SX 25
MAIN TUNING
BANDSPREAD
Super DEFIANT
HIGH FREQUENCY
COMMUNICATIONS RECEIVER
the hallicrafters inc
CHICAGO, U.S.A.
R.F. GAIN
BAND SWITCH
SELECTIVITY
TONE
HIGH — LOW
XTAL. PHASING
A.N.L.
ON — OFF
A.F. GAIN
PITCH CONTROL
SEND — REC.
B.F.O.
ON — OFF
PHONES

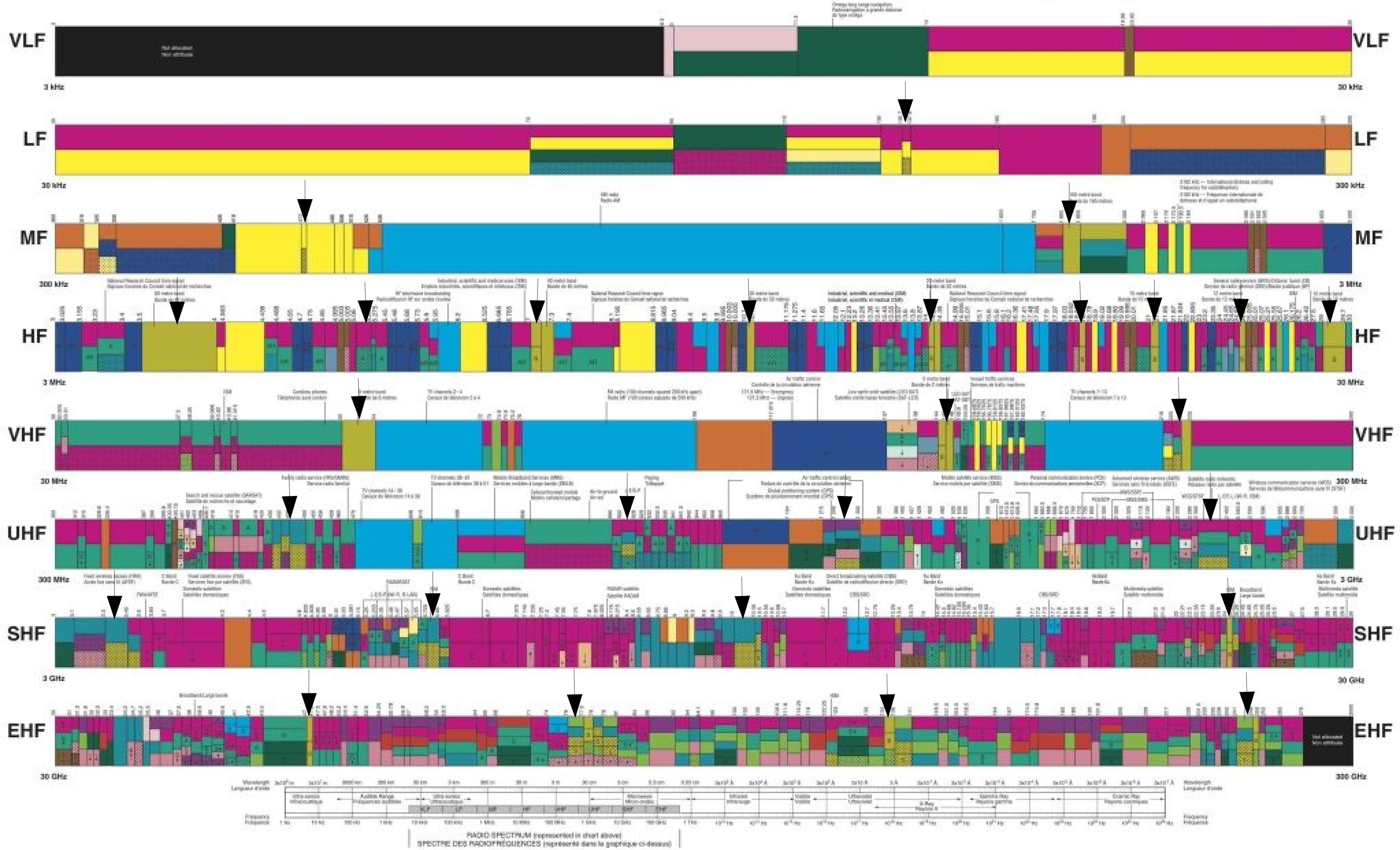
Receivers

The I.C. Basic Exam has about 25 questions regarding Receivers. This presentation covers those questions.

More importantly, an Amateur Radio Operator, or Ham, uses one or more receivers for the majority of their “radio-active” time. We listen much more than we transmit.

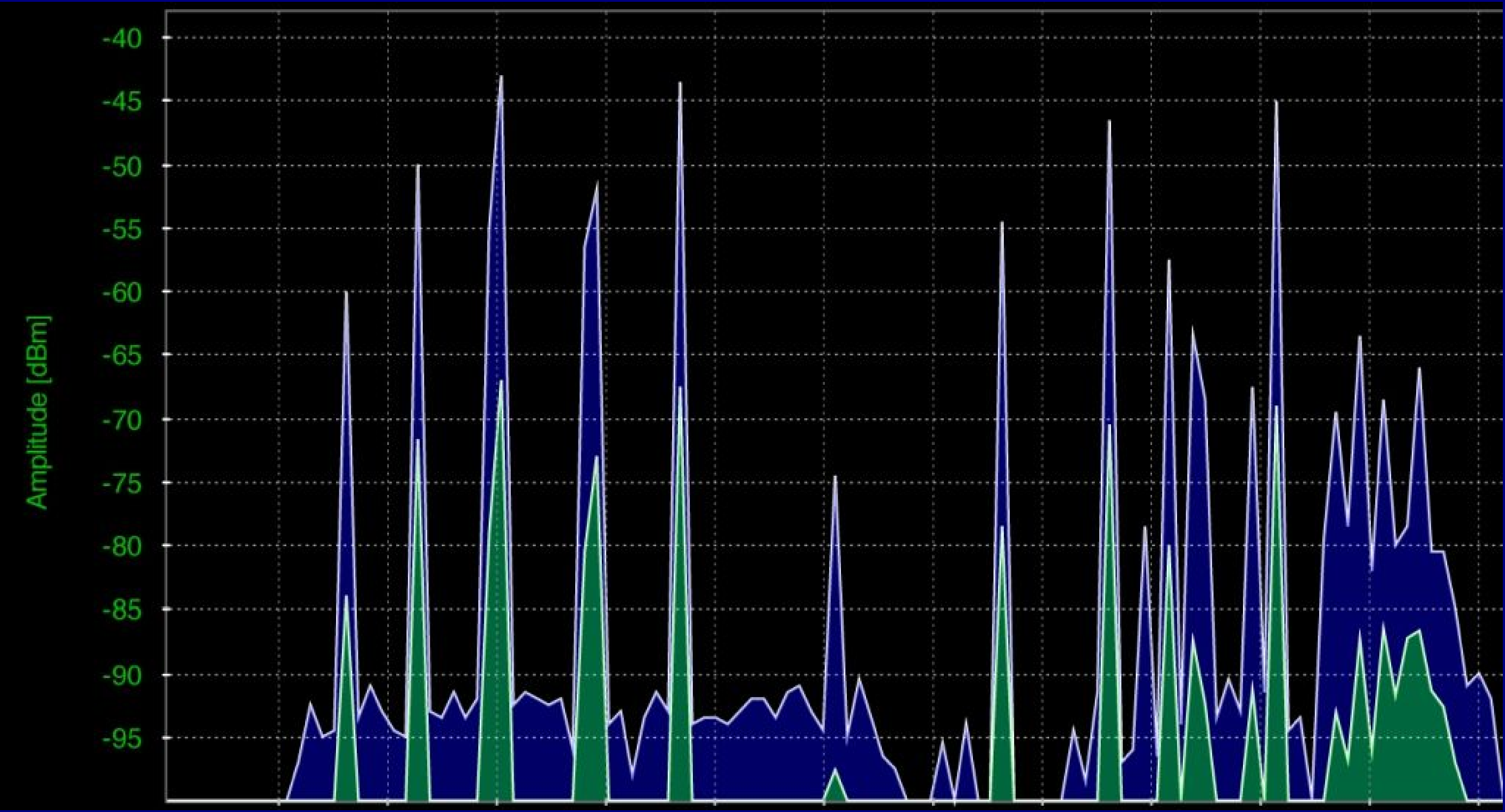
This presentation attempts to provide you with an understanding of how Receivers work, providing you with enough knowledge to properly make a good purchase choice. The Basic Operator may also build their own receivers, and working “Home Brew” is a special thrill in Ham Radio.

Canadian RF Spectrum Allocations



From 8.3kHz (36.12km) to 275 GHz (1.09mm)

The Radio Spectrum in Use: Many Users, Many Modes, Different Frequencies, Different Signal Strengths.



And All at the Same Time!
The Spectrum User wants to receive JUST ONE Signal.

Receiver Top Attributes

Selectivity: The ability to select one signal out of all the Electromagnetic Signals the antenna picks up.

Sensitivity: The ability to detect very weak signals, often in the range of microvolts (μV).

Stability: The ability of a receiver to remain tuned to a desired frequency indefinitely.

Dynamic Range: The ability to properly receive a weak signal in the presence of nearby strong signals.

The Receiver's Tasks

The Antenna picks up many Electromagnetic Radio Waves and delivers signals to the receiver input.

The desired Signal must be Tuned to and Selected from the many unwanted signals.

The Signal must be Amplified to useful levels.

The Signal may vary in strength due to changing propagation, so an Automatic Gain Control can keep signal output constant.

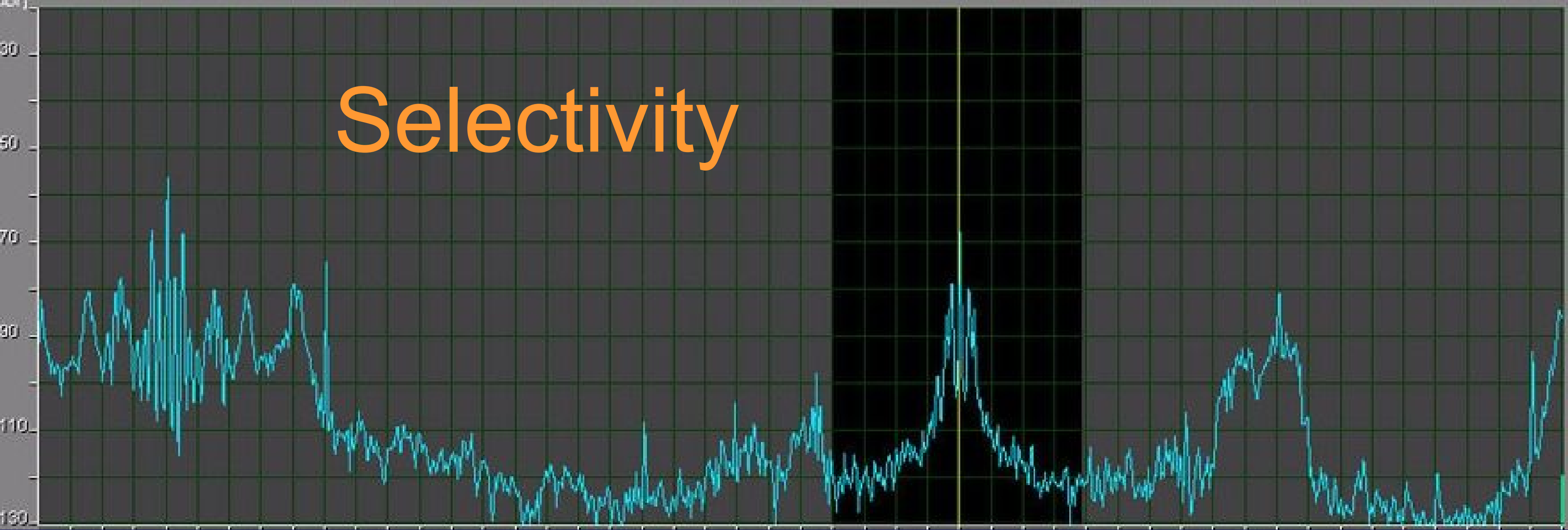
The Signal must be Demodulated to useful Audio signals.

The Audio signal may need to be Processed in some way.

The Audio Signal may require more Amplification.

The Audio Signal may be sent to a Speaker or Earphones so that it may be heard by the Amateur Radio Operator.

Selectivity



Selectivity defines the **Bandwidth** of the receiver, determining what frequencies are passed to the demodulation process.

The optimum bandwidth depends upon the signal mode, and the presence of adjacent channel interference.

Bandwidth

Wide Band FM is used for Commercial Broadcasting: 150 kHz

Narrow Band FM is used by Amateurs to conserve spectrum and make space available for more users: 15 kHz and even 7.5kHz

Amplitude Modulation by Amateurs is limited to 6 kHz bandwidth.

Single Side Band Suppressed Carrier is used by Amateurs to make effective use of transmitter power and bandwidth: 2.7 kHz

Continuous Wave, or Morse Code, depends upon the sending speed, comfortably received with bandwidths of 80 Hz to 500 Hz

FT-8, a modern digital mode, occupies less than 16 Hz bandwidth, and can be computer decoded when it is undetectable by ear.

Selectivity allows a receiver to separate closely spaced signals, the desired signal from the unwanted adjacent signals.

A more Selective receiver will have a narrower bandwidth, allowing fewer signals to pass through.

Bandwidth is a function of the Electronic Filters used in the Receiver.

Bandwidth is usually fixed in a simple low cost receiver.

Multiple filters may provide several bandwidth choices in a more expensive receiver.

Bandwidth may be completely variable between very wide and very narrow in a Software Defined Receiver.

Busy HF bands often require narrow receive bandwidths in order to seperate the closely packed signals. The ability to adjust bandwidth to suit conditions makes a real difference.

Sensitivity and "S" Levels

Defined as the Minimum Signal that a receiver can detect.

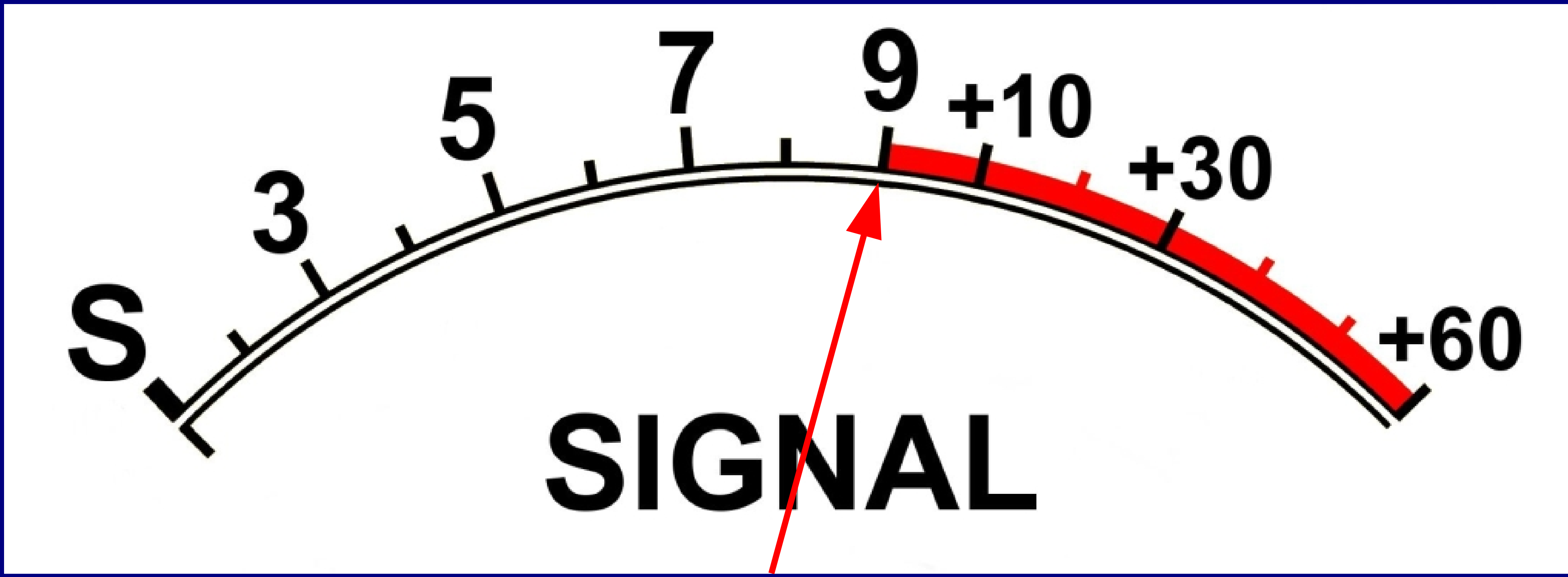
Most modern receivers can detect a 0.2 μV signal, and an "S9" signal is a very respectable 50μV at the 50Ω receiver input.

These signal levels represent a very tiny fraction of the power radiated by the typical 100W amateur station.

An "S9" signal of 50μV, using P = $50\mu V^2$ / 50Ω is 5^{-11} Watts, or 0.000 000 000 05 W, also called 50 picowatts.

A barely detectable 0.2 μV signal is only 8^{-16} watts, which is 0.000 000 000 000 000 8 watts, or 0.8 femtowatts. Very Tiny!

Consider that the receiver is expected to detect such tiny signals, when other nearby signals may be in the millivolt range.



S9 is defined as 50µV across 50Ω, which is 50 Picowatts!

An “S unit” represents a doubling of signal voltage.

- S8 is 25µV
- S7 is 12.5µV
- S6 is 6µV
- S5 is 3µV
- S4 is 1.5µV
- S3 is 0.75µV

Above S9 we measure signal in Decibels, factors of 10 in power, so...

- S9+10dB is 158µV and 500 Picowatts.
- S9+20dB is 500µV and 5 Nanowatts
- S9+30dB is 1.58mV and 50 Nanowatts
- S9+60dB is 50mV and 50 Microwatts

Decibels

Relative Power is measured in decibels, where 10dB is a factor of 10 times.

A reduction of power from 1500W to 150W is 10 times less, so a drop of 10dB.

A signal report of S9+20dB is a received power 10 times a report of S9+10dB.

Dropping the power by 10dB, from 1500W to 150W will result in a signal report of S9+10dB.

B-005-008-004 **(C)**

If a signal-strength report is "10 dB over S9", what should the report be if the transmitter power is reduced from 1500 watts to 150 watts?

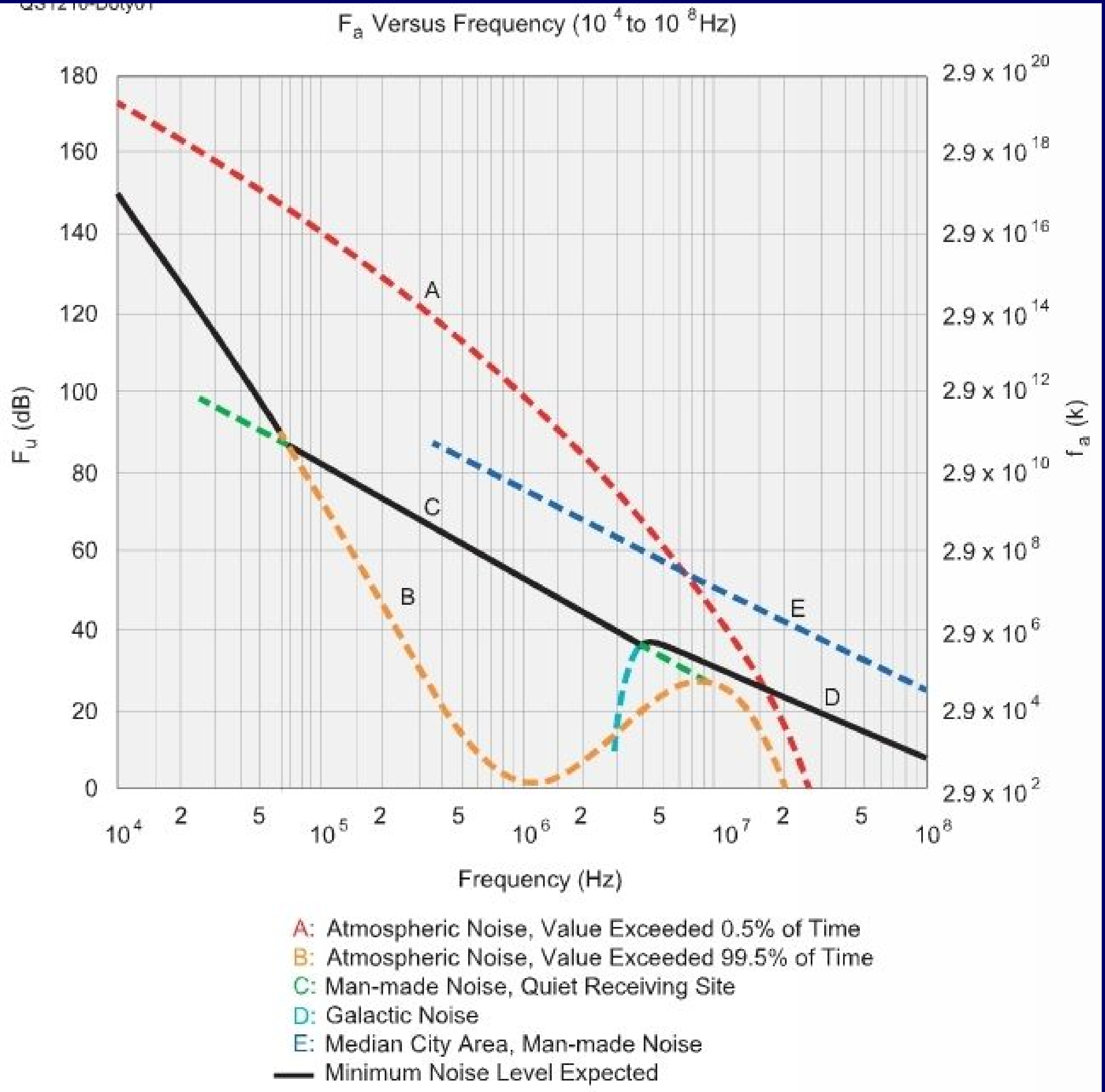
A S9 minus 10 dB
B S9 plus 5 dB
C S9
D S9 plus 3 dB

B-005-008-005 **(D)**

If a signal-strength report is "20 dB over S9", what should the report be if the transmitter power is reduced from 1500 watts to 150 watts?

