AGC Implementation

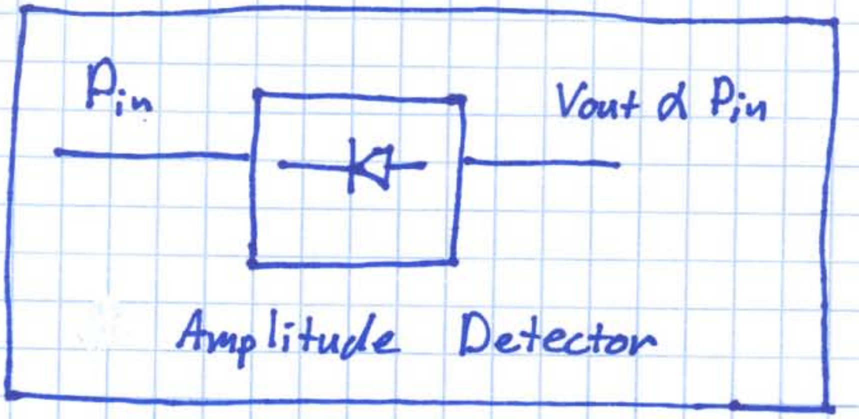
Q: What controls the AGC ??

A: Look at the name – Automatic Gain Control ⇒ The gain is controled automatically!

Automatically ??

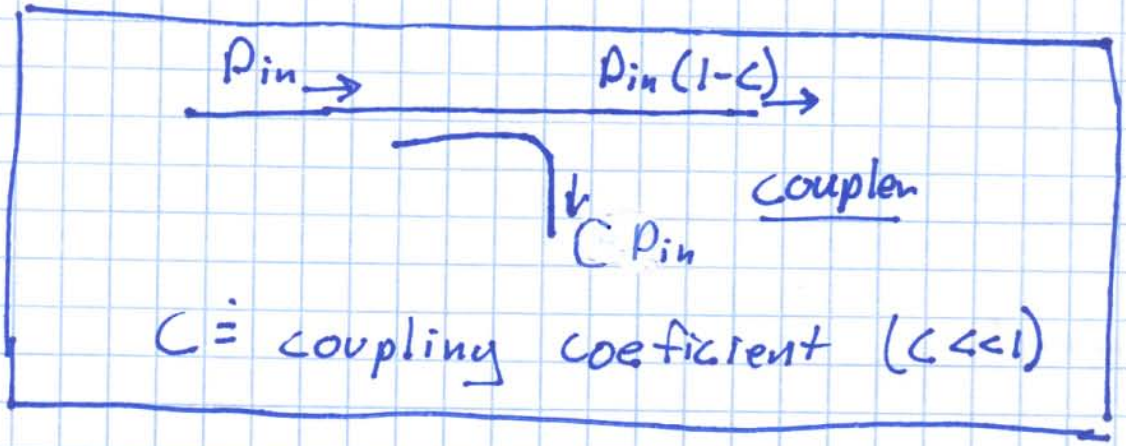
In engineering terms, the AGC is controlled using a feedback loop!

- To implement this feedback loop, we require an amplitude detector/demodulator.



i.e., an Amplitude detector provides an output voltage that is $\propto$ to the input signal power.

- We also require a coupler in the feedback loop:

