-4281.

Figure 1.

```
13000 REM* DECIBEL CONVERSION
      BY JULES GILDER AND HEIDNER
13010 CLS
13020 PRINT"  DB CONVERSION"
13030 PRINT:PRINT
13040 PRINT"THIS PROGRAM CONVERTS
      VOLTAGE, CURRENT"
13050 PRINT"OR POWER RATIO TO DB.
      SO SELECT MODE:"
13060 PRINT
13070 PRINT"  1. VOLTAGE"
13080 PRINT"  2. CURRENT"
13090 PRINT"  3. POWER"
13100 PRINT: PRINT
13110 INPUT"ENTER CHOICE:   ":N
13120 IF N =3 THEN 13150
13130 IF N=2 THEN 13140
13132 INPUT"ENTER V2,V1:   ":X2,X1
13134 DB= 20* LOG(X2/X1)/ LOG(10)
13135 A$ =" CURRENT"
13136 GOTO 13175
13140 INPUT"ENTER I2,I1: ":X1,X2
13144 DB=20* LOG(X2/X1)/ LOG(10)
13145 A$ = "CURRENT"
13146 GOTO 13175
13150 INPUT"ENTER P2,P1:   ":X2,X1
13160 DB = 10*LOG(X2/X1)/LOG(10)
13170 A$ = "POWER"
13175 DB = INT(100*DB+.5)/100
13180 PRINT: PRINT: PRINT
13190 PRINT"THE   ":A$:" RATIO ":X2:" ":X1
13195 PRINT
13200 PRINT"IS EQUAL TO  ":DB:"  DB."
13299 STOP
```

Automate

(continued from previous page)

The computer system performs the following functions:

- Monitors and controls WKDN's transmitter and provides a printed log of transmitter readings and alarm conditions;
- Monitors various radio station functions, such as tower lights, transmitter building and studio burglar alarms, and the Emergency Broadcast System receiver;
- Provides audible and visual indications when any monitored function is out of tolerance; and
- Provides WKDN with off-premise, unattended studio operation from midnight to 6 AM on weekdays using the phone modem as the studio-to-remote-location link and a dial-up phone line.

WKDN's computer system meets or exceeds all of the remote control requirements as set forth in FCC Report and Order MM Docket No. 84-110, RM 3046, adopted 19 November, 1984.

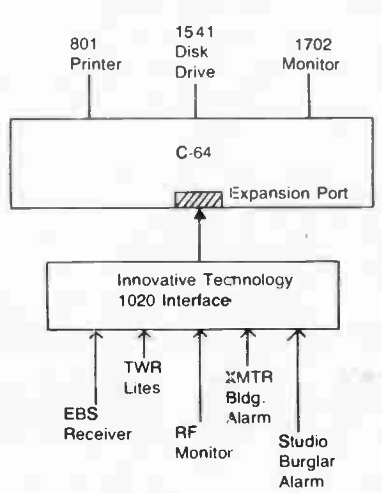
Note that our system is a real-time system for controlling and monitoring technical functions; it is *not* a program automation system. Programming at WKDN is delivered via Satcom IV satellite and is produced by Family Radio in Oakland, California, of which WKDN is an owned and operated station.

The Commodore 64 and Commodore peripherals were chosen for their: cost effectiveness; outstanding graphics and sound; ease of programming; availability and good documentation, including many helpful articles from *RUN* magazine.

The WKDN computer system provides a continuous printed log of transmitter readings and station alarm conditions, and has removed the tedium of regular transmitter readings. It also lets us have far better control of our transmitter than would an operator making periodic adjustments.

Based on our experience, a cost-effective, flexible and "user-friendly" microcomputer control system that can operate a radio station from an off-studio location is now a reality.

Figure 1.
WKDN Computer System



Note: Alarm Inputs are Contact Closures

Many Factors Affect Grounding

(continued from page 17)

3, where rods of various lengths and widths were driven into 100 ohms per meter soil. Note that a rod 50' in length by ¾" diameter was required to achieve only a 10 ohm ground. Conversely, the conventional 10' rod provides a 50 ohm ground, at best.

Variations in diameter seem to exercise little significance. A variation of from 1" to 10" lowers the resistance from about 40 ohms to only 30 ohms, a 25% reduction.

Rod deployment configuration

Multiple rods are often used to lower the grounding resistance in difficult situations. In doing so, care must be taken to maximize the effectiveness of each rod and the real estate used. As illustrated in Figure 4, rods too close together result in "shell interference," both reducing individual rod effectiveness and wasting copper.

Figure 5 estimates the number of rods required to achieve some typical low grounding resistance as a function of soil resistivity. Note that a 1 ohm ground requires about 1,000 rods 10' long by ¾" diameter in 1,000 ohms per cm soil.

In using multiple rods, the deployment configuration used is important, and can influence the ultimate resistance and/or effectiveness of the multiple-rod grounding resistance.

Figure 6 illustrates the potential grounding resistance that can be achieved through use of a square pattern of rods 1" in diameter and 8' in length in 100 ohms per meter soil. The rods were deployed at about 16' separation for the hollow square and 16' between, along the perimeter of the open square.

Figure 7 illustrates the impact of deploying rods of various lengths in a circle with a radius of 20'. Notice that using more than 15 rods has little effect on lowering the resistance. The ratio is the resulting resistance compared to that of a single rod. Circular configurations are usually a less effective use of real estate than are the square patterns.

Where there are only a few rods required to achieve the desired resistance, straight-line configurations are the most effective.

Horizontal grounding systems

The use of buried wires, or horizontal grounding electrodes, is another method to achieve a grounding system. This concept is particularly useful where the topsoil is of limited depth. It is also ideal for lightning neutralization and low frequency antenna counterpoids.

A horizontal grounding system has the advantage of being easy to deploy. Its disadvantage is that it requires much more real estate.

There are several factors that influence the effectiveness of this type of system. The first, grounding resistance, is influenced by the same factors as the driven rod, and can be estimated from those factors along with the equal depth factor.

Figure 8 presents an estimate of the grounding resistance for two wires of different diameters, buried at optimum depth (12" to 24"). The data indicates that a ½" wire requires about 300' to achieve 90% of its potential, where the 12" diameter conductor achieves 90% at about 200'. It is obvious that the larger diameter is desirable for low grounding resistance.

The depth configuration factors must be considered in concert with each other and with the length factor. For example, while a single long wire connected at the center provides the same grounding resistance as one connected at the end, its surge impedance is less than half.

Other patterns for buried wires are even more effective. Figure 9 indicates that carrying the "star," or center connection configuration, to eight arms yields the lowest resistance. It follows that additional arms or spokes will provide lower resistance, unless they are too short and the resulting wires are too close to each other.

Note that the proximity constraints for buried wires are approximately the same as for driven rods.

The self-inductance of buried wires is the factor that determines the surge impedance of the interconnecting wires where lightning protection is required. Figure 10 illustrates the effective inductance of two wires in air, as a function of their length. It also illustrates that the larger the diameter, the lower the impedance.

The 5 mil wire has an inductance of about 3μH/meter, while the 500 mil wire has an inductance of only about 1 μH. Each microhenry of inductance adds about 10 ohms of impedance to the flow of a lightning related current surge.