A S9 plus 5 dB
B S9 plus 3 dB
C S9
D S9 plus 10 dB

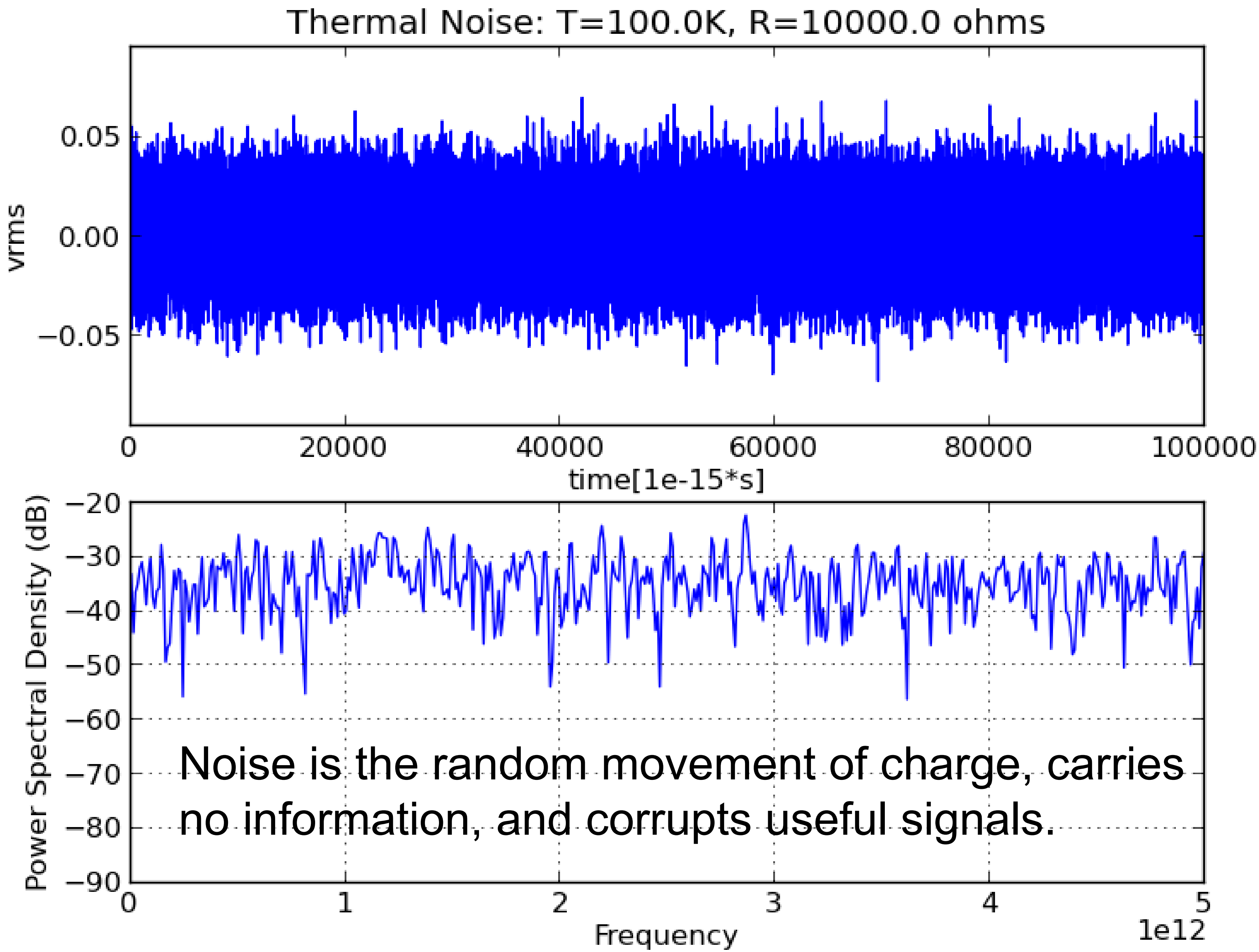
Limits to Receive Sensitivity



Noise, both Man Made and Natural limit the ability to receive radio signals.

Amplification of weak signals also adds noise due to the random thermal movement of charge carriers in the amplifier.

A typical HF receiver is required to detect signals well above the Total Noise floor.



Noise is the random movement of charge, carries no information, and corrupts useful signals.

Noise! Noise! Noise!

Noise is unwanted, not welcome, an interference, and a disturbance! Annoying!

Noise can be Natural in source, coming from nearby or distant lightning, auroral currents, Jupiter, the Galaxy, our Sun, snow or rain static. Even our electronic receiver circuits make a small hiss.

Hams call natural noise QRN, and it is usually worse in the summer months.

Receivers may have an effective “Noise Blanker” which mutes the receiver momentarily during a noise pulse, such as a lightning discharge.

Noise! Noise! Noise!

Noise is also Man Made, we call it QRM, and it can come from any device that switches current:

- Switch Mode Power supplies, including cell phone chargers, 12V lighting power supplies, Aquarium heaters, variable speed furnace motor controllers, hair dryers, lamp dimmers, touch lamps, faulty electrical connections, compact fluorescent lamps, car ignition wiring, etc.

QRM is best dealt with at the source, to prevent the radiation of Noise signals. Finding and fixing a Noise source is a real detective job! Your club may have experienced Hams who can help.

Desired Signal to Noise Ratio

Properly detecting a signal requires more signal and less noise.

This is called the "Signal to Noise Ratio", SNR, usually expressed in Decibels. ie: a 20dB S/N is a pretty clear signal. a 3dB S/N is not easily copied by ear.

A 20dB S/N means the signal strength is 100 times the noise.

A 3dB S/N means the signal strength is just twice as loud as the noise, which is almost impossible to decipher.

Some digital modes can detect signals buried in noise, ie: - 18dB

A Bandwidth wider than the signal lets more noise into the receiver, which lowers the S/N ratio. Not a good idea.

Increasing the Receiver Sensitivity amplifies band Noise as well as desired Signal, and additional signal amplifiers create their own noise! Adequate Sensitivity means "just enough".

Desired Signal to Noise Ratio

Receiver design takes into account the maximum bandwidth a particular modulation method requires, the typical signal levels and noise levels found on the Ham bands, and does not go beyond what is required to successfully receive and select the desired signals.

Most modern receivers have a Radio Frequency Amplifier at the Input to the Receiver which can be turned on and off.

On the 160m, 80m, and 40m bands the RF Amp usually does not improve the Signal to Noise Ratio as signals are already quite strong on these bands and noise levels are high.

On the higher frequency bands, 30m, 20m, 17m, etc the band noise is generally lower and signals may be far weaker, so the RF amplifier may be able to increase the desired signal strength without also increasing the band noise too much.

Stability

Once tuned to a frequency we expect a receiver to stay on that frequency.

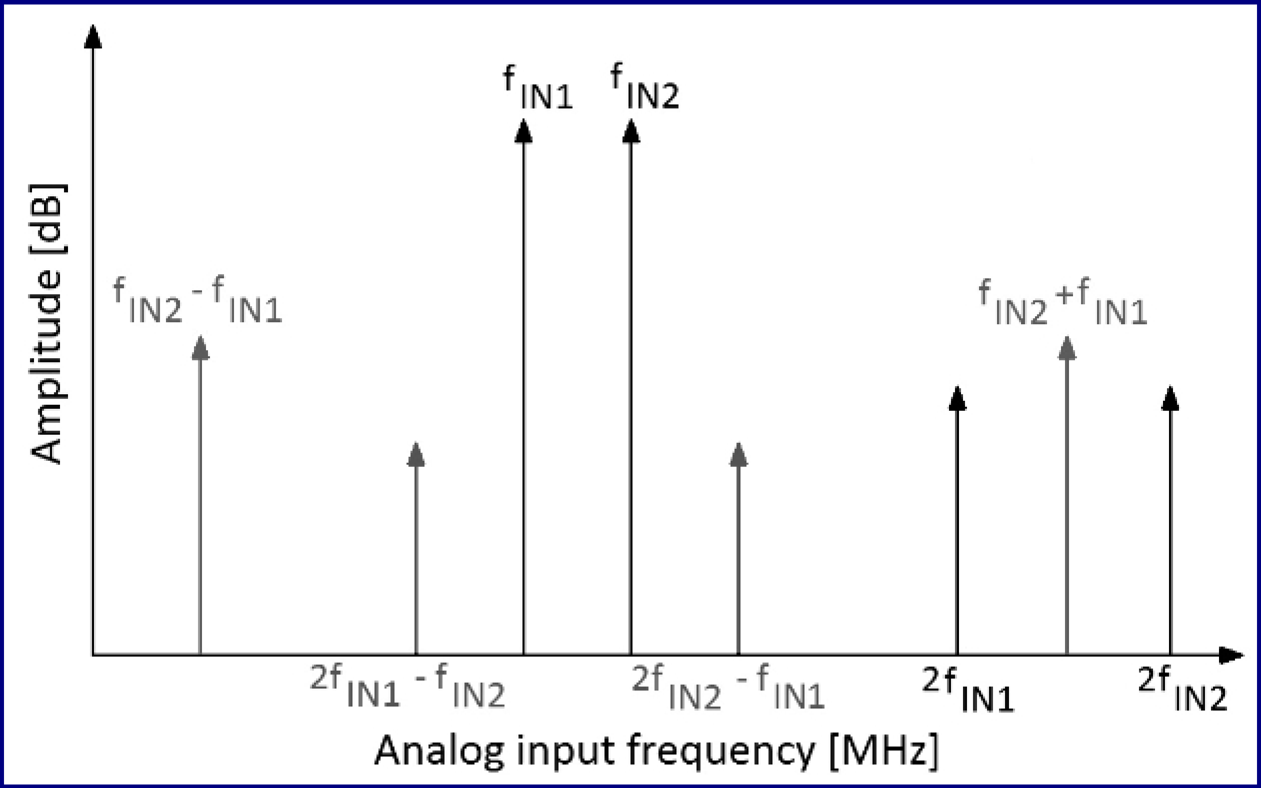
Drift, a slow change in frequency, will originate in the Local Oscillators that control the received frequency. Drift is due to tiny changes in the dimensions of the tuning components caused by the heat of operation, changes in circuit voltages, and component ageing. Careful design can minimize drift.

Modern Receivers Synthesize the local oscillators with reference to a precision Temperature Compensated Crystal Oscillator, a TCXO.

Frequency Drift after warmup can be less than one Hertz per hour.

Receiver Dynamic Range

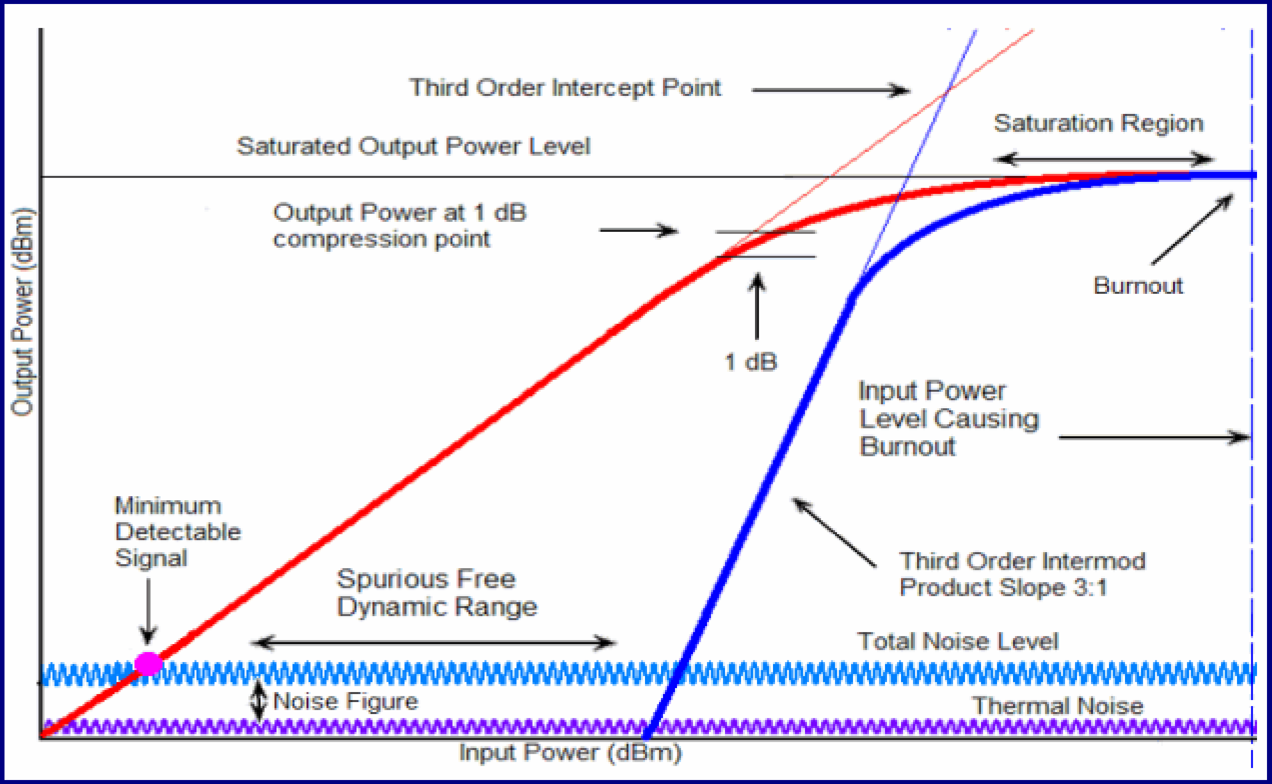
When signals pass through amplifiers the non-linear aspects of the amplifier will create mixing products, some of which will be close to the origional frequencies. These false signals may mask real signals, creating interference inside the receiver.



Receiver Dynamic Range Defined

Engineers measure the Dynamic Range of a receiver and specify the 3rd Order Intercept Point.

Rob Sherwood, NC0B, tests every receiver and posts results at: http://www.sherweng.com/table.html



Take a
Quick Break

A Brief Romp Through The History of Radio Receiver Development

There are Three Types of Radio Receiver

Direct Detection

A "Detector" or "Mixer" changes the Radio Frequency (RF) Signal directly into an Audio Frequency (AF) Signal which can then be fed into Headphones or a Speaker to make Audio.

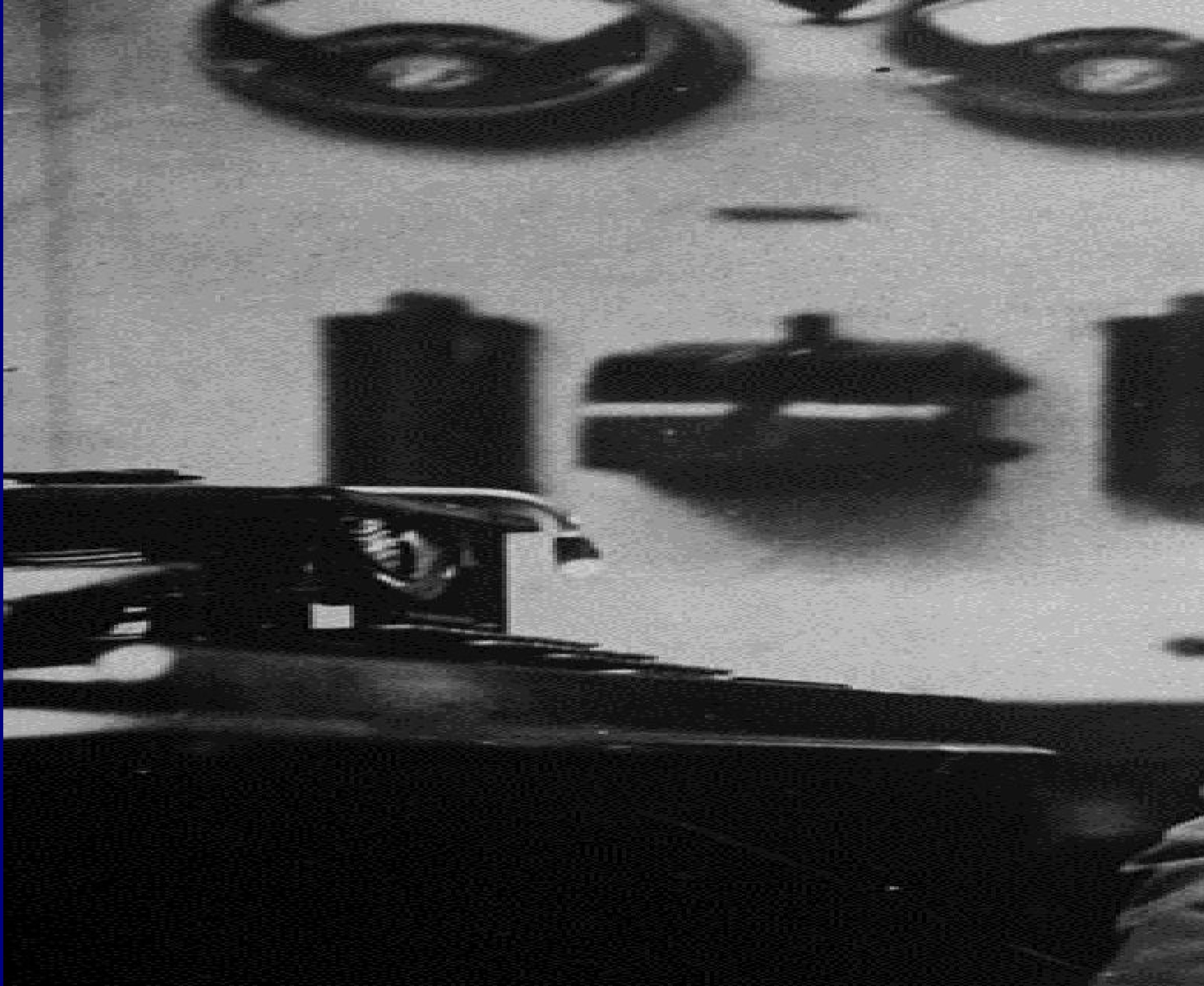
Superheterodyne

A "Mixer" or "Converter" changes the RF Signal into an Intermediate Frequency (IF) Signal where fixed Selective Filters can reject undesired signals, the IF signal can be Amplified, and then the IF signal can be Detected into Audio.

Software Defined

The Radio Frequency Signal is converted into a Digital Bit Stream, Processed by a Software Algorithm, then converted into Audio Frequency Signals to make audio.