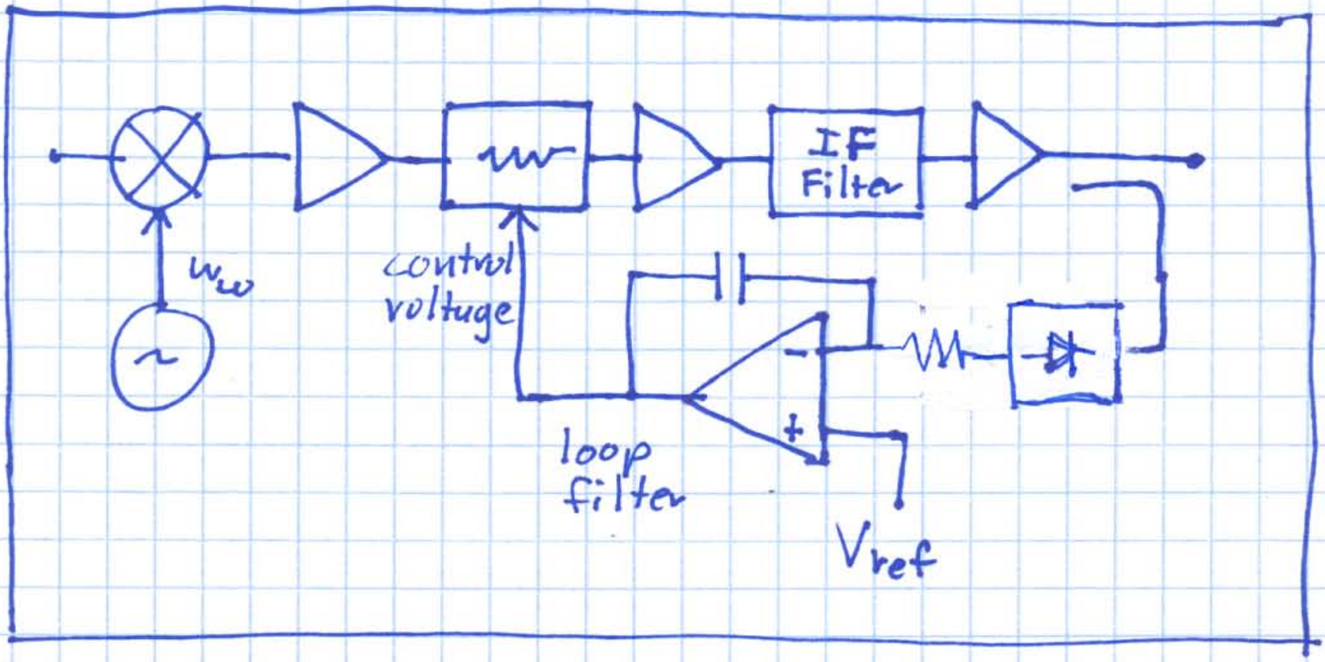


$C \doteq$ coupling coeficient $(C \ll 1)$

Typical values of C are 0.1 (-10dB) and 0.01 (-20dB).

∴ A coupler extracts a small ammount of signal power and sends it to the coupling port.

Now, we can construct an AGC feedback loop:



A control loop!

1) The coupler samples the IF signal and sends the power to the amplitude detector

2) The detector outputs a voltage that is proportional to the signal power.

3) The loop filter creates an output voltage that either <u>increases</u> the attenuation (If the signal is too high), or decreases it (if signal power is too low).

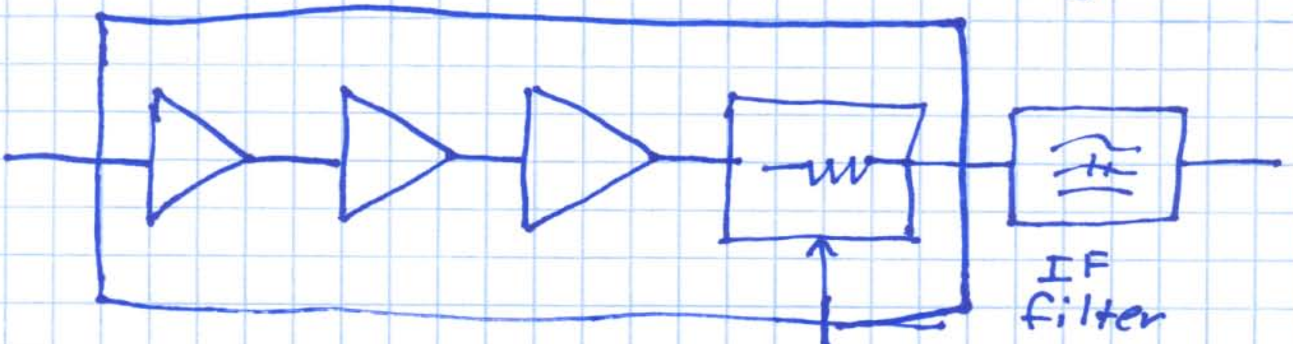
4) At equallibrium, the detector voltage will equal <u>Vref</u>. So Vref sets the signal power into the demodulator.

