Experimental Broadcaster's
Newsletter
Volume 5, Number 11
November 1988

Ghosts and Goblins have retired for the year. This and next month are not healthy for Turkeys and Winter is upon us.

Winter seems to bring an upswing in pirate radio activity. I suppose because it's too bleak or cold outside to do much of anything else. It's a bit tough to service the remotely operated transmitter located on a hill top however when it's covered with snow - or when the mud is a foot deep. Of course the FCC probably won't be looking for it either.

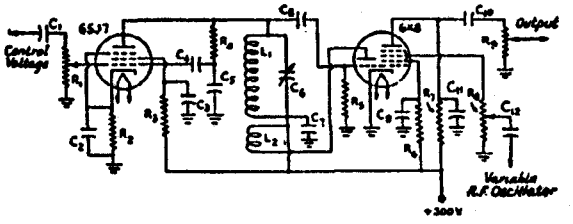
We have some pretty good stuff this issue. A Viking Ranger modification - a typical circuit revision made by short wave pirates to a well known amateur radio transmitter; a closet antenna for FM; answers and explanations for our "Techy Quiz"; plus letters and pictures from low-power experimental broadcasters, one who has joined the ranks of commercial radio and one who was broadcasting in the 1950's!.

We also have some reports of the rerun of "The Great Balloon Caper" - Mysterious messages from space heralding the visit of NEEWOLAH from NILBOG!

Some questioned the term "Wobbulator" in our Techy Quiz. The term may have been larger forgotten in this day of high tech but it was a nick name for a frequency modulated oscillator. Some receiver alignment equipment frequency modulated an oscillator mechanically. An oscillator operating at a mean frequency of 10.7 MHz for example could be varied either side of that frequency to adjust the 200 kHz bandwidth needed in FM receivers. Some of these early test instruments used a small loud speaker with a thin metal plate glued to its cone. This was screwed to a flat insulated board with a spiral coil glued to it. The coil was part of the oscillator circuit. Feeding a low voltage 60 Hz signal to the speaker moved the cone/plate close to, and away from, the coil thereby changing the frequency at a 60 Hz rate. Since this was a mechanical "wobble" the device was nick named a "Wobbulator". As proof - the following came from page 433 of the 1945 edition of The Radio Amateur's Handbook.

Measurements and Measuring Equipment **433**

Fig. 2041 — Frequency-modulated beat-frequency signal generator or "wobbulator."
C_1 — 0.25-μfd. 200-volt paper.
C_2 — 0.01-μfd. 400-volt paper.
C_3 — 10-μfd. 200-volt electrolytic.
C_4 — 0.002-μfd. mica.
C_5 — 3-30-μμfd. mica trimmer.
C_6 — 50-μμfd. variable.
C_7, C_{10}, C_{12} — 0.005-μfd. mica.
C_8 — [illegible] mica.
C_9 — 0.1-μfd. 200-volt paper.
C_{11} — [illegible] mica.
R_1 — 0.5-megohm variable.
R_2 — 5000 ohms, ½-watt.
R_3, R_4 — 50,000 ohms, ½-watt.
R_5 — 0.1 megohm, ½-watt.
R_7 — 30,000 ohms, ½-watt.
R_8, R_9 —25,000-ohm variable.
L_1 — 150 turns No. 28 e., 1½-inch diameter.
L_2 — 20 turns No. 28 e, 1½-inch diameter.



Published by PANAXIS PRODUCTIONS, PO Box 130, Paradise, CA 95967-0130

Letters From Free Radio Land

Dear EBN,

I have been reading and enjoying your newsletter for quite some time.

Back in the early 1950's I had a small station when I was in high school. The call sign was WFHR. For a transmitter I had a two-tube phone oscillator using a 35W4 & 50B5. The antenna system was a #12 - 30 foot length of wire.

The studio consisted of two record players that had 78 & 45 rpm speeds. The mixer was a home brew with six inputs, the amplifier was an old guitar amp fed into a phone- oscillator. We had 1 good wire recorder, 1 RCA crystal mic, 1 Astatic JT-30 mic, 1 FM Pilot tuner, 1 5-tube AM radio. We operated on 830 kHz and today its 530 kHz. We would broadcast for about 1 small city block, and since TV. was not that poplar we had quite a few listeners. All of the 1000 & 500 Watt stations had to sign off at sundown, we did not know that we were a "pirate station".

