EXPERIMENTAL BROADCASTER'S NEWSLETTER

August 1, 1985 Vol. 2, No. 8

We're going to start off the Newsletter this month with a mini-lesson. I get a lot of calls asking questions about antenna hook-ups, impedances, stacking, ranges, heights, etc. Antennas are strange beasts and confuse a lot of people (myself included). Let's see if we can't set down some of the basic characteristics and answer some questions before they're asked.

PLAIN AND SIMPLE ANTENNAS

(1) A horizontal dipole has an impedance of about 75 ohms
(2) A vertical dipole has an impedance of about 75 ohms
(3) A vertical antenna with a flat ground plane has an impedance about 35 ohms
(4) Multiple antennas can increase your effective radiated power by redirecting energy from an unused direction to a more useful direction.
(5) AM band vertical antennas generally work best at ground (Earth) level
(6) FM band antennas work best the higher they are above ground
(7) The feed coax should be "grounded" only at the antenna and the transmitter
(8) When phased properly multiple antennas will have a feed impedance of Z/#a, where Z=antenna impedance and #a = number of antennas
(9) Current flowing the length of the antenna produces a magnetic field which "breaks free" and travels outward in waves. Anything you can do to increase the antenna current strengthens the wave and increases range.
(10) Any conducting material can be used for an antenna, and it will radiate ok
(11) Radio frequency currents travel on the surface of a conductor, therefore a large surface (skin) area (within reason) is generally good.
(12) Balanced type antenna (dipoles) when fed with an unbalanced line (coax) will usually radiate energy from the coax. This can cause interference in nearby audio circuits, change the antenna's apparent feed impedance, and disturb the coverage pattern.
(13) Balanced antennas fed by coax should use a "balun" (BALanced to UNbalanced) coupler or a 1/4 wave decoupler.
(14) Coax power losses are small at AM band frequencies, but are appreciable at FM band frequencies. RG 8 coax eats up 1/2 of the power in a 100 foot run. RG 58 and 59 eat up about 3/4 of the power in 100 feet.
(15) An ohmmeter check of an antenna may show it as a "short", but it may be perfectly o.k. as an antenna. This is because every length of wire has some amount of inductance. A 1 foot length of wire at dc would measure as a dead short, but at radio frequencies might have an impedance of several hundred ohms.
(16) Ground conductivity is VERY important with AM band vertical antennas
(17) Height above the average terrain is VERY important with FM antennas. It is often found that doubling the height above ground gives greater range than doubling transmitter power.
(18) FM band antennas should be located more than 1 wavelength above "ground"
(19) A wavelength in space is about $300/f_{MHz}$ = Meters; wavelength of wire or pipe is up to 10% less; wavelength in coax is 66% for poly center insulation, and 82% for foam insulation.

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LETTERS

Hi, I am Paul K., the owner of KREG AM. Some of you may remember the stunning photos of the station that were included in the February edition of EB. Some improvements have taken place since then, including a brand new Numark DM-1550 studio mixer which I recommend for any lower power broadcaster who wishes to broadcast stereo quality material.

Our summer hours here at the station are from 10 am (to allow for morning grogginess from late night partying) to 8 pm (to allow me to get out of the house and commence partying!). At the current moment I carry the Rock Album Countdown, Doctor Demento, and Rock Chronicles from the Westwood One Radio Network and Rock Over London from Radio International.

Enough about me, the real reason I took time to write is that there seems to be a lazy attitude taken lately in low power circles particularly when it comes to the Low Power Broadcasting Network (a prime example). The whole idea started out very nicely, but none of the tapes ever got back to the originating station and were never forwarded. I would personally looove to know who has my $4.50 Maxell tape!

The EB Newsletter is the absolute perfect place in which to exchange ideas, technical information, and other assorted goodies. I am a big fan of station photos! I simply love staring at other station's photos. I am always hearing of people who are either going or are thinking of taking photos but are always putting if off promising that they will do it later.