OBACH'S
OBACH'S
Coherer Receiver, by Guglielmo Marconi, 1896
Marconi used this device for a famous public demonstration of wireless in
London's Toynbee Hall in 1896. At a public lecture given by William Preece,
chief engineer to the General Post Office, whenever Preece switched a



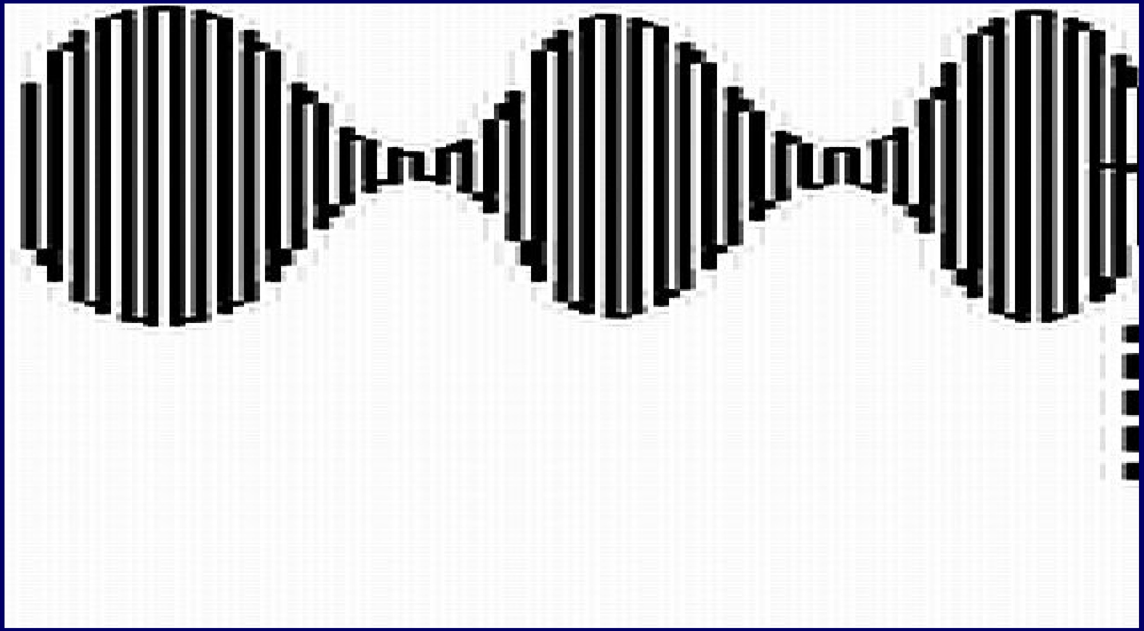
Crystal or Diode Detector

A Point Contact Galena Crystal Detector

A Simple Crystal Radio

The single tuned circuit provides limited selectivity and poorly limits receive response to nearby radio stations.

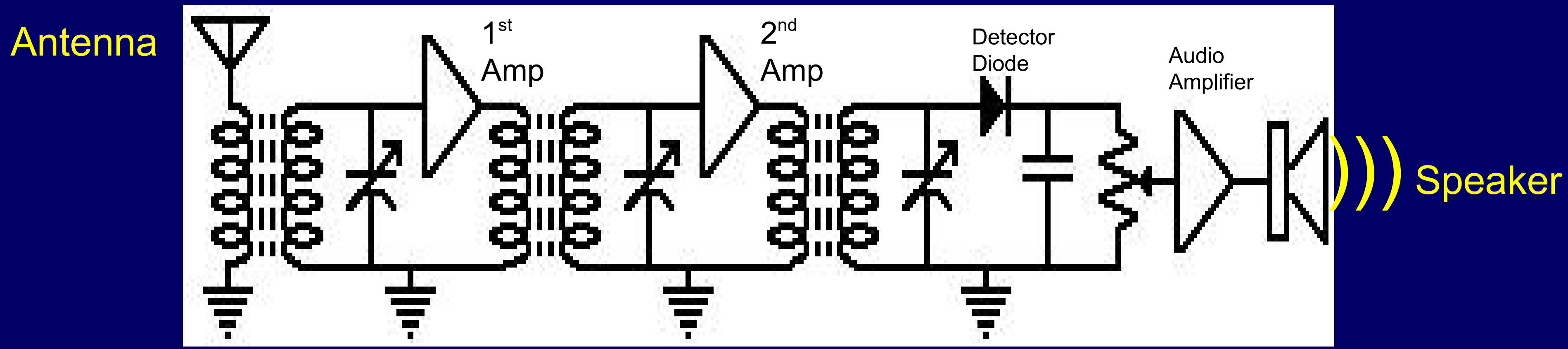
Drift is not an issue when the bandwidth is 50 kHz or more.



The Diode Detector rectifies the received radio energy, and high impedance headphones are required to hear the weak signal. A longer antenna and better ground improves received signal strength.

Germanium Point Contact Diode 1N60A

Tuned Radio Frequency Receiver

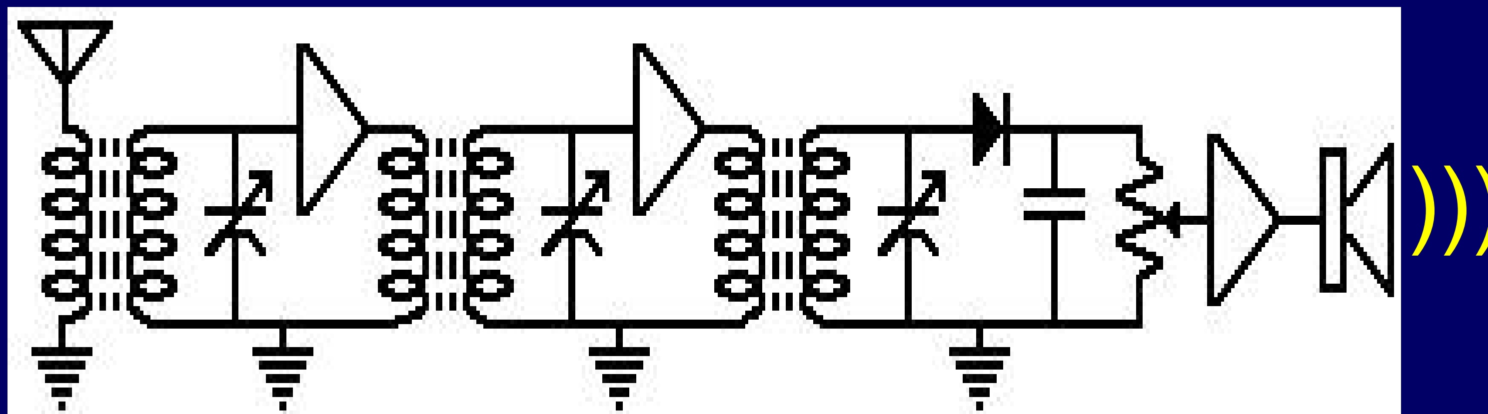


Incoming Signals induce a current in the antenna. The antenna winding couples signal magnetically into the First Tuned Circuit, which provides some selectivity.

The first RF Amplifier increases the signal strength by perhaps 100 times, (20dB), and couples into the Second Tuned Circuit, which provides more selectivity.

The second RF Amplifier increases the signal strength even more, perhaps by another 20dB, and couples signal into the Third Tuned Circuit, for even more Selectivity.

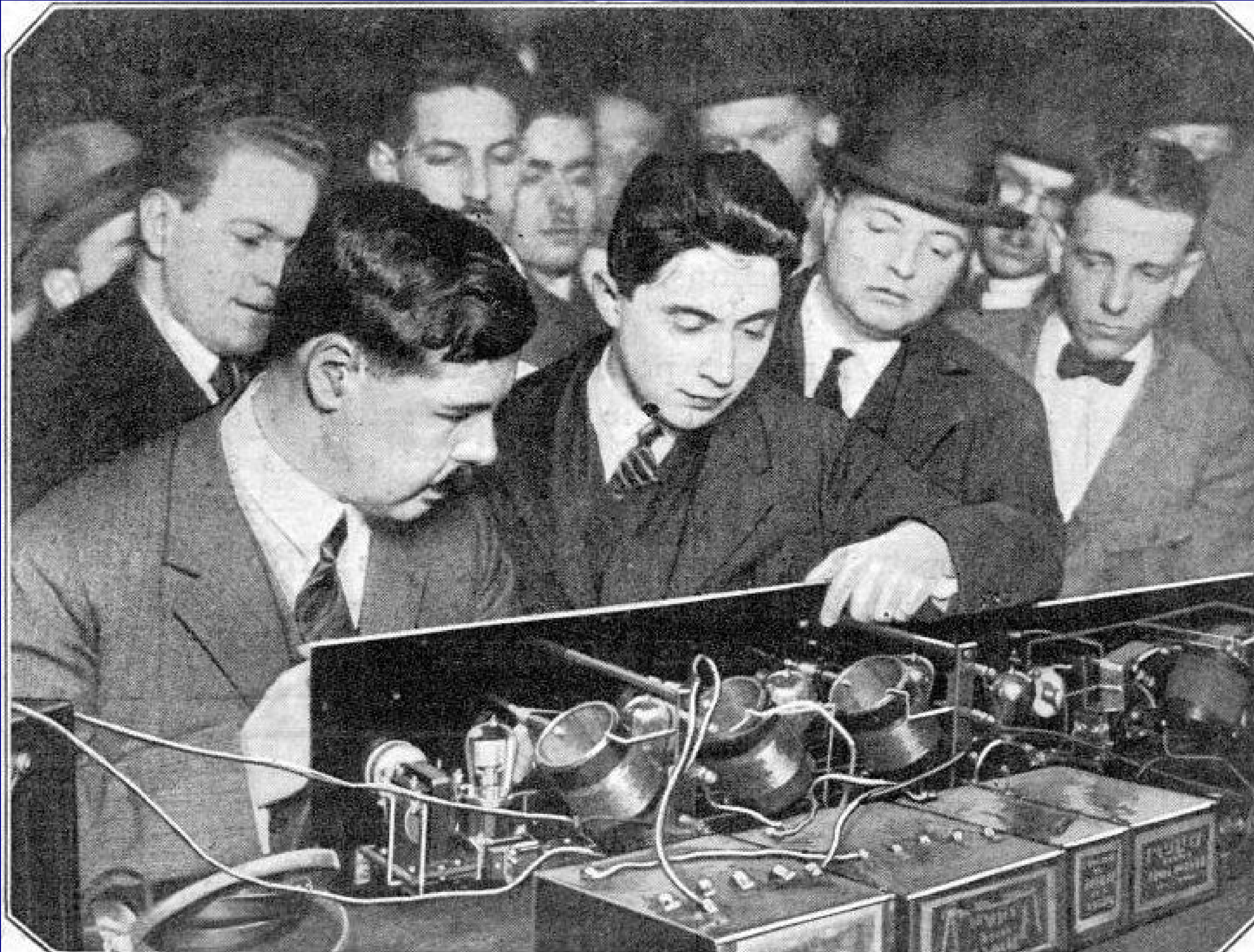
Tuned Radio Frequency Receiver

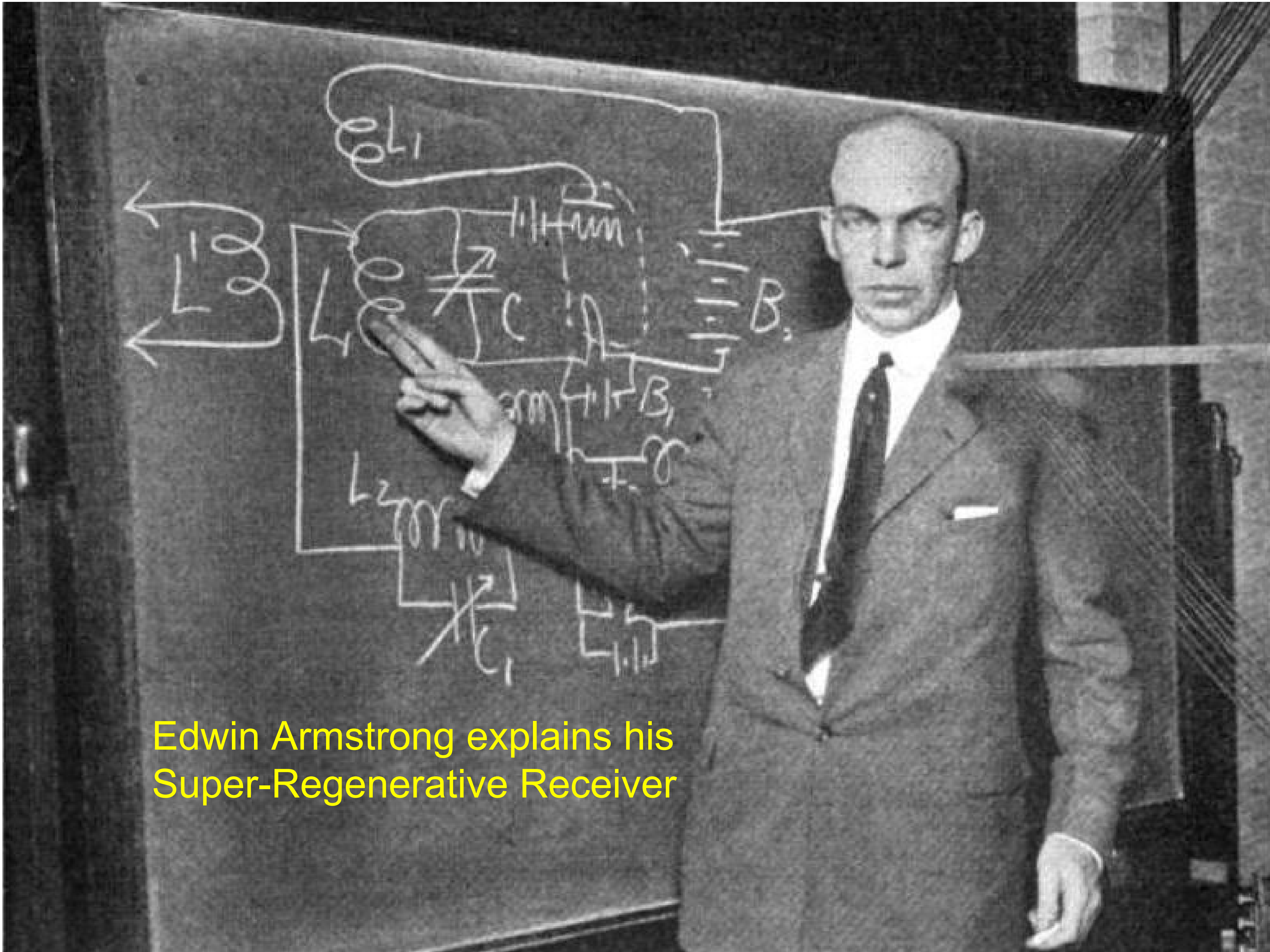


The desired signal, now amplified by 40dB or 10 000 times is detected by the solid state diode to produce the audio signal.

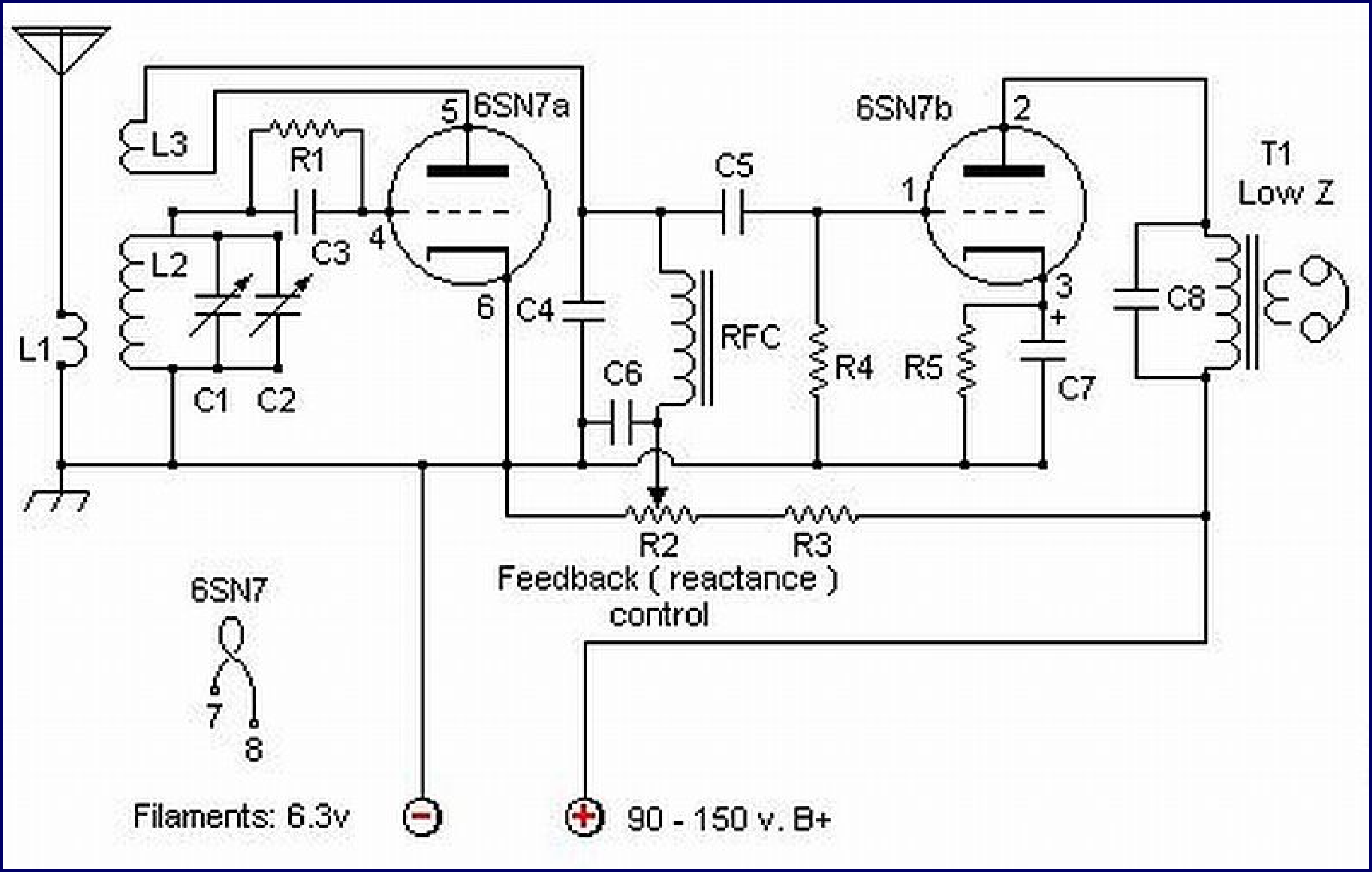
Even after all that amplification, in order to drive a loud speaker more audio gain is required.

A volumn control feeds just the right amount of audio signal into the Audio Amplifier, which drives the speaker.





Edwin Armstrong explains his
Super-Regenerative Receiver



Single Tube Regenerative Receiver from post WWII ARRL Handbooks, developed by Edwin Armstrong.

Receive Broadcasts on a Loop

With THIS Super-Regenerative Receiver

Price complete, unassembled,
$75.00
No. RG600

Includes all necessary parts, with drilled and finished Bakelite panel, filter unit and choke coils of correct values especially designed and manufactured by us. Loop and loud speaker extra.

Price, completely assembled in attractive solid mahogany cabinet, ready for wiring,
$95.00
No. RG601

Harkness Booklet free with each set. Loop and loud speaker not included.

Described by Kenneth Harkness in his new booklet on

The Construction of Super-Regenerative Receivers

Approved by the New York Evening Mail Radio Laboratory and Leading Radio Experts throughout the Country

Literary Digest says: "full instructions are given by Mr. Harkness for the home construction of various Super-Regenerative circuits."

N. Y. Evening Mail says: "these sets have been examined by a representative of the *Evening Mail*, and bear out exactly the statements made in the booklet."

Washington Herald says: "The booklet is authoritative, fully illustrated and well arranged. It. . . .is comprehensible by the radio expert and the experimental novice as well."

Atlanta Journal says: "One of the most complete sources of information. . . . in which Kenneth Harkness gives a detailed description of the Armstrong Circuit."

This new and improved edition of the popular Harkness booklet describes the construction and operation of two different Super-Regenerative Receivers, with full and detailed mechanical drawings, wiring diagrams and numerous photographs. It also describes the theory of super-regeneration in detail, with four diagrams.

