# Brass Tacks

***An in-depth look at a radio-related topic***

## What the heck is squelch, and why do we need it?

You reach for your HT (handheld transceiver) and turn it on. After it makes its usual startup beeps and blaps, you hear nothing. So you turn up the volume, check the frequency, and maybe even shake your radio a bit, but still nothing. Then again, you come to your senses and realize that's pretty much what you'd expect when nobody's talking within range on your frequency, so it seems all is well after all. But then you remember back at Field Day, hearing the constant noise of the ***GOTA*** (get-on-the-air) station tuned to an HF frequency. It was issuing a very loud ***SSSHHHHHHHHHHHH*** sound between transmissions, but your HT is quiet.

The loud hissing you heard at the GOTA station is known as *atmospheric noise*, and is the natural accumulation of random signals and static from surroundings, local electronics, and most especially, distant thunderstorms. So, what's making the difference between hearing the noise at the GOTA station and hearing nothing on your HT? The frequency or mode? Your location? The radio or antenna type?

## In your radio

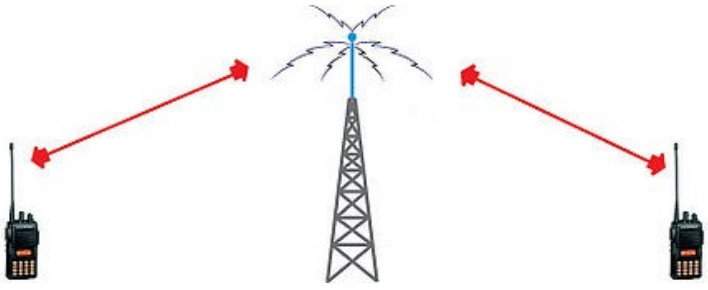
What's going on is that the atmospheric noise you heard on the GOTA rig can also be heard on your HT, but is ***squelched***, or silenced. Deep inside the receiver portion of your HT is a little circuit that actually *mutes* all sounds normally sent to your speaker while the radio is not receiving a ***carrier*** (unmodulated, single-frequency) signal. But as soon as this squelch circuit senses that a carrier signal is being picked up, it ***opens*** the audio channel, and you hear the sound that was intended for you, including all the static.

The surrounding (ambient) atmospheric noise can be stronger (exhibit a greater power level) on some days or some locations than others. For that, most of today's radios can adjust this squelch sensitivity, such that you can still mute this noise if you adjust (turn up) your squelch setting to compensate. So, if you'd like to hear what the radio actually hears, simply turn the squelch control off or all the way down. Suddenly, your HT will sound just like the GOTA station, and you can already feel your agitation level start to rise.

As a side note, the GOTA station rig also has a squelch control, but since most signals it receives don't come with a carrier (because they are SSB, unlike AM or FM), it's very difficult for the incoming signal to trigger the squelch circuit to open the audio, and you hear little or nothing while the squelch is activated.

## In a repeater

So, if both your HT and the GOTA station's HF rig have squelch controls, do repeaters also have them, since they too are radios with their own receivers? Yes, and in fact, just like your radio puts out its audio only when a carrier signal is received, a repeater only re-transmits the signal when it receives a carrier signal.



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Furthermore many, if not most repeaters are configured to re-transmit a signal when it receives two signals: a carrier signal and a ***tone***. As mentioned, the carrier is an unmodulated (not modified), high-frequency radio signal, but the tone is a simple low-frequency *audio hum* that is *modulated and transmitted along with the carrier signal*. As long as the repeater detects the presence of both the carrier and the tone signals, it opens its squelch (***opens the repeater***, as we say) to re-transmit the signal.

Because the tone must be received continuously while the repeater is performing the re-transmission function, this feature is called ***Continuous Tone-Coded Squelch System*** (CTCSS) or simply *Tone*. It was formerly called ***PL Tone***, which is easier to say, but the term has been retired and discouraged due to copyright assertions by Motorola. A digital version of this tone system, DCS or ***Digital-Coded Squelch***, is also supported by many radios.

The frequencies of these tones are designed for a range that's higher than that of household current (60 Hz) and lower than 300 Hz, to provide a reasonable FM deviation buffer, something we won't get into here. As a result, most radio receivers will filter out the lower 300 Hz of all incoming signals following demodulation, to spare you the pain of hearing the tone, and so we call it a ***sub-audible tone***, even though technically it comfortably exists within the audio -frequency range.

## A little experiment


Let's try an experiment to demonstrate how carrier squelch works. Set two HTs in VFO (Frequency) Mode to 147.580 MHz simplex and low power, and give one of the HTs to your friend Bob. Without any signals on this frequency, the HTs should seem very quiet, because their squelch circuits are actively muting everything. But, when you transmit your call sign on your HT, Bob hears your voice crackle on his. So far, so good.

Now, press and hold the Monitor (MONI) button on your HT. You should hear a very loud hiss on it, because you've turned off the squelch, and your HT hasn't detected the presence of a carrier signal. While you keep the Monitor button pressed, have Bob say his call sign on his HT. Suddenly the hissing on your HT is replaced by Bob's voice. For extra credit, try doing the same thing to test Tone Squelch, by setting Bob's radio to transmit a tone, and yours to receive the same tone. This is similar to how a *Code* setting works in a walkie-talkie radio pair.

## Summary

*Squelch* is nothing more than the muting of natural atmospheric noise received by your radio, until it receives a carrier signal. *Carrier Squelch* is the opening of a repeater due to the presence of only the carrier signal, while *Tone Squelch* opens a repeater that requires the *CTCSS* tone as well as the carrier, to re-transmit a received signal. You can test this feature with a friend and two HTs on simplex.

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