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QRP operation From Wikipedia, the free encyclopedia

In amateur radio, **QRP operation** means transmitting at reduced power levels while aiming to maximize one's effective range while doing so. The term QRP derives from the standard Q code used in radio communications, where "QRP" and "QRP?" are used to request, "Reduce power", and ask "Should I reduce power?" respectively. The opposite of QRP is QRO, or high-power operation.

Philosophy

Most amateurs use approximately 100 watts on HF and 50 watts on VHF/UHF, but in some parts of the world, like the US, they can use up to 1500 watts. QRP enthusiasts contend that this is not always necessary, and doing so wastes power, increases the likelihood of causing interference to nearby televisions, radios, and telephones. A lot of Amateurs subscribe to the idea, use "the minimum power necessary to carry out the desired communications". The current record for a QRP connection is 1 µW for 1,650 miles on 10m.

Practice

There is not complete agreement on what constitutes QRP power. While most QRP enthusiasts agree that for CW, AM, FM, and data modes, the transmitter output power should be 5 watts (or less), the maximum output power for SSB (single sideband) is not always agreed upon. Some believe that the power should be no more than 10 watts peak envelope power (PEP), while others strongly hold that the power limit should be 5 watts. QRPers are known to use even less than five watts, sometimes operating with as little as 100 milliwatts or even less. Extremely low power—1 watt and below—is often referred to by hobbyists as QRPp.

Communicating using QRP can be difficult since the QRP'er must face the same challenges of radio propagation faced by amateurs using higher power levels, but with the inherent disadvantages associated with having a weaker signal on the receiving end, all other things being equal. QRP aficionados try to make up for this through more efficient antenna systems and enhanced operating skills.

QRP is especially popular with CW operators and those using the newer digital modes. PSK31 is a highly efficient, narrow-band mode that is very suitable to QRP operation.

QRSS

Some extreme QRP enthusiasts use **QRSS** — transmitting extremely slowly — to compensate for the decreased signal-to-noise ratio involved in QRP operation. QRSS derives from the standard Q code used in radio communications, where "QRS?" asks "Shall I send more slowly?" and "QRS" requests "Send more slowly".

Rather than directly listening to such slow transmissions, many QRSS enthusiasts record the transmission for later analysis, later decoding "by ear" while playing it back at much faster rates (time compression), or decoding "by eye" on the waterfall display of a spectrum analyser.

QRSS enthusiasts typically use some form of Morse code, except much slower — rather than a typical 1/10 second "dit" time, QRSS transmissions may use a full second for the "dit" time, or in extreme cases, a full minute for a single "dit" time.

- Morse code with standard on-off keying
- FSCW (Morse code with frequency-shift keying), where "key up" is one frequency, "key down" is another frequency.

- DFCW or Dual Frequency CW, where "dit" is one frequency, "dah" is a different frequency, and spaces have no carrier or a third carrier frequency. With DFCW, the "dah" time is typically shortened to the same length as the "dit" time, and the short space between "dit" and "dah" in a letter is often eliminated.

A few people apply QRSS techniques to other narrow-band communication codes or protocols, such as the "Slowfeld" variant of Hellschreiber, slow-scan television, MT63, etc.

Technology used in home constructed QRP rigs.

Many QRP enthusiast make their own QRP rigs from kits, circuits in magazine and from the internet or home brew cobbled together, often from ideas and circuit from other enthusiasts.

A search on the internet will yield a good number of commercial kits available from around the world and searching further will bring up reviews of many these products.

The simplest QRP rig to build is a direct conversion receiver and many variations of this technology can be found with a simple Web search. The one I have based my experiments on is the Beach40 by Peter Parker, (VK3YE) and this is a Direct Conversion, Double Side Band Suppressed Carries rig. More complicated rigs will use Single Sideband technology like their bigger brothers. Commercial QRP rigs like the Yaesu FT817are all SSB rigs.

