ECE 513 - Lecture 9.

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Receiver Sensitivity ← minimum input signal power that the RX can detect (BER)

Noise floor at the RX

$$P_{sen}\big|_{dBm} = -174\,dBm + NF\big|_{dB} + 10\log\Delta f\big|_{Hz} + SNR_{min}\big|_{dB}$$

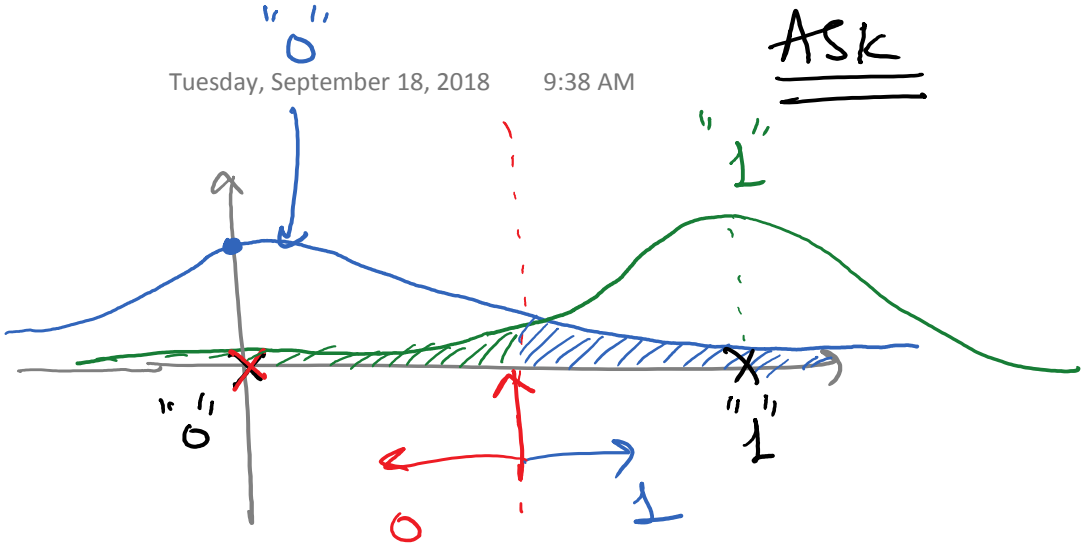
- kT
- NF of the overall RX: $F = f_1 + \frac{f_2 - 1}{g_1} + \cdots$
- Δf → BW
- SNR_{min}: min SNR req. to decode the bit constellations ASK, PSK, QAM with acceptable quality ↳ BER

Noise floor at the Rx input = $kT\Delta f$.

