Some Thoughts About

Noise, Interference, the FCC & the ARRL

Bob DePierre, K8KI

October 10, 2003

Characteristics of Broadband Noise

- Average = 0
- Statistically flat → same at all freqs
- Several types of flat noise
  - Readily calculable RMS value
  - Dominant type is usually Thermal Noise
- 1/f noise → 0 freq on spectrum analyzer
- Noise in any resistor: $e_n^2 = 4kTRB$
- Matched Load Noise Power → kTB
  - Independent of Impedance
  - In "dBm" terms → $N_T = -174 + 10 \log(B)$

Q-TRACK™
The Q-Track Corporation

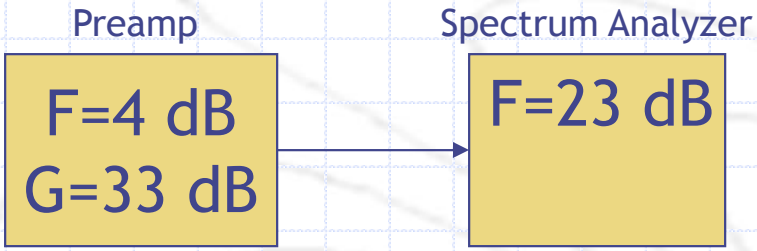
RF Link Budgets

- The idea is to find the minimum SNR that provides acceptable performance.
- $P_{RX} = P_{TX} - P_{losses}$
- Free Space Loss: $\frac{(4\pi r)^2}{\lambda^2}$
  - Doubling *range* or *freq* → 6 dB loss
  - Line of Sight case

Q-TRACK™
The Q-Track Corporation

Receiver Sensitivity

System Noise Figure: $$F_{Sys} = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_2} + \ldots$$