Price of Booklet 50 Cents
from your own dealer or direct

Radio Frequency Specialists

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256 West Thirty-fourth Street, New York City

Designers and Manufacturers of the "Vox Humana" the Receiver with the Living Voice

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its class for the last 10 years. Over th
improved by making different modificat
new types of valves etc. We decided th
to endeavour to improve the Hikers On
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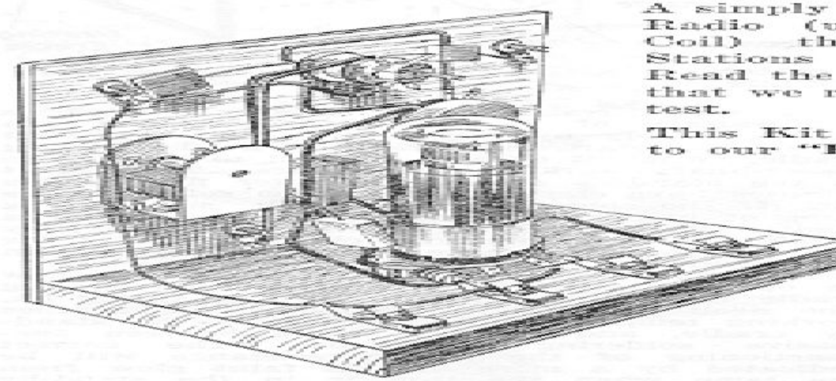

Parts List

1 Baseboard and Panel.
1 1Q5GT or DL36 Valve.
1 Octal Valve Socket.
1 Special Iron Cored Coil.
1 .0005 mfd. Air Spaced Variable Condenser.
1 .5 meg. Volume Control.
1 S.P.S.T. Toggle Switch.
1 .00005 mfd. Mica Condenser.
1 .0001 mfd. Mica Condenser.
1 .001 mfd. Mica Condenser.
1 2-Megohm Resistor.
8 Fahnstock Clips.
2 Knobs.
6ft. Hook-up Wire.
1 9-volt "C" Battery.
1 1½-volt "A" Battery.
SUNDRIES: Solder Lugs, Screws, Nuts and Bolts.

COMPLETE KIT AS ABOVE.
Cat. No. AK2085 .. £2/15/-
(Headphones Extra.)

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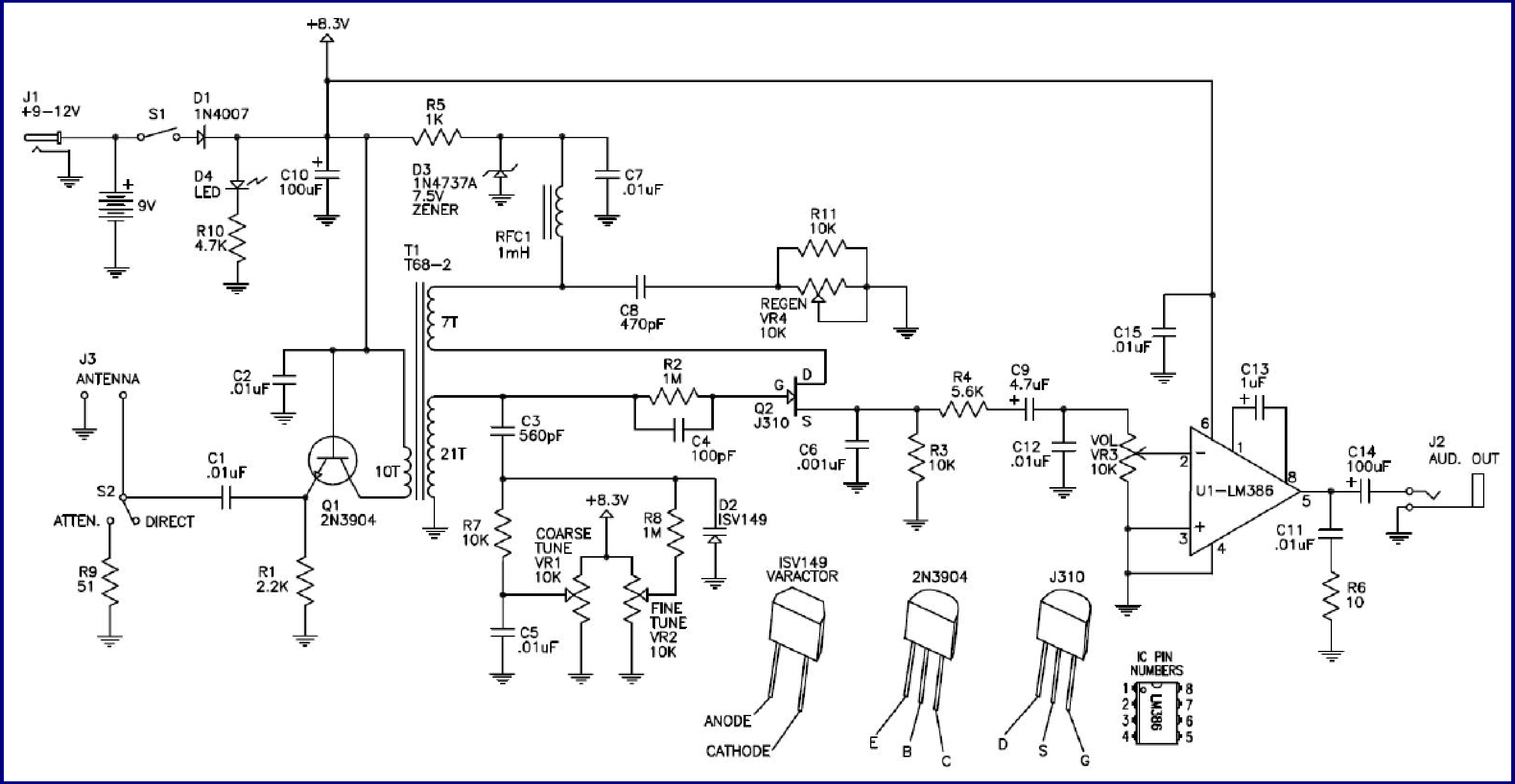
T1
VR1
VR2
VR4
C2

QRPGuys.com Regen Receiver

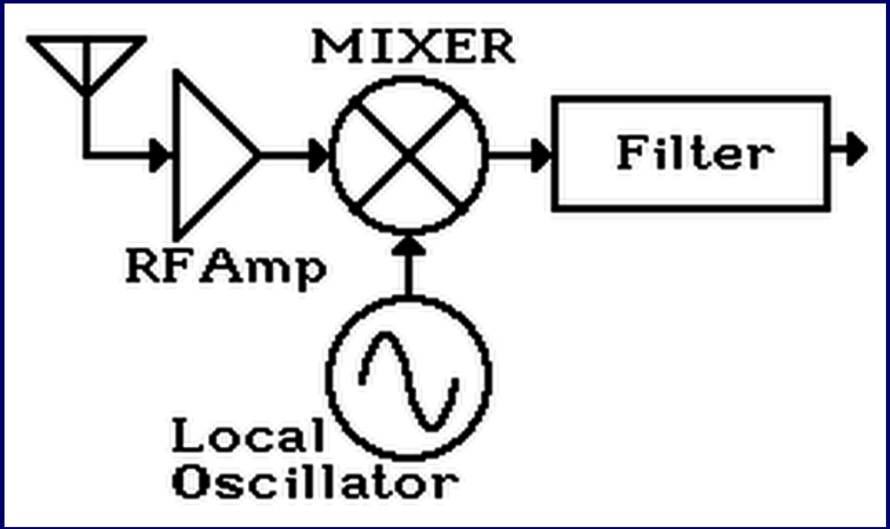


An evening build, & one of the kits undertaken at the LARC Kit Building Sessions.

Costs $35.00 USD plus shipping.

Edwin and Marion Armstrong on their honeymoon at Palm Beach, Dec, 1923 with the Superheterodyne radio he built for her as a wedding gift.

Superheterodyne Mixer

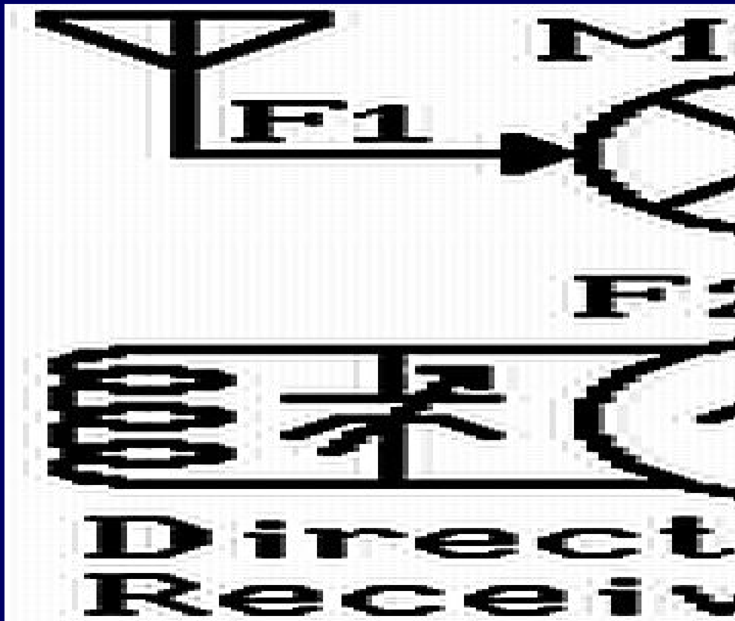


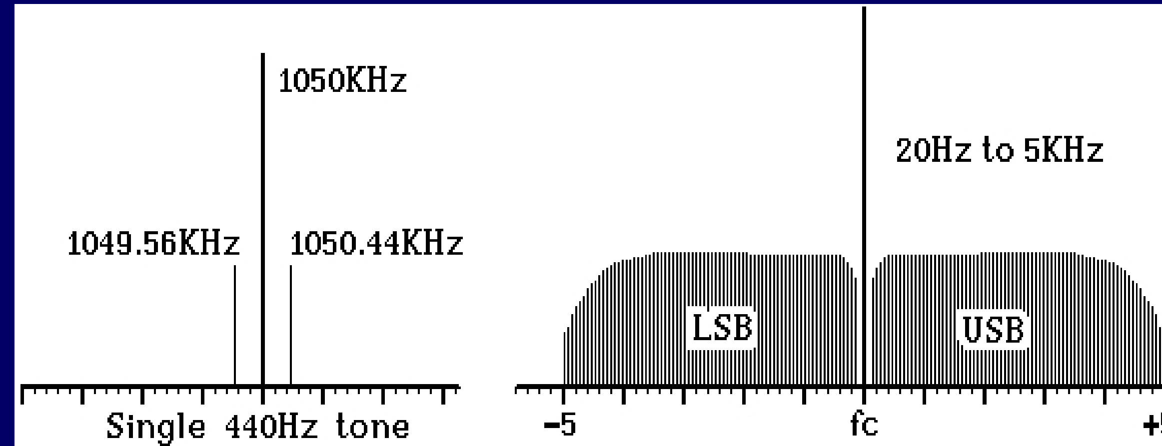
A Mixer uses a diode, transistor, or vacuum tube, which is switched rapidly between conducting and nonconducting states by a Local Oscillator. This Non-Linear operation will mix or "Heterodyne" the incoming RF signals with the Local Oscillator to create both Sum and Difference signals in the output.

These new Sum and Different signals, at different frequencies, maintain all the Attributes of both of the origional signals.

A Filter may be used to Select one frequency (eg: 455kHz) and reject signals at all other frequencies.

Direct Conversion Receiver



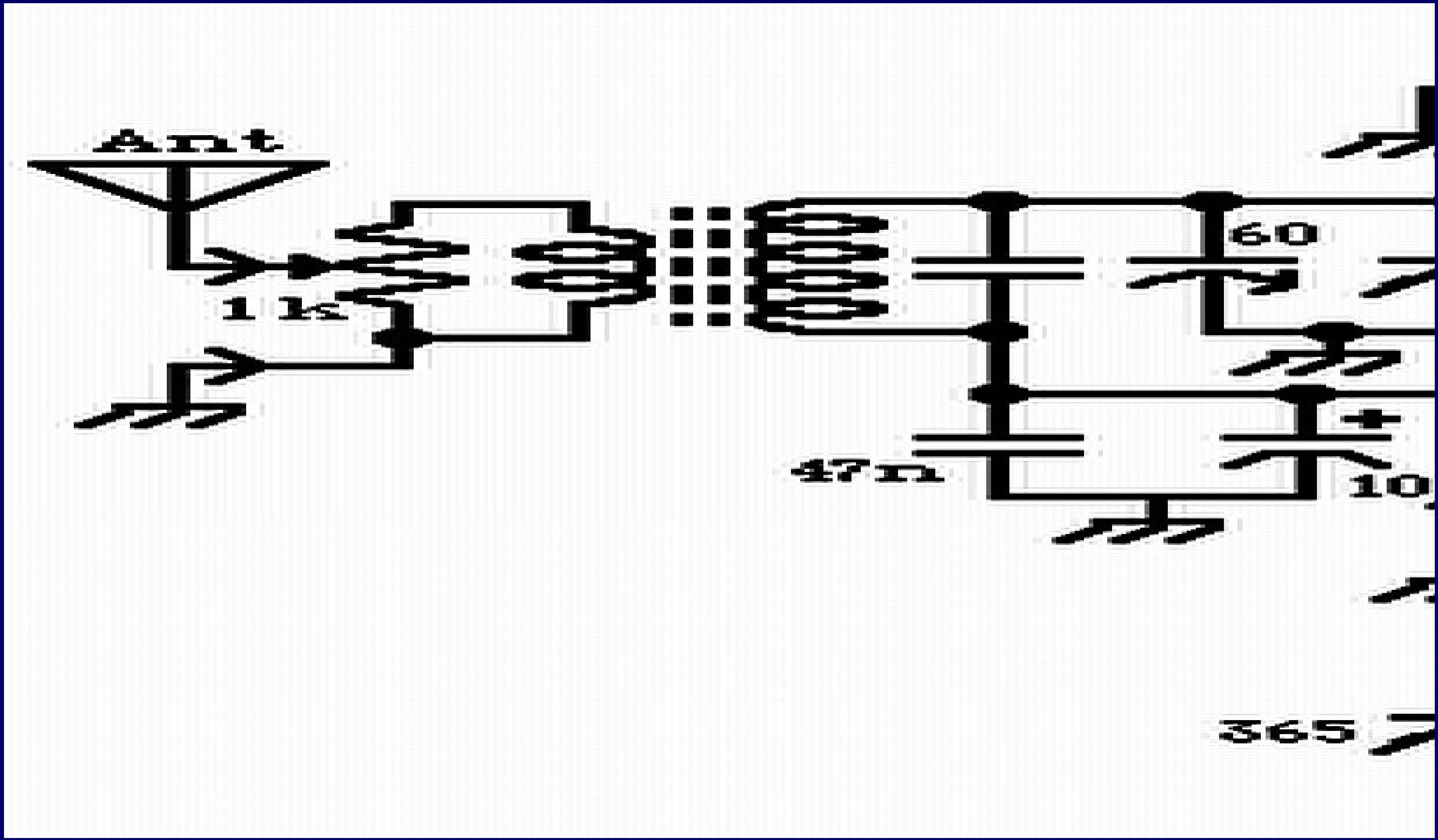


Carrier Modulation creates sidebands on either side of the carrier.

In a Direct Conversion or Synchrodyne Receiver the local oscillator is tuned exactly to the carrier frequency and Hetrodynes the information carrying sidebands directly to audio frequencies. A low noise audio amplifier brings the signals to sufficient strength for headphones or a speaker.

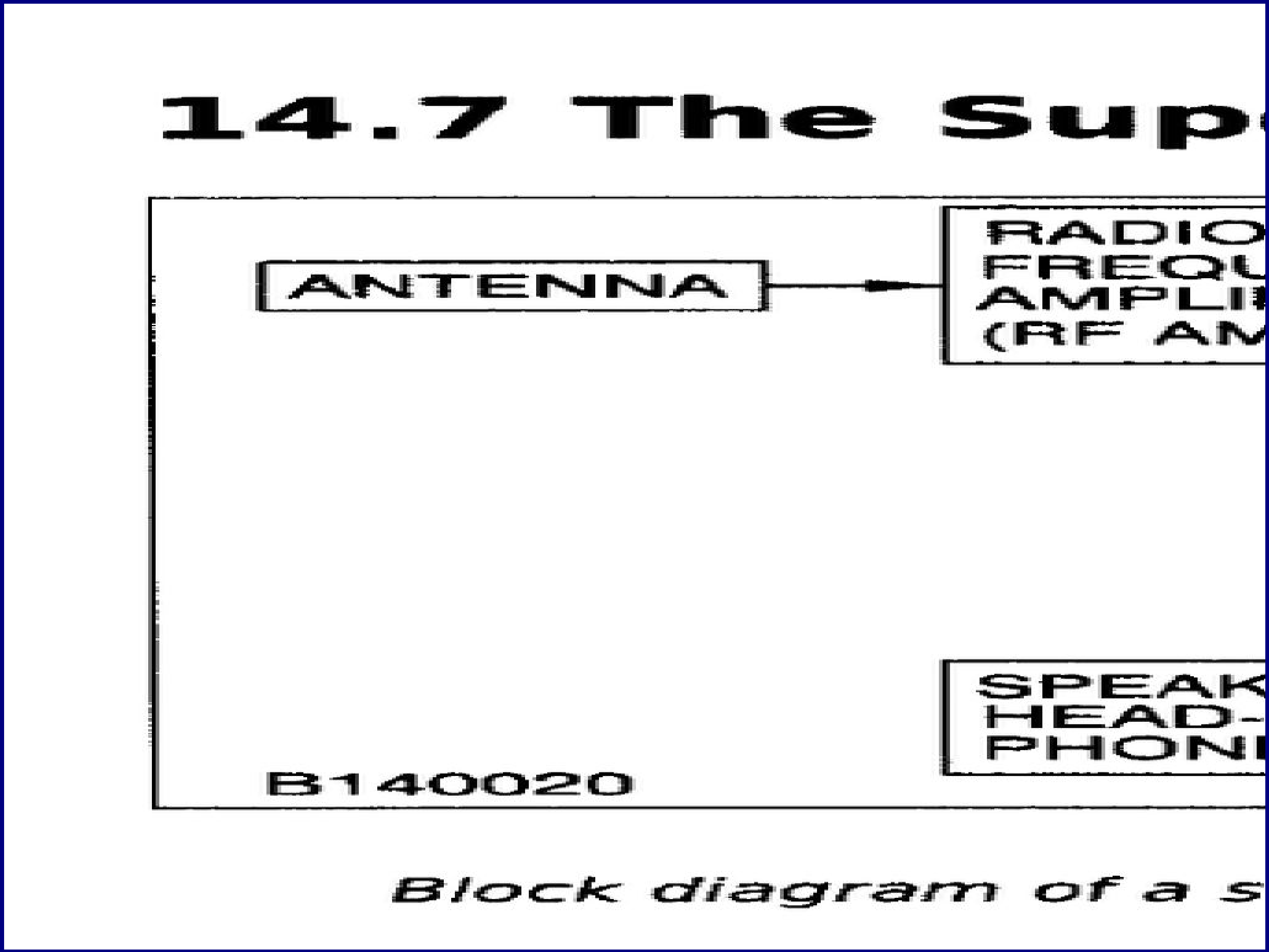
Both Upper and Lower Sidebands are demodulated equally, which may create interference if the band is crowded with signals. This simple receiver is most often used in QRP rigs.

