

UNDERSTANDING THE 1420 MHz SUPERHETERODYNE RECEIVER

AIM :

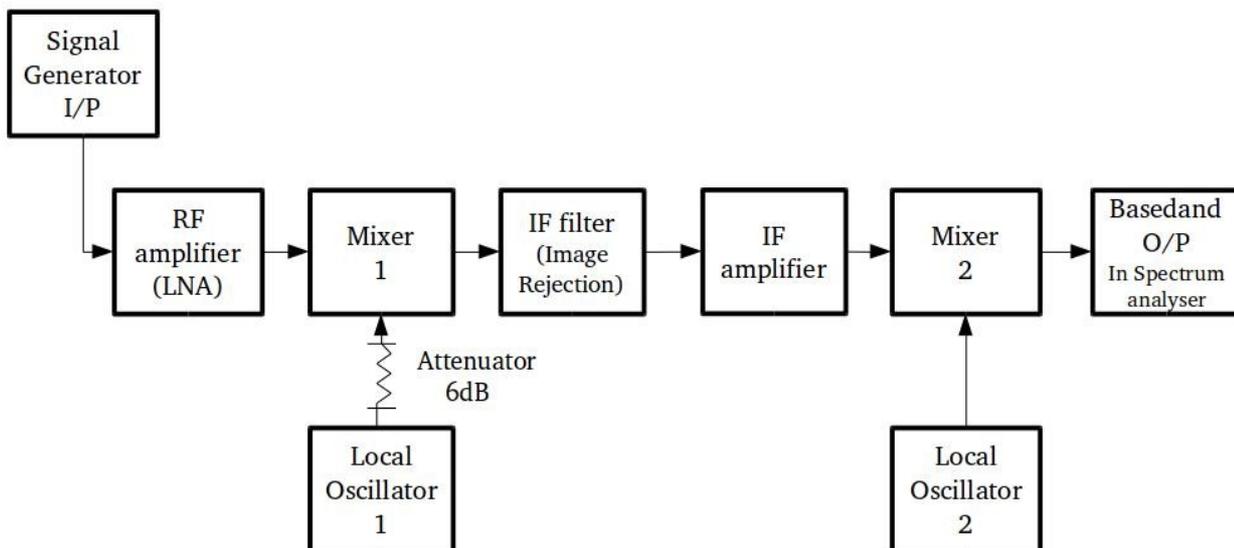
Astronomical signals in Radio Astronomy are processed with Superheterodyne receivers before meaningful measurements can be made of quantities such as flux density, spectra, line intensities and so on. The aim of this experiment is to familiarize with building blocks of a Radio Receiver and study the signal flow through the receiver. In the process we will also gain familiarity with test and measuring instruments.

TEST AND MEASUREMENT INSTRUMENTS :

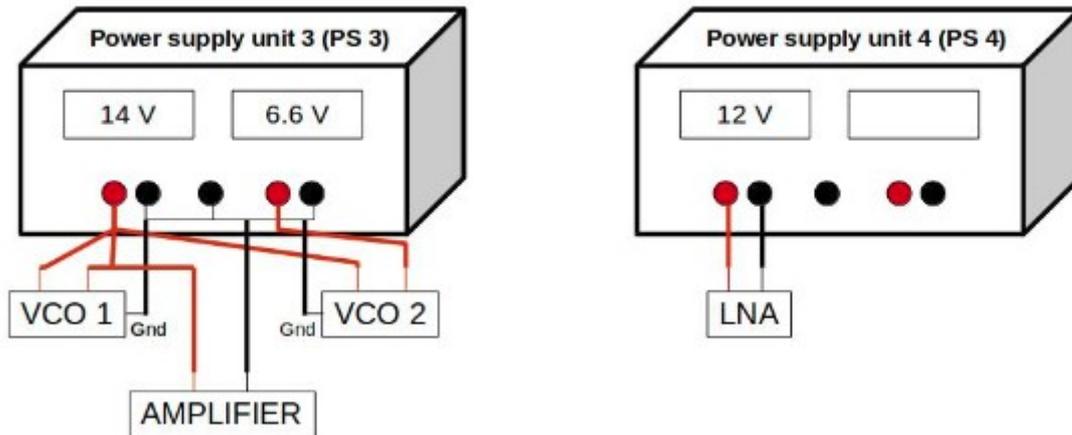
We are going to use 3 different types of instruments – Signal Generator, Spectrum Analyzer and Digital Storage Oscilloscope.