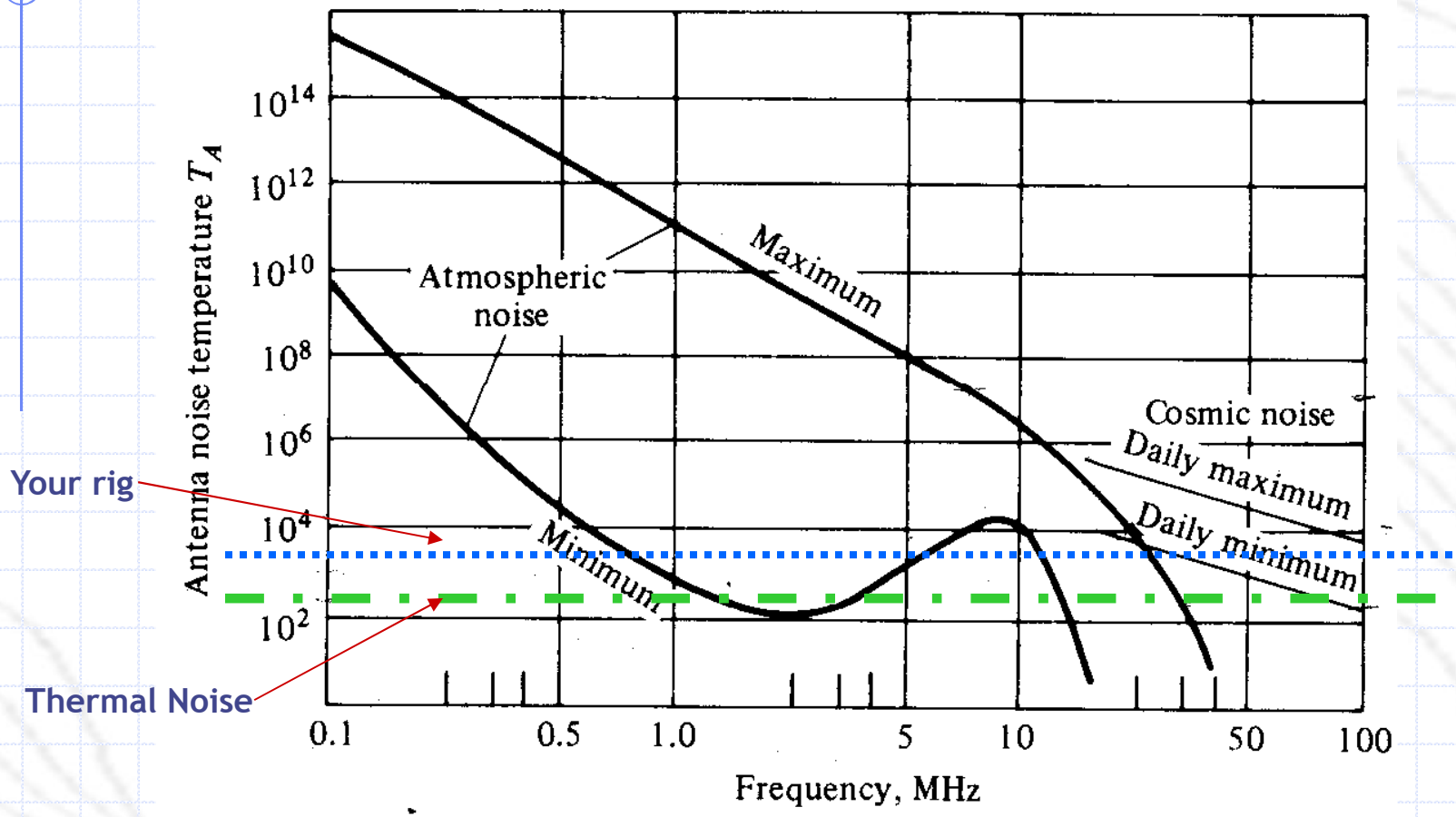


	Old	New
NF	23 dB	4.15 dB

Q-TRACK™
The Q-Track Corporation

Atmospheric Noise Levels

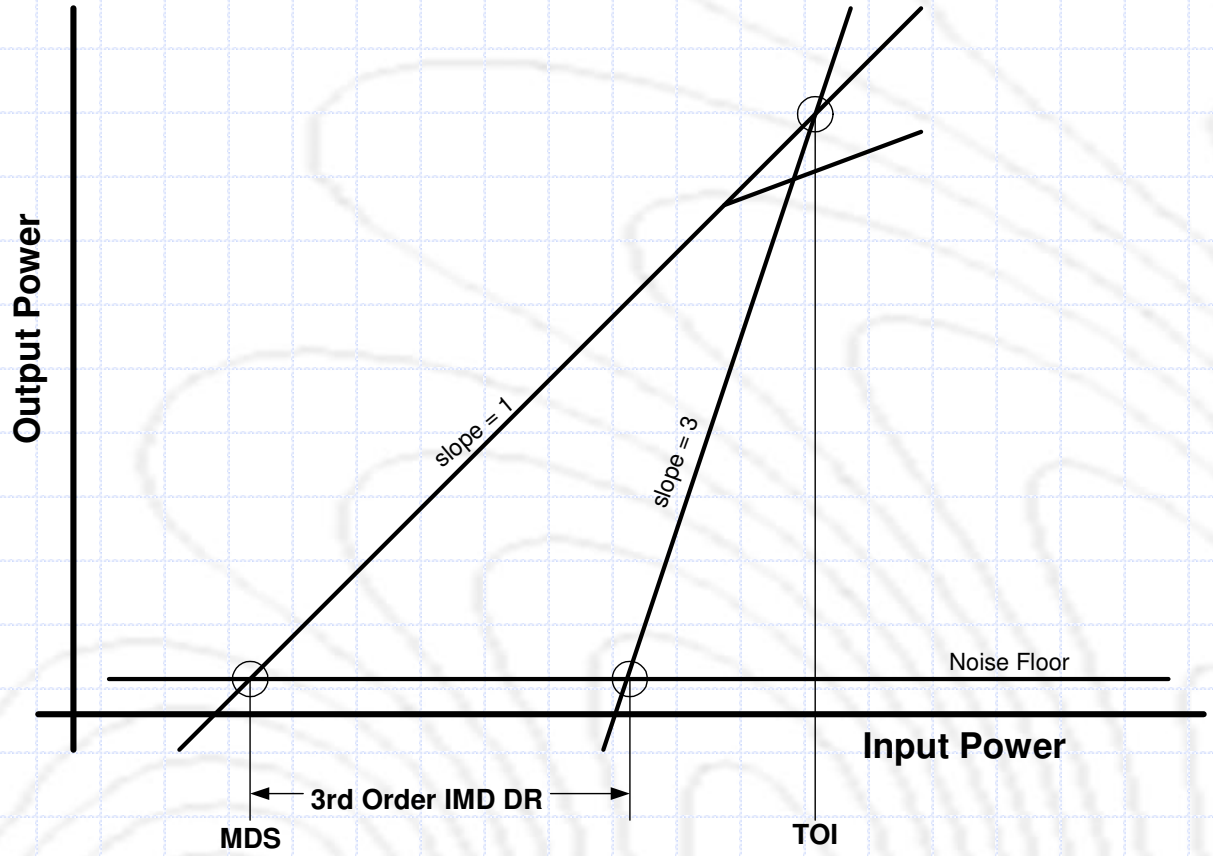
Noise Power in your HF receiver → kTB + Atmospheric



