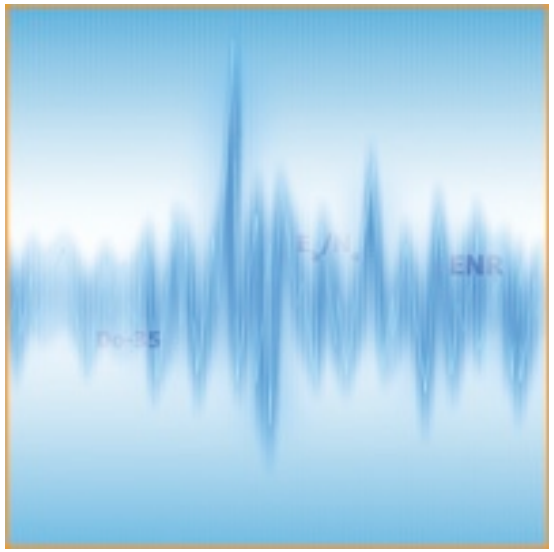
Noisecom



Noise by the Numbers

A Basic overview of noise

Presenter: Mr. Bob Muro

Today's Webinar

- What can be done with noise?
  - Technologies and Applications
- Sources of noise
  - Natural and artificial
  - How it is measured & described
- What types of noise can we provide?
  - How is it generated
  - What are important characteristics
  - How is it properly controlled
- How do I choose a noise solution?
  - Diodes or modules
  - Instruments
  - What do I need to know about my system

What's all the noise about?

- Removing noise is an essential part of circuit design
- Using noise during this process can be counter-intuitive
- This webinar will discuss how noise can be used to improve product design and reduce noise-related design flaws.

Technologies affected by noise

- Wireless
  - Satellite communication links
  - Mobile devices
  - HDTV services
  - 3G/4G or WiMax systems
- Coaxial or wired
  - High-speed serial data transmission (PCIe, USB, SATA, & 10 GigE)

Common Noise Applications

- Telecommunication signal impairment
  - Gradual change in SNR to measure receiver circuit behavior
- Reference level comparison
  - Calibrated noise source power compared to instrument DUT noise floor
  - Noise figure
- Secure signal jamming
  - High power and Broad Band for signal disruption

Industry Examples

- Digital engineers need to insert noise into a PCI-express bus while testing receiver system eye closure on an oscilloscope.
- A communications engineer comparing several modulation schemes for satellite modem development by varying SNR.
- A calibration technician verifying spectrum analyzer frequency response

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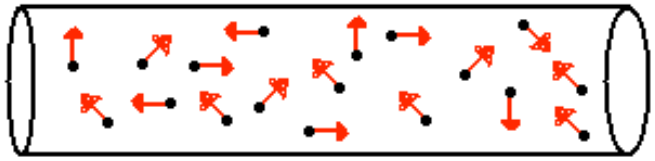
Natural sources of noise

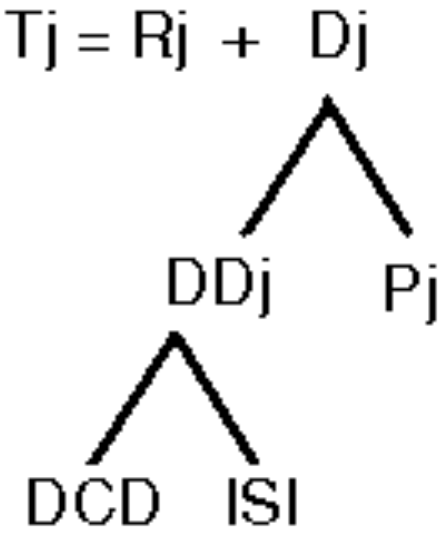
- Random noise exists everywhere and occurs naturally in matter above absolute zero
- White noise is generated by hot iron, but not practical
- Johnson, or shot Noise is generated in a conductor by free electrons but very low power
- Noise power = kBT and is proportional to temperature



random electron movement

Other sources of noise

- Wireless signals
  - Naturally couple with random back ground EMI via (AM)
  - Random electronic noise from circuit components components couple via AM
- PC-board data signal
  - Random electronic noise from circuit components couple via (AM, PM, or FM)
  - Deterministic noise from the same components (CW & harmonics) couples via AM,PM, or FM
  - Digital engineers refer to this phenomenon as “Jitter”
  - Latest model is Tj, total jitter (see figure)



How do engineers measure noise?