The combination of the grounding resistance and inductance factors tends to be somewhat self-compensating in low resistivity soil. In high resistivity soil there is little influence from the soil contact.

The interconnect system

The interconnect system in a rod-wire matrix may be specified from the foregoing data. It should be of large diameter and short lengths. Soft-drawn copper tubing is an ideal alternative since it is inexpensive, easy to work and is readily available most anywhere.

The soil temperature exercises a significant influence on the ground resistance of a given electrode, as illustrated in Figure 9. At temperatures above freezing, large variations make little difference.

Below freezing, starting at 0° C, the grounding resistance for any given conventional system rises rapidly with decreasing temperatures. In permafrost,

(continued on next page)

System Zaps Lightning, Static

(continued from page 15)

protection while having an insignificant effect on the AM antenna.

Static charge dissipation by this method has been used for many years by the aircraft industry. Small strands of conductive fibers or metal are located on the trailing edges of wings and other surfaces to neutralize the charge between an airplane and the surrounding atmosphere, preventing lightning and static charge buildup.

Architects often include pointed rods around the periphery of buildings in their designs. It's a proven technology which can be utilized by the broadcast and communications industries to protect their facilities.

Design is primarily a function of structure height, history of lightning in the area and degree of protection required. An inexpensive device can reduce the chance of lightning by perhaps 99%. The additional 1% can be very expensive.

Foremost in the design must be ruggedness, because any device of this kind will be exposed to the greatest weather extremes.

Another essential is a good discharge path for the device. There must be good, low resistance DC continuity between the device and earth ground. AM stations already have this in their ground systems, provided that a ground system is properly maintained and a path is provided in the form of a lightning choke or a static drain choke across the base insulator.

It is important to remember that a static discharge device normally operates with a small DC current, usually only a few milliamperes. A severe storm may cause a flow of a few amperes, so great pains and expenses need not be taken with large copper conductors.

Remember, the method of static discharge by low voltage ionization eliminates lightning strikes completely. Lightning strikes are not transferred to other structures; the energy is instead dissipated by a continuous low-current, low-voltage flow of energy between a structure and the surrounding atmosphere.

Instead of an instantaneous zap of a few microseconds duration, a steady flow of electrical energy occurs over many seconds, minutes or even hours. And it's not complicated or expensive.

I would like to give credit to Richard Ives, Ph.D., physics, and others at San Juan College for their assistance in verifying the technical accuracy of this article

Variables in Grounding

(continued from previous page)

there is essentially no electrical ground.

In warm climates, temperature makes little difference. Obviously, any steps that can be taken to lower the freezing point or to maintain above-freezing temperatures will ensure a better grounding concept.

The moisture content of the soil is also significant in achieving a low resistance. From Figure 10, it may be observed that a moisture level of from 12% to 15% is required to approach the optimum grounding resistance for the given soil type and other conditions.

Moisture levels of less than 4% for sandy loam or as much as 14% for clay mandate some form of forced moisturization to achieve reasonably lower resistance. This data shows that attempting to achieve lower resistances in dry soil through conventional means is an impractical objective.

Variations/unmeasured factors

Granularity, compactness, content and uniformity of soils are all factors that do not lend themselves to parameterization. Conversely, they seem to provide a wide range in grounding resistance values that show little relation to measurable parameters. Table 1 presents some estimates of the range in these values for various soil types.

The variations within these categories are probably the result of a complex combination of the foregoing parameters unmeasured at the time that the data was taken. The variations are also the result of random combinations of the unmeasured factors within the specific category; i.e., for "sandy loam," no ratio between sand and loam is given.

Soil conditioning

Mineral content is known to have a significant impact on soil resistivity. In fact, mineral salts have been used to "precondition" soil known to be of high resistivity in order to lower the earth/rod interface resistance.

Several techniques have been used to implement this process, but they all amount to a removal of the natural soil, mixing it with charcoal or some other absorbent material, plus a generous portion of a selected metallic salt, usually sodium chloride. The soil is then replaced, and the rod(s) are driven to the depth of the conditioned soil only. Extended lengths are of no use.

This technique works well for a year or so, depending on rainfall. Later, the resistance starts to increase, as illustrated by Figure 11, never again to achieve the initial low resistance level, regardless of the recurrent conditioning cycle.

Part 2 on grounding criteria concepts and capabilities will be featured in the 15 March RW.

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Distributor Notes

Got any updates on new product lines, new employees, or changes of address? Send your information or press releases to Radio World.

PAGS Among Inc. 500

Ocala FL . . . Pro Audio General Store was named by *Inc. Magazine* as one of the 1985 Inc. 500.

Pro Audio was named 296th among Inc.'s 500 fastest growing privately owned companies. In addition, Pro Audio was named 15th among Floridas's fastest growing privately held companies.

Pro Audio General Store sells pro audio equipment to radio stations, recording studios and universities.

Bill Shute, founder of Pro Audio General Store, along with Chris Shute and Steve Beverly, have joined Tom Hay in establishing a new company, Heie Engineering.

The new company will manufacture on-air broadcast consoles.

For more information, contact Bill Shute at Pro Audio General Store: 904-622-9058.

RF Specialties Appointment

Seattle WA . . . RF Specialties of Washington has announced the appointment of Bob Arnold to the position of sales engineer in the Seattle office.

Arnold held a similar position with Allied Broadcast Equipment's Federal Way, WA office. Prior to his position with Allied, Arnold worked as an independent contract engineer in Montana and Wyoming.

RF Specialties of Washington is a west coast distributor of radio station RF equipment, with offices in Seattle and Santa Barbara. It is a member of the RF Specialties Group, which has three other offices nationwide.

For more information, contact John Schneider at 206-363-7730.

Aphex Rep Named

North Hollywood CA . . . Aphex Systems Ltd., has announced the appointment of Marcon as Aphex' rep for Texas, Louisiana, Mississippi, Oklahoma and Arkansas.

Marcon is located at 5327 N. Central Expressway, Dallas TX 75205.

For more information, contact Bruce Marlin, sales manager, at 214-521-4313.

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Eliminating Hum

(continued from page 11)
grime build up, and the connections can go a little flaky.

If the impedance rises, you'll detect a change in level, and possibly a loss of lower audio frequencies as well, if the problem is severe.

But, if the dirt is just enough to make a rectifying junction, the normal audio sounds fine but is colored by RFI feedback. Added hum is one possible effect.

Grounding and shielding are even more of a concern at transmitter sites than studios. Part of the reason is the stray RF field that envelops everything.

Even without the RF problem, transmitter rooms have massive amounts of AC power running around. It doesn't take much of a ground loop to pick up a trace of those kilowatts. Make sure to use heavy conductors for single-point grounding and keep everything else well insulated.

Audio processing

Many stations have all the processing just before the transmitter. This trend has been encouraged by the single-box processors that have been so popular for the last 10 years. Even if you process at the studio, you will need a final limiter or clipper just before the transmitter.