Today in 1988 the interest is still there, only the transmitters are a 100 mW transistor unit and for a standby its the Miller phono-oscillator using a 6A8 & 25Z6. The antenna system is a 30 foot, 1 1/4 inch piece of pipe with a capacitive hat on top. The ground system consists of 400 feet of #12 solid copper wire 6 inches under the surface of the back yard in the form of a wheel with spokes. I have a good size back yard.

The studio consists of 2 BSR 45 & 33 1/3 rpm turntables, 2 tape decks, 1 Vanco me 110 stereo mixer with 6 inputs, 1 Radio Shack 10 Watt transistor amplifier, 1 Radio Shack AM- FM stereo tuner, 1 dynamic mic and 1 studio battery clock. To power the entire house and station I have a 10 year old Craftsman 4500 Watt alternator. The call sign of the station is WNFR-AM 530 kHz. We play mostly the music of the 50's and 60's.

I feel that the EBN Newsletter is very well done, therefore if any one has a schematic or print of a phono- oscillator or small transmitter that uses a 50B5 beam power amplifier or 35W4 rectifier I would appreciate it in the Newsletter.

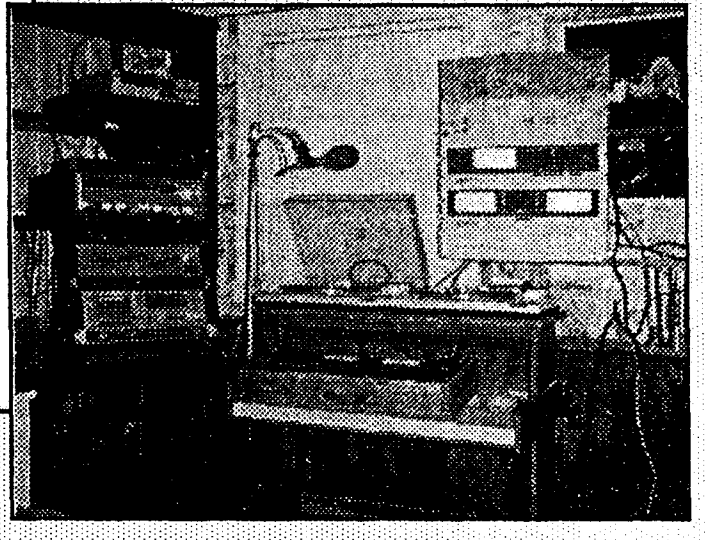
Howard

Hello EBN!

There have been some major changes out here. First of all, I am now a FORMER pirate. About two months ago I began working on the air as a radio personality on ----, a 50 kW FM station. Our antenna is on top of a large mountain enabling us to blow away even out 100 kW competition! We have the best coverage In the state reaching all major points and the eastern half of the next state.

I still have my pirate set up but only go on occasionally if that. I will be selling most of the transmission equipment and convert the audio equipment into a production studio for free lance commercial production. Photo's are enclosed of the air studio before I purchased better equipment.

Frank



More Letters From Free Radio Land

Dear EBN,

First of all I should explain my frequency change to you. From the time I went on the air to just a few weeks before I wrote you my last letter I was at 104.1 FM. I decided it was about time for change. I finally decided to change to 105.7 FM after about 5 weeks of being at this frequency I discovered I was interfering with a 50 kW station at 105.3 FM. At this time I went back to my old frequency.

To get back to the history of WFUN. Back in 1986 my father established a 3 kW FM station in my home town. After about 3 months of being at the station for about 24 hours a day, and becoming more and more interested in radio, I decided to go out on my own. In April of 1986 I purchased a Realistic wireless microphone and a used Panasonic stereo. My first studio was about a crude as you can get! I propped the wireless microphone against a speaker attached to my stereo, which had a cassette deck and a turntable. This studio lasted for about 7 months.