Direct-conversion receiver From Wikipedia, the free encyclopedia

A **direct-conversion receiver** (DCR), also known as **homodyne**, **synchrodyne**, or **zero-IF receiver**, is a radio receiver design that demodulates the incoming radio signal using synchronous detection driven by a local oscillator whose frequency is identical to, or very close to the carrier frequency of the intended signal. This is in contrast to the standard superheterodyne receiver where this is accomplished only after an initial conversion to an intermediate frequency.

The simplification of performing only a single frequency conversion reduces the basic circuit complexity but other issues arise, for instance, regarding dynamic range. In its original form it was unsuited to receiving AM and FM signals without implementing an elaborate phase locked loop. Although these and other technical challenges made this technique rather impractical around the time of its invention (1930's), current technology and software radio in particular have revived its use in certain areas including some consumer products.

Principle of operation

The direct-conversion receiver feeds the radio frequency signal into a frequency mixer, just as in a superheterodyne receiver. However unlike the superheterodyne, the frequency of the local oscillator is not offset from but right at the received signal's frequency. The result is a demodulated output just as you would obtain from a superheterodyne receiver using synchronous detection (a *product detector*) following an intermediate frequency (IF) stage. In other words, the conversion to baseband is done in a single frequency conversion. This avoids the complexity of the superheterodyne's two (or more) frequency conversions, IF stage(s), and image rejection issues.

Technical issues

To match the performance of the superheterodyne receiver, a number of the functions normally addressed by the IF stage must be accomplished at baseband. Since there is no high gain IF amplifier utilizing automatic gain control (AGC), the output level at baseband varies over a very wide dynamic range. This is one major technical challenge which limited the practicability of the design. Another issue is the inability of this design to implement envelope detection of AM signals. Thus direct reception of AM or FM signals (as used in broadcasting) requires phase locking the local oscillator to the carrier frequency, a much more demanding task compared to the more robust envelope detector or ratio detector at the output of an IF stage in a superheterodyne design. However this can be avoided in the case of a direct-conversion design using quadrature detection followed by digital signal processing. Using software radio techniques, the two quadrature outputs can be processed in order to perform any sort of demodulation and filtering on down-converted signals from frequencies close to the local oscillator frequency. The proliferation of digital hardware, along with refinements in the analog components involved in the frequency conversion to baseband, has thus made this simpler topology practical in many applications.

History and applications

The homodyne was developed in 1932 by a team of British scientists searching for a design to surpass the superheterodyne (*two stage conversion model*). The design was later renamed the "synchrodyne". Not only did it have superior performance due to the single conversion stage, but it also had reduced circuit complexity and power consumption. The design suffered from the thermal drift of the local oscillator which changed its frequency over time. To counteract this drift, the frequency of the local oscillator was compared with the broadcast input signal by a phase detector. This produced a correction voltage which would vary the local oscillator frequency keeping it in lock with the wanted signal. This type of feedback circuit evolved into what is now known as a *phase-locked loop*. While the method has existed for several decades, it had been difficult to implement due largely to component tolerances, which must be of small variation for this type of circuit to function successfully.

Advantages

Unwanted by-product beat signals from the mixing stage do not need any further processing, as they are completely rejected by use of a low-pass filter at the audio output stage. The receiver design has the additional advantage of high selectivity, and is therefore a precision demodulator. The design principles can be extended to permit separation of adjacent channel broadcast signals whose sidebands may overlap the wanted transmission. The design also improves the detection of pulse-modulated transmission mode signals.

Disadvantages

The design is not without other problems. Signal leakage paths can occur in the receiver. Local-oscillator energy can leak through the mixer stage back and feed back to the antenna input and then re-enter the mixer stage. The overall effect is that the local oscillator energy will self-mix and create a DC offset signal. The offset could be large enough to overload the baseband amplifiers and overcome the wanted signal reception. There are subsequent modifications to deal with this issue but added to the complexity of the receiver. Ultimately the higher production costs were found to outweigh the benefits.

