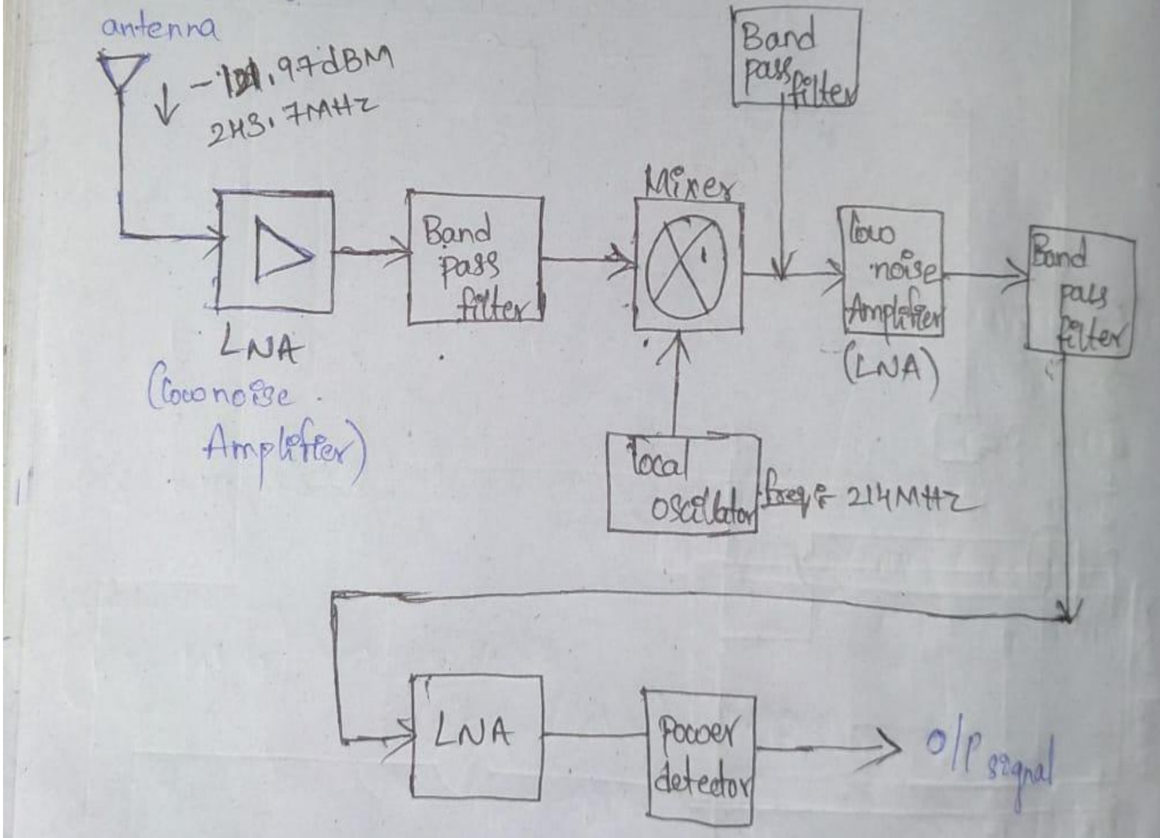
Theoretical Explaination of the project and calculations

Block diagram



Note : filters = these are passive Elements which don't generate noise, but it generates Attenuation of signal which affects the gain (decrement).

LNA, mixers = Exhibits noise changes and have impact on overall receiver Noise factor. (Have Low NF LNA can detect weak signals) (So, we have to select the accurate LNA and mixers which have low NF and

*) Mixer have low Gain loss, *) LNA have high Gain)

Theoretical calculation

Using friss formula

$$F_{total} = f_1 + \frac{f_2 - 1}{G_1} + \frac{f_3 - 1}{G_1 G_2} + \cdots + \frac{f_n - 1}{G_1 G_2 \cdots G_n}$$

Power in from satellite to antenna of receiver is,

$P_{in} = -129.97\,dBm$

And frequency comming from the satellite to the receiver antenna is,

$f_{in} = 243.7\,MHz$

where using friss formula calculating each and every component noise figure and power out and overall receiver cascaded noise and power out and frequency out from the receiver (Demodulate the frequency as our requirement by using local oscillator)

f_1, f_2, f_3 = Noise factors of the individual stages (not in dB)