1. Signal Generator – Generates test signals over a range of frequencies and amplitudes. It can also provide amplitude modulated signals and signals modulated by noise.
2. Spectrum Analyzer – A Spectrum analyzer displays intensity as a function of frequency. This spectrum helps in measurement of spectral properties of a signal and will be helpful to understand the translation of signal in both frequency and amplitude throughout the signal.
3. Digital Storage Oscilloscope – It displays intensity as a function of time. It gives a temporal representation of the signal.

BLOCK DIAGRAM OF SUPERHETERODYNE RECEIVER



POWER SUPPLY CONNECTION DIAGRAM :



INITIALISATION PROCEDURE :

IMP NOTE :-GROUND OF ALL THE SUPPLIES SHOULD BE COMMON. IN CASE OF A SHORT THE POWER SUPPLY WILL FALL TO ZERO. IF THIS HAPPENS PLEASE CHECK YOUR CONNECTIONS CAREFULLY.

1. Power ON SW1 and SW2 switches behind the table on the workbench.
2. Switch ON the Signal Generator(SG) and Spectrum Analyzer(SA).
3. Switch ON both the Power Supplies(PS).
4. Set PS 03 at +14 V and +6.6 V.
5. Set one of the PS 04 at +12 V.

NOTE :

To save your results that you view the spectrum analyser for reference,

1. Insert USB in the USB slot of the Spectrum Analyzer.
2. Click the capture button below the SETUP button.
3. The screenshot will be saved to the USB.

MAIN PROCEDURE :

1. In SG, press “<Freq><1420><MHz>”.
2. In SG, press “<Level><-10>”. If scale is not in dBm, select through the left and right cursors.
3. In SG, press “<RF ON>” and verify that RF is on the screen(with a tick mark in RF config).
4. In the Cable and Antenna Analyzer/ Spectrum Analyzer (SA), press “<Frequency><CenterFreq><1420><MHz>”.
5. In SA, press “<100><MHz>”.
6. In SA, press “<Scale><Reference Level><+10 dBm>”.
7. Connect the cable from SG RF O/P to SA port 1.
8. Plot the result. (Do you see a Signal ? What is the Frequency and Power level?)
9. In SA set “<Marker><New Marker>”.
10. Read the measurements of Power level and Frequency and note it down.
11. Why is the Power Level not the same at SA and SG ?
12. Connect the RAS 1420 LNA to Power Supply. Red -> +14 V, Black -> Gnd.
13. Connect the SG RF O/P cable to LNA IN(input).
14. Connect LNA OUT to the SA port 1.
15. Plot the result. (Do you see a Signal ? What is the Frequency and Power level?)

16. In SA set “<Marker><New Marker>”.
17. Read the measurements of the Power level and Frequency and note it down.
18. Connect the power supply (14V) of the 1230-1420MHz VCO.
19. Connect 14 V to 1230-1420MHz VCO Vtune input.
20. Connect two 3 dB attenuators at the VCO O/P.
21. Connect the attenuated VCO O/P to the port marked L(Local Oscillator) on the 10-2000 MHz Mixer.
22. Connect the 1420 LNA O/P to the port marked R(RF) on the 10-2000 MHz Mixer.
23. Connect the SA to the port marked I (IF) on 10-2000 MHz Mixer.
24. Plot the result. (Do you see a Signal ? What is the Frequency and Power level?)
25. In SA set “<Marker><New Marker>”.
26. Read the measurements of the Power level and Frequency and note it down.
27. Connect the port marked I on 10-2000 Mhz Mixer to the 0-150MHz LPF(Low Pass Filter).
28. Connect 14V supply to 0-500 MHz 26dB amplifier.
29. Connect the O/P of LPF to 0-500 MHz 26 dB amplifier I/P.
30. Connect the power supply 14 to Vcc and Gnd of the 50-100 MHz VCO of the Demodulator block.
31. Connect the 6.6 V to 50-100 MHz VCO Vtune input.
32. Connect the VCO O/P to the port marked L on the 0-500 MHz Mixer.
33. Connect the 0-500MHz 26 dB Mixer O/P to the port marked R on 0-500 MHz Mixer.
34. Connect the SA to the port marked I on 0-500 Mhz Mixer.
35. Plot the result. (Do you see a Signal ? What is the Frequency and Power level?)
36. In SA set “<Marker><New Marker>”.
37. Read the measurements of Power level and Frequency and note down.

OBSERVED RESULTS :

Note down the results while performing the experiment at each stage here.

Measurement end	Frequency (MHz)	Power Level (dBm)
Signal Generator RF output		
LNA output		
VCO (1230-1420 MHz) output		
Mixer (10-2400 MHz) output		
LPF (DC-140 MHz) output		
Amplifier (0.1-500 MHz) output		
VCO (50- MHz) output		
Mixer (0.5-600 MHz) output		