EAM, ENHANCED AMPLITUDE MODULATION, EAM

Part I - What is it? Why do I want it? How much is it going to cost me?

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Fig.1

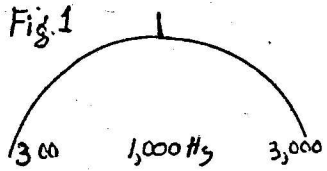


Fig.2

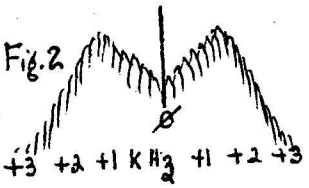


Fig.3

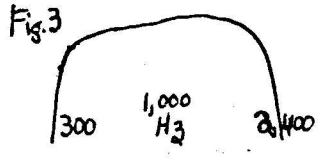


Fig.4

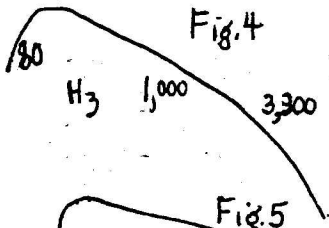


Fig.5

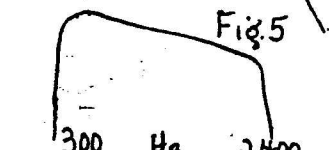


Fig.6

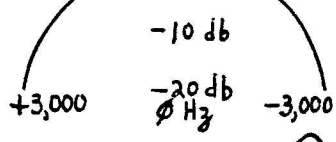


Fig.7.

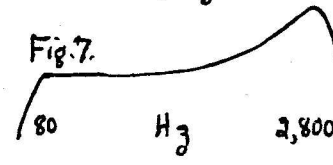


Fig 8

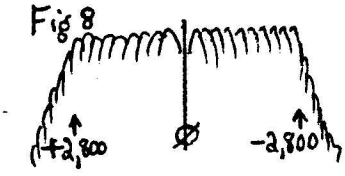
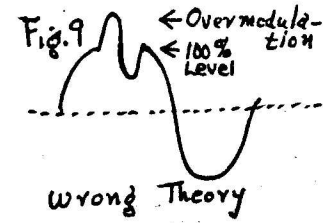


Fig.9



By using the new knowledge of what modulation is and applying it to voice radio, we can have the most readable signals on the air. We used to think that an audio peaked near 1,000 Hz, Fig.1, was best. Most AM rigs, now, feature it. It gives sidebands as in Fig.2, as seen on my Scanalyzer.

However, SSB came in with an audio curve like Fig.3. With the human voice output curve of Fig.4, SSB results in Fig.5. The SSB filters chop off near 300 and 2,400 Hz, because of costs, not because of desirability.

The EAM, Enhanced Amplitude Modulation, receiver is open for any AM as its acceptace is shown in Fig.6. If Fig.4, the drop off of the voice energy with the higher pitched tones, is inverted, as in Fig.7, it reults in sidebands around the carrier as in Fig.8, unlike Fig.2, both Scanalyzer views.

When Fig.8, an EAM transmission, is received by the receiver of Fig.6, the resultant audio is similar to Fig.4, except for a cut off above 2,800 Hz. The differences between Fig.2 and Fig.8 is the Enhancement, which does perform.

The benefits are several. From my personal observations:

(1) SSB's do not crowd into the ± 3 kHz around my Fig.8 carrier as they do 1½ kHz closer to the carrier of Fig.2.
(2) Net operators ask me to make a transmission to clear off the SSB QRM.
(3) I log, frequently, reports including the words: "beautiful", "armchair copy", " in the room", "right here with me", "every word", "100 %", "taking everything out on the frequency when you talk", etc.
(4) In real heavy QRM, "The QRM is fierce but I am still able to read you", "your modulation comes through all the junk on the channel", "you are readable in all that mess".
(5) On band fadeouts, "Even when the S Meter doesn't move above zero I can still read that modulation", "yours is the first modulation to do this".
(6) The same rig, voltages and tubes are used. Only, by formula, a few condensers, a very few resistors are changed. No butchering. Costs for receiver and transmitter Enhancement is from $10 to $25.
(7) I don't have to use phonetics to get across like I used to through the Queen Roger Mary. I do not get request for repeats that used to be common.