Noise floor at the Rx output = $kT\Delta f F \cdot G$

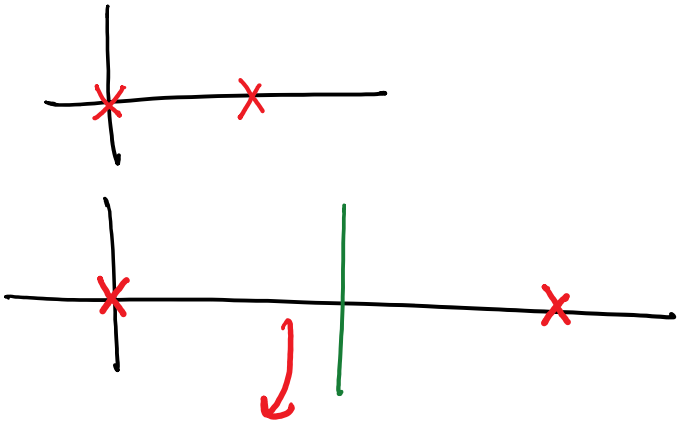
↳ power gain

ASK

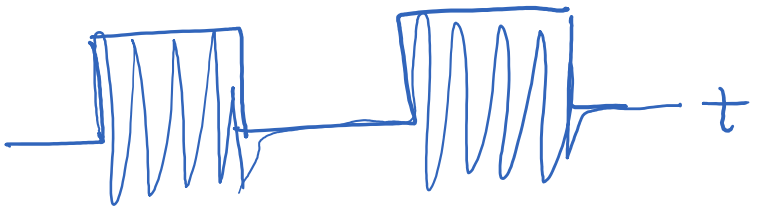


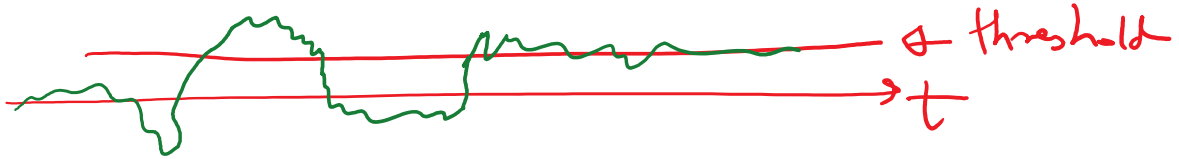
Gaussian noise is added to the signal

"bit error"