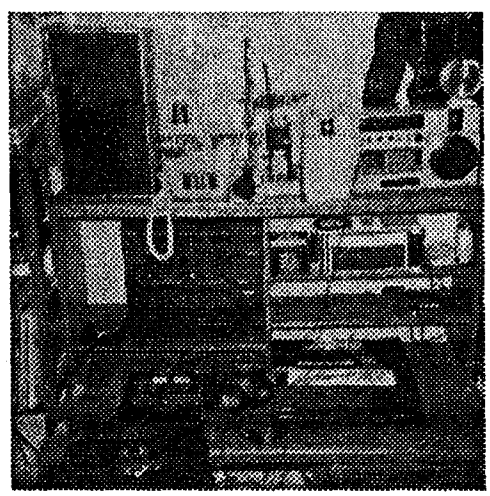
For Christmas of 1986 I received a new stereo system with dual cassette, turntable and CD player. In January of 1987 I received a 100 mW exciter. In the spring of 1987 I moved my station to school and set it up as a business class project. When school was out I moved back home. This setup lasted until December 1987. At that time I purchased Radio Shack's best mixer and another CD player.

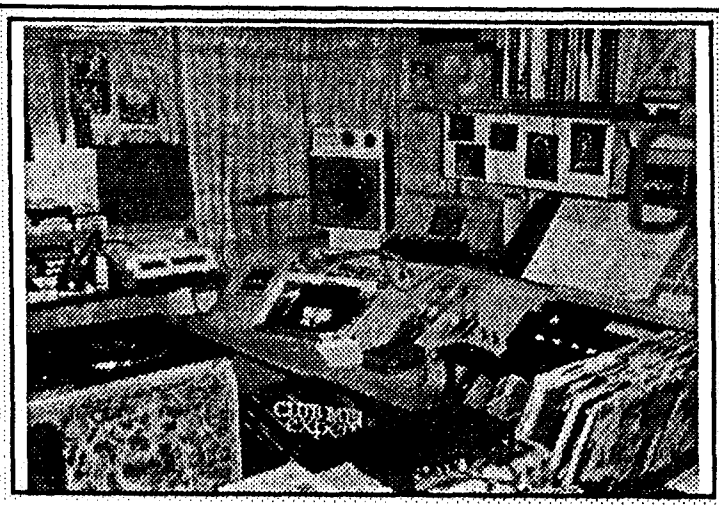
In January of 1988 I met another pirate over the CB radio. His name is "The Dude" and his station is 91 WGBR. "The Dude" modified my exciter and hooked up a linear for me. Until this time I was using a 30 inch wire dipole antenna sticking out of my bedroom. This was quickly changed to a Radio Shack omni-directional FM antenna. Right now I am putting out about 500 mW with a 1/2 mile range. "The Dude" and I are good friends constantly helping each other out with our stations.

My television station WATV has only been on the air since August of this year. I found my exciter in Cleveland while I was visiting my Aunt and Uncle. When I got home I set up a UHF loop antenna on my mast just above my FM antenna. My TV exciter's only 500 mW. I have about 1/4 mile range but with my commercial free programming I am steadily gaining popularity.

I look forward to a career as a broadcast engineer. But until I get that far I really think what you are doing is great - allowing experimental broadcasters to communicate.

