

# *Signal to Noise Ratio Affects on Guitar and Amp Tone*

(courtesy of Steve Crow and ChatGPT)

## **Instructions to ChatGPT:**

Give me a detailed explanation about how signal to noise ratio, noise, hum and emi affect guitar and amp tone

## **ChatGPT's Response:**

If your rig were perfectly silent, every nuance of your playing would come through untouched. In reality, you're always fighting a layer of unwanted signal riding along with your guitar tone. Understanding how that layer behaves is the key to controlling it.

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## **Signal-to-Noise Ratio (SNR): the big picture**

**Signal-to-noise ratio** is simply how loud your *intended guitar signal* is compared to everything you *don't want*.

$$\text{SNR (dB)} = 20 \log_{10} \left( \frac{\text{signal}}{\text{noise}} \right)$$

$$\text{SNR (dB)} = 20 \log_{10} \left( \frac{V_{\text{signal}}}{V_{\text{noise}}} \right)$$

- **High SNR** → clear, articulate, dynamic tone
- **Low SNR** → hiss, hum, muddiness masking your playing

Every stage in your chain (pickups → cable → pedals → amp) either preserves or degrades SNR. Once noise gets added early, later gain stages **amplify it just like your guitar signal**.

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What “noise” actually is “Noise” is a broad term. In guitar rigs, it usually shows up as:

### **1. Thermal noise (hiss)**

Comes from resistors, pickups, and electronics

Sounds like a steady “ssss”

Increases with:

Higher resistance pickups (more windings)

Higher gain settings

Cheap or noisy components

Effect on tone:

Masks high-end detail

Makes clean tones feel less “open”  
 Becomes very obvious with distortion

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## **2. Shot noise & circuit noise**

Generated inside active components (transistors, op-amps)  
 Common in pedals and amp preamps  
 Effect on tone:  
 Adds graininess to distorted sounds  
 Can make high-gain tones feel fizzy or harsh

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Hum: the low-frequency enemy  
 Hum is a specific type of noise, usually at:  
 60 Hz in the U.S. (from mains power)  
 Plus harmonics (120 Hz, 180 Hz, etc.)  
 Where it comes from:  
 Power lines in your walls  
 Transformers in amps  
 Lighting, especially dimmers and fluorescents  
 Why single-coils hum:  
 Single-coil pickups act like antennas. They pick up electromagnetic fields from the environment.  
 Humbuckers cancel this by using two coils wired out of phase:  
 Noise cancels  
 Signal (string vibration) remains

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### **Effect of hum on tone:**

Adds a low-frequency drone  
 Reduces perceived clarity and punch  
 Eats up headroom (your amp is amplifying hum along with your guitar)

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EMI (Electromagnetic Interference): the chaos factor  
 EMI is external interference entering your signal chain.

Common sources:  
 LED lights  
 Phone chargers  
 Computers and monitors  
 Wi-Fi devices  
 Bad power supplies (wall warts)  
 What it sounds like:  
 Buzzing  
 Whining  
 Chirping/digital artifacts

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### **How EMI affects tone:**

Adds unpredictable frequencies  
 Makes your tone feel unstable or “dirty”  
 Can interact with gain to create harsh, unpleasant overtones

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How gain multiplies everything

Here's the brutal truth:

Gain doesn't just amplify your guitar—it amplifies EVERYTHING.

If your noise floor is high:

Clean tone → mildly annoying

Overdriven tone → very noticeable

High gain → overwhelming

That's why a rig that sounds fine clean can fall apart with distortion.

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How these factors shape your actual tone

### **1. Loss of clarity**

Noise fills in the “space” between notes, so:

Chords sound less defined

Fast playing turns to mush

### **2. Reduced dynamics**

Low-level details (pick attack, finger nuance) get buried under noise.

### **3. Perceived EQ shift**

Hum adds low-end mud

Hiss adds harsh top-end

EMI adds random peaks → harshness or weird resonances

### **4. Sustain masking**

Noise can trick your ear:

It *sounds* like sustain

But it's actually just noise filling the decay

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Why your earlier fix worked so well

From what you described (shielding, star grounding, filtering your wall wart), you attacked noise at multiple levels:

Shielding → blocks EMI from reaching pickups and wiring

Star grounding → prevents ground loops (a major hum source)

Tailpiece grounding → stabilizes reference potential

Filter capacitors → clean up power supply noise

That combination:

→ lowers the noise floor

→ increases SNR

→ gives you a clearer, more “hi-fi” guitar tone

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**Practical takeaways****If you want the best tone possible:**

Maximize signal early  
Strong pickup output  
Proper pickup height  
Minimize noise before gain  
Shield cavities  
Use good cables  
Isolate noisy power supplies  
Control environment  
Turn off noisy lights/devices  
Use gain wisely  
More gain = more noise exposure

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**Bottom line**

Noise = unwanted signal  
Hum = low-frequency power-related noise  
EMI = external interference  
SNR = how much your guitar “wins” over all that

**Great tone isn’t just about pickups or amps—it’s about how clean your signal path is before it ever gets amplified.**