Let's see some people's views in the EB Newsletter! You paid your $18.00 to receive it and you have the possibility of getting ten times back that amount in valuable information and enjoyment that you can get by helping contribute. When you contribute it get others motivated to contribute also.

Kris Holtegard and I are now presently working on resurrecting Cablerock Report, which ceased in early April due to lack of time and lack of input. With the pull of Ernie, Kris, and I, we hope to help low power stations with all of their programming needs, such as album reviews, record company information, and other helpful information that can be of valuable use to any low power station.

With the new CABLEROCK, we hope that we are able to unite more and more stations across the country who all know about each other but yet fail to make contact. I hate to sound like one of those union freaks standing up on a chair in the middle of a busy factory, but...."LET'S UNITE!!!!"

Paul

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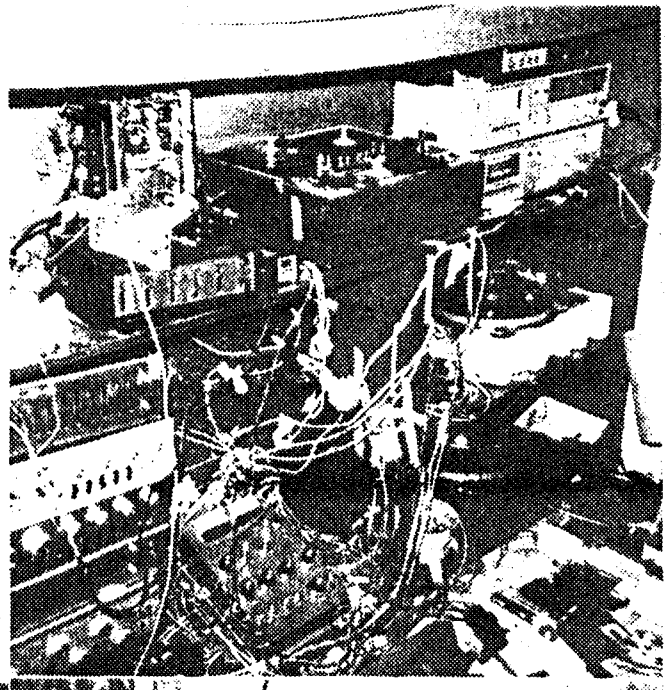
Editor's Note: Thank you Paul.....While this subject is out in front I would like to point out that John and Len are trying to get the LPBN up and moving in the right direction. Both Cablerock and the LPBN can compliment each other to provide member stations with some very fine programming.

Dear EBN,

Here are pictures of the studio of WDIF, 94.3 FM stereo (not the one in Marion, Ohio, this is the "other one"). We operate with 5 watts of power through a directional (SE) TV antenna.

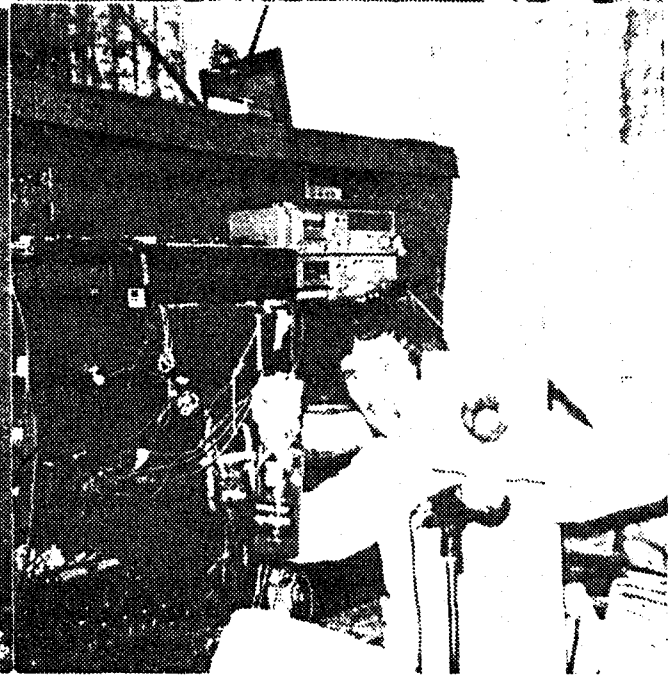
Transmitting equipment is a 20 mW FM stereo exciter, a 1 watt amp, which then goes into a Panaxis 5 watt amp.