Modern usage

The development of the integrated circuit and incorporation of complete phase-locked loop devices in low-cost IC packages made this design widely accepted. Usage is no longer limited to the reception of AM radio signals, but also find use in processing more complex modulation methods. Direct-conversion receivers are now incorporated into many receiver applications, including cell-phones, televisions, avionics, medical imaging apparatus and Software-defined radio systems.

Double-sideband suppressed-carrier transmission

From Wikipedia, the free encyclopedia

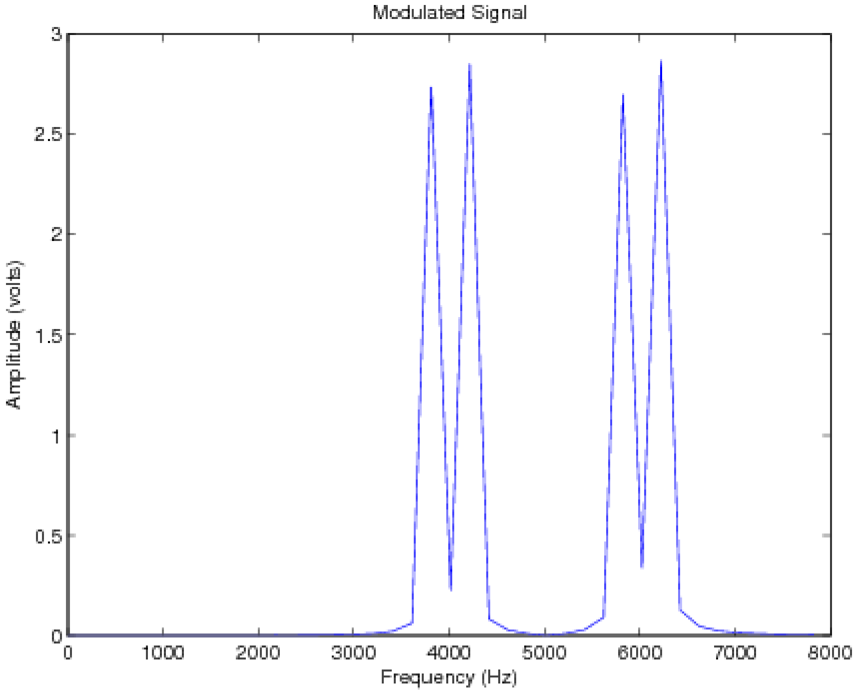
Double-sideband suppressed-carrier transmission (**DSB-SC**) is transmission in which frequencies produced by amplitude modulation (AM) are symmetrically spaced above and below the carrier frequency and the carrier level is reduced to the lowest practical level, ideally being completely suppressed.

In the DSB-SC modulation, unlike in AM, the wave carrier is not transmitted; thus, much of the power is distributed between the sidebands, which implies an increase of the cover in DSB-SC, compared to AM, for the same power used.

Spectrum

DSB-SC is basically an amplitude modulation wave without the carrier, therefore reducing power waste, giving it a 50% efficiency. This is an increase compared to normal AM transmission (DSB), which has a maximum efficiency of 33.333%, since 2/3 of the power is in the carrier which carries no intelligence, and each sideband carries the same information. Single Side Band (SSB) Suppressed Carrier is 100% efficient.

Spectrum plot of an DSB-SC signal:



Single-sideband modulation From Wikipedia, the free encyclopedia

In radio communications, **single-sideband modulation** (**SSB**) or **single-sideband suppressed-carrier** (**SSB-SC**) is a refinement of amplitude modulation that more efficiently uses transmitter power and bandwidth. Amplitude modulation produces an output signal that has twice the bandwidth of the original baseband signal. Single-sideband modulation avoids this bandwidth doubling, and the power wasted on a carrier, at the cost of increased device complexity and more difficult tuning at the receiver.

History

The first U.S. patent for SSB modulation was applied for on December 1, 1915 by John Renshaw Carson. The U.S. Navy experimented with SSB over its radio circuits before World War I. SSB first entered commercial service on January 7, 1927 on the long-wave transatlantic public radiotelephone circuit between New York and London. The high power SSB transmitters were located at Rocky Point, New York and Rugby, England. The receivers were in very quiet locations in Houlton, Maine and Cupar Scotland.