- RF/microwave engineers
  - Use Spectrum analyzers to measure signals in the frequency domain
  - Power vs. Frequency
    (Noise figure analyzer – dedicated receiver)
- Digital engineers
  - Use Oscilloscopes to measure signals in the time domain
  - Voltage vs. Time

Different tools, but common goal

- RF/microwave engineers measure:
  - Wireless modulated carriers contain digital information
  - Spectral abnormalities like ACPR or phase noise
  - BER is the final outcome
- Digital engineers measure:
  - PC board traces, or coaxial cable carry pulse data streams
  - Timing abnormalities refered to as “jitter”
  - BER is the final outcome

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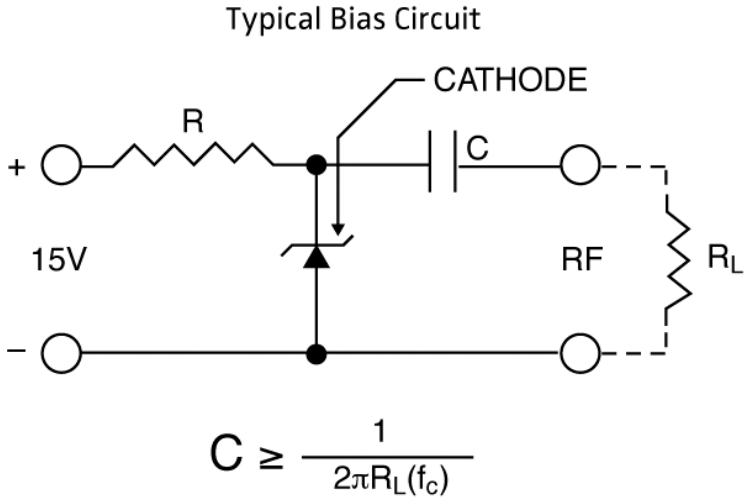
Noise available from Noisecom

- AWGN (Additive white Gaussian noise)
  - Truly random
  - Broadband
  - Created using a reverse biased diode in a small form factor
- Digital pseudo-random noise
  - Programmable digital noise
  - Allows specific configurations & profiles
  - Accurate control of power level & noise bands

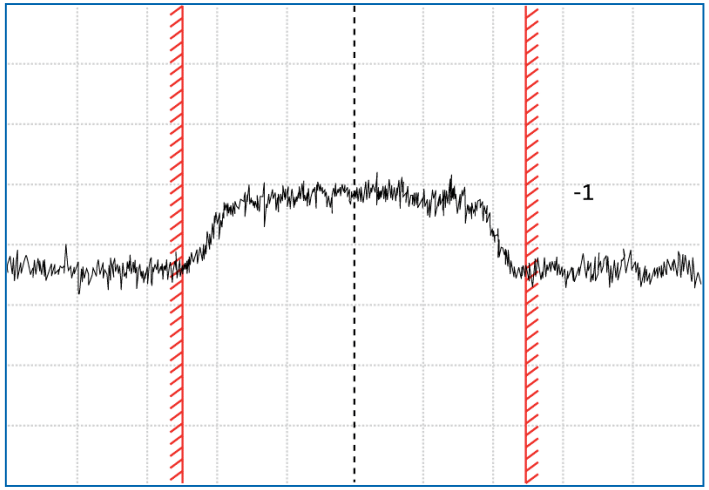
How is white noise generated ?

- Practical white noise is generated by using an RF, or microwave diode in a reversed biased circuit
- Selecting proper components and careful tuning allows Noisecom to provide high performance noise sources