Audio processors are no worse than other amplifiers as far as noise and hum problems, except for one added effect. Processors that include a gain varying element (all compressors and most limiters) tend to pull up hum and noise as the signal level drops. Some designs limit this activity with noise gates or compression/expansion circuits, but the fact is that a processor cannot process unless it can adjust audio levels.

While the processing makes your signal louder and more consistent, it is also making hum and noise more apparent. The raw audio may sound superb only because you can't detect the lower level problems. You'll get a better perception of your true signal if you monitor the audio line after the processing equipment.

Nearly all FM stations and more and more AM stations are following the processor with a stereo generator. Stereo generators are included as part of some audio processors, but others, especially those used for AM stereo, are standalone.

The only problems contributing to hum are ground loops or unshielded connections within the rack, or power supply failures in the generator.

Transmitter microphonics

The exciter is really a low power transmitter, and is subject to the same problems as transmitters having the oscillator, buffer and power amplifiers on a single chassis. Exciter power supplies tend to be regulated, and are not much trouble. Microphonics, however, are a slightly more troublesome concern.

Microphonics are pickups of noise and vibration by equipment that does not contain a microphone. How can that be?

Vacuum tubes, air capacitors and other components, when mounted loosely, can act as microphones. A condenser microphone is formed by one moving and one stationary metal plate. Air is the dielectric, and circuit voltages provide the charge.

Flimsy metal or tube elements work like condenser mics. They are not very sensitive, as microphones go, but they can easily pick up fan vibrations and transformer hum on the chassis.

The result is mysterious hum or buzz in your signal.

High power audio tubes and even some solid state circuits can become microphonic in the power stages. Rap your hand on the cabinet and see if you can hear anything on the air monitor. This works best after midnight, when you can shut down the audio and poke around the equipment. Just watch your fingers, or the transmitter will bite back!

Transmitter blowers can accentuate the microphonics problem. The air flow itself probably won't excite any resonances in the system.

However, vibration from the blower motor or squirrel cage can shake the chassis or tube cavity, and thus cause parts to move slightly. Blowers are shock mounted to prevent this, but if the mounting is faulty or some rotating part is off balance, you can have problems. The conducted vibration can indirectly modulate the high power RF at a line related frequency.

Oscillator stages are also prone to this, and might be AM or FM modulated by vibrations from motors or transformers.

AM transmitters have special problems related to high power audio circuits. Many plate modulators have a circuit similar to the one in Figure 2. The pot is adjusted for minimum hum, which serves to balance each side of the filament to ground.

The filament is also the cathode in this triode. As long as the filament AC power is balanced, it won't become part of the audio.

You should tweak this adjustment whenever you change tubes. Set the level sensitivity on the mod meter to −50 or −60 dB and adjust for a null in the noise.

The other big hum generator in all transmitters is the power supply. Transmitter supplies aren't too sophisticated. A transformer, rectifiers, a couple of oil filled caps and a choke are pretty much it for the high and medium voltages.

The circuit is designed to meet FCC noise specs, but if the choke shorts or a cap starts to lose its microfarads, the meters can look good even though hum is being added to the audio.

Sometimes lightning will take out one of the rectifier blocks. You can limp along at low power, but the hum will decrease with fewer rectifiers.

At the start of this column I ducked the issue of antennas as a contributor to hum problems. But there are a couple of ways in which antennas can be part of the problem. The less obvious is the tower lighting circuit.

Tower lights require large amounts of AC power and that pulsating current can find its way into a poorly grounded studio/transmitter system. If you can hear a slight buzzing every second or so at night, suspect this source.

The other path is RFI radiated from the antenna. You learn to live with a certain fixed amount, but sometimes the problems seem to come and go. Weather conditions affect AM arrays. When the weather gets worse, so do the RFI complaints.

If the RF hum problem gets suddenly worse on FM, take a quick peek at your reflected power. When the bays are iced up, that power will come back at you and may make its presence known by additional noise. Actually, this is a blessing in disguise; if the standing waves are bad enough to be audibly noticeable, think how the poor transmitter must be groaning under the load.

RFI problems are a challenge in themselves. Next month, I'll pass along some RF puzzles and their solutions.

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AMPLIFIERS

Want to Sell

McMartin B-200B stereo phono preamps (6) $100 ea. CE. KQIZ. POB 7488, Amarillo TX 79114. 806-353-6662.

Altec 1568A tube amp. $25 or BO. L Houck, Rollin Recdg. 210 Altgelt, San Antonio TX 78201. 512-736-5483.

BGW 75 excel cond. $250. D Smith, Group One Prod. 2597 Romig Rd #1V, Akron OH 44320. 216-753-4733.

Audiometrics PA-1 phono preamps (2), new, sell or trade for $50 preamps. $175 ea. T Belcher. United Ministries in Music, Allenville KY 42204. 502-265-5810.

DC-300A, excel cond. $450. J West. West Side Sound, 602 W Hemlock, Bozeman MT 59715. 406-587-1420.

RCA BA-43 prog amp. w/RCA BA-45 AGC unit. BO. M Meyer, KLQP, Box 70, Madison MN 56256. 612-598-7301.

Bogen CHS-60A solid state PA amp. 60 W, gd cond. $130. B Stallman, Mtn Forrest Comm, 95 Fraley, Kane PA 16735. 215-664-4539.

BE Spotmaster TT preamps, stereo, balanced outputs (2), $100 ea. L Wagner, Ardnigva Radio Net, POB 1788, Orlando FL 32802. 305-299-1299.

McIntosh MC 250 50 W/chan stereo amp in gd cond. $175. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

Altec 1570B 165 W tube amps, vgc (2), $175 ea. W Busetti, Lizard Electr, 114 N Robinson, Florence CO 81226. 303-784-3540.

McIntosh MI-75 super mono amp in gd cond. $200. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

Nakamichi stereo amp. 60 W/chan. new, $225; Biamp TC60, $250. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

UREI 6500, still in box, $1599. L Schara, Pyramid Audio, 450 W Taft, S Holland IL 60473. 312-339-8014.

Peavey CS-800 amps, vgc, $450 ea. S Hofmann, Cameron Univ Theater, 2800 W Gore, Lawton OK 73505. 405-248-2200 X428.

Custom freq amp, controls speed of recorders & electr equip. $100. G Nichols, Creative Prod, 200 Main, Orange NJ 07050. 201-676-4418.

ANTENNAS & TOWERS

Want to Sell

Gates (ERI) FMC-2A, 2-bay CP FM antenna. $1200. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

Andrews JHS-50, 50 ohm heliax transmission line w/Andrews 75AR & 75AN. $250. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

Low pass filter, 1-5/8" EIA, 5 kW, FM 94.9 MHz, approx 7' long, copper, $200. J Cunningham, KEOR, POB 1110, Atoka OK 74525. 405-265-4496.

Crouse-Hinds 46996 motor flasher unit, new; Crouse-Hinds FCB-12 tower beacons for 2-620 W lamps; ancient RCA FM isocoupler; Harris FMS-5, 5-bay CP FM antenna. P Wells, KLZZ, 8665 Gibbs Dr #201, San Diego CA 92123. 619-565-6006.