Rob, WFUN FM 104.1, WATV TV 19





WROK-FM

10 Watt stereo

New Jersey

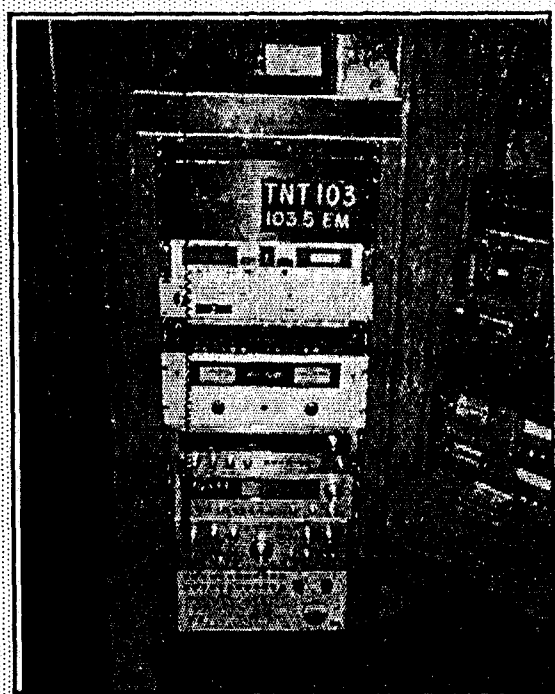
Still More Input From Free Radio Land

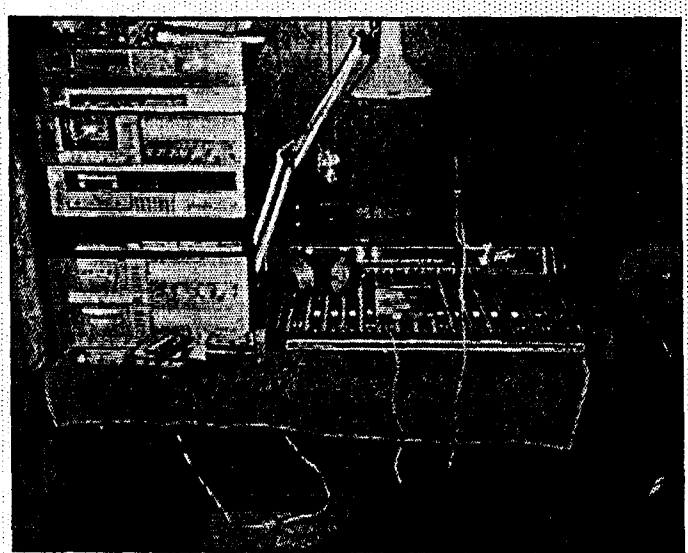
Dear Ebn,

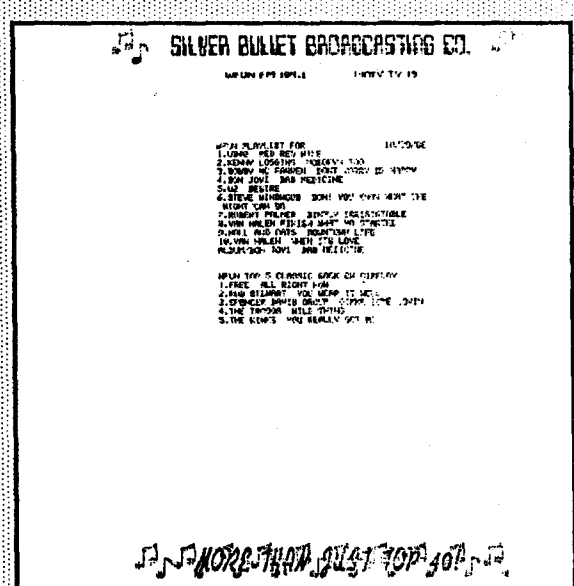
I now have a new address and lots of room to play with WTNT.

WTNT-FM is still ten watts pep and is functioning fine. Have not had any problems with it. I do want a new antenna, the one I have has no gain. I get out only about 3 miles tops! I live on the flat ground. I do have a tower, 40 feet with a 20 foot mast. I have an order in for a broadcast style antenna with about 5.6 dB gain, its a vertical beam. I am also thinking about adding an amplifier of about 100 Watts. That should be interesting.

