I'm not a robot

Heterodyne vs superheterodyne

The two intermediate signals $\cos((\omega_{RF} - \omega_{LO}) t)$ and $\cos((\omega_{RF} + \omega_{LO}) t)$ - which are called the heterodynes are then passed through a bandpass filter. AM demodulation requires envelope detection, which can be achieved by means of rectification and a low-pass filter (which can be as simple as an RC circuit) to remove remnants of the intermediate frequency.[19] FM signals may be detected using a discriminator, ratio detector, or phase-locked loop. The diagram has blocks that are common to superheterodyne receivers,[10] with only the RF amplifier being optional. When one uses an intermediate frequency one can just perform automatic control of the amplifiers gain till one receives always the same intermediate frequency amplitude which makes life on the receiver and demodulator side much easier. ISBN 0-471-71814-9. "United States Patent 7227912 Receiver with mirror frequency suppression". (2006). There is a second frequency conversion (making a triple-conversion receiver) that mixes the 81.4 MHz first IF with 80 MHz to create a 1.4 MHz second IF. To tune the receiver to a particular station, the frequency of the local oscillator is controlled by the tuning knob (for instance). Radio Communications Concepts: Analog. 2007-06-14. He came across it while considering better ways to produce RDF receivers. Discusses frequency tracking, image rejection and includes an RF filter design that puts transmission zeros at both the local oscillator frequency and the unwanted image frequency.) ^ Langford-Smith, Fritz, ed. Armstrong referred to this concept as a regenerative receiver, and it immediately became one of the most widely used systems of its era. Early Morse code radio broadcasts were produced using an alternator connected to a spark gap. The Electronics Handbook. 69. By the 1930s, improvements in vacuum tube technology rapidly eroded the TRF receiver's cost advantages, and the explosion in the number of broadcasting stations created a demand for cheaper, higher-performance receivers. History of Wireless. This allows one to sweep different frequencies that are mapped to a single intermediate frequency that’s then decoded by a demodulator after passing through a fixed frequency bandpass filter. US 706740, Fessenden, Reginald A., "Wireless Signaling", published 1901-09-28, issued 1902-08-12 US 1050441, Fessenden, Reginald A., "Electric Signaling Apparatus", published 1905-07-27, issued 1913-01-14 US 1050728, Fessenden, Reginald A., "Method of Signaling", published 1906-08-21, issued 1913-01-14 Witts, Alfred T. 13. Many radio systems of the 1920s were based on the regenerative principle, and it continued to be used in specialized roles into the 1940s, for instance in the IFF Mark II. La Liaison des Transmissions (in French). When the first receiver began to oscillate at high outputs, its signal would flow back out through the antenna to be received on any nearby receiver. By the mid-1930s, commercial production of TRF receivers was largely replaced by superheterodyne receivers. Learn about AM, FM, SSB, direct conversion, superheterodyne architectures, and direct RF sampling. The local oscillator is once transmitted to some device under test, a splitted part of the local oscillator is simply bypassing the testing area. The stages of an intermediate frequency amplifier ("IF amplifier" or "IF strip") are tuned to a fixed frequency that does not change as the receiving frequency changes. Also, it is easier and less expensive to get high gain at a lower frequencies. One or more tuned circuits at this stage block frequencies that are far removed from the intended reception frequency. As a result, any number of simple amplification systems could be used. 649–652.. Red parts are those that handle the incoming radio frequency (RF) signal; green are parts that operate at the intermediate frequency (IF), while blue parts operate at the modulation (audio) frequency. However, the higher the IF, the more difficult it is to achieve high selectivity in the IF filter. Douglas, Alan (November 1990). Homodynes The next type of receiver or converter is a homodyne. For example satellite TV operates at frequencies up to around $10 GHz$. In most cases, a receiver's input band is wider than its IF center frequency. p. Note that one also has to take care of leakage when designing such receivers - the LO leakage is one of the common