Q-TRACK™

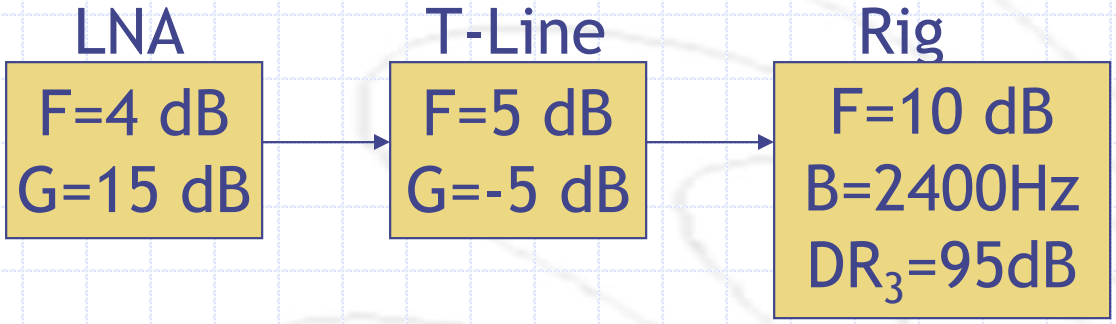
The Q-Track Corporation

Amplifier Intercept Graph



Q-TRACK™
The Q-Track Corporation

Typical Ham Noise Problem



	OLD	NEW
NF	10 dB	6.1 dB
Sensitivity	-130 dBm	-134 dBm
DR3	95 dB	85 dB

Q-TRACK™
The Q-Track Corporation

Determining Impact of Interference

- How much interference does it take to degrade reception by an unacceptable amount?
  - Who determines what is an acceptable amount?
- Situation can be modeled and graphed.
  - Math models can predict performance.
  - Depends on assumptions.
  - Must determine
    - Required SNR at the detector for acceptable performance
    - Power of received signal
    - Signal handling characteristics of the receiver
    - What is the noise normally received
    - What is the power of the received interference

Determining the Impact of Interference

- Math Modeling Considerations
  - Digital systems are a lot easier to model than analog.
  - Freqs where only thermal noise is present is a lot easier than HF.
  - Freqs propagating via LOS easier than those using Ionosphere.
  - Statistical modeling most often used (various distributions)
  - Test results should be used to back up modeling rather than the reverse.
- What outsiders often think of ARRL positions
  - Special Interest Group. ALL interference is bad.
  - Only consider test analysis.
    - ARRL never predicts via math modeling.
    - ARRL never does the test properly or fairly.
    - ARRL never conducts tests with the right signal.
    - “In your face” approach. Never negotiable.

Q-TRACK™

The Q-Track Corporation