E.T. of WTNT Central New York's Alternative Radio - Stereo 103.5

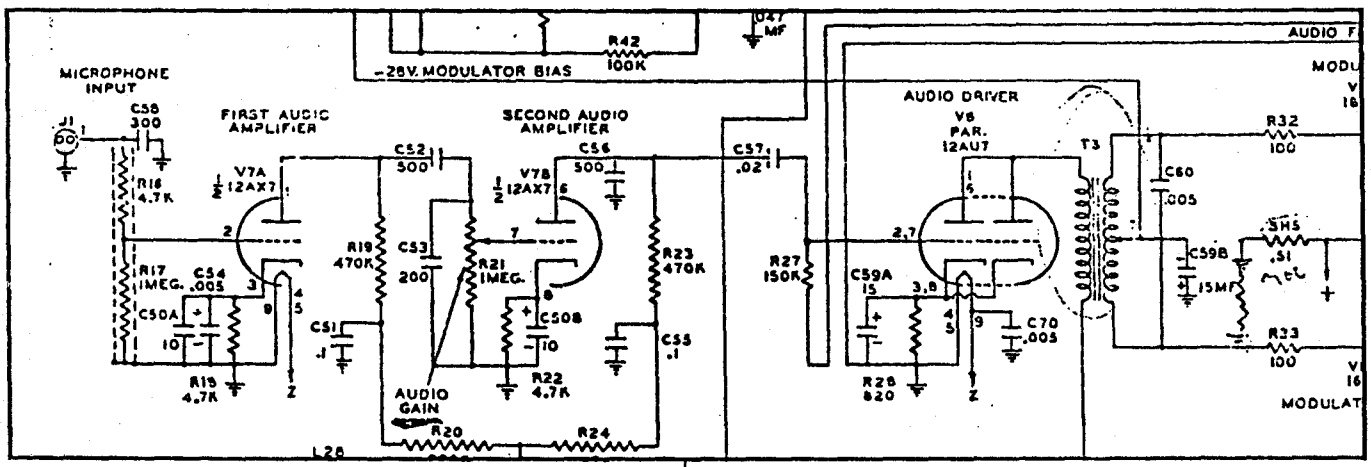






Play list submitted by WFUN-FM

Ham Radio Transmitter Modifications By Pirates For Short Wave Broadcasts



The Viking Ranger amateur radio transmitter is a favorite among short wave pirates. Apparently they turn up now and then at "Ham Fests" and "Flea Markets" with the sellers not caring who they sell them to. With very little technical knowledge the SW pirate can get one on the air and begin broadcasting.

One of the problems, from the pirate's point of view, is that the unit lacks audio quality. This is not surprising as the audio circuits were designed for amateur radio work - not "broadcasting". The audio circuits were deliberately designed to limit audio response to "voice frequencies". For "intelligible" voice these are considered to be from 300 Hz to 3000 Hz. This audio response shaping is almost all done in the microphone pre-amp section of the unit.

Amateur radio operators that know their stuff, and happen also to be pirate operators, change certain components. For example, the microphone pre-amp response is improved by changing C52, C53, C56, and C57. The theory behind these changes are as follows:

For best low-frequency coupling the capacitive reactance should be no more than 1/10th of the circuit resistance. Looking at C52 (500 pF) and the resistance R21 (1M) and assuming 20 Hz as our lowest frequency we can use the formula: Capacitive Reactance = 1/(6.28xFxC).

C52 has a reactance of 15,923,566 Ohms. This is 15 times more than the 1M of R21 therefore it reduces the low frequency response. The proper value is found by the formula: 1.6/(FxR) This turns out to be .08 uF. In practice a standard value of either .1 uF or .05 uF could be used. The reactance of a .05 uF at 20Hz is 159,235 Ohms.

Now we'll examine the C57, R27 coupling. R27 is 150K. By the formula 1.6/FxR we find C57 should be .33 uF. A .33 uF is a standard value but a .5 uF or .25 uF could be used and be close enough.

Looking for high frequency attenuating components we find C53 and C56. Both tend to shunt higher frequencies to ground - shorting them out so-to-speak. The reactance of C53 (200 pF) at 10kHz is 79,617 Ohms. When C52 was 500 pF this caused severe high frequency attentuation. That 500 pF had a reactance of 31,847 Ohms. Neglect the resistance in the circuit for a moment. Consider just the voltage-divider action of the reactances of C52 and C53. The percentage of 10kHz signal appearing across C53 (input to 2nd amplifier) would be found by the formula: Xc2/Xc1 + Xc2 x 100 = 79617/111464 x 100 = 71% This amounts to about a 3 dB reduction at 10kHz. The low-frequency correction made by changing C52 to a .05 uF however also corrects this problem. The reactance of the .05 uF at 10 kHz is only 318 Ohms. High frequency coupling with C52 changed therefore is 79617/79935 x 100 = 99.6 %

The reactance of C56 (500 pF) at 10 kHz is 31,847 Ohms. The plate resistance of the 12AX7 tube is 62,000 Ohms (from a tube spec manual). The 470K Ohms of R23 can be neglected because it's about 10 times larger in value. The 31,847 Ohms reactance of C56 shunts the 62,000 ohm tube plate resistance. Rather than go into all the calculations just accept that this about 5 dB reduction at 10 kHz. The new value of C57 tends to reduce the shunt effect of C56.