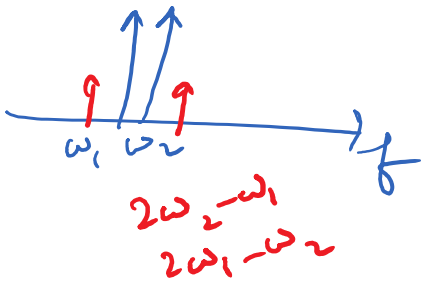
Higher SNR min

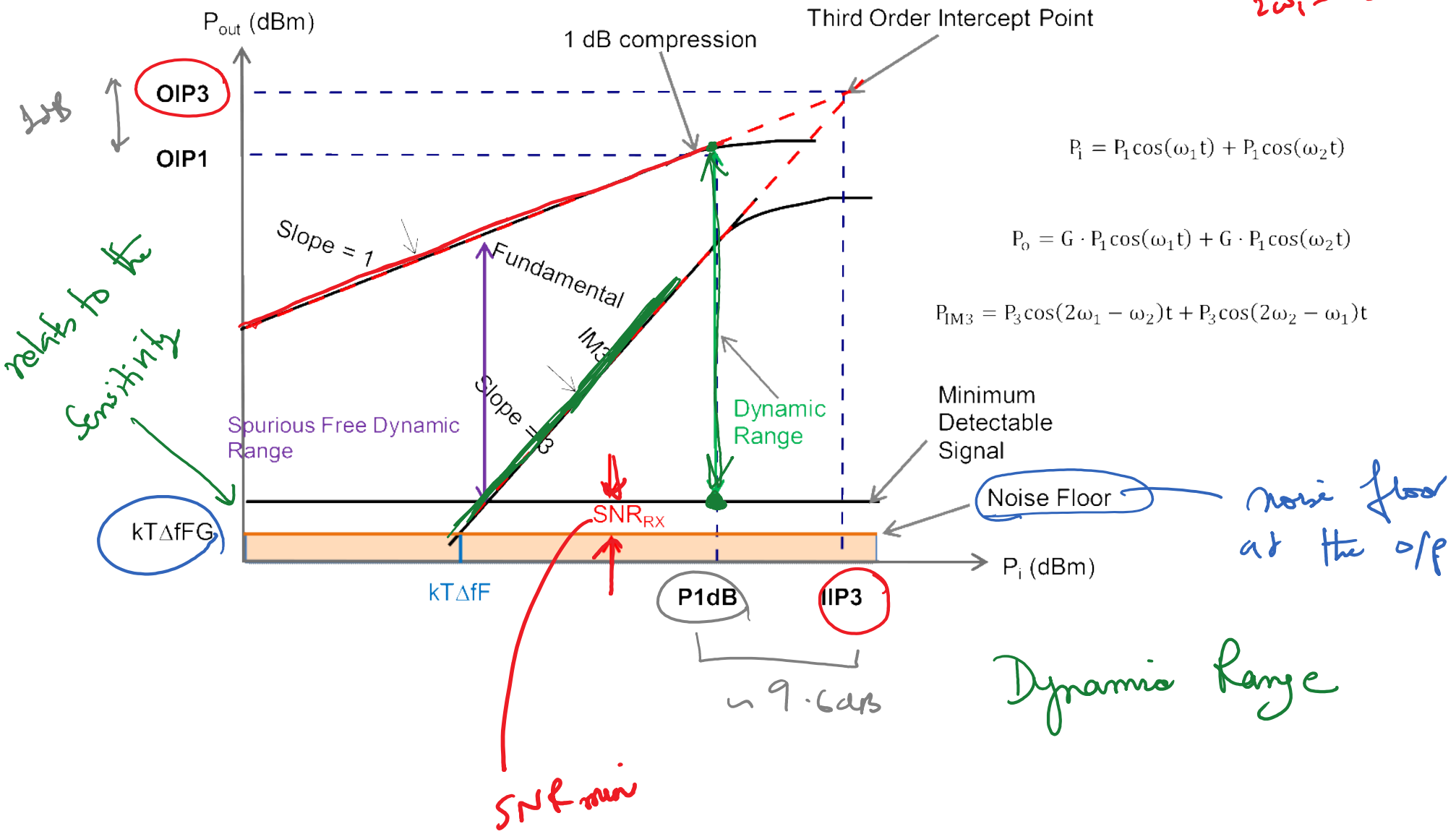




* Bit error rate (BER) ~ 10^{-6} – 10^{-12}

↳ related to SNR min at the detector


f
ω_1 ω_2
$2\omega_2 - \omega_1$
$2\omega_1 - \omega_2$


P_{out} (dBm)
1 dB compression
Third Order Intercept Point
OIP3
OIP1
Slope = 1
Fundamental
IM3
Slope = 3
Spurious Free Dynamic Range
Dynamic Range
Minimum Detectable Signal
Noise Floor
$kT\Delta fFG$
$kT\Delta fF$
SNR_{RX}
P_i (dBm)
P1dB
IIP3
$P_i = P_1\cos(\omega_1 t) + P_1\cos(\omega_2 t)$
$P_o = G \cdot P_1\cos(\omega_1 t) + G \cdot P_1\cos(\omega_2 t)$
$P_{IM3} = P_3\cos(2\omega_1 - \omega_2)t + P_3\cos(2\omega_2 - \omega_1)t$
relates to the Sensitivity
noise floor at the o/p
~9.6dB
Dynamic Range
SNR min

Dynamic Range

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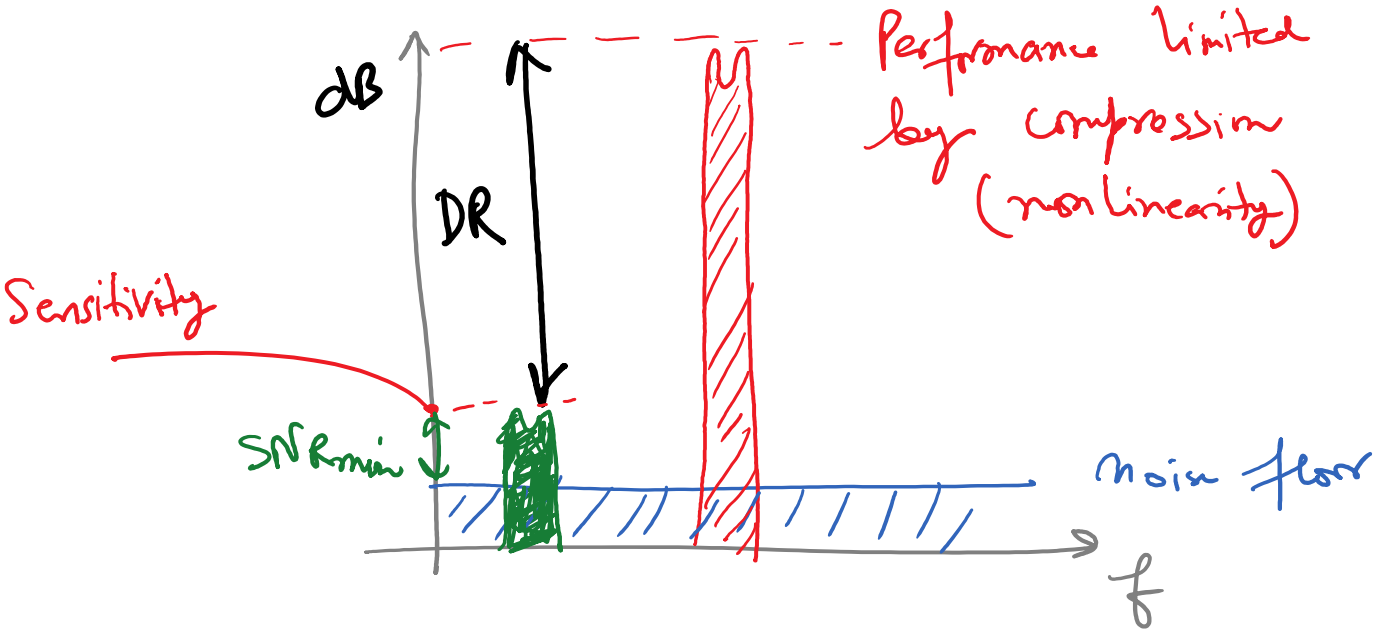
* loosely defined as the maximum input level that a Rx can "tolerate" divided by the minimum input level that it can detect.