Dielectric 40 kW FM isocoupler, rebuilt to new at factory, awaiting your freq calibration. BO. T Spencer, WMVA, POB 3138, Martinsville VA 24112. 703-632-2152.

Copper ground screen for AM antenna installation. $1 sq ft. L Tighe, WRNJ, Box 1000, Hackettstown NJ 07840. 201-850-1000.

Utility antenna, 230' insulated AM tower, heavy duty to hold large FM antenna, on ground. $3500. H Dybedock, WBSW, POB 999, Kankakee IL 60901. 815-939-4541.

Phelps Dodge CFMLP-3 3 bay FM, 4 yrs old, excel cond. $1000. D Allan, WOCQ, POB 1850, Ocean City MD 21842. 301-641-0001.

Utility tower 130' on ground, w/guys. BO. JP Robillard, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

Collins G5CPS, 4 bay FM antenna, 3 yrs old, tuned to 92.5 MHz. B Harlan, WFAH, 393 Smyth NE, Alliance OH 44601. 216-821-1111.

Fisher Pierce No. 63364DA photo light control, new in box, $100; Code Beacon 300mm KG-114, vgc w/lamp, $300. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-486-2337.

Miller 7872 tower RF chokes, 20 amp. (4), gd cond. $20 ea. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-486-2337.

Collins G 5cps 4 bay FM antenna, excel cond. $2500. B Harlan, WDJQ, 393 Smyth NE, Alliance OH 44601. 216-821-1111.

Andrew 47R-3, 1-5/8" EIA FL connector for use w/Heliax, new w/coupl/kit, $95. G Churpek, N6FL, 839 Cambon Circle, Ojai CA 93023. 805-646-5296.

Want to Buy

CP antenna 2-6 bay, w/deicers, for 94.3 MHz. B Dodge, WTIJ, POB 150, Waterburry. 802-244-5683.

FM antenna 2-3 bay, CP pref w/100' 7/8" transmission line w/1-5/8" connectors. L Perkins, KWVR, 107 SW First St, Enterprise OR 97828. 503-426-4577.

Self-supporting 240' tower forTV ant; 2-bay CP antenna on 92.7 MHz; isocoupler on 92.7 MHz to handle up to 10 kW. C Haynes, Haynes Comm, POB 31235, Jackson MS 39206. 601-981-4245.

FM 2 or 3 bay, tuned to 98.3; also 75-95' guyed or self supporting tower, close by. B Taylor, KQSS, Box 292, Miami AZ 85539. 602-425-4378.

Tower, 150', FM antenna 96.3 MHz. C Stover, Stover Bdctg, 1305 Sunset Dr, Norwalk IA 50211. 515-981-4217.

AUDIO PRODUCTION (OTHER)

Want to Sell

Howe 2100 Phase Chaser, brand new in box, $950/BO. S Reynolds, WFFX, POB 2000, Tuscaloose AL 35403. 205-758-5523.

CBS air alert, $400. T Pounds, WREL, POB 902, Lexington VA 24450. 703-463-2161.

Nortronics QK76 head mount, new (2), $10 ea; Nortronics 9223 heads, new (2), $60 ea. CE, KQIZ, POB 7488, Amarillo TX 79114. 806-353-6662.

LPB S2 audio compressor, $200. T Pounds, WREL, POB 902, Lexington VA 24450. 703-463-2161.

Shure M610 feedback controller, new, $95. A Ross, 8022 27th NE, Seattle WA 98115. 206-575-4624.

Audio equip inc: audio cassette duplicators, limiters, reverbs, program EQ's, call for details & prices. B Rase, Rase Prods, 955 Venture Ct, Sacramento CA 95825. 916-929-9181.

API & Fax mic pre & buss cards, BO. A Polhemus, Excalibur Snd, 750 8th, NY NY 10036. 212-245-2435.

UREI 530 2 chan 10 position EQ, $250. A Polhemus, Excalibur Snd, 750 8th, NYNY 10036. 212-245-2435.

Orban 622B 2 chan parametric EQ, 4 hrs used, like new cond. $500. T Andrews, WLKI, No Wayne Plaza, Angola IN 46703. 219-665-9554.

Fairchild 662 mic preamps (2); Fairchild 663 compressors (2); Langevin PS222 power supply; RCA 76D bdct console, rebuilt for stereo, updated transistorized circuitry w/2 mic preamps. $500 for all or BO within 2 weeks. C Grout, Rte 2 Box 141, Mt Vernon MO 65712. 417-466-7751.

Lexicon PCM-60 digital reverb, like new in box w/manual, $800/BO. B Goldes, Ford Motor, 1937 Byrd, Dearborn MI 48124. 313-594-2600.

ADC 4-26170 (2) Pro Patch wired, shielded, punch termination, never used, $350 ea; Orban 622B, like new, balanced outputs, $500; Shure M67, excel cond, $225. D Smith, Group One Prod, 2597 Romig Rd Ste 12, Akron OH 44320. 216-753-4733.

Opamp Labs reverb units (3), $100 ea. L Wagner, Ardnigva Radio Net, POB 1788, Orlando FL 32802. 305-299-1299.

Orban 622B parametric EQ w/transformer output option, as new, unused, in carton, $600. M Hoffman, Hoffman Telecomm, 4976 Dick, San Diego CA 92115. 619-287-4961.

Gates V-22 volume indicator, w/book, like new, $180. P Schneider, KPMJ, 1280 S Oxnard, Oxnard CA 93034. 805-486-2337.

Eventide BD955 delay unit, mono, new, $2800; Comrex TLX freq extender, transmit end, new, $850. A Soroka, WJRO, POB 159, Glen Burnie, MD 21061. 301-761-1590.

Eventide BD955 stereo digital delays, 15 kHz, 3.2 sec, never used, $5500. L Henry, KIQQ, 6430 Sunset #1102, Hollywood CA 90028. 213-469-1631.

Want to Buy

Wegener 1648/1626/1601/2-1644 audio processing units. B Dodge, WTIJ, POB 150, Waterburry. 802-244-5683.

Shure M62V Level Lock. K Smith, WMER, 583 Warren Ave, Portland ME 04103. 207-775-3439.

Burwen/KLH TNE-DNE NR system for removing record noise, scratches. P Delaney, Quality Audio Bdct Srvs, RR 2 Box 106A, LaCrescent MN 55947. 507-895-2065.

Burwen DNF & TNE noise filters wanted, new price paid for units in gd cond. J Stitt, WLLT, 250 W Court St, Cincinnati OH 45202. 513-241-9500.

Burwen NR units, (2) one impulse & one broadband. J Stitt, WLTT, 250 W Court Ste 300E, Cincinnati OH 45202. 513-241-9500.

Bdct & prod quality equip needed for new station, console preferably 10×4, R-R's, cart machines, etc. A Samuels, Spanish Radio Net, 17446 Kingsbury, Granada Hills CA 91344. 818-368-5662.

AUTOMATION EQUIP.

Want to Sell

IGM (2) 48 tray stereo Instacart, $7000 ea. E Miller, KXLE, 1311 Vantage Hwy, Ellensburg WA 98926. 509-925-1488.