The overall correction then is: C52 should be .05 uF to .1 uF, C57 should be .25 uF to .5 uF, C53 may be left alone or removed, C56 probably should be removed.

The above assumes all input will be through the microphone input. High level audio from a mixer output can be injected *after* the mic pre-amp at the input to the audio driver. Another point might be by bridging at the input to the second audio amp at the "top" of R21.

RNI Hits the Waves Again!

"The good ship lollypop" - aka "Sarah" is again in the news. As you may recall Sarah is a 170 foot freighter rigged for broadcasting. It was outfitted last year by members of Radio Newyork International (RNI) and broadcast briefly off the shores of Long Island. The crew operated the radio ship's station believing they were not bound by FCC Rules because they were in International waters. The FCC and Coast Guard boarded the ship in July of 1987 with charges the crew was violating a treaty established by the International Telecommunications Convention.

Allan Weiner and Ivan Rothstein, principles in the establishment of the radio ship were also charged with "conspiracy". Conspiracy in this case was defined as planning to impede governmental functions. Conspiracy is a "felony" and if convicted is punishable with up to 5 years in prison and a fine of $250,000.

After the ship was siezed last July it was impounded by the Coast Guard. FCC charges of operating the station illegally were dropped and the ship released back to its owners. Apparantly there were promises that the ship would not be broadcasting again until it could do so legally.

Sarah carried a registration under the Honduran government but not as a radio ship. The ship is now owned by Atlantic Radio Communications, a British corporation. It is registered as a radio ship by the little-known principality of Sealand. Sealand is a floating platform about the size of a high school gym which was purchased by a British businessman - Roy Bates. The sea platform was used during World War II as part of Britain's sea defense. Through some legal maneuvering Bates was able to establish Sealand as a sovereign territory - a country unto itself! He proclaimed himself "Prince" and his wife "Princess" of this miniature country and has even printed money and stamps as well as writing a "constitution" and designing a flag. This was in 1968! Bates himself did some pirate broadcasting in the 1960's.

The new owners intend to accomodate advertisers and to operate in International waters - apparantly just a few miles of the U.S. coast near Long Beach - Long Island. The station began broadcasting under the old call sign of RNI. The ship's FM and short wave facilities lay dormant as they broadcast at 1620 kHz with their AM equipment. The FCC listened and are now investigating whether or not the station is legal under these new conditions. While the investigation continues however a Boston Judge was contacted and a restraining order was issued. The station has agreed to comply with the order rather than face a confrontation with the Coast Guard. Station RNI broadcast for only three days before the restraining order was issued.

The Great Pumpkin Watch of 1988

In our September issue we published a letter from some Halloween prank broadcasters. A group of "techy types", three from what the letter said, got together and constructed a Helium filled balloon outfitted with automatic radio gear. The transmitter was to operate across almost the entire FM band and deliver a message from NEEWOLAH - of the NILBOG people, visitors from outer space. The balloon was to be launched before dawn on October 31st.

Several Southern California EBN readers phoned-in early Monday morning to tell us they heard the broadcasts. Others wrote in almost immediately because we received their letters by November 9th. All responses were from California leading one to beleive the balloon got into trouble and didn't make it over the Sierra-Nevada mountains. We have yet to hear from the group that launched the project.

We heard "the voice of Neewolah" in San Jose, California! The time was 6:45 AM on October 31st. The signal was not very strong. We could hear it for about 5 minutes but not too clearly. We heard it several places on the dial below 100.1 Mhz.

Picked up something Monday morning October 31 that might have been your NEEWOLAH. There was a scratchy voice saying something that bled over onto 4 or 5 channels for about 30 seconds. Couldn't make out what he was saying.

We heard it! That radio balloon transmitter! Voice was pretty distorted but we could make out almost every word. They must have changed the words though because what we heard was "People of this planet - we have come to visit other life forms - this is -----?" we couldn't understand the guy's name. We heard it again a few minutes later but it was real weak and the words sounded different.