SFDR (Spur-free Dynamic Range)

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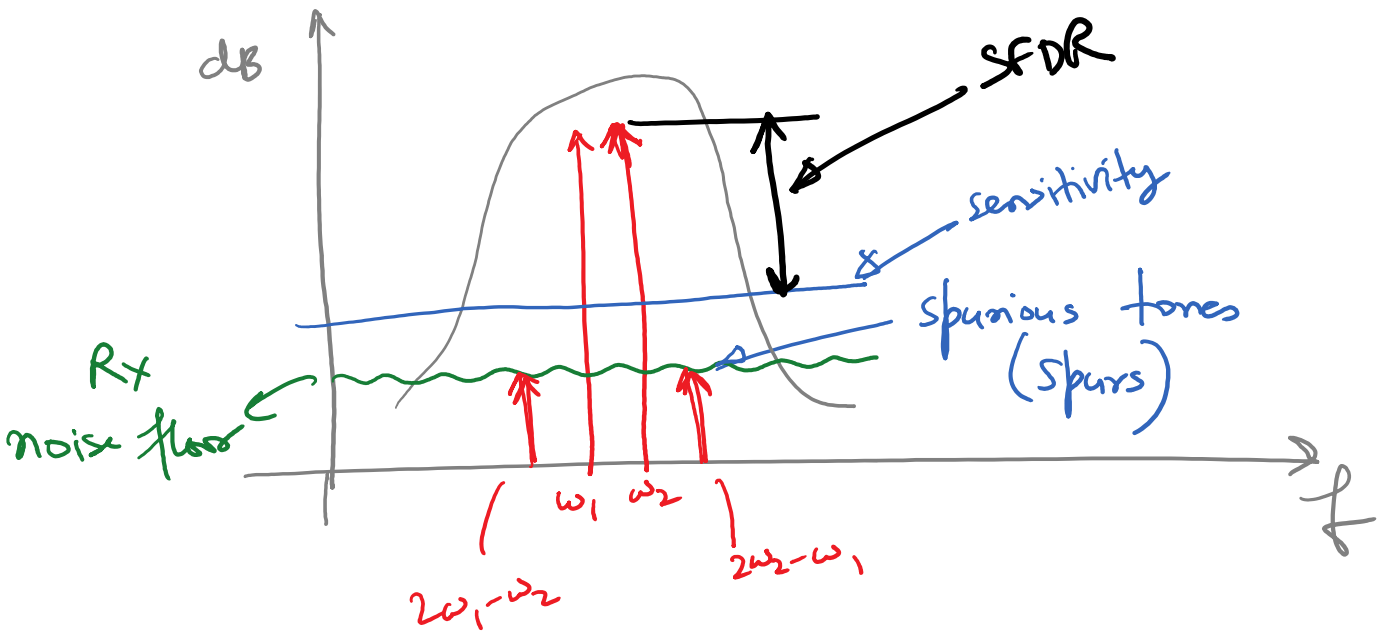


two-tone test

* The upper-end is defined as the maximum input-level in a two-tone test for which the third-order IM products do not exceed the noise floor of the receiver.

