AGC Dynamic Range

Now let's consider the **dynamic range** of our **AGC**, defined as:

$$AGC \text{ Dynamic Range} = \frac{G_H}{G_L} = \frac{G_{fixed} G_H^{IF}}{G_{fixed} G_L^{IF}} = \frac{G_H^{IF}}{G_L^{IF}}$$

Therefore:

$$\begin{aligned} AGC \text{ Dynamic Range}(dB) &= G_H(dB) - G_L(dB) \\ &= G_H^{IF}(dB) - G_L^{IF}(dB) \end{aligned}$$

Q: *Just how much dynamic range do we **need**?*

A: Since $G_H > G_{min}$ and $G_L < G_{max}$, we can conclude that:

$$AGC \text{ Dynamic Range} = \frac{G_H}{G_L} > \frac{G_{min}}{G_{max}}$$

Meaning that, since $G_{min} = P_D^{min} / MDS$ and $G_{max} = P_D^{max} / P_{in}^{sat}$:

$$\begin{aligned} AGC \text{ Dynamic Range} &> \frac{P_D^{min}}{MDS} \frac{P_{in}^{sat}}{P_D^{max}} \\ &> \frac{P_D^{min}}{P_D^{max}} \frac{P_{in}^{sat}}{MDS} \\ &> \frac{TDR}{IDR} \end{aligned}$$

Thus, we conclude that:

$$AGC \text{ Dynamic Range} > \frac{TDR}{IDR}$$

or

$$AGC \text{ Dynamic Range}(dB) > TDR(dB) - IDR(dB)$$

From the standpoint of "IF Amplifier" **design**, this result has a **specific** meaning.

Since the gain of the **amplifiers** used in the "IF Amplifier" design is fixed (e.g., G_1G_2), the **ratio** of the largest and smallest IF amplifier gain is simply the ratio of the largest and smallest **attenuator** values:

$$AGC \text{ Dynamic Range} = \frac{G_H^{IF}}{G_L^{IF}} = \frac{G_1G_2}{A_L}\frac{A_H}{G_1G_2} = \frac{A_H}{A_L}$$

or

$$AGC \text{ Dynamic Range}(dB) = A_H(dB) - A_L(dB)$$

Thus, we can conclude that the variable attenuator(s) in an "IF amplifier" **must** be selected such that the **range of attenuation**, from A_H to A_L satisfies:

$$\frac{A_H}{A_L} > \frac{TDR}{IDR}$$

or

$$A_H\left(dB\right) - A_L\left(dB\right) > TDR\left(dB\right) - IDR\left(dB\right)$$

Note this, however, provides only **one** "IF Amplifier" design equation. We must **also** select the gains of the **amplifiers** in the "IF Amplifier" such that:

$$G_H^{IF} > \frac{G_{min}}{G_{fixed}}$$

where we recall that G_{fixed} represents the gain of all the receiver components, **except** those components comprising the "IF Amplifier".