What is going on ? It used to be thought that treble audio waveforms had to climb on top of base audio waveforms, as in Fig.9. Actually, we scan our tones, from lowest upwards to the highest, about 125 times per second, as in Fig.10. Surprisingly enough, at first learning, the frequencies of our voices are not the pitch. The pitch is the rate of scanning. A girl will use the same tones as a man, but she will scan maybe 260 times per second.

As Fig.10 shows as frequencies from 80 Hz to 3,3000 Hz, it does not represent the energy of AM shown in Fig.2 nor of SSB of Fig.5. With SSB cutting off energy below 300 Hz and above 2,4000 Hz the start of the scan is omitted and the end is omitted, leaving time holes in the delivery of intelligence, as in Fig.11. Hence, SSB uses about 50 % of the time to carry intelligence while the noises continue 100 % of the time. Meanwhile, EAM uses about 90 % of the time to carry intelligence. Thus, were we to compare an SSB of 100 watts PEP with an EAM which has an equal PEP in one of its sidebands, we would find a difference of 80 % more watt-hours in the EAM sideband. This is at the same peak percentages of modulation.

For Example: Let us compare a KW of EAM with a 2 KW PEP of SSB. The EAM operates at 1,000 watts d.c. and produces, @ 75 % efficiency, 750 watts of carrier, which has peaks of 750 watts of sidebands to null or double it. This 750 watts of EAM @ 90 % scan time leaves about 675 watt-hours of intelligence. Meanwhile the SSB peaks 2 KW, @ 60 % efficiency, a 1,200 watt sideband. This 1,200 watt sideband @ 50 % of scan time, leaves about 600 watt-hours of intelligence. By similar calculations, the AM of Fig.2 will result in about in a poor showing of about 375 watt-hours, more or less, depending on how poor is its modulation spectrum and distortion free characteristics.

Not only is the sideband energy improved about two to one, but the real "loudness" of the modulation is up about 2 db. The noise polution studies show that voice frequencies that are narrowed down, like in SSB, have to have more wattage to sound as loud as wider spectrum. The difference between SSB and EAM loudness is about 2 db. This is why an EAM station sticks out louder on tuning the band than other AM stations. However, if the receiver is narrow, like old AM receivers, or the SSB systems, the difference is hardly noticable. EAM is also an advantage in the receiver.

Compared with SSB's poor spectrum occupancy of Fig.11, EAM is there most of the time, as in Fig.12. Notice that the higher audio freqencies of Fig. 12 have beeen built up at the same rate that they normally fall off, as in Fig.4, and corrected with the slope of Fig.7. That is why a hi-fi AM station will not do so well as EAM, the hi-fi looking like Fig.10 compared to Fig.12 for EAM.

Enhanced Amplitude Modulation packs in the most possible modulation that can be carried in this bandwidth, as shown in Fig.8 and Fig.12. There is not any room left to put modulation in. This is as far as we can go.

The next installment will show you the simple formulas and where they go.

Don "Holly" Holsington
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Fig.10

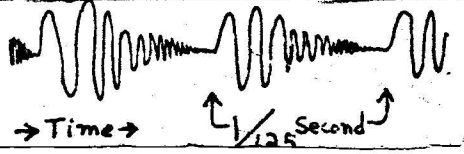

Fig.11

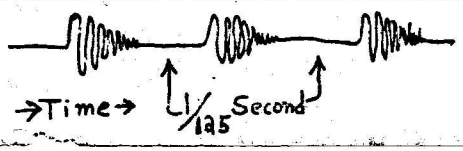

Fig.12