We were watching channel 6-TV when a funny sounding voice was heard in the background. The picture had wiggly lines in it too. Whatever was being said only lasted 10 or 15 seconds and went away after that. Was that the thing you talked about in volume 5 issue 9 of the EBN?

KDPT-FM in California reporting hearing balloon broadcast about 8:00 am October 31, 1988. Distorted voice broadcast over several channels at once but could not make out what they were saying.

Techy Quiz Answers

We had two winners of our September issue's "Techy Quiz". Jerry A. of New Jersey and Pete P. in Georgia. Both came in with all 14 correct answers! Congratulations guys! You have both won a two year extension of your EBN subscription. Answers:

1. The U.S. FM pre-emphasis standard is 75 microseconds - Europe is 50 microseconds

2. Maximum positive peak modulation for AM in the U.S. is 120 percent.

3. Maximum negative peak modulation for AM in the U.S. is 100 percent.

4. Frequency deviation at 100% modulation of an FM transmitter is + and - 75kHz

5. To increase a station's range (distance) by 5 times its effective radiated power must increase by 25 times.

6. A transformer has two 600 Ohm primary windings. Connected in parallel-aiding the impedance is 600 Ohms.

7. A transformer has two 600 Ohm secondary windings. Connected in series-aiding the impedance is 2400 Ohms.

8. Audio power required to 100% plate-modulate a 10 kW AM transmitter amplifier (neglecting losses) is 5 kW.

9. The sub-carrier frequency used for U.S. composite-stereo signals transmitted by FM stations is 38 kHz.

10. "Backporch" refers to the portion of a TV sync pulse which follows the "pedestal" (the "front porch comes before the pedestal).

11. "Carrier-shift is most often found in the AM broadcast service.

12. A " Wobbulator" produces FM modulation. See front page for explanation and and early tube version of an "electronic" wobbulator.

13. A transformer connected as in 6 and 7 above, with a 1 volt rms input would have a secondary rms current of .833 milliamperes.

14. A typical crystal frequency for the the old Phasitron exciters was around 200 kHz.

Some of the answers to the Techy Quiz may not be too apparent. Perhaps a bit of explanation will help.

(2) An AM carrier's amplitude changes in relation to the audio modulation. When modulated 100 % the carrier amplitude is increased to twice that of the resting carrier during positive audio peaks - it is reduced to zero during negative peaks. Transmitters are usually capable of increasing the carrier amplitude to more than twice the resting amplitude but of course can not reduce it to less than zero. The FCC permits AM stations to increase the carrier level to slightly more than twice the resting carrier amplitude during positive audio peaks - to 120 %. But since you can't reduce the carrier to less than zero then negative peaks are still limited to 100%.

(5) A station's range (distance signal travels) is related to the signal voltage intercepted by the radio receiver's antenna. For an example let's say a particular radio located 10 miles from a station receives a 1 micro-volt signal level. If we look at that distance as a fixed resistance we can apply the formula for power/voltage/resistance which is $E^2/R = P$ or $E = \sqrt{PR}$ or $E/P = R$. For this we'll use $E = \sqrt{PR}$ where E is voltage, P is power, and R is our resistance. The resistance (distance) remains constant in our example. If we increase power by 25 times then E, the voltage, increases as the square-root, or 5 times. The signal strength at the receiver would increase from 1 microvolt to 5 microvolts. On the other hand if we moved the receiver 5 times as far away it would see just 1 microvolt - the same as before the power increase. The range therefore can be said to have increased 5 times for a 25 times power increase.

(6) Transformer windings have a value of inductance determined in part by the number of turns. Two windings connected together, when closely coupled to each other - which is the case in a transformer, affect each other. The amount they affect each other is called their "mutual inductance" (M). The mutual inductance is equal to the coefficient of coupling (k) times the square-root of the product of the two inductances. If (k) is 1 and the inductances are the same then the mutual inductance is equal to the same value also.

$$M = k\sqrt{L_1 L_2}$$

In our example the two primary windings are connected in parallel-aiding (same polarity). The inductance is found by

$$Lt = 1 / (1/(L1 + M) + (1/(L2 + M))$$

Another way to look at it is the number of turns have not increased. We have effectively only increased the wire size (two wires instead of one) but still have only one primary winding.

