1. dB is a ratio, not a unit

- dB (decibel) = a **way to compare two powers** on a logarithmic scale.
- Why log? Because our ears, radios, antennas, amplifiers — all work across *huge* ranges (from nano-watts to kilowatts).
- Without log, graphs would be either microscopic or gigantic.

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2. The formula

- **Power ratio in dB**:

$$\mathrm{dB} = 10 \cdot \log_{10}\left(\frac{P}{P_{\mathrm{ref}}}\right)$$

- But in IQ signals, we often deal with **voltages or magnitudes** (not direct power).
  Power ∝ Voltage².
  So when comparing **voltage amplitudes**:

$$\mathrm{dB} = 20 \cdot \log_{10}\left(\frac{V}{V_{\mathrm{ref}}}\right)$$

That's why your code uses **20·log10(|FFT|)**.
Because FFT gives us **magnitude (like volts)**, and we want **power in dB**.

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3. Quick head-tricks (cheat sheet)

- **+3 dB ≈ ×2 power**
- **+10 dB = ×10 power**
- **+20 dB = ×10 voltage** (because 20 log10 handles voltage)
- **−3 dB ≈ half the power**
- **0 dB = equal (ratio = 1)**

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4. Why does SDR world love dB?

- Signals span **100+ dB range** (weak GPS signals vs strong FM broadcast).
- Noise levels, signal strengths, antenna gains, FFT plots → all easier to see/log on dB scale.
- Without dB, your spectrum would just look like a **flat noisy mess**.

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5. Tiny thought experiment ◈

- Suppose your FFT bin magnitude is **0.001**.
- In raw linear scale: meh, it's "0.001".
- In dB scale:

$$20 \cdot \log_{10}(0.001) = -60\,\mathrm{dB}$$

- Now you instantly know: "that's 60 dB weaker than my reference" → clear, human-readable.

✅ **So the expert summary**:

- Use **10·log10** for power ratios.
- Use **20·log10** for amplitude/voltage (FFT magnitudes, I/Q samples).
- That's why `20 * log10(abs(fft))` is the universal way to plot SDR spectrums.