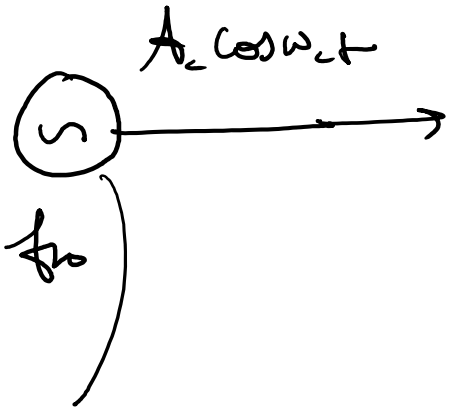
↳ SFDR ⇒ represents the maximum relative level of

interference that a Rx can tolerate while producing acceptable signal quality from a small input level (sensitivity)

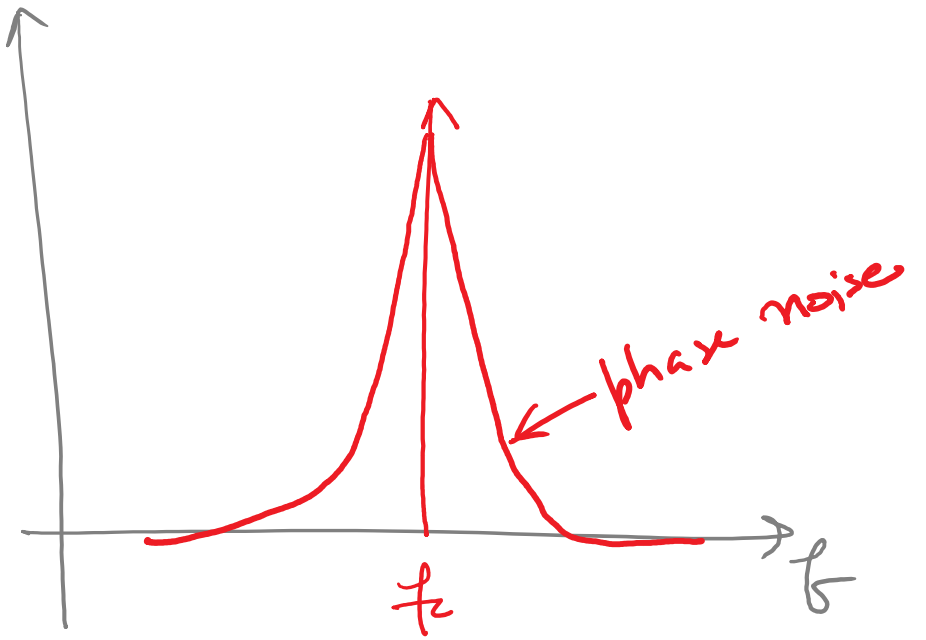
NF, IIP3, DR, SFDR, G, Sensitivity, BER

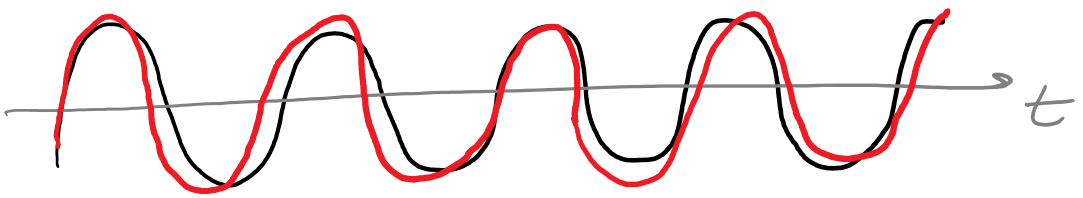
P_{1dB}

Phase Noise



PLL
Xtal oscillator





jitter

Zero-IF Rx