Neophyte Receiver QST Feb 1988



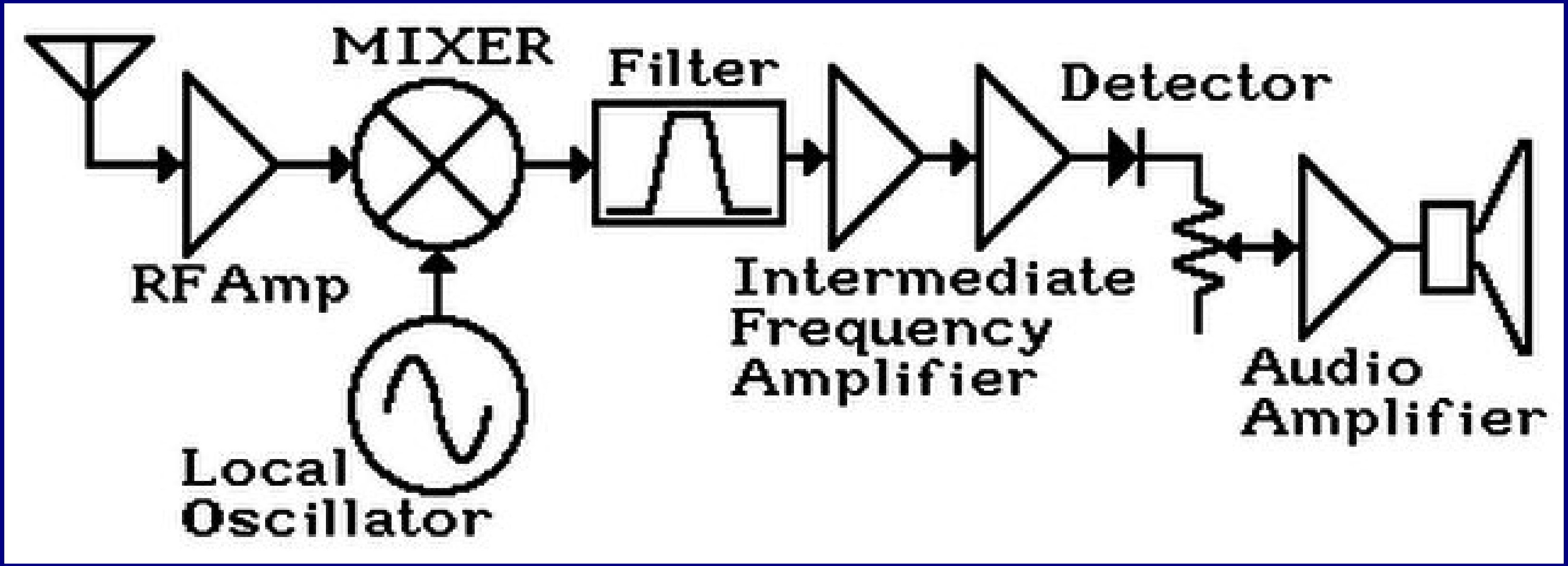
Direct Conversion 40m version shown. Inductors are Green core 10.7MHz IF transformers, or purpose wound Toroid coils. Specs are 0.5μV across 50Ω, BW of 7.5kHz, ½ watt audio out.

A Home Made Neophyte Receiver
for 80m Code Band



Local Oscillator controls the received frequency. Nobody calls it a HFO! The LO can be above (high side) or below (low side) the received frequency by an amount determined by the IF frequency.

The AM Superhetrodyne Receiver

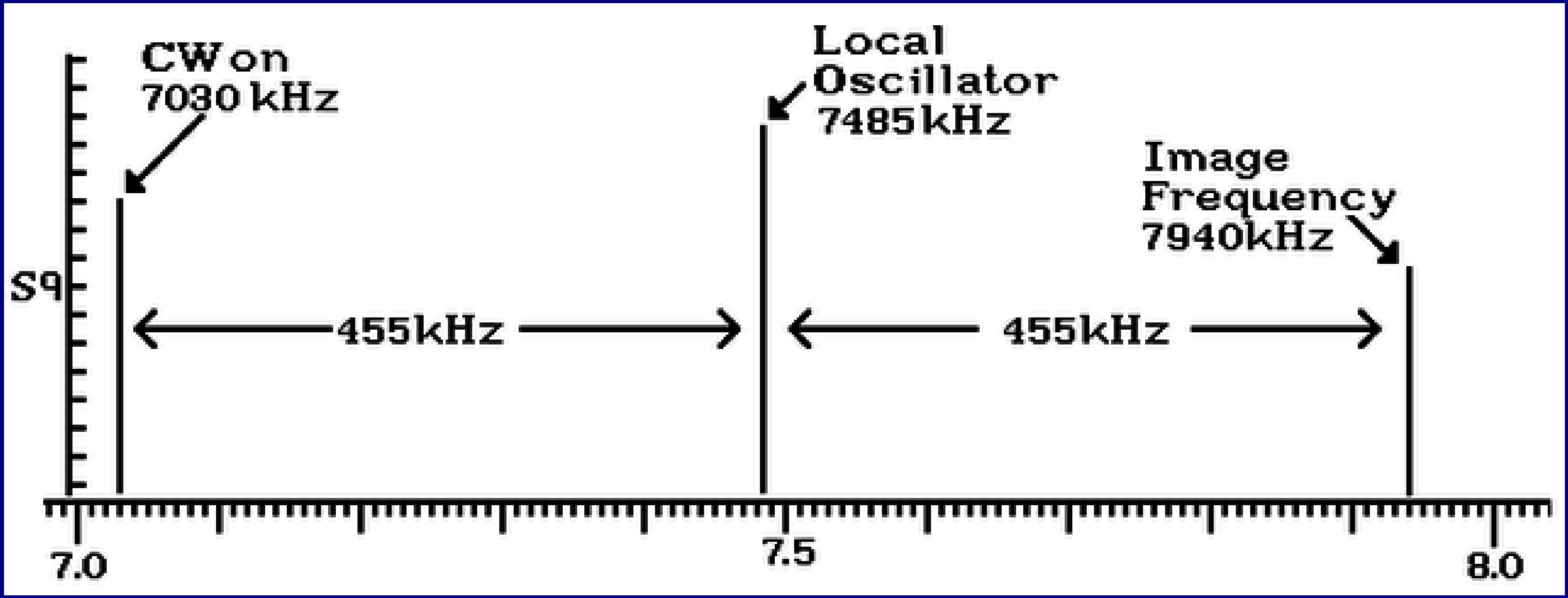


A Mixer and Local Oscillator Hetrodyne the desired signals to an Intermediate Frequency, such as 455kHz, where a Selective Filter passes the desired signal and rejects all other signals.

An Intermediate Frequency Amplifier provides Selectivity and increases the signal strength to the Detector Diode.

A Volume Control adjusts signal level to an Audio Amplifier which drives a speaker or earphones.

The Superhet Image Problem



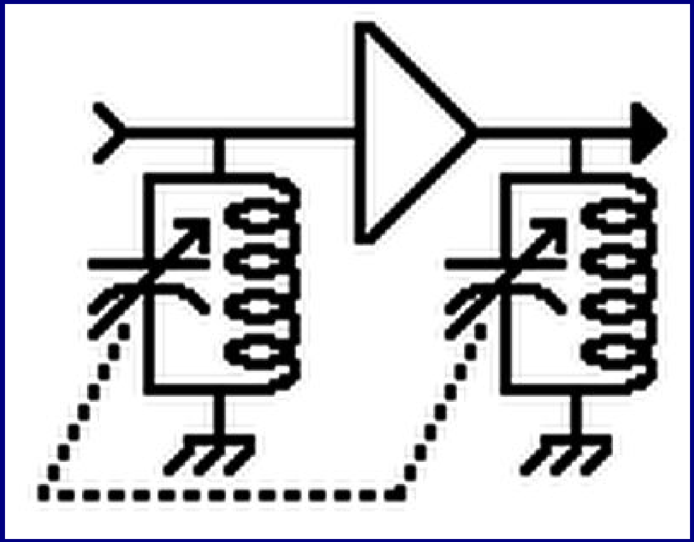
We want to receive a signal at 7030kHz, in the 40m band, converting it to an I.F. of 455kHz. The Local Oscillator is set to 7485kHz.

7485kHz - 7030kHz = 455kHz So far so good!

A strong station begins transmitting at 7940kHz! Being 455kHz away from our L.O. means it will create an IF signal at 455kHz.

This SuperHet Image Frequency must be rejected before it can reach the mixer.

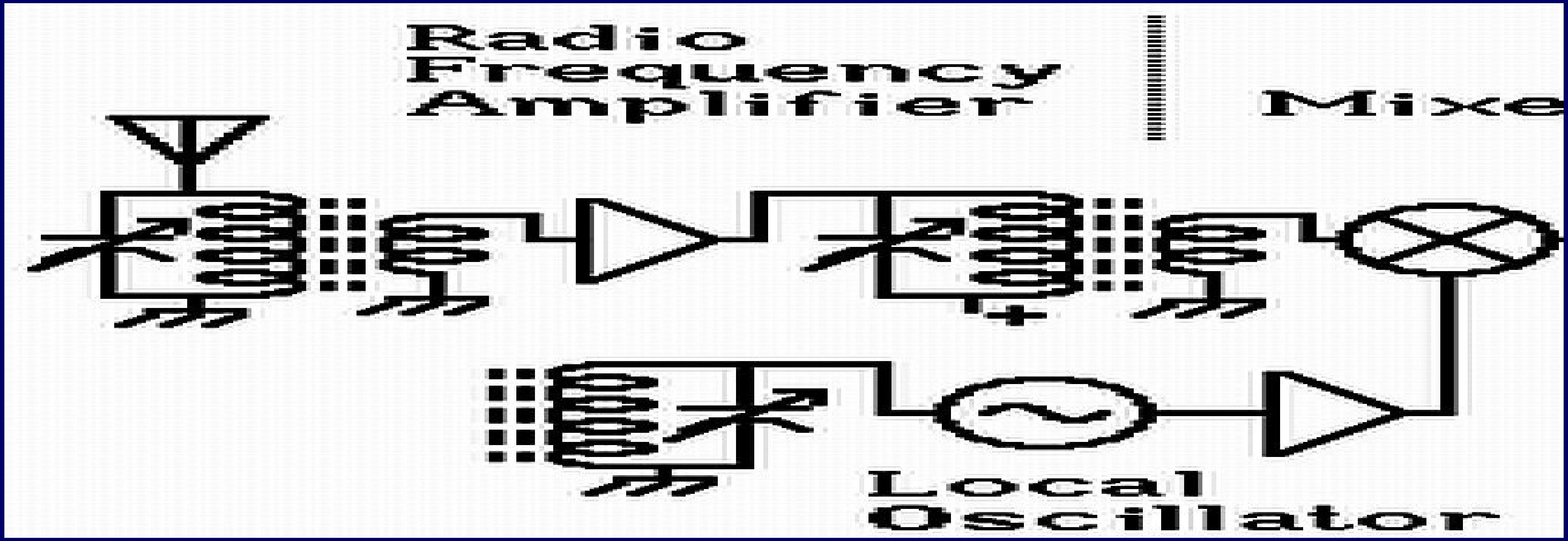
Radio Frequency Pre-Selector or Pre-Amp



Many Superhet Receivers using low frequency IFs use a Tunable Radio Frequency Pre-Selector, usually along with some RF amplification, to select the desired Radio Frequency Band and substanially Reject the Image Band.

The Operator may be required to seperately tune this Pre-Selector to peak the signal strength. This feature was common on receivers up to about 1980, when high frequency IFs became common.

The AM Superheterodyne Receiver



The RF amplifier sets the receiver noise level, compensates for Mixer Losses, and Pre-Selects a narrow band of signals.

The L.O. and Mixer convert received signal to the IF, where most of the selectivity and signal amplification occurs.

The Diode Detector rectifies the Amplitude Modulated carrier to Audio plus a DC voltage from the carrier which is used for AGC to control the gain of the IF stage and often the gain of the RF Amp.

Circa 1954 five tube Superheterodyne receiver with AM band, three short wave bands, and a feedback type BFO for CW.

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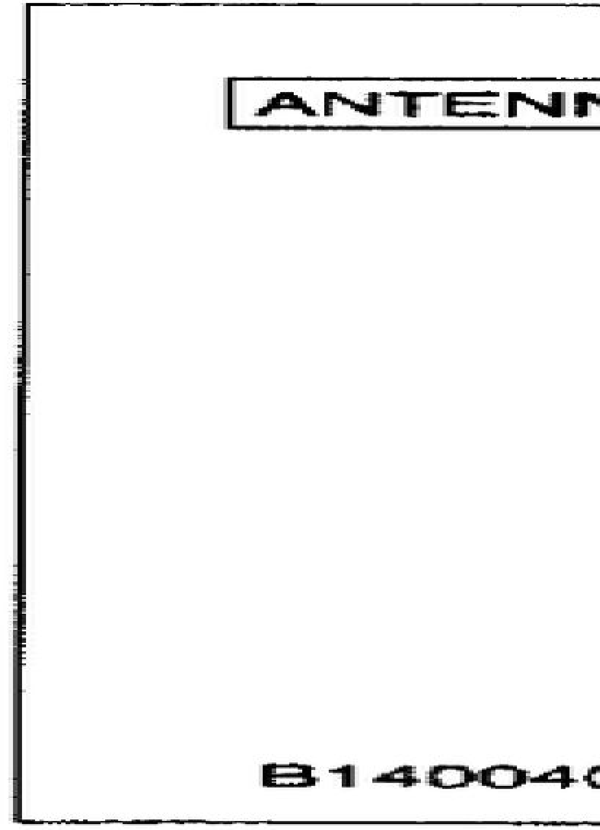
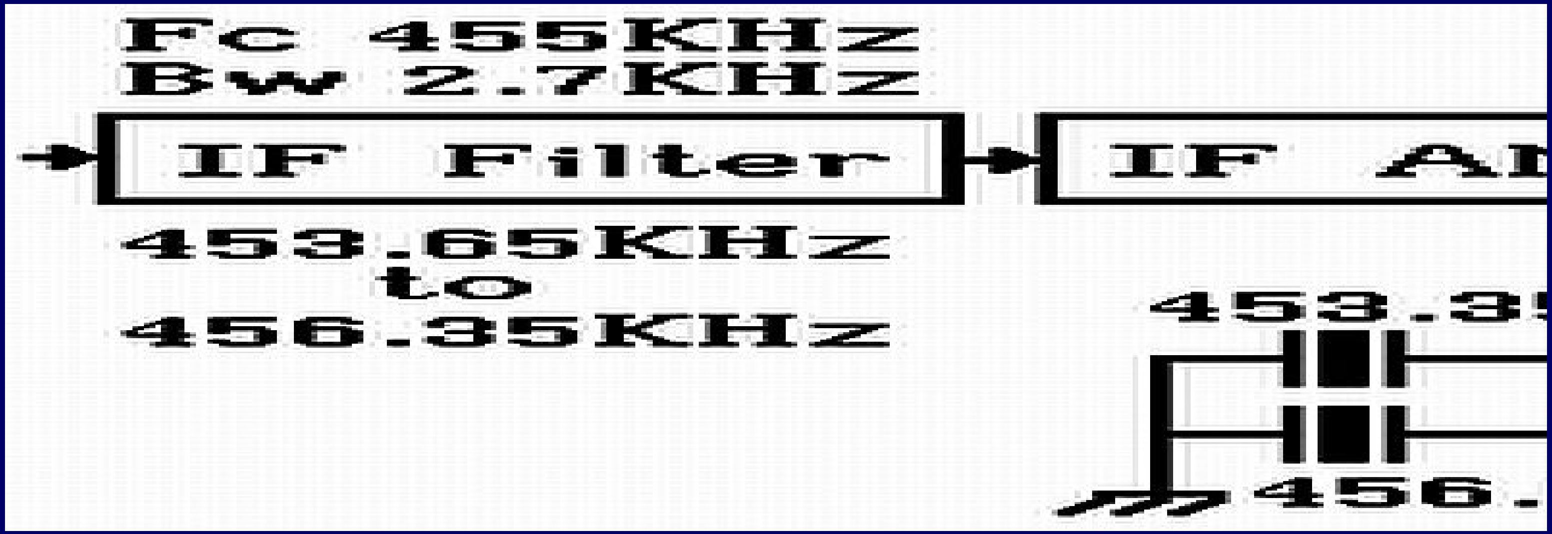


Block di

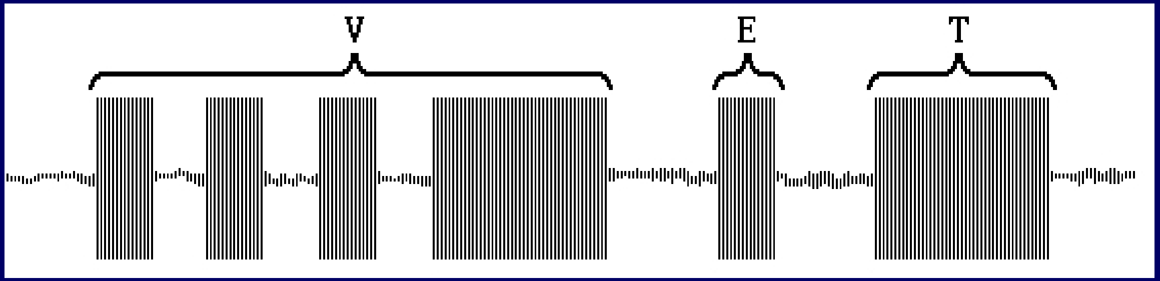
The Radio Carrier, absent in CW and SSB, provides a frequency and amplitude reference for the received signal. The BFO subsitutes for the missing Carrier, and will need to be finely tuned to make SSB voice intelligible and natural.

The Beat Frequency Oscillator

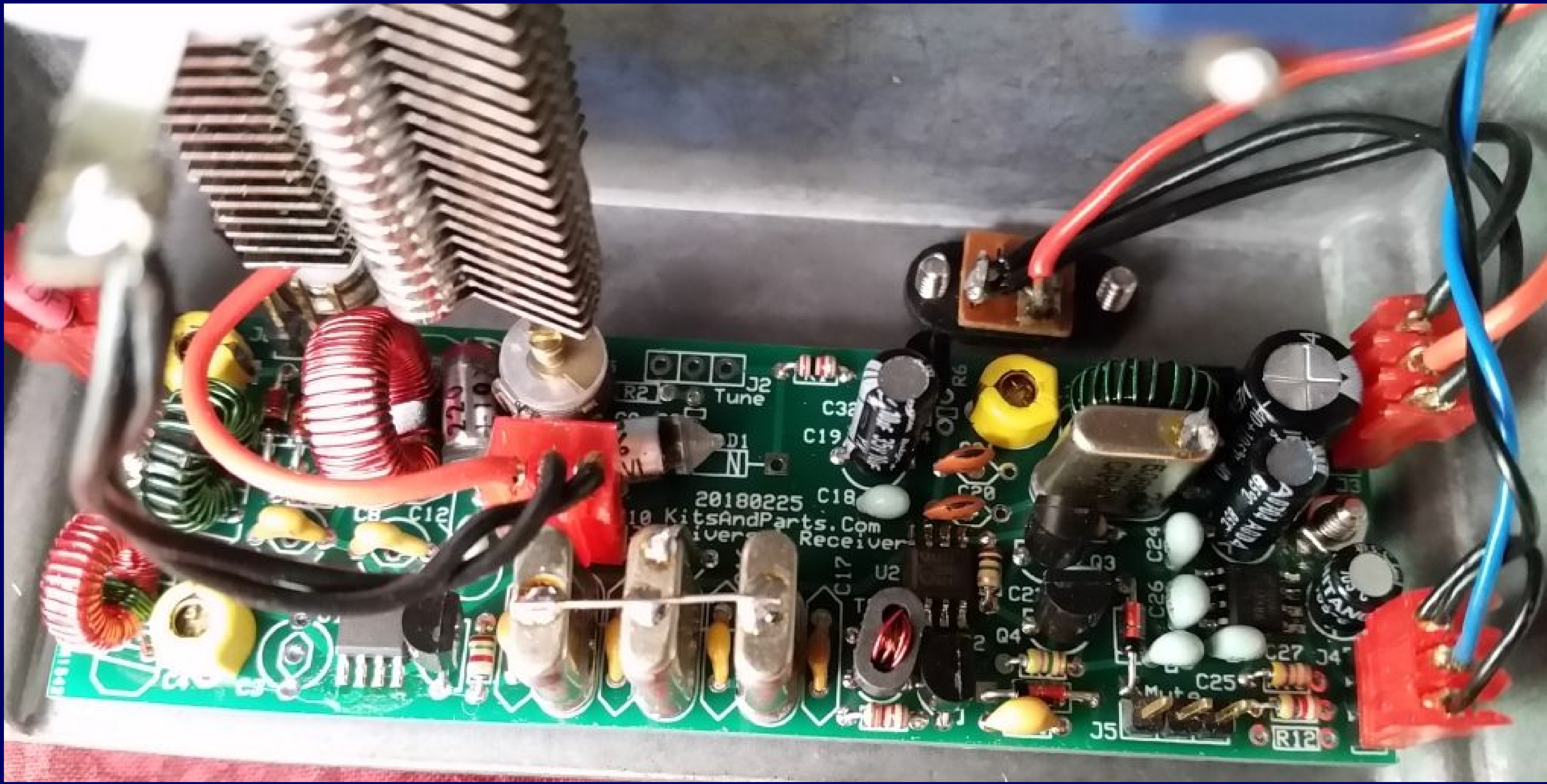


Single Sideband Suppressed Carrier and Continuous Wave signals do not have a Carrier Wave for a diode detector to hetrodyne.