interference sources when running such systems without proper termination - either on the LNB side or on the receiver side. On that receiver, the two signals mixed just as they did in the original heterodyne concept, producing an output that is the difference in frequency between the two signals. Local oscillators typically generate a single frequency signal that has negligible amplitude modulation but some random phase modulation which spreads some of the signal's energy into sideband frequencies. For instance, to receive a signal at 1300 kHz, one could tune the LO to 1360 kHz, resulting in the same 60 kHz IF. QSL RF Circuit Design Ideas. (1988). ^ Hagen, Jon B. Armstrong v. To narrow down to the topic it also takes a look at the heterodyne receiver (for up- and downconverison), the superheterodyne and the homodyne which are commonly used in RF communication equipment as of today. BC Internet education. Archived from the original on 2021-07-11. modulation local oscillator shifted by 90 degrees) where one would not receive any signal To counter that one usually does not multiply once with the local oscillator but in parallel with a 90 degree shifted local oscillator. Continuous wave and single sideband signals require a product detector using a so-called beat frequency oscillator, and there are other techniques used for different types of modulation.[20] The resulting audio signal (for instance) is then amplified and drives a loudspeaker. The IF band-pass filter and amplifier supply most of the gain and the narrowband filtering for the radio. In contrast to the spark gap, however, the output from the alternator was a pure carrier wave at a selected frequency. Usually one uses an antenna, input bandpass filter that is usually also tuned and an pre-amplifier at high RF frequencies in front of the mixer that then performs the downconversion: The input signal $f_{RF} = \sin(\omega_{RF} * t)$ is simply multiplied by the local oscillator (LO) signal $f_{LO} = \sin(\omega_{LO} * t)$. Image rejection is an important factor in choosing the intermediate frequency of a receiver. Higher IF frequencies (455 kHz was a common standard) came into use in later years, after the invention of the tetrode and pentode as amplifying tubes, largely solving the problem of image rejection. This is the ratio (in decibels) of the output of the receiver from a signal at the received frequency, to its output for an equal-strength signal at the image frequency. The local oscillator is tuned to 580 + 455 = 1035 kHz. But a signal at 580 + 455 + 455 = 1490 kHz is also 455 kHz away from the local oscillator; so both the desired signal and the image, when mixed with the local oscillator, will appear at the intermediate frequency. ISBN 0-86341-188-6. Raises Paul Laüt published six months before Lévy; Étienne published the memo. Thus S2 interferes with S1. This leads to a modulation of the measured intensity one sees on the y axis. The superheterodyne So what is the superheterodyne? Icons of Invention: The Makers of the Modern World from Gutenberg to Gates. T. The receiver would then receive both signals, and as part of the detection process, only the beat frequency would exit the receiver. 116.Champeix (April–May 1979). ^ Wright, Peter (1987). (2017-05-27). The image frequency results in two stations being received at the same time, thus producing interference. London, UK: Peter Peregrinus Ltd. Since the frequency separation between the bandpass and the image frequency is 2 f I F {\displaystyle 2f_{\mathrm {IF} }\!} , a higher intermediate frequency improves image rejection. It may be possible to use a high enough first IF that a fixed-tuned RF stage can reject any image signals. Armstrong realized that this effect was a potential solution to the "short wave" amplification problem, as the "difference" output still retained its original modulation, but on a lower carrier frequency. 326. For early domestic radios, tuned radio frequency receivers (TRF) were more popular because they were cheaper, easier for a non-technical owner to use, and less costly to operate. f I M A G E = { f R F + 2 f I F , if f L O > f R F (high side injection) f R F − 2 f I F , if f L O < f R F (low side injection) {\displaystyle f_{\mathrm {IMAGE} }= {\begin{cases}f_{\mathrm {RF} }+2f_{\mathrm {IF} },&{\text{if }}f_{\mathrm {LO} }>f_{\mathrm {RF} }{\text{ (high side injection)}}\\f_{\mathrm {RF} }-2f_{\mathrm {IF} },&{\text{if }}f_{\mathrm {LO} }