Gates Automation Systems, (2) recently rebuilt, complete w/main programmers, sub-programmers, tape decks, random access Carousels & cart decks, priced to sell. K Carlson, KEEP, POB 246, Twin Falls ID 83303. 208-733-7512.

Carousel, 250 RS. R Baker, Bdct Parts & Srvs, POB 426, Fairburn GA 30213. 404-964-3764.

IGM 48 tray Instacart stereo machines, in excel cond. $8000 ea/BO. S Cilurzo, KGMG, Box K, Oceanside CA 92054. 619-757-1320.

Carousel 350 (2), mono, perfect cond. $2000 ea. Edwards, KJKL TV, Rt 1 Box 24AA, Utica NE 68456. 402-534-2071.

Harris R-R source interface cards (2) for System 90 or 9000 P/N 995-7867-001, $150 ea. C Bryson, Comserv, 93 Robinhood Dr, Zellenople PA 16063. 412-776-3793.

IGM 48-tray stereo Instacart, works gd, $6000. M Meyer, KLQP, Box 70, Madison MN 56256. 612-598-7301.

SMC DP-1 (2) programmers, 6 Carousels, 4 dual carts, & more, complete except for R-R's, $16,000. D Grant, KEZV, 1115 Third St, Spearfish SD 57783. 605-642-5747.

BE BE16 automation system, approx 4 yrs old, 4 Carousels, 4 Otari R-R playback, 3 racks, excel cond, $23,500. D Holt, WENZ, 4719 Nine Mile Rd, Richmond VA 23223. 804-222-7602.

Systemation cassette automation, 5 deck on-air system, 370 spot capacity & stand alone prod system, all soft & hardware to interface w/satellite, $9500. K Reising, WRZQ, 921 25th St, Columbus IN 47201. 812-379-1077.

IGM 78 tray Go-Cart, $3500; IGM 48 tray stereo Insta-Cart, $22500; IGM MOS automation control unit, 1000 event memory, 4 voice chans, scan follow, alarm, cue & remote panels, PAL encoder, decoder, Teletype Corp printer, $3500, all excel cond. D Workman, 8151 Anchor Dr, Longmont CO 80501. 319-785-6069.

IGM 20ARS Carousel, $1000. G Bissell, WEAV, Box 157, Peru NY 12972. 516-561-0960.

Sono-Mag DT-5 data terminal w/Extel printer & video monitor, $800 plus shipping. C Larsen, KOOC, POB 1580, Cozad NE 69130. 308-784-1580.

SMC DP2 automation system, call for details, BO over $18,000. D Fields, KBYG, POB 1713, Big Springs TX 79720. 915-263-7326.

SMC DP2, 4 Carousels, 3 Otari ARS1000DC, 2 dbl plays, 2 remote control heads, complete logging package, excel cond, BO. D Fields, KBYG, Box 1713, Big Spring TX 79720. 915-263-7326.

SMC automation system, 4 Carousels, 5 R-R's, computer logging & printer, more, $24,000. C Scott, WVTS, POB 280, W Terre Haute IN 47885. 812-533-2141.

Harris 9000, inc 3 ITC 750 R-R's, time announce deck, network R/P deck, 2 IGM Instacarts, $45,000. J Quesenberry, WCIR, 305 Reservoir Rd, Beckley WV 25801. 304-252-6452.

IGM-PAL logging system incl Extel printer, Vistar CRT, logger & decoder, $500. T Wojciechowski, Garden City Bdct, 400 Ryman St, Missoula MT 59802. 406-728-9300.

Harris 9A01 program automation system, brain, pwr supply, source rack, cards & spares, extra memory, spare CPU, Tec 70 console, sell or trade for DP1 & cash, avail now. R Baxter, WMAY, POB 460, Springfield IL 62705. 217-629-7077.

ITC 750 R-R PB decks w/25 Hz tone sensors, new stereo Nortronics heads, perfect, $1000. B Fornoff, KKEI, 402-534-2071.

IGM 48-S stereo Instacarts (3), mint cond, at $6500 ea. T McGinley, First Media Corp, POB 10239, Wash DC 2A018. 301-441-3500.

Carousel RS252 stereo, $795. D Robinson, WISV, Rt 4, Viroqua WI 54665. 608-637-7200.

Harris System 9000 time announcers, (2) Insta-carts (3) reels, like new, $45,000. J Quesenberry, WCIR, 305 Reservoir Rd, Beckley WV 25801. 304-252-6452.

Want to Buy

Automation equip, need w/4 R-R's, must be stereo, w/time announce. B Walters, WEKY, POB 747, Richmond KY 40475. 606-623-1340.

Sat Master, BE, Sonomag or equal satellite automation controller. R Meyers, Benchmark Comm Corp, 4700 SW 75th Ave, Miami FL 33155. 305-264-5957.

CAMERAS (VIDEO)

Want to Sell

Ikegami HL-33 EFP camera, new plumbicons, rebuilt, studio CCU, excel, $2500; Panasonic WV-3990 saticon camera, 5" studio or portable VF, 10-120 zoom, excel, $1200. U George, 175 5th Ave Ste 3206, NY NY 10010. 212-677-2200.

IVC 500A, 3 plumbs, spare head, working good, 10:1, w/enc & enhan, several, $1500/set. M Paradiso, Ultimate Image, 7200 Dunfield Ave, LA CA 90045. 213-410-1009.

Motorola & Philips closed circuit TV cameras w/monitor, $80 plus frt. J Baltar, Reel Comm, 67 Green St, Augusta ME 24330. 207-623-1941.

Sony 1800 color camera, used 25 hrs, like new w/case, $1400. C Potorti, Potorti Video, 10005 Lacey, Morrisville PA 19067. 215-945-3990.

Want to Buy

Viewfinder, manual & lens for Sony DXC-1210; also Sony DXC-1610 (& manual) for parts or repair, reas. C Asplund, WATR, 79 Baldwin, Waterbury CT 06706. 203-755-1121.

CART MACHINES

Want to Sell

Tapecaster X700RP stereo, like new cond, under 200 hrs use, $850/BO. WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

RCA & Collins cart machines, 2 RCA's mono PB & 1 Collins mono PB, RCA mdl $15/BO & Collins mdl $50/BO. L Houck, Rollin Recdg, 210 Altgelt, San Antonio TX 78201. 512-736-5483.

ITC RP Series R/PB, $1250 ea. R Rocks, KZLS, 300 N 25th, •101, Billings MT 59101. 406-248-2681.

Harris triple cart deck, $950. K Decamp, KUCV, 3800 S 48th St, Lincoln NE 68506. 402-488-0996.

ITC/3M Delta I mono, vgc, single play cart machine, $1500. M Eliot, WWJ, 16550 W 9 Mile Rd, Southfield MI 48086. 313-423-3366.

BE cart winder, gd cond, sell or trade. C Frienwald, KNBQ, POB 11000, Tacoma WA 98411. 206-383-9700.

Spotmaster 605-B, (2), 5 deck PB, BO. B Glasser, WHBC, POB 9917, Canton OH 44711. 216-456-7166.

ITC SP record amp for SP Series. C Frienwald, KNBQ, POB 11000, Tacoma WA 98411. 206-383-9700.