Tom Smith, station engineer and fill-in DJ., invented his own automatic level control and compressor using LED's and cadmium photocells. The control board was also handbuilt by Tom. This complex audio system also includes 4 equalizers, 2 preamps, and plenty of wires, as photos attest. Tom also designed, with the help of DJ Clyde Mahoney, a professional sounding phone patch system.



Photos: top, right..WDIF studio and audio equipment. Bottom,right.."Song and drink go hand in hand with Tom Smith" Below..."Doctor Dave" attempts some transmitter adjustments.

Thanks....Steve Dallas, WDIF DJ



WHAT'S NEW AT THE FCC

The "Government" has always been great for creating new "forms". They have forms to fill out for this and forms to fill out for that. The FCC however has been using forms which haven't been revised in years. Well, finally with the deregulation of broadcasting they are also attempting to reduce the paper work as well. As of April this year they have new forms for applying for a station license. These forms are free to the public, so if you are thinking of applying for a station, or are just curious, contact your local FCC Field office. Form 301 covers commercial AM, FM, and TV construction permit applications, while form 340 is used for non-commercial stations.

If you didn't send away for the new FCC Rules pertaining to broadcasting, which we mentioned in the May issue, you should think about it gain. If for no other reason they will give you an insight of how the FCC and broadcasting are tied to one another. Those parts of greatest interest to Experimental Broadcasters (possible future commercial broadcasters) are:

Parts 0-19 (includes part 15, low power radiation devices)
Stock # 022-003-95441-4 $13.00

Parts 70-79 (includes part 73, am,fm,tv broadcasting,docket 80-90 allocations)
Stock # 022-003-95443-1 $13.00

These are part of Title 47, Code Of Federal Regulations - Telecommunications, as revised October 1, 1984

You should also ask for "Rules in Print", Part 73 (stock #004-000-00411-6) at $6.50 and Part 15 (stock #004-000-00410-8) at $5.50

These can be ordered by letter with a check, money order, or Mastercard or VISA, or on the phone with MC or VISA, from: US Government printing office, Superintendent of Documents, Washington, D.C. Phone: (202) 783-3238

Not so nice perhaps was the FCC's approval of rate hikes for a class of phone lines that broadcasters use for Studio to Transmitter links. When your studio is located in the heart of down-town, and your transmitter is on a hill several miles away, phone lines have been the least expensive way to get your audio there. Radio frequency STL's usually operate in the microwave frequencies above 950 MHz. Units of this sort have been considered expensive installations when compared to the lowly telephone line. With the raise in phone line tariffs however radio STL's are now looking like the least expensive way to go. We'll go into this in greater detail in just a bit.

The NAB (National Association of Broadcasters) are not quite in agreement with some broadcasters and receiver manufacturers. There have been some proposals that AM broadcast stations should use a standard pre-emphasis similar to that used by FM stations. The aim is to improve the audio quality at the upper end (now around 5000 Hz). Even if the FCC approves, there would be no guarantee broadcasters would adhere to the specifications. It may not be their intent, but with all the audio processing going on in their audio chain, adding preemphasis could lead to adjacent channel interference and other problems as well.

WHAT ABOUT AM PREEMPHASIS, AM STEREO, BANDWIDTH, AND RECEIVER MANUFACTURERS?

In its basic form AM radio has all the capability it needs to perform as well as FM. Amplitude modulation itself is capable of handling audio frequencies well past human hearing (16,000 Hz) and even up to hundreds of KHz. The problem of high fidelity in AM is not the method of modulation, but the restrictions placed on bandwidth during the establishment of the AM band.