Techy Quiz Explanation, Continued

(7) The secondary windings are another story. When connected in series-aiding the total inductance is:

$L_t = L_1 + L_2 + 2M.$

In other words the inductance is now 4 times greater! As it turns out the same formulae apply to the calculations for impedance. Therefore, (6) above retains the same impedance as with only only one winding, 600 Ohms, but the new secondary winding impedance went from 600 Ohms to 2400 Ohms.

(11) When an AM carrier is modulated 100% the carrier level is increased to twice its resting value during positive audio peaks and to zero during negative audio peaks. The average carrier level is the same as the unmodulated or resting carrier. When the carrier is modulated 120% on positive audio peaks and 100% on negative peaks the *average* carrier level increases. This is known as "carrier shift".

(13) Assume that each 600 Ohm winding on the transformer was 100 turns. The new primary winding (to 100 turn windings in parallel) is still 100 turns. The secondary is two 100 turn windings in series for a total of 200 turns. This is a turns ratio of 1:2. With 1 volt rms going into the primary we should have 2 volts rms coming out of the secondary. In an example like this it must be assumed that the secondary is terminated with its characteristic impedance, in this example 2400 Ohms. If we use the formula i = e/r we find the output current (through the 2400 Ohms load) to be 2/2400 = .000833 Amperes which is .833 milliamperes.

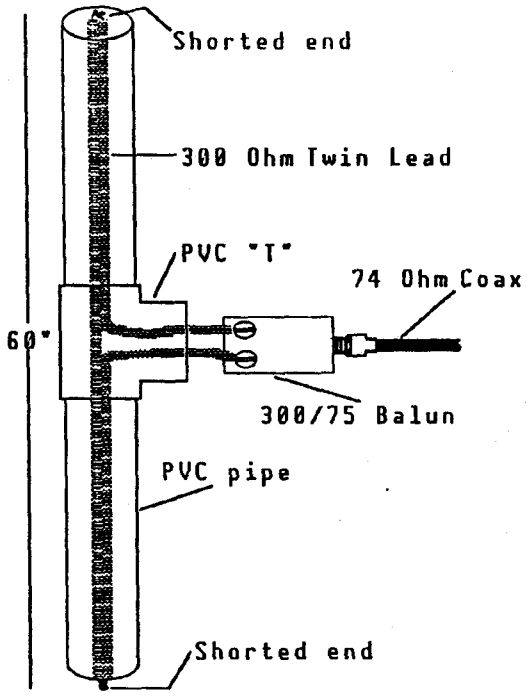
(14) A Phasitron exciter multiplied the oscillator frequency by 464 times to get it up to the FM band. A 100.1 MHz carrier frequency would require a crystal of 100100000/464 = 215732.7586. In other words 215.732 kHz.

Closet Antenna

Dear EBN,

I had the need for a small indoor antenna for low power broadcasting. I wanted to keep it indoors so my station wouldn't be too obvious by seeing an antenna outside. It handles 2 Watts really well and gets out about 3 miles. The whole thing only took me an hour to build at a cost of about $7.00. I keep it and the transmitter in my bedroom closet. The studio is at the other end of my room. I thought other EBN readers might be interested. You can re-draw it if you want.

WBBC-FM 100.3 Gene P.



Unclassified, Barter, Trade, and What Have You

WANTED: UHF TV transmitter, 100 mW minimum, or information leading to same. Contact John P. PO Box 1111, Bronx, NY 10459

FOR SALE: 2 Realistic tape-decks, 2 Technics speakers, Technics turntable, Pioneer reverb, headphones, mic stands, and other miscelaneous equipment. All equipment in excellent condition and nothing over $75.00! Call Mike at (216) 793-9447.

FOR SALE: Sintronix SI 10-E 10 Watt FM Exciter/Transmitter. Slightly modifiied for output of at least 25 Watts. Mono and wideband stereo inputs. Working on 89.3 MHz but crystals for other frequencies also included. A profession unit in mint condition. $1,150.00 Includes owners manual. Contact Frank at (508) 794- 1554