A Beat Frequency Oscillator is required to create a substitute carrier to convert the I.F. signal to audio. The BFO may be tuneable, as in post war receivers, crystal controlled or synthesized in the frequency tuning circuits.



A Simple Superhet Receiver

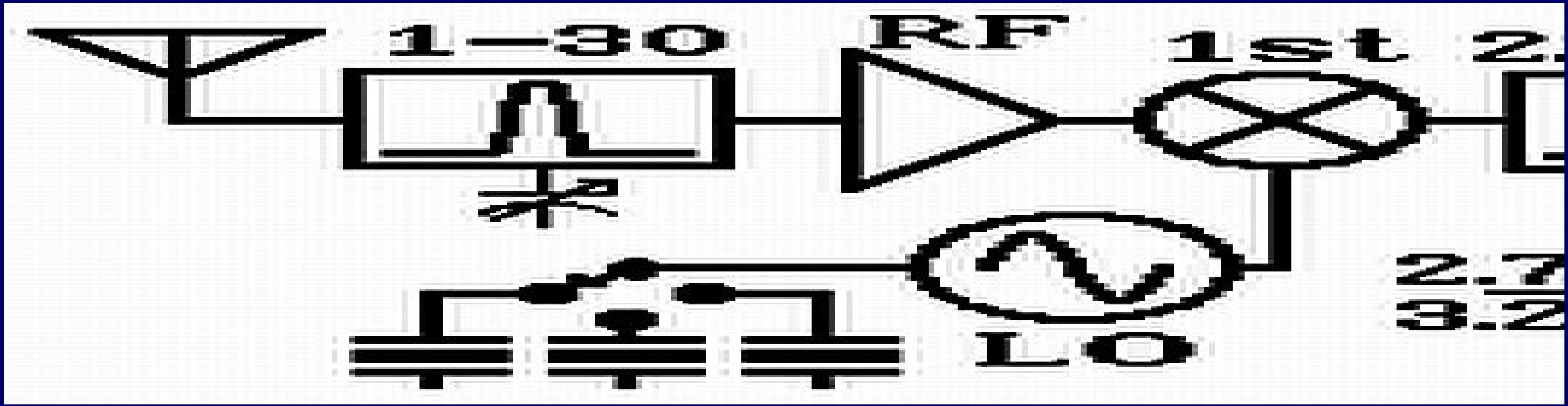


NE602 Front End mixer, 3 Crystal IF Filter, NE602 BFO Product Detector and LM386 Audio Amplifier. Very Sensitive and Selective, a fun kit to build, from www.KitsandParts.com for $20.00 USD plus shipping.

Dual Conversion Superhet Receiver “Boat Anchor” from 1955

Collins Receivers, Transmitters, and Transceivers still attract top dollar at Flea Markets and on line Swap Shops.

Dual Conversion Block Diagram



Front End Pre-Selector passes a narrow band to the RF amplifier.

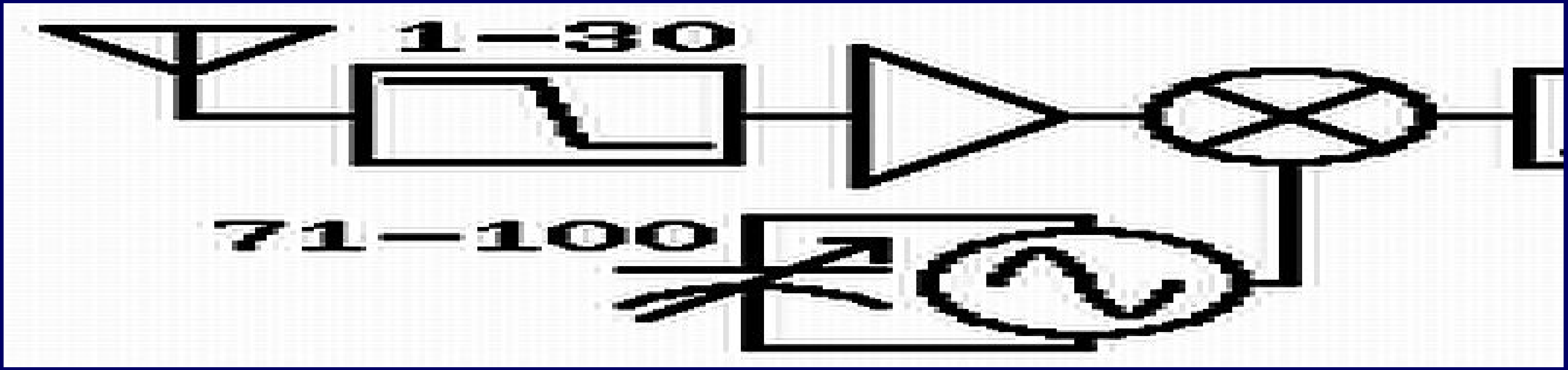
Crystal Controlled Band Selection first local oscillator mixes a 500 kHz chunk to a mid frequency IF, typicaly 2.3MHz to 2.8Mhz.

A tuneable second local oscillator mixes the 1st IF to a second narrow IF, tuning across the 500 kHz.

The receiver selectivity and most of the gain is in the second IF.

A crystal controlled BFO and Product Detector convert the IF to audio, with switchable Sideband selection.

Up Converting Superhet Receiver



Up conversion moves the Image Range into the VHF, which a 30 MHz low pass front end filter easily removes.

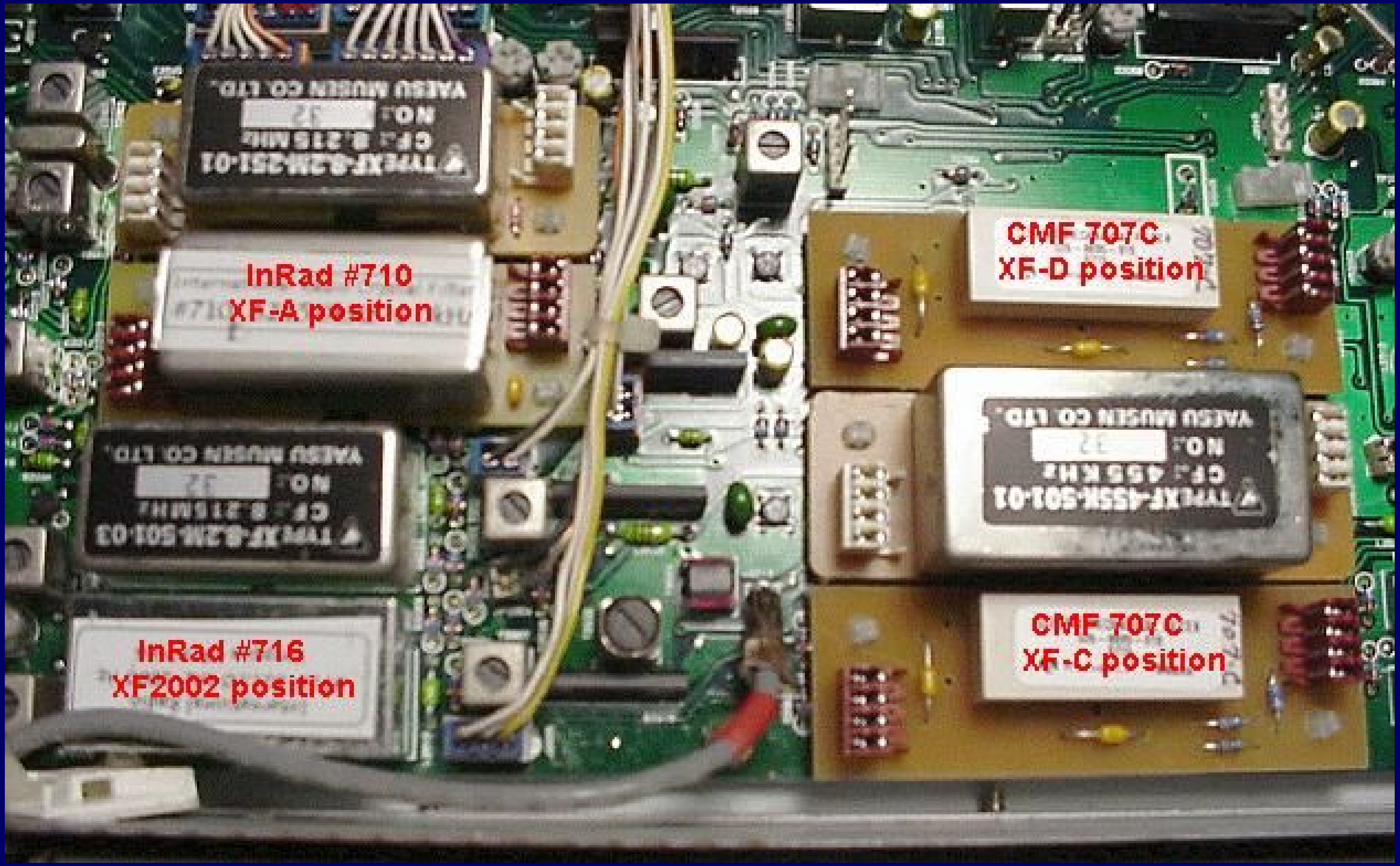
The VHF Local Oscillator tunes 70 MHz above the receive frequency.

The 1st IF sets a wide bandwidth, 6kHz to 15kHz wide "Roofing Filter" which provides a first level of selectivity.

The 2nd Local Oscillator and mixer converts the 1st IF to the 2nd IF, where all of the narrow band selectivity is defined. The 9 MHz filters may be switchable.

The BFO and product detector converts the 9 MHz IF to audio, followed by an audio low pass filter and audio amplifier.

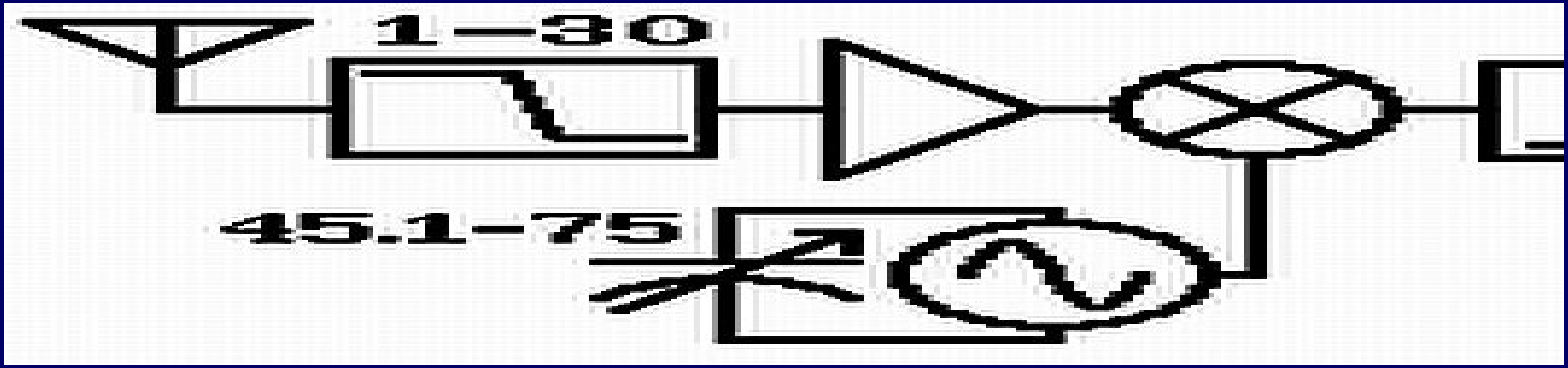
Intermediate Frequency Filters



Multiple Crystal Filters provide flexibility to chose an optimum bandwidth to match receive conditions and modes. Each filter can be $100 to $250. This is the filter deck of a Yaesu FT-1000-MP

Crystal Controlled Dual Conversion vacuum tube receiver, still a favourite of DXers and rag chewers. Sometimes seen at premium prices on the Swap Shop or Flea Market tables.

Digital Signal Processing Receiver



An Upconverting Front End provides some RF gain, selectivity and AGC control. Instead of an IF system the signal is digitized and then processed with software filters and demodulation.

Software filters allow almost infinite choice of bandwidth, from 15 kHz for FM on 10m & 6m to an ultra narrow 80 Hz for slow CW.

Literally everything in the receive and transmit path is configurable, which can be quite overpowering and confounding at first.

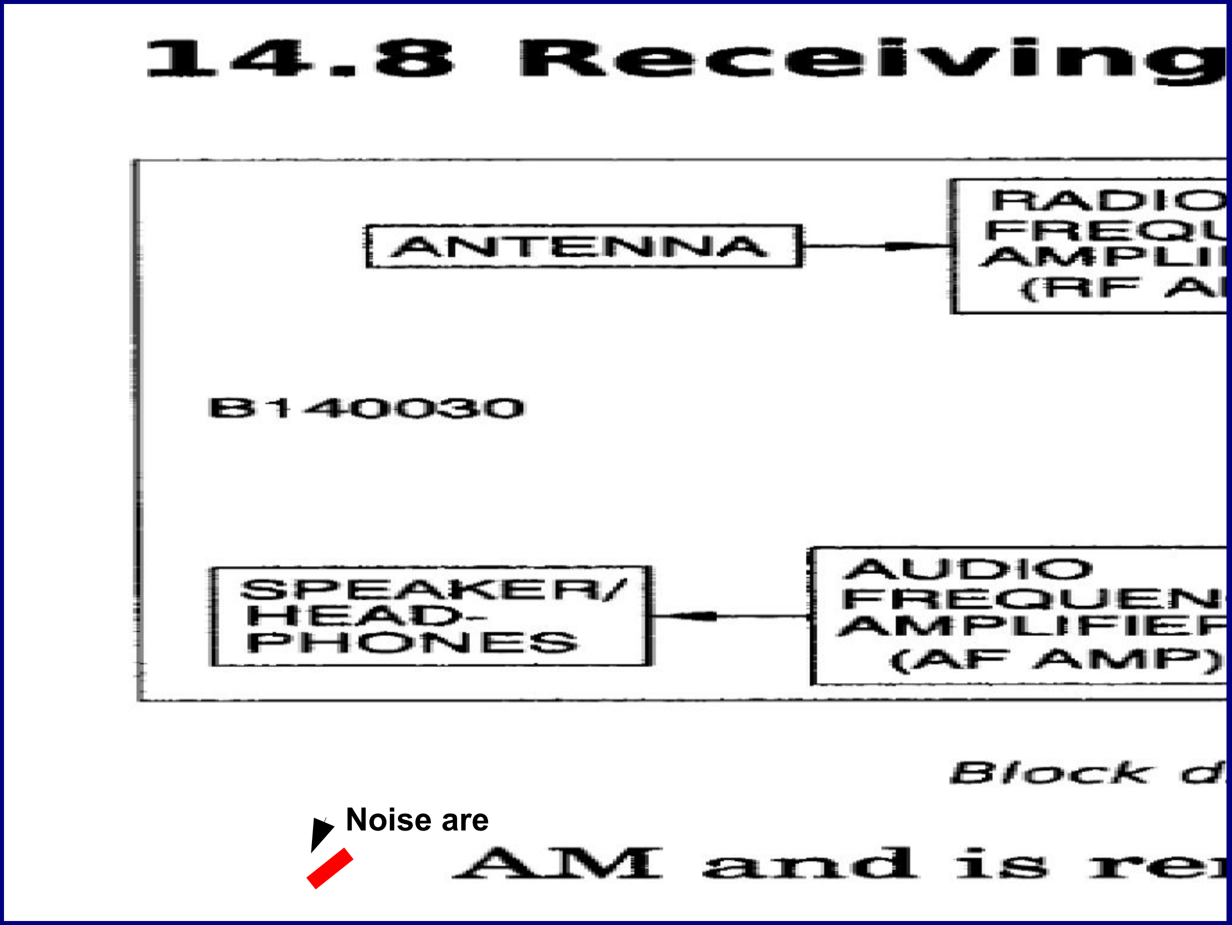
Digital Noise Blankers can be trained to completely ignore repetitive signals and man made noises.

Yaesu FT-950 DSP Receiver

No question a darn good receiver. Flexible, easily learned, dual VFOs, easy split operation. Stable. Affordable.

Receiving Frequency Modulation

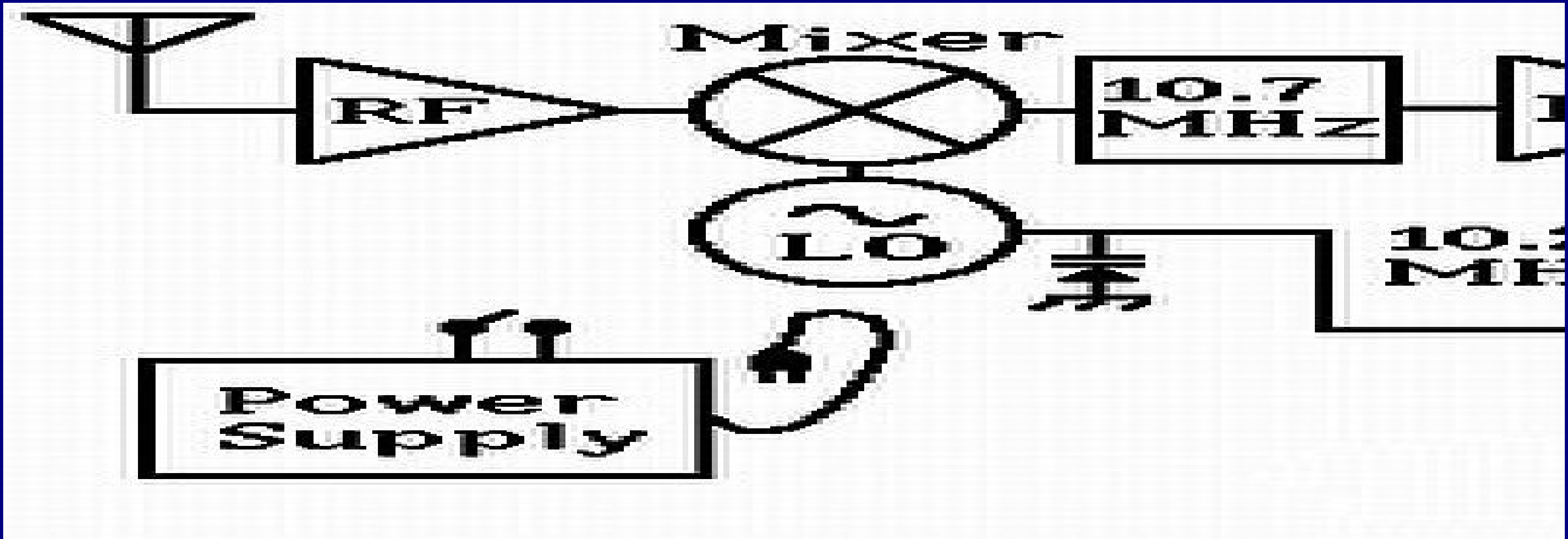
The FM IF filter must have a wider BW than used for AM, SSB or CW, ~ 15kHz



The Limiter Causes the FM receiver to only respond to the strongest signal in the passband, weaker signals are lost. This is called the Capture Effect.