AM station assignments are spaced 10,000 Hz apart (540, 560,580...1400, 1410, 1420, etc.). AM sidebands are produced by the heterodyne action of mixing the carrier and modulating audio. A 5000 Hz audio tone produces a lower and an upper sideband, each 5000 Hz away from the carrier. This gives a total bandwidth of 10,000 Hz. Since AM channels are at 10,000 Hz spacings the lower sideband of one station touches the upper sideband of next lower channel station. Most of the time this is not a major problem.

During night time operation however two stations many miles apart may start to interfere with each other. Receiver manufacturers have been building their radios with a bandpass of just the 10,000 Hz needed to capture the two sidebands. This permits better selectivity - being able to tune just one station at a time.

If preemphasis is used, or if a higher audio frequency is permitted, there are risks that greater interference will occur. Raising the upper limit of the audio to 8,000 Hz for example would require a receiver bandwidth of 16,000 Hz. If receiver manufacturers increase the bandwidth on their new radios it would seem reasonable that greater interference will also result.

Another problem, sometimes encountered with AM, which is annoying for mono broadcasts, is fatal to AM stereo. This is when the two sidebands travel slightly different pathes from transmitting tower to receiver. It is not unlike the multipath distortion found on FM stereo broadcasts. A wider bandwidth could worsen the problem. On the other hand if a wider bandwidth is permitted then preemphasis could be dropped as a means for improving AM's sound quality.

This is not an easy problem to correct. The restrictions built into the system tend to keep it locked onto the old bandwidth. Broadcasters, the receiver manufacturers, and the FCC will do a lot of knocking their heads together before the whole thing is resolved.

BROADCASTERS AND PHONE LINES

Back in 1961 your editor was lucky enough to install the second stereo generator in the San Francisco Bay area. The first was installed by James Gabbert at KPEN just a couple of months before. Phone lines of course had been used by broadcasters for years to transmit their studio audio to their transmitter site. Stereo was something new, but the phone company came through.

There were several grades of lines used by broadcasters. There was the dc, or metallic pair - used for transmitter control. The unequalized line - good up to 5000 Hz if you were lucky. Then there was the 5Kc (5000 Hz), 8Kc, lines used by AM stations and the 15Kc lines used by FM stations.

A 15 Kc (KHz) line cost $30.00 for installation and $15.00 per month if it was all within one toll-office area. Then came mileage rates and additional fees if the line extended through another toll area. With stereo came the additional problem of balance. Two lines had to be used, they had to be "flat" within 1 dB and balanced to one another to within 1 dB. We thought the costs were high for an equalized 15 Kc pair. Today's costs have gone out of site!

Radio World reports that one station in Houston had its bill jump from about $35.00 a month to almost $1000.00 a month. Other stations reported increases anywhere from 40% to 2000%. All this as a result of the FCC approving a rate hike.

Microwave STL's which can relay stereo from studio to transmitter cost up to $10,000. This includes microwave dish antennas at both ends, a transmitter and a receiver, and tower space, FCC licensing of the equipment, and a delay getting it from the manufacturer (who is busy trying to supply other stations also). Even then the STL will save money in the long run. At almost $1000 a month a $10,000 STL would be paid for in less than a year.

This also makes it tough on the experimental broadcaster who wants to get audio from one place to another. Cable FM broadcasters who must rely on phone lines to reach their cable "headend" are also in trouble.

WHAT TO DO IF YOU ARE STUCK WITH PHONE LINES

About the only thing you can do is try to lower the grade of line you have. Keep in mind that the following mini-lesson is true for any type of audio transmission over a pair of wires or coaxial cable.

A favorite of AM broadcasters that need a temporary line for covering an afternoon soft ball game is the "unequalized" line. This is essentially the same as a regular voice grade line (like on your telephone). It is the least expensive to have installed and to rent. If you are lucky the upper response is somewhere around 5000 Hz, but it isn't guaranteed. You can do a few things to it however that can bring up the response.