$G_1, G_2, \ldots$ = Gains of preceding stages (not in dB)

Noise factor (f) $= 10^{NF(dB)/10}$

Gain (G) $= 10^{Gain(dB)/10}$

⇒ ~~Start~~ Noise factor from first component the calculation of noise factor (where overall noise can be determined through overall noise factor (f))

LNA ⇒ $NF = 1.5$, Gain $= 25$

$f_1 = 10^{NF/10} = 10^{1.5/10} = 1.412$

$G_1 = 10^{25/10} = 316.2$

BPF ⇒ $NF = 1.5$, Gain $= 25$ ⇒ $f_2 = 1.412$

(for filters there is no change in gain) G_2 = No Gain factor

Mixer ⇒ $NF = 1.5$, Gain $= -3$

In mixer we have (-3 dB loss), so Gain reduced

$f_3 = 10^{1.5/10} = 1.412$, $G_3 = 10^{\cancel{23}/10} = 5.011$

BPF $\Rightarrow$ Nf = 1.5 , Gain = $\cancel{0}$ (for filters there is no change in Gain)

$f_4 = 1.412$, $G_4 = 10^{22/10}$ = No gain factor

LNA $\Rightarrow$ Nf = 1.5 , Gain = 20

$f_5 = 1.412$, $G_5 = 10^{20/10} = 0.01\,(1\times10^{2}) = 100$

BPF $\Rightarrow$ Nf = 1.5 ; Gain = 0 (No change of Gain & Nf)

$f_6 = 1.412$, G_6 = No gain factor

LNA $\Rightarrow$ Nf = 1.5 , Gain = 30

$f_7 = 1.412$, $G_7 = 10^{30/10} = 1\times10^{3}$

Power detector $\Rightarrow$ No change of any parameter

So, $f = f_1 + \frac{f_2 - 1}{G_1} + \frac{f_3 - 1}{G_1 G_2} + \cdots$

$f = 1.412 + \frac{1.412 - 1}{3.162} + \frac{1.412 - 1}{(3.162)(5.011)} + \frac{1.412 - 1}{(3.162)(5.011)(1\times10^{2})}$

*) consider only which have gains so,
$G_1 = 3.162$
$G_2 = 5.011$
$G_3 = 1\times10^{2}$
$G_4 = 1\times10^{3}$

$\boxed{f = 1.56}$ $\Rightarrow$ Convert to dB.

$= 10\log_{10}(1.56) = 1.93$ dB

Power calculation $\Rightarrow$ $P_{in} = -121.97$ dBM $\Rightarrow$ -121.97

LNA $\Rightarrow$ Gain = 25 = Pout = +25 | $+25$ → -96.97

BPF $\Rightarrow$ Attenuation = 2 = Pout = −2 | -2 → -98.97

modulator $\Rightarrow$ Gain = −3 = Pout = −3 | -3 → -101.97

BPF $\Rightarrow$ Attenuation = 0 = Pout = 0 | 0 → -101.97

LNA $\Rightarrow$ Gain = 20 = Pout = +20 | $+20$ → -81.97

BPF $\Rightarrow$ Attenuation = 2 = Pout = −2 | -2 → -83.97

LNA $\Rightarrow$ Gain = 30 = Pout = +30 | $+30$ → -53.97

power detector $\Rightarrow$ Gain = 0 = Pout = 0

final Pout = −53.97

Gain

LNA = 25 = +25

BPf = 0 = 0

Mixer = −3 = 22

BPf = 0 = 22

LNA = 20 = 42

BPf = ~~2~~ = 40

LNA = 30 = 70

$\boxed{Gain_{out} = 70\,dB}$

frequency

f_{in} = 243.7 MHz

LNA = No change = 243.7 MHz

BPf = No change = 243.7 MHz

Mixer = due to local oscillator which has 214 MHz can reduce the 214 MHz from 243.7 MHz frequency of the signal as per our requirement for accurate output signal.

= 243.7 − 214 = 29.75 MHz

futher LNA, BPf, power dector No change so, f_{out} = 29.75 MHz