BE 2100RPS brand new, excel cond, $1900. J Pauli, Stage 4 Prod, 7352 Newburgh Rd, West Land MI 48185. 313-421-5330.

Contel CT101R RP mono, works fairly well, w/srvs manual, $25. P Combs, Only Son Prod, 2316 Forrest Home Dr, Dayton OH 45404. 513-236-2340.

Audicord A3 series triple deck 3 tone stereo PB, $1000/3. R Rocks, KZLS, 300 N 25th, •101, Billings MT 59101. 406-248-2681.

Sono Mag PB (1) & R (1), $50 ea. J West, West Side Sound, 602 W Hemlock, Bozeman MT 59715. 406-587-1420.

UMC 12-123-022 stereo cart recorder w/mono heads. P Wells, KLZZ, 8665 Gibbs Dr #201, San Diego CA 92123. 619-565-6006.

Tapecaster 700-RP stereo R/P, like new, under 200 hrs use, $850. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

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RW Broadcast Equipment Exchange

CART MACHINES ... WTS

BE Spotmaster 3200 PS stereo cart machine, PB only, excel cond, $1100; BE Spotmaster 3200 RPS stereo cart machine, R/P, excel cond, $1900. L Wagner, Ardnigva Radio Net, POB 1788, Orlando FL 32802. 305-299-1299.

BE 3000 & 2100 cart machines wanted. Exporter needs 90 used machines, working cond, not more than 6 yrs old, reasonable price avail. Send particulars to: RW, POB 1214, Falls Church VA 22041. Attn: Box 1-1.

ITC 3 deck stereo. R Baker, Bdct Parts & Srvs, POB 426, Fairburn GA 30213. 404-964-3764.

ITC Record/playback stereo. R Baker, Bdct Parts & Srvs, POB 426, Fairburn GA 30213. 404-964-3764.

ITC 99, (2) mono PB, used for 20 hrs, $2300 ea. S Borden, York Prod Group, 4537 28th Ave S, Minneapolis MN 55406. 612-722-4597.

ITC WP, (2) rack mount, almost new, mono, $500 ea. D Hastings, WKYB, POB 1000, Hemming SC. 803-558-2558.

RCA BA-27 record/RT27 unit w/extra RT27 PB, mono 3 pcs, ready to use w/rack, $250. J Cunningham, Radio YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Gates Criterion 80 PBs (3), mono, single cue, excel cond, $325 ea; Gates Criterion 80 R/PB (2), mono, single cue, excel cond, $450 ea. T Baun, WEZW, 735 W Wisconsin #401, Milwaukee WI 53233. 414-272-1040.

Tapecaster X-700RP, mono, new in factory box, $850. G Kippel, KAMB, 90 E 16th St, Mereed CA 95340. 209-723-1015.

ITC Delta III 3 deck mono cart machine, new, $3500. A Soroka, WJRO, POB 159, Glen Burnie, MD 21061. 301-761-1590.

RCA RT-7 cart machines (2). J Gilchrist, WTBF, POB 747, Troy AL 36081. 205-566-0300.

Want to Buy

Cart machines, as is, Tapecaster, Spotmaster or any other make, mono or stereo. J Daugherty, WGMR, POB 204, State College PA 16804. 814-238-0717.

Cart machine, any rack mountable machine for ED FM station. B Gray, Gray Audio, 223 W Mtn Rd, W Simsbury Ct 06092. 203-658-7786.

Spot Master 500 series table top or rack recorders & players, repairable; also ITC RP series motor, one w/rapid cue, also need some boards. C Asplund, WATR, 79 Baldwin, Waterbury CT 06706. 203-755-1121.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Ampex MM-1000, mint cond, $8750; Ampex 440-4B 4 trk in Ampex console, mint, manuals, $3800; Ampex 440-2B 2 trk in Ampex console, mint, manuals, $2850. J Jones, RBY Recording, 920 Main St N, Southbury CT 06488. 203-264-3666.

Scully 280B mono. R Baker, Bdct Parts & Srvs, POB 426, Fairburn GA 30213. 404-964-3764.

ITC 750 (3) R-R stereo reproducers, $850 ea. N Allebaugh, WICE 100 John St, Cumberland RI 02864. 401-725-9000.

Pentagon C-320, excel cond w/new belts & pinch rollers, $695. R. Sumner, CAVU Comm, 3351 Contessa Ct, Annandale VA 22003. 703-560-0233.

Ampex 351 mono, just ser,iced w/electr, $350/BO; Ampex 351 mono w/heads & motor for parts, BO; AKAI GX-220D, $225. J West, West Side Sound, 602 W Hemlock, Bozeman MT 59715. 406-587-1420.

Ampex 960 portable stereo recorder, 7" reels, old but works, $100. B Stallman, Mtn Forrest Comm, 95 Fraley, Kane PA 16735. 215-664-4539.

Scully 270 (3) stereo R-R automation type reproducers, bi-directional, 14" reel capability, rack mountable, gd cond, $350 ea. B Stallman, Mtn Forrest Comm, 95 Fraley, Kane PA 16735. 215-664-4539.

Eumig FL1000, all transport & motor mods made (3), BO. R Hoffman, POB 29804, Atlanta GA 30359. 404-636-9911.

Electro-Sound 1800, cassette loader, 300 ips w/vac pump, $4200. R Woolf, Fidelity Sound, 3986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Otari 5050 (3) 2 trk, gd cond, 1/4", $1100; Otari 5050 (2) 4 trk, gd cond, 1/4", $1300, buy all 5 Otari's & receive free parts machine; Tascam 44 1/4" 4 trk, new, $2000. D Price, World Class Prod, 6341 Ditman St, Phila PA 19135. 215-567-0400.

Magnecord 1021 19" rack mount, mono, BO. J Cunningham, KEOR, POB 1110, Atoka OK 74525. 405-265-4496.

Stephens 811C 16 trk recorder w/8 trk heads, $4500; Ampex 440B 2 trk, new heads, excel cond, $2000. B Yauger, UCA Recdg, 1310 Lenox, Utica NY 13502. 315-733-7237.

Ampex 351 mono recorder, $750. A Polhemus, Excalibur Snd, 750 8th, NY NY 10036. 212-245-2435.

Fostex A8 w/remote, in rack, $1100; Teac A3346 four chan w/simulsync, $550. G Ernst, Bayside Snd, POB 166, Lincoln City OR 97367. 503-996-6020.

Ampex 350 deck w/mono heads & Inovonics 375 solid state electr; ITC 750 stereo recorder; Ampex 700 reel deck, stereo w/ mono heads. P Wells, KLZZ, 8665 Gibbs #201, San Diego CA 92123 619-565-6006.

Scully 270 R-R reproducers w/o tone sensors, gd for parts (2), $200. L Ayer, KRPL, POB 8849, Moscow ID 83843. 208-882-2551.

ITC 850 MD Series R-R inc play/rec amp, $500; Ampex R-R MD 602S, $250; MCI R-R MD JH110A, $1200, CE, KQIZ, POB 7488, Amarillo TX 79114. 806-353-6662.