SSB was also used over long distance telephone lines, as part of a technique known as frequency-division multiplexing (FDM). FDM was pioneered by telephone companies in the 1930s. This enabled many voice channels to be sent down a single physical circuit, for example in L-carrier. SSB allowed channels to be spaced (usually) just 4,000 Hz apart, while offering a speech bandwidth of nominally 300–3,400 Hz.

Amateur radio operators began serious experimentation with SSB after World War II. The Strategic Air Command established SSB as the radio standard for its aircraft in 1957. It has become a de facto standard for long-distance voice radio transmissions since then.

Practical implementations

Bandpass filtering

One method of producing an SSB signal is to remove one of the sidebands via filtering, leaving only either the **upper sideband** (**USB**), the sideband with the higher frequency, or the **lower sideband** (**LSB**), the sideband with the lower frequency. Most often, the carrier is reduced or removed entirely (suppressed), being referred to in full as **single sideband suppressed carrier** (**SSBSC**). Assuming both sidebands are symmetric, which is the case for a normal AM signal, no information is lost in the process. Since the final RF amplification is now concentrated in a single sideband, the effective power output is greater than in normal AM (the carrier and redundant sideband account for well over half of the power output of an AM transmitter). Though SSB uses substantially less bandwidth and power, it cannot be demodulated by a simple envelope detector (simple diode detector) like standard Amplitude Modulation.

Hartley modulator – “Phasing”

An alternate method of SSB generation known as a **Hartley modulator**, named after R. V. L. Hartley, uses phasing to suppress the unwanted sideband. To generate an SSB signal with this method, two versions of the original signal are generated, mutually 90° out of phase for any single frequency within the operating bandwidth. Each one of these signals then modulates carrier waves (of one frequency) that are also 90° out of phase with each other. By either adding or subtracting the resulting signals, a lower or upper sideband signal results.

Shifting the baseband signal 90° out of phase cannot be done simply by delaying it, as it contains a large range of frequencies. In analog circuits, a wideband 90-degree phase-difference network is used. The method was popular in the days of vacuum-tube radios, but later gained a bad reputation due to poorly adjusted commercial implementations. Modulation using this method is again gaining popularity in the homebrew and Digital Signal Processing fields. This method, utilizing the Hilbert transform to phase shift the baseband audio, can be done at low cost with digital circuitry.

Other forms of reduced carrier modulation for you to look up on the web are: Weaver modulator and Suppressed carrier SSB

Demodulation

The front end of most SSB receivers is similar to that of an AM or FM receiver, consisting of a superheterodyne RF front end that produces a frequency-shifted version of the radio frequency (RF) signal within a standard intermediate frequency (IF) band. In simple receivers this IF frequency is usually 455KHz.

To recover the original audio information from the Intermediate Frequency SSB signal, the single sideband must be frequency-shifted down to its original range of baseband frequencies (audio frequencies), by using a product detector which mixes it with the output of a beat frequency oscillator (BFO). In other words, it is just another stage of heterodyning.(mixing down to base band). For this to work, the BFO frequency must be exactly adjusted. If the BFO frequency is off, the output signal will be frequency-shifted (up or down), making speech sound strange and "Donald Duck"-like, or unintelligible. For audio communications, there is a common agreement about the BFO oscillator shift of 1.7 kHz. A voice signal is sensitive to about 50 Hz shift, with up to 100 Hz still bearable. Some receivers use a carrier recovery system, which attempts to automatically lock on to the exact IF frequency.

Some QRP kit suppliers members of NERC have purchased from

http:// qrpkits.com - Hendricks QRP Kits is a company that specializes in high quality, low cost QRP Kits. Hendrick has over 15 years experience producing kits, having started with the NorCal 40 in 1993, and have kitted over 20,000 kits through his association with NorCal QRP Club and Hendricks QRP Kits. He will strive to provide complete customer satisfaction and will guarantee all kits to be 100% complete. If you are missing any part in your kit, please email Hendrick at parts@qrpkits.com and he will ship the missing parts to you via first class mail and at his expense.