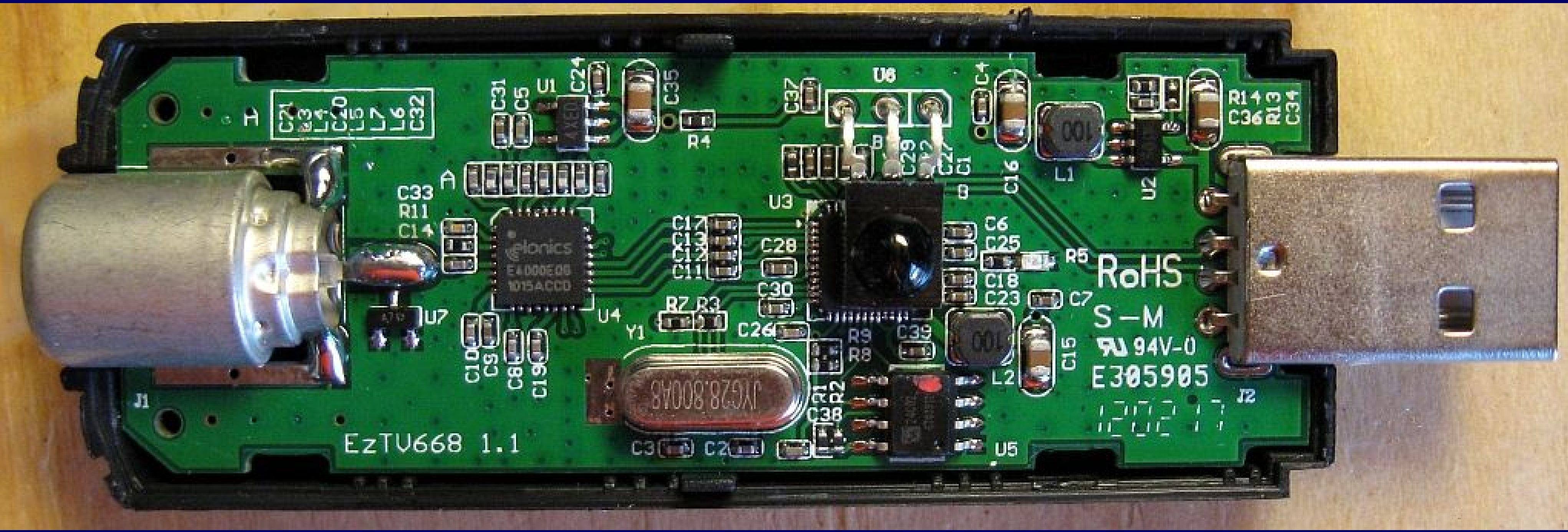
The Only Downside of FM is the wide bandwidth required, which limits FM to the 10m (28MHz) band and above.

Frequency Modulation Receiver



A FM Receiver uses dual conversion Superheterodyne to convert VHF RF to a low intermediate frequency.
An Amplitude Limiter amplifier removes any AM noise, so that just the FM signal makes it to the FM Detector, usually a Quadrature Detector.
Audio is De-Emphasised to reduce high frequency noise and return audio ballance.

USB Software Defined Receiver



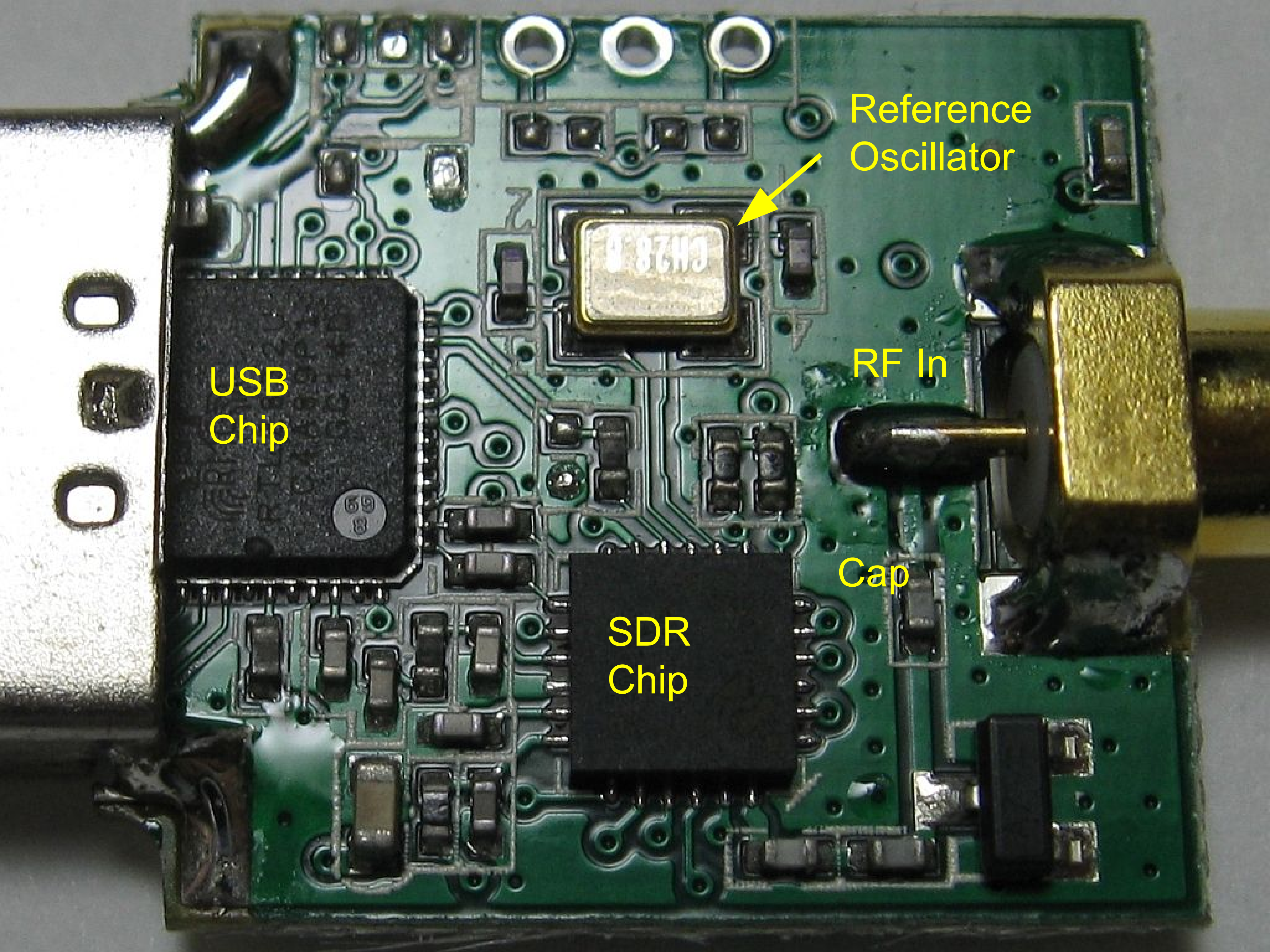
European Digital TV to USB receiver. Uses the Elonics E4000EQ6

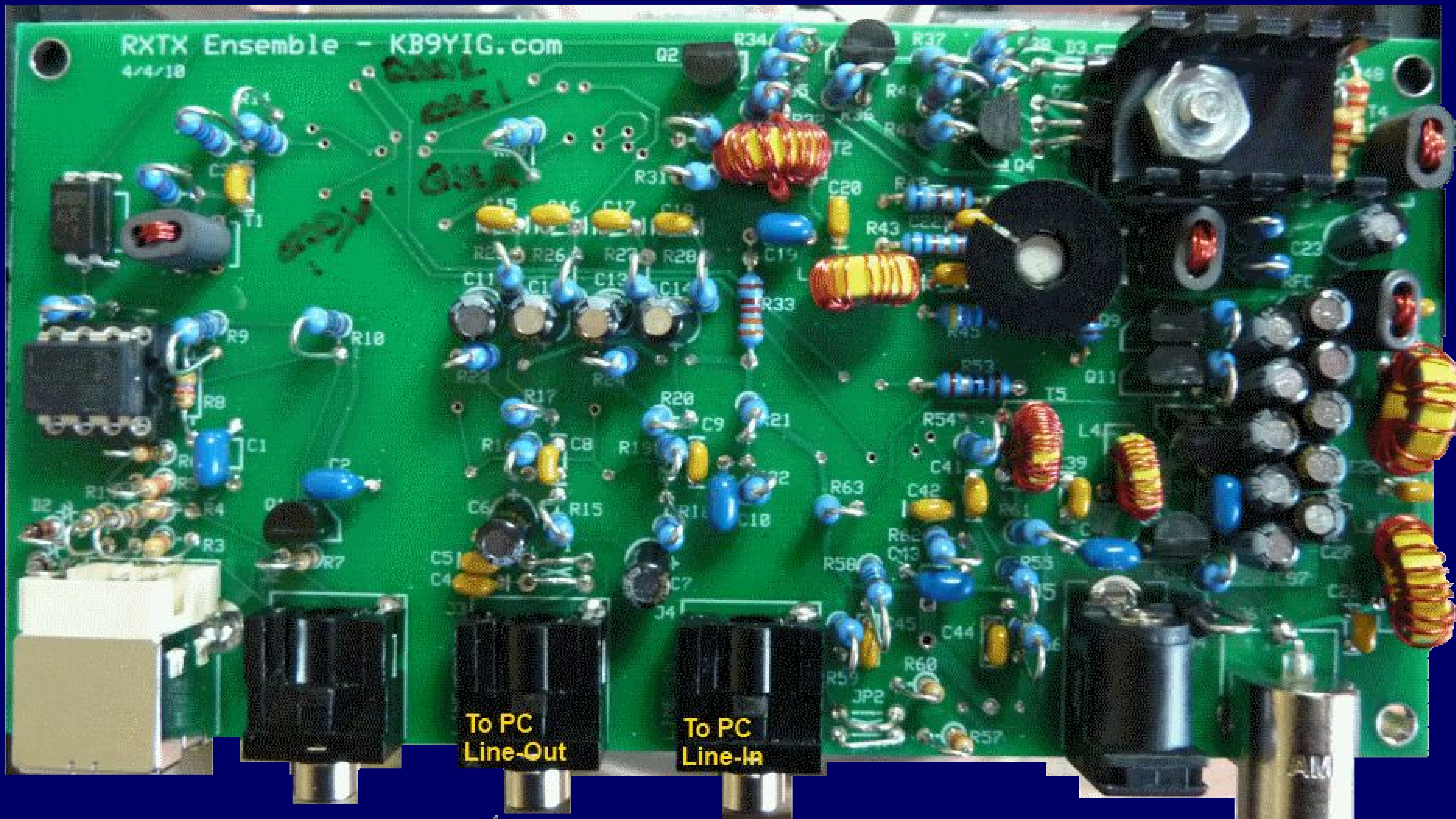
Covers 25 MHz to 1700 MHz, all modes.

Controlled by Software such as SDHDR.exe

Cost: $16.65 “Buy it Now”

Check out “Nooelec” and other bargains on eBay.


Reference
Oscillator
USB
Chip
RF In
Cap
SDR
Chip

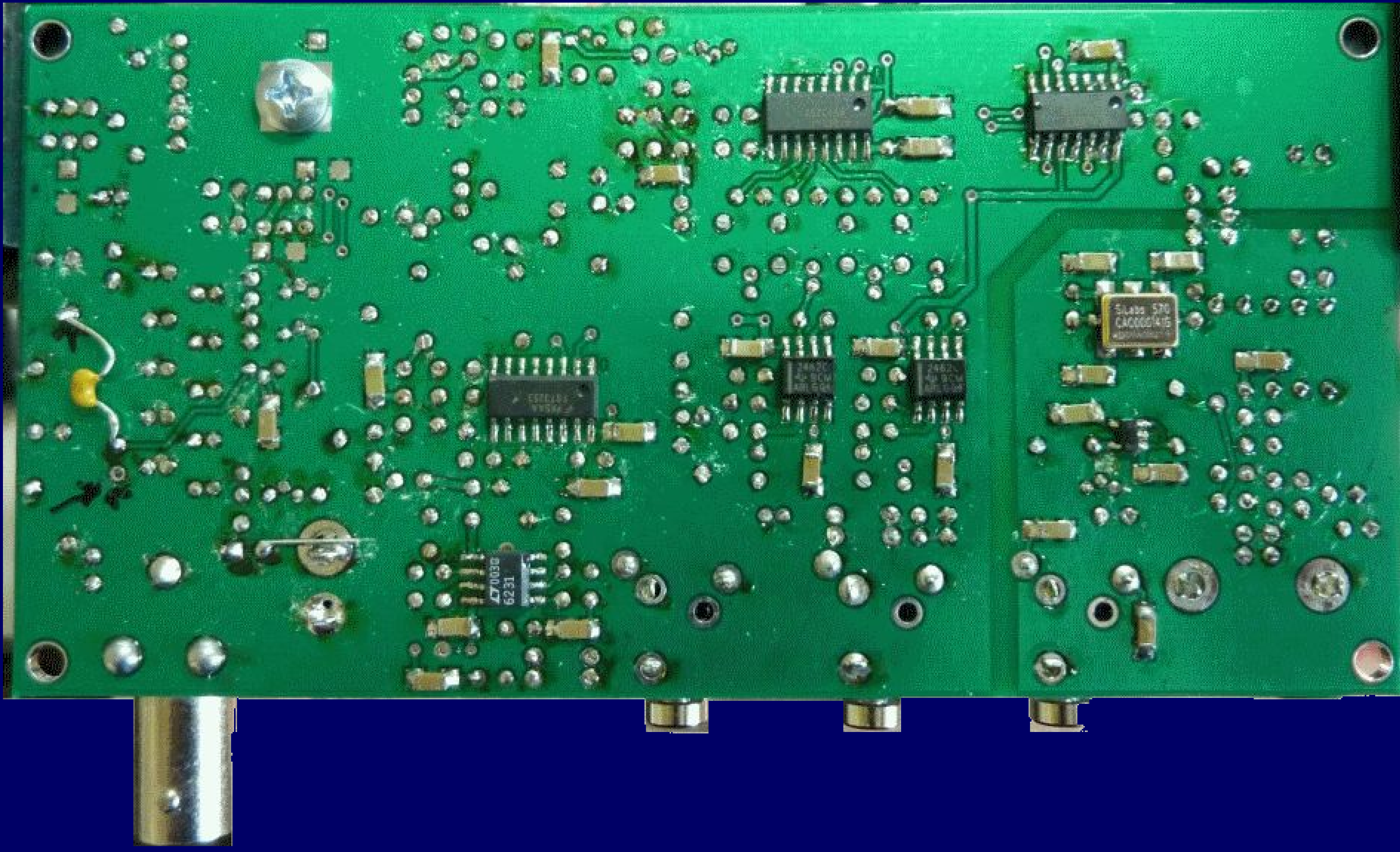


RXTX Ensemble by Tony Parks KB9YIG

Built for 2 ~ 3 bands

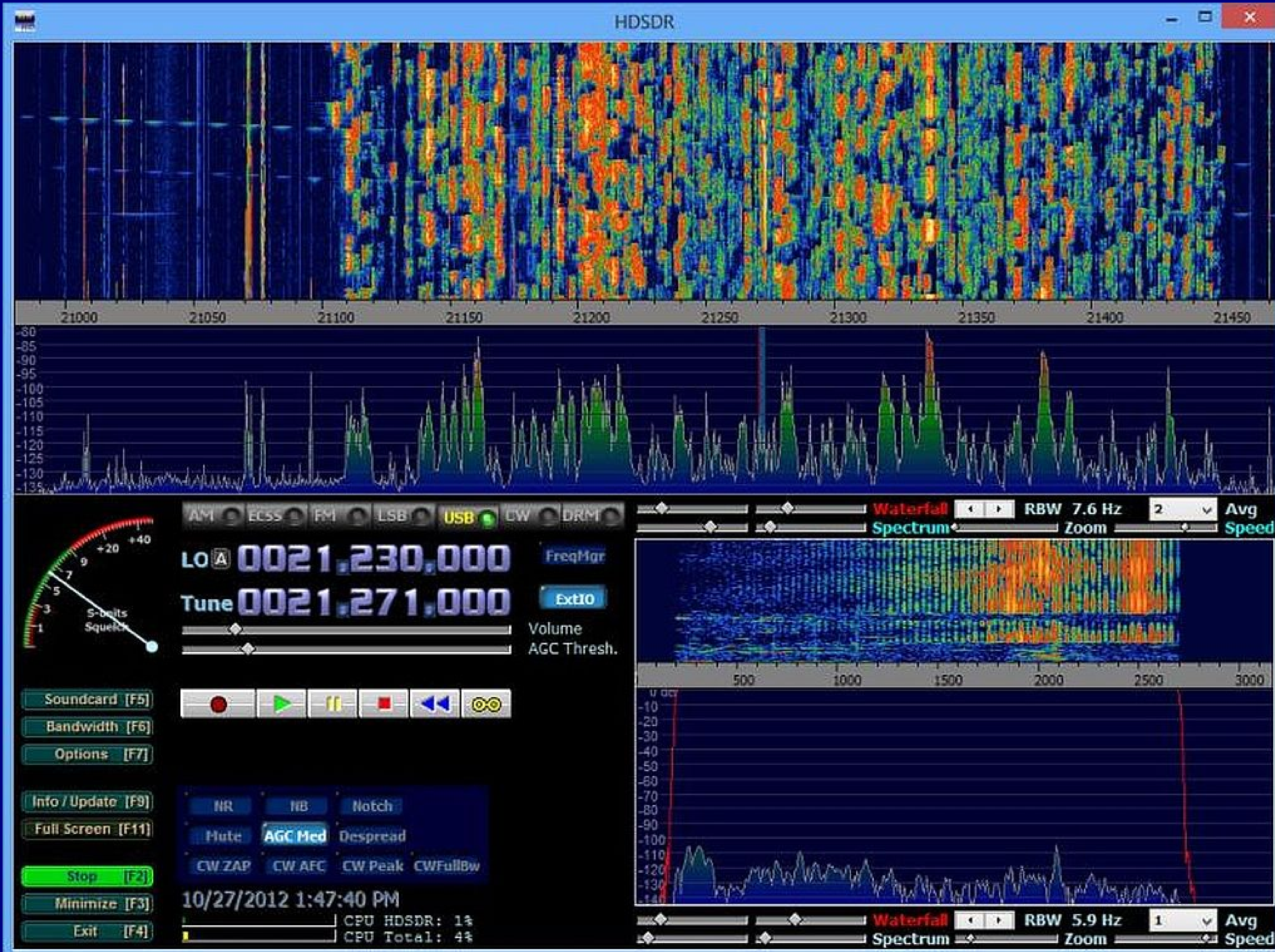
Software Defined Receiver and Softward Defined Transmitter 1W

Uses mostly through hole construction. $90 as kit.



The Surface Mount components and fine lead spacing makes for challenging soldering, but it is very do-able with care and some learning.

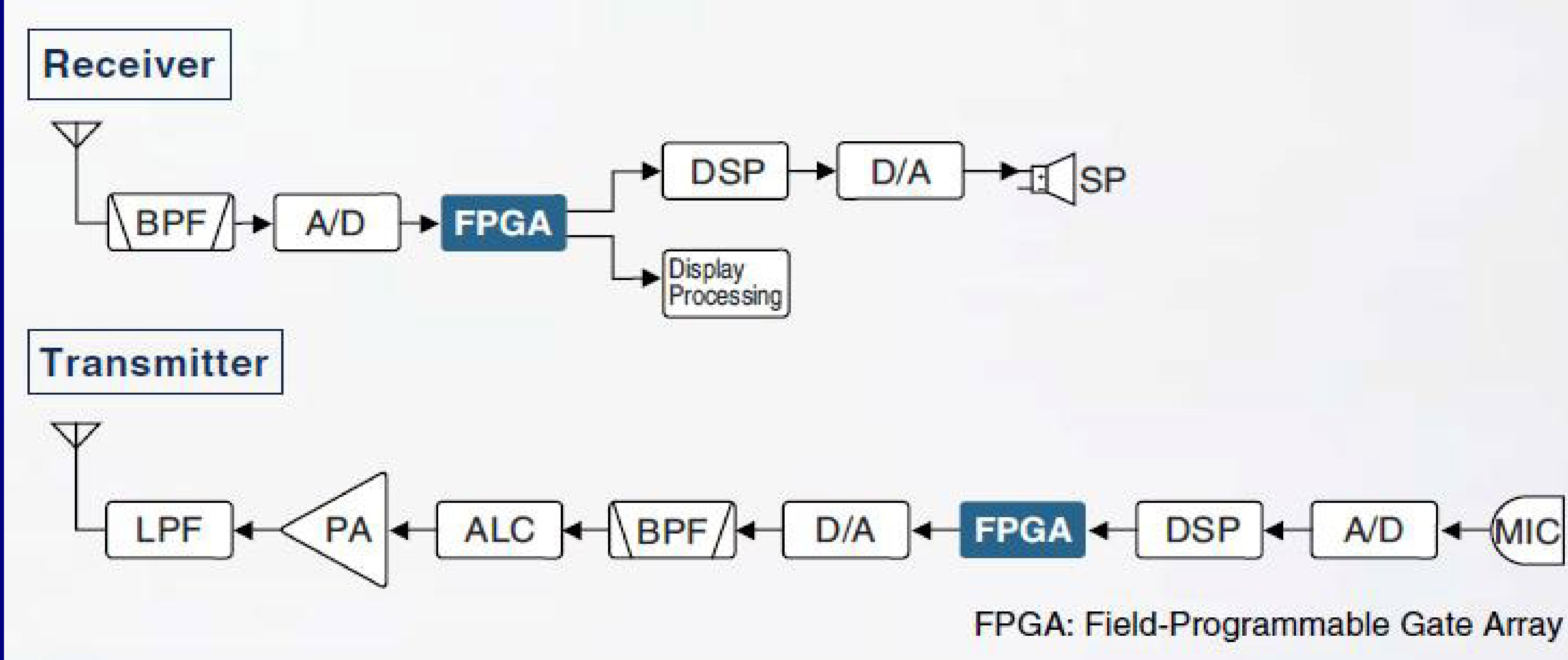
Single Band QRP Transceiver Kit,
Computer controlled via USB


HDSDR
21000
21050
21100
21150
21200
21250
21300
21350
21400
21450
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
AM
ECSS
FM
LSB
USB
CW
DRM
Waterfall
RBW 7.6 Hz
2
Avg
Spectrum
Zoom
Speed
+40
+20
9
7
5
3
1
S-units
Squelch
LO A 0021.230.000
Tune 0021.271.000
FreqMgr
ExtIO
Volume
AGC Thresh.
500
1000
1500
2000
2500
3000
Soundcard [F5]
Bandwidth [F6]
Options [F7]
Info / Update [F9]
Full Screen [F11]
Stop [F2]
Minimize [F3]
Exit [F4]
NR
NB
Notch
Mute
AGC Med
Despread
CW ZAP
CW AFC
CW Peak
CWFullBw
10/27/2012 1:47:40 PM
CPU HDSDR: 1%
CPU Total: 4%
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
Waterfall
RBW 5.9 Hz
1
Avg
Spectrum
Zoom
Speed

State of the ART!