Ampex 350 tube electr w/spare 12SJ7 tube, BO. L Houck, Rollin Recdg, 210 Altgelt, San Antonio TX 78201. 512-736-5483.

Metrotech logger, 10-1/2" reels 2TS, $75/BO; Ampex 600 rack mount mono $100/BO; Ampex PR10, $100/BO. L Houck, Rollin Recdg, 210 Altgelt, San Antonio TX 78201. 512-736-5483.

MCI JH-110B 1/2" 4 trk w/remote in mint cond, $3995/BO. J Stitt, WLLT, 250 W Court St, Cincinnati OH 45202. 513-241-9500.

Ampex 350, 14" reel mono 1/2 trk 1/4" headblock parts or whole units. N Mishaan, Mishaan Enter, POB 73, Carle Place NY 11514. 516-882-1927.

Scully 280 4 trk 1/2", old, $800; Scully 280B mono version, gd cond, $1000/BO. P Perkins, Cutler Prod, 1639 Westwood Ste 200, LA CA 90024. 213-478-2166.

Manuals for Ampex 350 & 351, $20 ea plus postage. R Schneider, Savage Ind, 183 Woodside Terr, Springfield MA 01138. 413-736-5853.

Pioneer RT 2022, fair cond, sell or trade. C Frienwald, KNBQ, POB 11000, Tacoma WA 98411. 206-383-9700.

Tascam 35-2 w/rollaround rack & dbx, $1500. D Curtis, Creative Snd, 2810 W 4th, Appleton WI 54914. 414-733-2299.

Otari MX-7800 1" 8-tk w/remote & digital counter, low hrs, $8500. L Schara, Pyramid Audio, 450 W Taft, S Holland IL 60473. 312-339-8014.

Scully 280A 4 trk recorders (2), both in custom-built walnut roll-around cabinets, one has re-lapped heads, both in gd cond, $1850 ea. D Weinstein, Cinema Snd Ltd, 311 W 75th, NY NY 10023. 212-799-4800.

Teac 80-8 8 chan, ½" recorder, vgc w/dbx DX-8 NR unit, also vgc & Teac alignment tape YTT-1144, $3000. W Busetti, Lizard Electr, 114 N Robinson, Florence CO 81226. 303-784-3540.

Ampex 351, electr only in gd working order, $125/pr. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

3M 20×20 AFV routing switcher; (2) Ampex 440C FT ATRS; Ampex Vari Speed accessory for 440C; Telex 300 R-R, cassette dubber. J Grahne, US Senate Rec, ST-71 US Capitol, Wash DC 20510. 202-224-4977.

Nortronics tape recorder heads for Crown, Magnacord or Presto, (13) mdl 8406 ½ trk, (17) mdl 8208 FT, for Scully mdl 9202 FT w/mounts, brand new record head 8401, erase 9128, a few extras. S Russell, 80441 CR 3585, Decator MI 49045. 616-782-9258.

Scully 280-8, excel cond, $4700; Ampex 351-2, roll-around console, excel, $1400. D Lundy, Lundy Recdg, POB 408, N 25E, Heidrick KY 40949. 606-546-6650.

Scully 280 (2) ¼" mono recorders, gd cond, $800 ea. B Harlan, WDJQ, 393 Smyth NE, Alliance OH 44601. 216-821-1111.

Ampex 351, tube elect only (4), $100. L Entz, KGEI, 1400 Radio Rd, Redwood City CA 94063. 415-591-7374.

Teac 80-8 w/servo, DX-8, rack, factory manuals, spares, $3500/BO. T Trott, Little Caribou Std, 5477 Carter Rd, Lake May FL 32746. 305-323-0472.

Otari MTR-90 wired 2" 24 trk, 8 trks installed w/autolocate, $20K/BO. T Trott, Little Caribou Std, 5477 Carter Rd, Lake May FL 32746. 305-323-0472.

Technics RP9690 wired remote for 1500 series, mint, $50. S Hofmann, Cameron Univ Theater, 2800 W Gore, Lawton OK 73505. 405-248-2200 X428.

Ampex 440B ¼" 2 trk mounted in roll around rack w/manual, $1500; Ampex 440B, ½" 4 trk, $2800. P Gregory, Snd Concepts, 30 Hazel Terr, Woodbridge CT 06525. 203-397-1363.

Ampex AG440 ¼ & 2 trk head assy, 7½-15 ips electr, rebuilt, gd cond, $1100; Ampex MM1100 24 trk w/16 trk & 24 trk head assy, well maint & extras, $16,000. R Oren, Mirromere Audio, 7150 W 38th Ave, Wheatridge CO 80033. 303-431-2348.

Sony PCMF1 audio digital recorder, mint cond, never used, $1599. R Kunn, POB 11069, Las Vegas NV 89111. 702-733-3902 X521.

Scully 280, (2) 1/4" mono, 3¾-7½, gd cond, $800 ea. B Harlan, WFAH, 393 Smyth NE, Alliance OH 44601. 216-821-1111.

Ampex 300-4 1/2" 4 trk recorder in gd working cond, you pick up, $500. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

Ampex 3200 hi-speed R-R tape dup system, gd cond, in use, $1500. D Weinstein, Cinema Snd Ltd, 311 W 75th, NY NY 10023. 212-799-4800.

Teac 80-8 8 trk recorder w/dbx, $2000; Teac 3340 4 trk recorder, $600. R Dias, Creative Snd, 602 Cree Dr, San Jose CA 95123. 408-224-1777.

Nagra 1V-S stereo recorder, non-sync QHT leather case, CHQ carrying strap, QHP carrying handle, $3500. G Craig, KNEW, POB 910, Oakland CA 94607. 415-836-0910.

Sony TC-355 stereo R-R deck, 3 speeds, working, clean, $120. J Cunningham, Radio YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Akai R-R cross field heads, tube type, perfect cond, stereo, 3 speeds, $120. J Cunningham, Radio YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Revox B77 recorder 7½-3¾ speed, ¼ trk, $600; Tascam 80-8, gd cond, $1200. T Roller, Hollywood Demo Srvs, 1626 N Wilcox #105, Hollywood CA 90028. 818-994-5368.

Ampex AG-440C PB only, excel cond, (4), $1000/ea. T McGinley, First Media Corp, POB 10239, Wash DC 2A018. 301-441-3500.

ITC 750 R-R decks, excel, like new, PB only w/25 Hz sensors, $1000 ea. S Wilson, KLIR, Columbus NE 68601. 402-534-2071.

Technics 1506US 2 trk R&P, 4 trk PB, new head block, low useage, $900. A Allegra, Calvary Baptist Press, 1360-B Valley Forge Rd, Lansdale PA 19446. 215-855-4008.

Sony TC-755 3¾-7½ ¼ trk 10½ reel, mint, new heads, $600. J Pines, Creative Audio, 705 W Western, Urbana IL 61801. 217-367-3530.

Magnacord PT6-R, Magnacord 1024, (2) Concertone 20/20. R Sauter, WSLU, Payson Hall St Lawrence Univ, Canton NY 13617. 315-379-5356.

