CQ de WA2LQO

Seventy Five Years (1944 -2019) as the official voice of the Grumman Amateur Radio Club

FEBRUARY / MARCH 2019 VOLUME 92 NUMBER 2

MEETING – WE ARE NOT HOLDING MEETINGS JUST NOW

After January being so eventful, February was so quiet that I don't really have anything to offer just now. As a result, I am combining both the February and March issues into one, and am continuing with my serialized article.

Serialized Paper - Radio Receivers from Spark to 16-QAM [continued - Part 3]

From a paper delivered at Ham Radio University 2019 by Ed Gellender WB2EAV.

One interesting aspect of the AM radio band is that a tremendous amount of signal amplification is not needed. Our planet is one tremendous spark transmitter, with every thunderstorm adding to the din. Enough of the lightning-induced emissions travel far enough to establish a "noise floor" of atmospheric noise that covers up weak signals. To be heard over the din, AM broadcast transmitters must run high power to be heard over their listening area (50 KW is common). This further helps keep the costs of the home receiver down.

The long-distance effects that the old wireless operators depended continued into the AM band, which is fairly well controlled during the daylight hours. At night, "ground-wave" causes signals to better follow the curvature of the earth. Under ideal conditions, on a clear cold night, AM stations over 1000 miles away (1600km) can come in every bit as well as the local ones.

With a huge new AM broadcast consumer market, the TRF receiver was becoming a problem, carefully re-tuning several stages each time the listener wanted to change the station. A radio receiver that needs a trained operator was holding down consumer acceptance. Something that anyone could operate was needed, and quickly.

The superheterodyne receiver design adds complexity, but makes the receiver much easier to use. The home radio listener no longer needs to regularly retune multiple stages. The idea is to build a single-frequency receiver at what is called an intermediate frequency (IF), and factory-tune it to get the desired performance that will hold constant for the life of the receiver. Then, some device was needed up-front to allow the user to select a desired frequency and convert that signal to the IF frequency. There are two new features introduced by the superheterodyne: the IF amplifier, and the converter that changes a selectable input frequency into the constant IF frequency.

The single frequency IF receiver typically operates 455 kHz in most AM broadcast band home radio receivers. The "IF strip" consists of two or three L-C tuned amplifier stages that are factory-adjusted not only to be right on frequency, but also to have the optimum bandwidth for reception of AM broadcasts (approximately 15 kHz). Each stage has several adjustments, usually implemented with screw-adjustable metal cores in the inductors. Cores increase the inductance of a coil, and add adjustability as they can be moved in and out. They are often made of ferrite, which is a ceramic-like

material made with powdered iron-based alloys. Because inductors convert currents into magnetic fields, interaction between stages is avoided by encasing them in small metal shields, resulting in the name “IF cans.” Typically there is one IF can per stage and they usually include the resonating capacitors so as to allow factory pre-tuning of the can before installation.

The frequency converter is the second section added to make a superhet receiver.. Since the selected input signal is to be converted to the IF frequency, the converter must be tunable. There are two parts to the converter – the mixer and the local oscillator (LO).

The key to the process is the function known as heterodyning which is based on a mathematical process. If, in a mathematical exercise, two sinewaves of different frequencies are multiplied, when all resulting the terms are simplified, the resulting terms are primarily a sinewave at a frequency that is the sum of the two input frequencies, and a similar sinewave at the difference frequency.

It is not necessary for the conversion stage, or “mixer” to exhibit a true multiplication; an amplifier with any nonlinearity will generate the necessary sum and difference frequencies.

This is not as abstract as it first seems. Flying on an airliner, sometimes the droning sound of the engines will begin to show some slow wobbling variations. Or, tuning a musical instrument against a tuning fork, sometimes creates a wobbling characteristic in the ears, slowing down as the instrument is brought in perfect tune. These effects are known as “beat notes” and are generated in our ears due to their logarithmic characteristics. What we hear is a sound component at the difference frequency between the two engines or two separate musical tones. There is also a sum frequency, but the wobbling characteristic of the difference really stands out.

The second signal used in the heterodyning process is generated in a “Local Oscillator” (LO), a circuit that (similar to part of a transmitter) generates a frequency dependent on its L-C network. The LO must be tuned to select the desired station. For a receiver with an IF of 455 kHz, and, let’s say, 1 MHz as the local oscillator frequency, inputs at either 1.455 MHz (sum) or 545 kHz (difference) will send IF frequency signals to be processed. One is the desired frequency; The other, referred to as “image,” must be rejected. Note that the two are identical, and neither is fundamentally good or bad; it all depends on user preference.

It is customary to add another tunable L-C circuit to the input of the mixer to select the desired choice of the two possible inputs is selected and which is rejected (preselection). Note that we now have two tuning adjustments to change the station – local oscillator frequency and preselector tuning. Customarily, both L-C circuits use variable capacitors that are “ganged” on the same shaft. Much effort goes into the design of such combined units so the two track closely over the AM broadcast band.

When the same ferrite core is used for both the preselector and local oscillator coils, any interaction between the two is not an issue, as they are supposed to be combined anyway. The use of such “ferrite loopsticks” provides enough pickup of the received signals into the preselector that an outdoor antenna is not needed for strong signals, tremendously improving convenience of use.

Figure 8 shows the block diagram of a superhet receiver and Figure 9 shows the rear view of the chassis of the table radio of Fig 7. Note that the preselector is referred to as “RF amplifier”, which simply means the preselector amplifies the input signal.

<continued next month>

TREASURER'S REPORT – Ed, WB2EAV
Ed reports that finances continue to be in good shape.
REPEATER REPORT
146.745 Repeater is intermittent.
VE REPORT – Ed, WB2EAV
Due to inclement weather, the February VE session had to be cancelled
GARC NETS: Net Controller Karen W2ABK **40 Meters: 7.289 MHz at 7:30 AM EST Sundays**
2 Meters (repeaters) Thursdays: 146.745 MHz (-600 kHz) at 8:15 PM
145.330 MHz (-600 kHz) at 8:30 PM. Tone for both repeaters: 136.5 Hz.
ARES/RACES NETS: Mondays.
PROGRAM:
WEBSITE
The GARC web site can be found at http://www.qsl.net/wa2lqo. Webmaster is Pat Masterson, KE2LJ. Pictures of GARC activities, archives of newsletters, roster of members, and other information about the GARC may be found there. Please inform Pat Masterson if you need to delete, update or edit your roster information.
MEETINGS
Board and General Meetings are now combined. Unless otherwise notified, meetings start at 5:30 PM on the FOURTH Wednesday of the month, at HAYPATH ROAD Town Park in OLD BETHPAGE. **[NO meetings for February and March 2019]**
GARC Officers:

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GARC VE EXAMS We normally proctor exams for all classes of ham licenses on the second Tuesday of each month, starting at 5:30 PM, BUT sessions may be cancelled if no applicants make appointments. The fee is $14. All applicants must pre-register with Ed Gellender wb2eav@yahoo.com All new applicants should be aware that they must write their Social Security number on the application form if they have not gotten an FRN number. Applicants for an upgrade must leave with the examiner a copy of their current license. All applicants must show a photo ID such as a driver's license. Study material may be obtained from ARRL-VEC at http://www.arrl.org, or W5YI-VEC at http//www.W5YI.org. All VECs use and update the same Q&A pools.

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