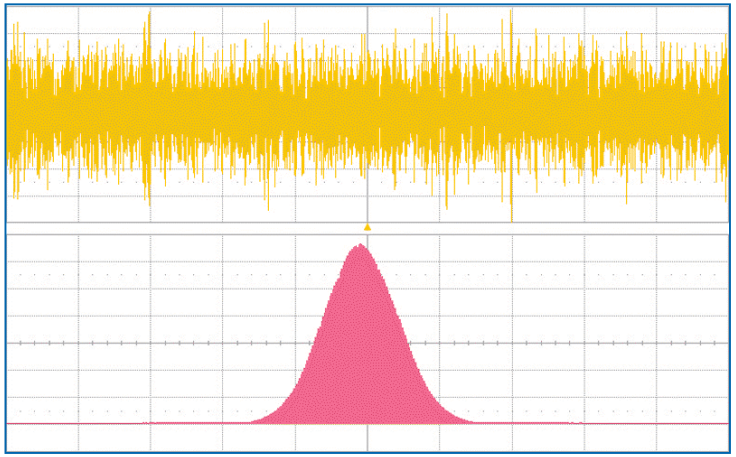


Important noise characteristics

- Frequency Domain
  - Flat spectrum with uniform power spectral density
  - White noise contains all frequencies for a given BW



- Time Domain
  - Amplitude has a Gaussian distribution
  - Signal should have high crest factor (Pk/avg)



How do I control noise?

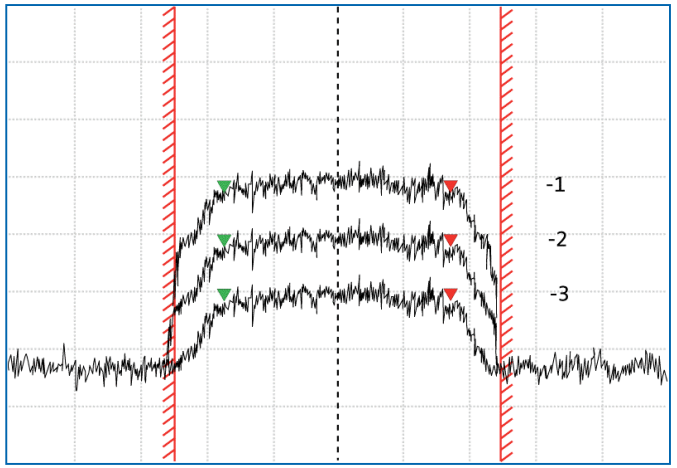
Testing a wireless, or PC-board receiver system requires a gradual change in SNR

- Methods to change SNR:
  1. Amplify the noise
  2. Amplify the signal
  3. Subtract noise via attenuation

Why should I choose noise attenuation?

- Amplification
  - Adding power to change SNR adds cost and complexity
  - Using an amplifier to change gain (volume control) adds uncertainty

- Passive attenuation
  - Noise source is tuned at maximum power for the best flatness
  - Is repeatable because passive attenuators produce monotonic curves (see figure)



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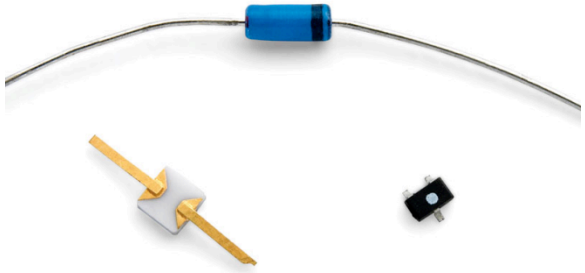
How can you use our components?

- Built in testing (BIT) provides custom form factors
- Calibration of communication and radar warning systems
- Improve receiver gain accuracy
- Randomizing the quantization errors of high-speed A/D converters (dithering a circuit)



How can you use our instruments?

- From the bench top to a rack system we have several form factors

- Bench top instruments plug into a common lab outlet and require minimal operating instructions

- Computer controlled instruments are the solution for complex ATE system
- Instruments with power meters and filters provide advanced capability

How do I request a noise solution?

Things we need to know about your system

- What is the maximum BW of your system?
- How much power do I need to disturb my signal?
- What amount of noise do I need to add, or subtract?
- What increments are required for my testing?
- How will I implement the noise system?

Please see our Noise by the Numbers brochure for the necessary formulas to calculate total power, excess noise ratio, and power spectral density

How can we help you today?

Noisecom has been working with industry leaders since 1985 that manufacture:

- Microprocessors
- HDD & Flash memory
- Radar equipment
- Satellite systems
- Radiometers
- Antenna systems
- Cellular service providers
- Calibration systems

Please visit our website for international locations:
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Thanks for participating!

Any questions?

Application Support
Mr. Bob Muro
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Please join us for our next webinar about Basic Power Measurements on Wednesday 9/8/10.