First of all it is your line so you can connect almost anything within reason to it without further permission. The line's impedance is between 500 and 1200 ohms. It has a great deal of "capacitance" across the line just because of its length and construction. It may also have "loads" in series with the line. These are inductors put there on purpose to reduce the high frequency response for telephone service. If you feed this line with a lower than normal impedance you can increase your frequency response. You use a 600 ohm to 150 ohm transformer at both ends of the line. The 150 ohm side goes to the line at each end. If you use a 75 ohm input and output to the line you should do even better.

Of course the frequency response may not be very flat. Next you connect a good 8 band equalizer to the output of the line (transmitter end). Use the EQ to boost some more highs out of the line and flatten out the overall response. I've seen "uneq" lines turned into 10KHz lines this way. Not quite Hi-Fi, but not as costly as a 15KHz line either.

Now you might want to examine this one step further. Suppose you have a regular telephone installed at the transmitter site. You know, handset and all, and with its own bell and number and everything. Its only going to cost the amount of a normal telephone service. However, you can dial that number from your studio and talk to it, or play music to it. A few circuit connections would allow you to have it answer when you called it, connect to your low impedance transformer and equalizer, and turn on the transmitter.

Its not all peaches and cream however. The above has at least two problems. One, the phone company doesn't like people connecting stuff to their lines that are not generally approved. They fear you might upset the system. The most they will do however is to disconnect it if it causes trouble to the line. Secondly, you have no way of selecting the line that ultimately gets connected when you dial your remote phone. Some lines are better than others and sometimes you'll get a bad one. Because each line is little different you might need to readjust your EQ. If this becomes a problem you might put the EQ at the studio end to drive the line - it'll be easier to reach. But be careful, the phone company doesn't like an audio level higher than 0 dB on their lines as it could cause cross talk.

This system was used by KVHS, Clayton Valley High School, Concord, CA., to tune in the County Board of Supervisors during their meetings. The connection was made by sending a specific tone down the line from the studio. The remote phone would only connect the system when it heard that tone, so it was safe from other people accessing it. It was turned off automatically when the studio phone was hung-up. By that time we had been making connections to the phone lines for several years...the phone company techs knew us and looked the other way.

If enough EBN readers are interested in such a system your editor might be persuaded to come up with a schematic or two. Just think of the possibilities for broadcast and SW pirates....your transmitter in Ohmaha and your studio in Houston. But then we're getting long distance rates into the act.

WANTED, FOR SALE, EXCHANGE, SWAP, BARTER

Wanted: Public domain and/or computer programs for IBM compatible. Areas of interest are graphs, word processing, records, data management, satellite location, general and communications electronics. Can work trade (for programs or Panaxis products) or cash for the right stuff. Write Ernie c/o EBN, PO Box 130, Paradise, CA 95969

Wanted: Information, stories, etc., about short wave and broadcasting PIRATES. Names do not have to be given. Material to be used in preparation of new book in Panaxis' "Broadcaster's Library". Title of book "How to get into Pirate Broadcasting". A copy of the book will be sent to anyone contributing substantial and worthwhile materials. Contact Panaxis book division at address above.

FREE program exchange, for low power broadcast stations. Contact LOW POWER BROADCAST NETWORK (LPBN), PO Box 1625, Silver Springs, FL 32688-1625

For Sale: FM broadcast antennas. All half wave types - circular or horizontal, power levels to 150 watts. Can be stacked for more ERP (effective radiated power) from array. Cut and tuned for your exact frequency. Send self addressed stamped envelope to: Nova Productions, Inc. 1175 Durson Rd. Ponchatoula, LA 70454

Wanted: Contact with other EBer's, especially those living in my state. Contact: John Hart, 5157 Longston Rd, Virginia Beach, VA 2346

NICE TO KNOW STUFF

The Electronic Industries Association (EIA) Consumer Electronics Group, has prepared three books which they will send you free. [illegible] out [illegible] $1.00 to cover postage. Send to:

EIA/CONSUMER ELECTRONICS GROUP, [illegible], Washington DC [illegible]

The three books deal with: Television Interference, Interference to Audio Systems, and a Replacement Parts Sourcebook. The interference books show how to construct "traps" to eliminate radio frequency interference, these would [illegible] to be most important to experimental broadcasters.....