Nagra III, gd cond, $1200; Scully 8 trk w/motion sensor, roll around cart & 4 trk head stack, $5000. T Cereste, Lightscape Prods, 420 W 45th 4th Fl, NY NY 10036. 212-757-0204.

Nortronics 8 trk 1" erase & R/P heads. R Robinson, TNA Records, 10 George St, Wallingford CT 06492. 203-269-4465.

Teac 80-8 w/servo & DX8 w/spare motor, manuals, new head, $3000/BO. T Trott, TTA Prod, 5477 Carter, Lake Mary FL 32746. 305-323-0472.

Ampex 300 decks, mono, 1 missing T/U motor, $100; Presto RC1024 deck w/2 electr w/schematics, $50. R Robinson, TNA Records, 10 George St, Wallingford CT 06492. 203-269-4465.

Scully 280 SP-14, 2 trk stereo rec/rep, takes 14" reels, motion sensing, remote control, console, vgc (2), $1800 ea. T Baun, WEZW, 735 W Wisconsin #401, Milwaukee WI 53233. 414-272-1040.

Ampex 351 mono w/tube electr, $350; Ampex 354 electr only, $100; Ampex 350 for parts transport & tube electr, no heads, $150; Ampex SP-300 4 trk recorder, $400. T O'Laughlin, WERN-ROC, 821 University Ave Rm 7135, Madison WI 53706. 608-266-6667.

Ampex ATR's 102's & 104's, remotes, search to cue, VSO, spares. A Varner, Pennylane Studios, 1350 Ave of the Americas, NY NY 1A019. 212-687-4800.

Want to Buy

Ampex 350's, FM stereo mod mon, FM processor. E Kazmark, KAPA, 2065 Ocean Ave, Raymond WA 98577. 206-875-5551.

Ampex 440 2 trk head stack & remote control. B Lipis, KCBQ, POB 1629, San Diego CA 92112. 619-280-1170.

Scully 280B rec & rep electr, stereo, any cond; sell Scully 280B 7-1/2 & 15 ips tape transport inc all stereo heads, gd cond, $600. B Stallman, Mtn Forrest Comm, 95 Fraley, Kane PA 16735. 215-664-4539.

10-1/2" reel cap 15 ips, $600. T Belcher, United Ministries in Music, Allenville KY 42204. 502-265-5810.

Ampex ¼", 4 trk hd stacks, sel sync; Ashland-Ampex reel-meters, 300-350 series; Ampex multi channel 351 elec, 11 or 12 models. R Riccio, ETS Record Co, POB 932, Honolulu HI 96808. 808-533-6095.

Revox A-77 machines needed; xmtr doors needed, front & rear for Gates FM-5C; FM monitor & stereo monitor; FM exciter, Gates tube type OK. R Van Zandt, WGNV, POB 88, Milladore WI 59454. 715-457-2288.

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October 6, 1983

Mr. Eric Small
Modulation Sciences Incorporated
99 Myrtle Avenue
Brooklyn, N.Y. 11201

Dear Eric;

As I was connecting up my new **Sidekick** to our **Harris** 20 K, I was thinking back about all the electronic marvels that Eric Small has contributed to the radio business. From early development work on the **Optimod**, to that clever Upstart unit, your contributions have been many.

And now, I'm happy to report that I can add another unit to the long list of developments and place it in it's own very unique category.

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Once again, I don't know how you did it...all I know is that it works! and it works very well!

Best regards;

Jim Davis
General Manager
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NRB Exhibits Well-Attended

by Edward Wytkind

Washington DC ... A well-attended National Religious Broadcasters (NRB) convention, held 2-5 February at the Sheraton Washington Hotel, was marked by substantial growth in the amount of first-time manufacturers displaying broadcast gear.

In addition to program related booths, a number of manufacturers, including Broadcast Electronics, Motorola, Continental, Nautel, Dielectric, Cablewave, QEI, Shively and Harris, exhibited a variety of radio equipment.

Several sessions and workshops covered issues in broadcast technology, station ownership and management, in addition to the traditional sessions on operational and financial issues in running a religious radio or TV station.

Representatives from equipment companies were generally pleased with the exhibit floor traffic. Several first-time exhibitors said they intended to return next year because the four-day event had generated sales and promising sales leads.

Floor activity

Although the exhibit hall was dominated by program-related booths, several major manufacturers of radio broadcast equipment were showing AM and FM transmitters, AM stereo gear, RF equipment, consoles, studio equipment and accessories and other categories of equipment.

Broadcast Electronics, a first-time NRB exhibitor, displayed the AX-10 AM stereo exciter, an audio console and some television gear. BE representatives Tim Beillor and Bill Harland reported "very good traffic," and said the NRB show attracted a broad mix of station representatives, from owners to technicians.

Canada-based Nautel showed the solid state AMPFET medium wave AM transmitter that features modular redundancy, a main and standby exciter, various on-air service functions and other features.

Continental, also an NRB exhibitor for the first time, was exhibiting its line of AM and FM transmitters. Continental District Sales Manager R. Clifford Rogers said Continental visited the NRB show last year and saw a strong potential for sales and contacts. Rogers said that this year attendees were very interested in buying equipment, with several people requesting price quotations.

Motorola exhibited its C-QUAM AM stereo system, while Harris showcased a 12-channel dual stereo audio console, the Medalist-12, along with information on its line of AM and FM transmitters.

Harris District Manager/Radio Sales S. E. Hawkins, Jr., said the show was "very good" for Harris, with sales leads ranging from California to Puerto Rico.

Hawkins said traffic consisted mainly of "owners and operations managers—all good leads."

Shively's Charles Peabody brought up an unexpected benefit to attending the NRB show. "All the consultants come here," because most are based in or near Washington, he said. "It's especially nice for firms that are remote from Washington."

Peabody added that he was pleased with the traffic at the show. "We'll be here next year for sure."

Distributors

Equipment distributors present included Barrett Associates, Systems Wireless and Bradley Broadcast Sales.

Barrett Associates' exhibit included Tascam and Orban gear.

Barrett Associates representative Dennis Nelson said "We're doing pretty good. This is the first year we've been here. Barrett (Mayer) was impressed. He didn't know what to expect."

Nelson said traffic had "more station owners and less engineers" than the NAB show. "They're mostly from the US and Latin America" he added.

Systems Wireless representative Bill Sien said "It's (the show) not an NAB, but the people that come by are quality people."

Systems Wireless was featuring Cetec Vega wireless microphones, ranging in price from $658 to $4,000.

Bradley Broadcast Sales was displaying the belt-driven Key-Cart and the Telos 10, among other products.

Technical program

Though the majority of NRB sessions and workshops were on programming and business issues, several technical topics were also covered.

One session was devoted to FM broadcast expansion via translators, which is an issue now before the FCC and involving petitioner Moody Bible Institute, a member and exhibitor at the NRB.

Moody is asking the FCC to allow it to feed its radio translator stations by satellite or microwave. However, critics of the plan say the proposal could easily be exploited by permitting translators outside a station's local coverage area.

Other NRB session topics included the operation of a noncommercial station and emerging satellite technologies, with emphasis on different methods for receiving satellite programming.