Icom IC-7300

A Direct Sampeling Totally Digital Receiver/Transmitter for $1400.00



BPF – 15 Band Pass Filters eliminate out of band signals.

A/D – Analog to Digital Converter samples at 124.033 Msamples/sec & 14 bit (97dB) representation of the radio frequency signals.

FPGA – Field Programmable Gate Array digitally processes the bit stream to “tune” and “filter” out the desired signals.

DSP – Digital Signal Processor demodulates the bit stream into a digital audio signal for AM, CW, SSB, FM, etc.

D/A – Digital to Analog Converter outputs audio signals we can hear.

A Modern SDR Full Dual Receiver

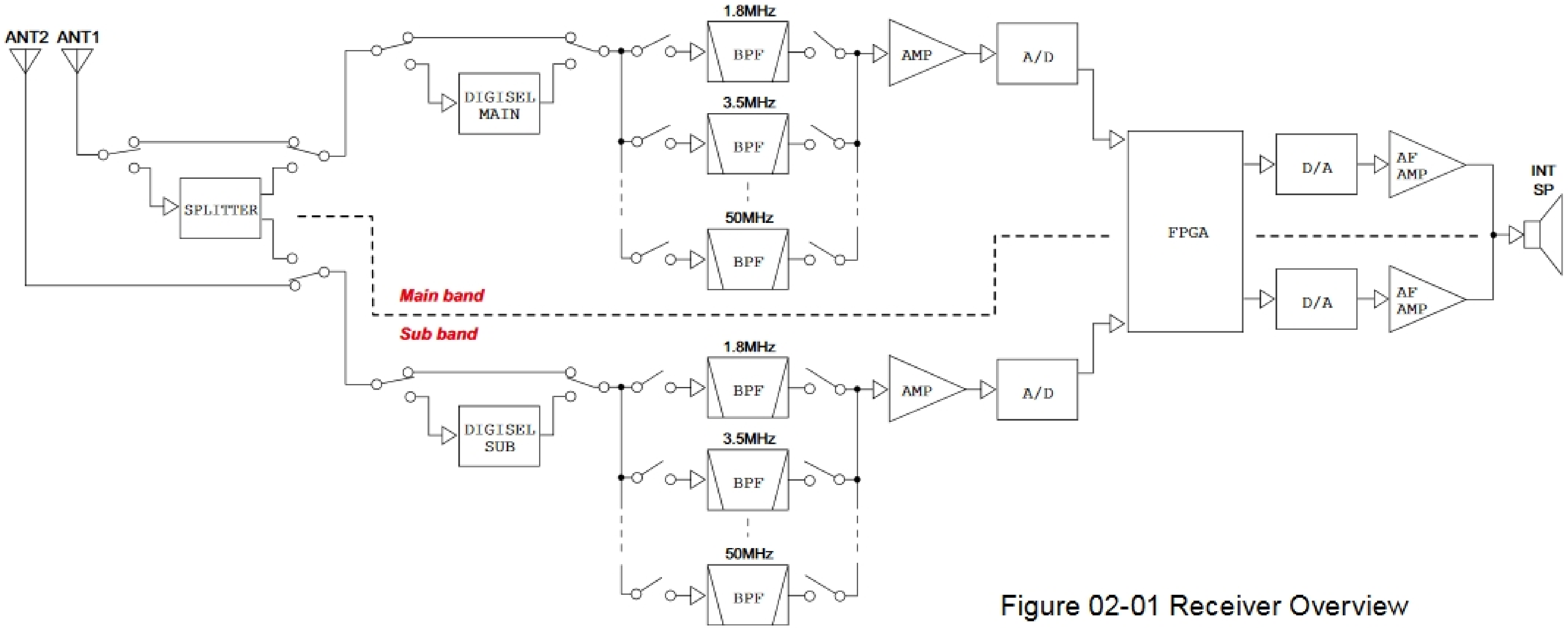


Figure 02-01 Receiver Overview

The IC-7610 provides two fully functional SDR receivers with an added advantage of a digital tracking filter that pre-selects signals to remove harmful interference.

Icom IC-7300 Main Board. Digital Everywhere!

This is where the received signals are digitized, processed, filtered, and demodulated. All by software that can be updated.

B-003-003-004 **(A)**

In a frequency modulation receiver, the output of the _________ is connected to the mixer.

A local oscillator

B frequency discriminator

C intermediate frequency amplifier

D speaker or headphones

B-003-003-005 **(D)**

In a frequency modulation receiver, the__________ is in between the mixer and the intermediate frequency amplifier.

A limiter

B frequency discriminator

C radio frequency amplifier

D filter

D filter

B-003-003-001 **(D)**

In a frequency modulation receiver, the ________ is connected to the input of the radio frequency amplifier.

A mixer

B frequency discriminator

C limiter

D antenna

B-003-003-002 **(D)**

In a frequency modulation receiver, the __________ is in between the antenna and the mixer.

A audio frequency amplifier

B local oscillator

C intermediate frequency amplifier

D radio frequency amplifier

B-003-003-003 **(C)**

B-003-003-006 **(C)**

In a frequency modulation receiver, the ________ is located between the filter and the limiter.

A mixer

B radio frequency amplifier

C intermediate frequency amplifier

D local oscillator

B-003-003-007 **(B)**

In a frequency modulation receiver, the__________ is in between the intermediate frequency amplifier and the frequency discriminator.

A radio frequency amplifier

B limiter

C filter

D local oscillator

B-003-003-002 **(D)**

In a frequency modulation receiver, the ___________ is in between the antenna and the mixer.

A audio frequency amplifier

B local oscillator

C intermediate frequency amplifier

D radio frequency amplifier

B-003-003-003 **(C)**

In a frequency modulation receiver, the output of the local oscillator is fed to the:

A limiter

B antenna

C mixer

D radio frequency amplifier

B-003-003-007 **(B)**

In a frequency modulation receiver, the___________ is in between the intermediate frequency amplifier and the frequency discriminator.

A radio frequency amplifier

B limiter

C filter

D local oscillator

B-003-003-008 **(C)**

In a frequency modulation receiver, the ___________ is located between the limiter and the audio frequency amplifier.

A speaker or headphones

B local oscillator

C frequency discriminator

D intermediate frequency amplifier

B-003-003-009 **(C)**

In a frequency modulation receiver, the __________ is located between the speaker or headphones and the frequency discriminator.

A intermediate frequency amplifier

B radio frequency amplifier

C audio frequency amplifier

D limiter

B-003-003-010 **(D)**

In a frequency modulation receiver, the ___________ connects to the audio frequency amplifier output.

A intermediate frequency amplifier

B frequency discriminator

C limiter

D speaker or headphones

B-003-005-001 **(C)**

In a single sideband and CW receiver, the antenna is connected to the _______________ .

A local oscillator

B intermediate frequency amplifier

C radio frequency amplifier

D product detector

B-003-005-002 **(A)**

In a single sideband and CW receiver, the output of the _______________ is connected to the mixer.

A radio frequency amplifier

B filter

C intermediate frequency amplifier

D audio frequency amplifier

B-003-005-003 **(A)**

In a single sideband and CW receiver, the ___________ is connected to the radio frequency amplifier and the local oscillator.

A mixer
B beat frequency oscillator
C product detector
D filter

B-003-005-004 **(A)**

In a single sideband and CW receiver, the output of the ___________ is connected to the mixer.

A local oscillator
B intermediate frequency amplifier
C beat frequency oscillator
D product detector

B-003-005-008 **(A)**

In a single sideband and CW receiver, the output of the ___________ is connected to the product detector.

A beat frequency oscillator
B mixer
C radio frequency amplifier
D audio frequency amplifier

B-003-005-009 **(C)**

In a single sideband and CW receiver, the ___________ is connected to the output of the product detector.

A local oscillator
B radio frequency amplifier
C audio frequency amplifier
D intermediate frequency amplifier

B-003-005-005 **(B)**

In a single sideband and CW receiver, the ______________ is in between the mixer and intermediate frequency amplifier.

A product detector

B filter

C radio frequency amplifier

D beat frequency oscillator

B-003-005-006 **(B)**

In a single sideband and CW receiver, the ___________ is in between the filter and product detector.

A radio frequency amplifier

B intermediate frequency amplifier

C audio frequency amplifier

D beat frequency oscillator

B-003-005-010 **(B)**

In a single sideband and CW receiver, the ___________ is connected to the output of the audio frequency amplifier.

A beat frequency oscillator

B speaker or headphones

C mixer

D radio frequency amplifier

B-003-006-001 **(B)**

In a single sideband transmitter, the output of the _________ is connected to the balanced modulator.

A mixer

B radio frequency oscillator

C variable frequency oscillator

D linear amplifier

B-003-005-006 **(B)**

In a single sideband and CW receiver, the ___________ is in between the filter and product detector.

A radio frequency amplifier

B intermediate frequency amplifier

C audio frequency amplifier

D beat frequency oscillator

B-003-005-007 **(D)**

In a single sideband and CW receiver, the ___________ output is connected to the audio frequency amplifier.

A local oscillator

B beat frequency oscillator

C intermediate frequency amplifier

D product detector

B-003-010-004 **(D)**

Which of the following modes of transmission is usually detected with a product detector?

A Double sideband full carrier

B Frequency modulation

C Pulse modulation

D Single sideband suppressed carrier

B-003-010-005 **(D)**

A receiver designed for SSB reception must have a BFO (beat frequency oscillator) because:

A it beats with the received carrier to produce the other sideband

B it reduces the passband of the IF stages

C it phases out the unwanted sideband signal

D the suppressed carrier must be replaced for detection

B-003-010-001 **(A)**

Which list of emission types is in order from the narrowest bandwidth to the widest bandwidth?

A CW, RTTY, SSB voice, FM voice

B CW, SSB voice, RTTY, FM voice

C CW, FM voice, RTTY, SSB voice

D RTTY, CW, SSB voice, FM voice

B-003-010-002 **(C)**

The figure in a receiver's specifications which indicates its sensitivity is the:

A bandwidth of the IF in kilohertz

B number of RF amplifiers

C RF input signal needed to achieve a given signal plus noise to noise ratio

D audio output in watts

B-003-010-003 **(A)**

If two receivers of different sensitivity are compared, the less sensitive receiver will

signal

D the suppressed carrier must be replaced for detection

B-003-010-006 **(C)**

A receiver receives an incoming signal of 3.54 MHz, and the local oscillator produces a signal of 3.995 MHz. To which frequency should the IF be tuned?

A 3.995 MHz

B 3.54 MHz

C 455 kHz

D 7.435 MHz

B-003-010-007 **(C)**

What kind of filter would you use to attenuate an interfering carrier signal while receiving an SSB transmission?

A An all pass filter

B A pi-network filter

C A notch filter

D A band pass filter

A bandwidth of the IF in kilohertz

B number of RF amplifiers

C RF input signal needed to achieve a given signal plus noise to noise ratio

D audio output in watts

B-003-010-003 **(A)**

If two receivers of different sensitivity are compared, the less sensitive receiver will produce:

A less signal or more noise

B a steady oscillator drift

C more than one signal

D more signal or less noise

B-003-010-007 **(C)**

What kind of filter would you use to attenuate an interfering carrier signal while receiving an SSB transmission?

A An all pass filter

B A pi-network filter

C A notch filter

D A band pass filter

B-003-010-008 **(A)**

The three main parameters against which the quality of a receiver is measured are:

A sensitivity, selectivity and stability

B selectivity, stability and frequency range

C sensitivity, stability and cross-modulation

D sensitivity, selectivity and image rejection

B-003-010-009 **(B)**

A communications receiver has four filters installed in it, respectively designated as 250 Hz, 500 Hz, 2.4 kHz, and 6 kHz. If you were listening to single sideband, which filter would you utilize?

A 500 Hz

B 2.4 kHz

C 250 Hz

D 6 kHz

B-003-010-010 **(B)**

A communications receiver has four filters installed in it, respectively designated as 250 Hz, 500 Hz, 2.4 kHz and 6 kHz. You are copying a CW transmission and there is a great deal of interference. Which one of the filters would you choose?

A 6 kHz

B 250 Hz

C 500 Hz

D 2.4 kHz

B-003-010-011 **(A)**

Selectivity can be placed in the audio stages of a receiver by the utilization of RC active or passive audio filters. If you were to copy CW, which of the following bandpasses would you choose?

A 750 - 850 Hz

B 2100 - 2300 Hz

C 300 - 2700 Hz

D 100 - 1100 Hz

B-003-013-011 **(D)**

FM receivers perform in an unusual manner when two or more stations are present. The strongest signal, even though it is only two or three times stronger than the other signals, will be the only transmission demodulated. This is called:

A attach effect

B interference effect

C surrender effect

D capture effect

B-003-014-009 **(B)**

A switching system to enable the use of one antenna for a transmitter and receiver should also:

A disconnect the antenna tuner

B disable the unit not being used

C ground the antenna on receive

D switch between meters

B-003-014-010 **(D)**

An antenna changeover switch in a transmitter-receiver combination is necessary:

A to change antennas for operation on other frequencies

B to prevent RF currents entering the receiver circuits

C to allow more than one transmitter to be used

D so that one antenna can be used for transmitter and receiver

B-005-008-004 **(C)**

If a signal-strength report is "10 dB over S9", what should the report be if the transmitter power is reduced from 1500 watts to 150 watts?

A S9 minus 10 dB

B S9 plus 5 dB

C S9

D S9 plus 3 dB

B-005-008-005 **(D)**

If a signal-strength report is "20 dB over S9", what should the report be if the transmitter power is reduced from 1500 watts to 150 watts?

A S9 plus 5 dB

B S9 plus 3 dB

C S9

D S9 plus 10 dB

B-005-008-006 **(C)**

The unit "decibel" is used to indicate:

A certain radio waves

B a single side band signal

C a mathematical ratio

D an oscilloscope wave form

B-005-008-007 **(C)**

The power output from a transmitter increases from 1 watt to 2 watts. This is a dB increase of:

A 6

B 1

C 3

D 30

B-008-001-008 **(B)**

Two or more strong out-of-band signals mix in your receiver to produce interference on a desired frequency. What is this called?

A Front-end desensitization

B Intermodulation interference

C Receiver quieting

D Capture effect

B Band-pass

C No filter

D High-pass

B-008-001-005 **(A)**

During a club ARRL Field Day outing, reception on the 20 m SSB station is compromised every time the 20 m CW station is on the air. What might cause such interference?

A Receiver desensitization

B Both stations are fed from the same generator

C Improper station grounding

D Harmonic radiation

B-008-001-009 **(A)**

Two mobile stations are traveling along the same road in close proximity to each other and having trouble communicating through a local repeater. Why may it be necessary to use simplex operation to communicate between these cars?

A The strong signal of one mobile transmitter may desensitize the receiver of the other mobile receiver

B Simplex operation does not require the use of CTCSS tones

C There is less time delay using simplex operation compared to using a repeater

D There are many more simplex frequencies than repeater frequencies available

B-008-001-011 **(C)**

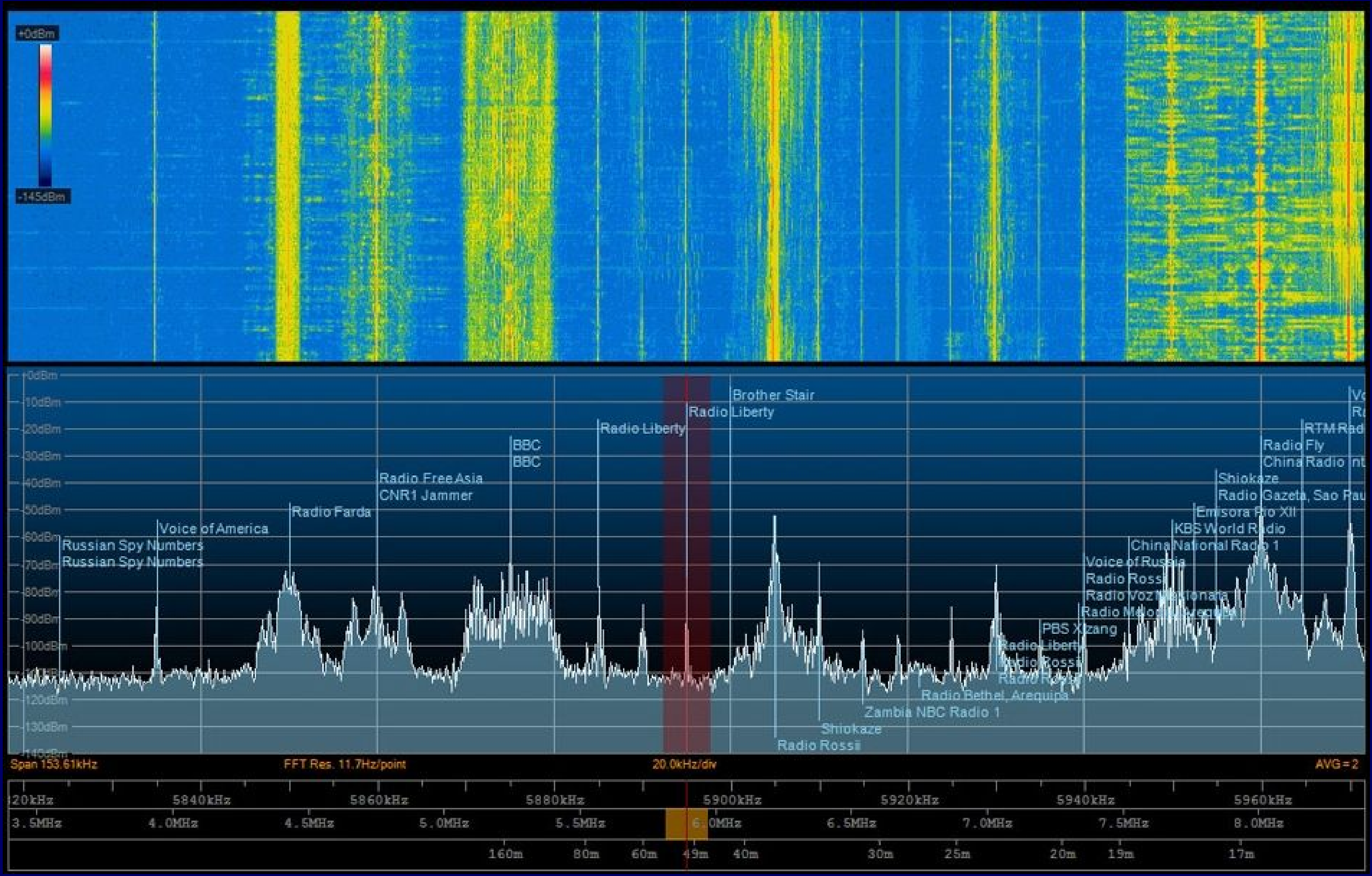
How can intermodulation be reduced?

A By increasing the receiver RF gain while decreasing the AF gain

B By adjusting the passband tuning

C By installing a suitable filter at the receiver

D By using a better antenna



What Will You Be Listening To?