5) The loop filter also sets loop <u>speed</u> and <u>stability</u>.

A final question. Does it make any difference how we arrange our <u>IF chain</u>??

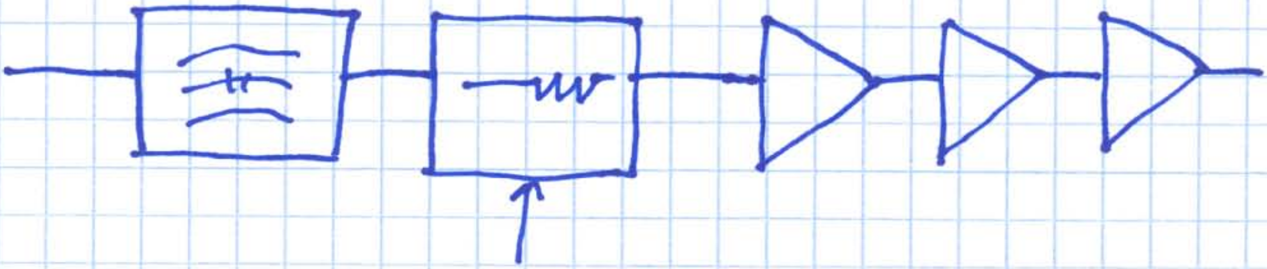
In other words, is this design:

Ⓐ



better or worse than this one:

Ⓑ



???

A: In term of gain and noise figure (approximately), the two designs are equivalent!

BUT, that does not mean that one design is no better than the other!

For example, we might find that the third amplifier of design Ⓐ may cause the Rx to *saturate* prematurely.

We can fix the problem by moving the amplifiers to the end of the IF chain — in other words, design Ⓑ.

HOWEVER, this in *not* to say that design Ⓑ is without problems!

For example, the IF filter in Ⓑ is the first device in the IF chain. In other words, it is connected to the *output* of the mixer.

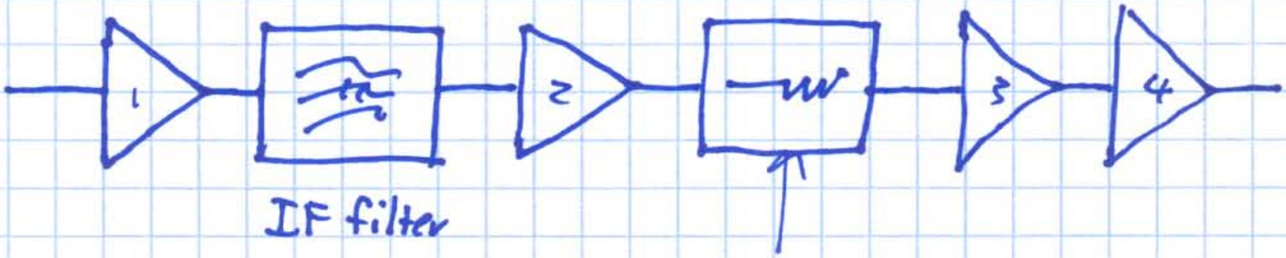
Q: So??

A: So!?! Recall the impedance of the mixer ports are particularly poor – the mixer performance may be degraded!

More over, the attenuator follows the filter in Ⓑ, and voltage controlled attenuators likewise exhibit notoriously poor VSWR.

⇒ We need to <u>isolate</u> the IF filter!!

E.6.:



IF filter

Q: How do we calculate the input compression power associated with amplifiers 3+4?? What "gain" value do we use for the attenuator??

A: The receiver will compress when the input signal is *large*. ∴ the AGC attenuation will likewise be *large*!

As a result, we should use the largest attenuation value (i.e., A_H) when calculating the receiver compression point

→ Note this means that components after the attenuator will never saturate! ∴ Move amplifiers to locations after the attenuator *if* they are causing saturation problems

→ IF Amps should *never* determine receiver saturation!!

Likewise, always set the attenuator to its minimum (i.e. A_L) value when calculating Rx *noise figure* F.