OZQRP - http://www.ozqrp.com/
Discover the thrill of making contacts with a rig you built yourself. All kits are proudly designed and kitted in Australia by Leon Williams VK2DOB. Leon offers a range of kits to build a complete QRP SSB transceiver, for example the MST2.

The MST2 (Minimalist Sideband Transceiver series 2) is an easy to build and fun to use mono band SSB QRP transceiver that can be built for 20M, 40M or 80M amateur bands. The MST transceiver follows a minimalist design making it inexpensive and simple to build yet still delivering excellent performance and being a pleasure to operate. A complete transceiver can be built by combining the following kits: MST2 transceiver board kit, DDS VFO kit and LED S meter kit.

QRP Kits from China - http://crkits.com/
Australia distributor: Terry, VK5TM **http://www.tkrm.com.au**
TKRM Enterprises Pty Ltd PO Box 599 Tintinara South Australia 5266
Tel 0412 226 083
Email admin@tkrm.com.au

KD1JV Designs - Steven "Melt Solder" Weber - **http://kd1jv.qrpradio.com/**

WØCH QRP and More - http://www.w0ch.net/kits/kits.htm
QRP Equipment and Accessory Vendors

QRP clubs, associations and suppliers

QRP enthusiasts are well catered for by clubs dedicated to the technology. These are on-line clubs and some have a regular paper copy newsletter, other have only on-line newsletters. These publications are a good source of project information and many have a club shop supplying hard to get items used in QRP rigs. Here is a list of mostly the English speaking clubs and there are many in Europe and Asia, some of which will have at least some content in English. If you know of any please email me (vk5srp@wia.org.au) so I can include them in this list. The links below are active and should direct you to their web sites.

American QRP Club
Arizona ScQRPions
DL-QRP-AG (Germany) Only in German
Four State QRP Group
GQRP Club (United Kingdom)
New England QRP Club
New Jersey QRP Club

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NorCal (Northern California QRP Club)
North Georgia QRP Club
North Texas QRP Club
VK QRP Club (Australia) (CW Operators' QRP Club)

Commercial Vendors
AE9RB
Acme QRP Company
American Morse Equipment
Better QRP
Bliss Radio QRP Kits
Breadboard Radio
CR Kits
Dan's Small Parts and Kits
DX Kits (United Kingdom)
EA3GCY (Spain) In English
Elecraft
Emtech
Etherkit
Genesis Radio (Australia)
Glow Bug Kits
Hans Summers (United Kingdom)
Jackson Harbor Press
Juma Kits (Finland) In English
K5BCQ
KB9YIG SoftRock Radio Kits
Kanga Products (United Kingdom)
Kanga US
KD1JV "Melt Solder" Kits
Kits and Parts
KX3/KX1 and QRP Accessories
LNR Precision End Fedz
Midnight Design Solutions
MFJ
Morse Express (Milestone Technologies)
N3ZI Kits
Oak Hills Research
Pacific Antenna
QROlle (Sweden) Only in Swedish
QRPme
QRP Project (Germany) Only in German
QRVTronics
Radio-Kits (United Kingdom)
Ramsey Electronics
Small Wonder Labs
Ten-Tec
SOTAbeams (United Kingdom)
Vectronics

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Walford Electronics (United Kingdom)
Wilderness Radio
Xtal Set Society
Yaesu *
YouKits (Canada)

*A number of manufacturers of more serious Ham Radio Rigs also produce, or have recently produced, QRP rigs. For example the Yaesu FT817, but I suspect soon Yaesu, Icom and Kenwood will drop QRP equipment from their product line and leave that segment of the marker to the smaller and newer players. An example of the “new kids on the block” is the Wouxun X1M Pro QRP HF Transceiver, available DownUnder from Spooktech http://www.spooktech.net/