MICROWAVE RECEIVER SYSTEMS

Jon Hagen, Sr. Staff Engineer

1. SINGLE/DUAL POLARIZATION
2. SUPERHETERODYNE PRINCIPLE
3. RECEIVER NOISE

BROADCAST RECEIVERS

DUAL POLARIZATION

POLARIZATION SEPARATORS

SINGLE AND DUAL-MODE TRANSMISSION LINES
FRONT-END PHOTOS

PRE-SUPERHETERODYNE RECEIVER BLOCK DIAGRAM

Signal frequency may be too high for practical narrowband filters.
Difficult to change the center frequency.
Too much gain—must be well shielded or will oscillate.
Back end must be near by to avoid transmission loss.
Signal frequency may be too high for amplifier technology.

PRE-SUPERHETERODYNE

Superheterodyne

Armstrong & The Superheterodyne

\[
\cos(\omega_L t) \cos(\omega_R t) = \frac{\cos((\omega_R - \omega_L) t)}{2} + \frac{\cos((\omega_R + \omega_L) t)}{2}
\]

\[
\cos(\omega_L t) \sum_{R} A_R \cos(\omega_R t) = \sum_{R} A_R \cos\left(\frac{\omega_L - \omega_R}{2} t\right) + \sum_{R} A_R \cos\left(\frac{\omega_L + \omega_R}{2} t\right)
\]

Single-Knob Tuning

Philco Model 39-70

http://www.grandcanyontuberadio.com/philco/philco10.html

Superheterodyne

Atwater Kent Model 4560

Western Historic Radio Museum

Virginia City, Nevada

Pre-Superheterodyne

Armstrong & The Superheterodyne

http://www.geocities.com/neveyaakov/electro_science/armstrong.html

RF Amplifier

Local Disc Voltage (Sine Wave)

FREQUENCY CONVERTER A.K.A. "MIXER"

I.F. Amplifier

I.F. Amplifier

FREQUENCY CONVERTER A.K.A. "MIXER"

IF/LO

SUPERHETERODYNE RECEIVER BLOCK DIAGRAM

AMPLIFIER AMPLIFIER AMPLIFIER TO BACK END

BAND PASS FILTER

SIG. FROM ANTENNA

BAND PASS FILTER

SIGNAL FREQUENCY MAY BE TOO HIGH FOR PRACTICAL NARROW BAND FILTERS

DIFFICULT TO CHANGE THE CENTER FREQUENCY

TOO MUCH GAIN—MUST BE WELL SHIELDED OR WILL OSCILLATE

BACK END MUST BE NEAR BY TO AVOID TRANSMISSION LOSS

SIGNAL FREQUENCY MAY BE TOO HIGH FOR AMPLIFIER TECHNOLOGY

Front-end Photos
Noise Figure - Alternate way to express the internal noise of an amplifier:

\[ NF_{amp} = \frac{290 + T_{amp}}{290} = 1 + \frac{T_{amp}}{290} \]

Note: NF is the ratio of the output noise power to the part of the output noise power attributable to the source when the source has a temperature of 290K.