Continuous Tone-Coded Squelch System (CTCSS)
demystified

by Gary Morrison VE7POP 02 Feb 2018

Key Ideas:

CTCSS is a non-audible tone, embedded in a transmitted radio signal which allows a receiver to suppress all signals except those that have the embedded tone.

- The frequency of the embedded tone is selected by the radio operator from a list of standard options (e.g. 123.0 Hz) and can be embedded in any VHF/UHF signal.
- The tone is “encoded” by the transmitter and “decoded” by the receiver.
- The encoded tone of the received signal is used to control squelch, thereby restricting whether or not the received signal can be heard.

CTCSS restricts the received signal, NOT the transmitted signal

- If a receiver is set to decode a tone at a given frequency, a signal received at that frequency *cannot* be heard unless it has been encoded with the same tone, BUT...
- A signal transmitted with an encoded tone can be heard by any receiver within range, *whether or not* the receiver is set to decode the tone, SO...
- *Encoding a tone in a transmission does not prevent interference with others on the same frequency and does not prevent others from hearing the transmission. It is not a “Private Line” despite some brand descriptions of CTCSS.*

CTCSS has a number of different applications

- Control access to repeaters.
- Reduce interference from other stations on the same or nearby frequency.
- Suppress digital signals such as C4FM transmissions which cannot be copied by an by an FM-only radio.

CTCSS has different proprietary terminologies

- Depending upon the brand and the application, CTCSS may also be called **PL** (Private Line); **CG** (Channel Guard); **TQSL** (Tone Squelch. Such expressions usually refer to combined encoding *and* decoding.
- Some radio manuals and other reference may use '**CTCSS'** with reference to a system of encoding *and* decoding but just "**Tone"** or “repeater operation” when referring to *only* encoding (e.g. Kenwood TM-V71A).
- DCS (Digital Coded Squelch) is similar to CTCSS in application but uses different technology (not to be confused with DSC Digital Selective Calling in marine radios, which has some similarities in application).

CTCSS is controlled differently in various radios

- Generally, a radio can be set (a) to encode only *or* (b) to encode *and* decode at the same tone frequency. The former is usually referred to as **T**(tone) and/or "repeater tone," and the latter as **TSQL** , **CTCSS**, **PL, CT,** etc. BUT…
- Some radios can be set to either encode *or* decode *or* both, with the same or different tone frequencies for TX and RX. (e.g. Wouxun KG-UVD1P uses T-TCT for encode and R-TCT for decode but **CT** is displayed when transmitting or receiving).
- Whilst most repeaters are set up to require a tone on the receive frequency, they may or may not encode a tone with the repeated transmission.

There are Pros and Cons of CTCSS in various situations

- If *all* users on particular frequency use both encoding *and* decoding, they can conduct a net without hearing interference (but the transmissions on this net could still interfere with others using the same or very close frequencies).
- By agreement, users in overlapping coverage areas can operate on the same frequency without interfering with each other by using different CTSCC tone frequencies.
- If a receiver is set to hear only an encoded signal at a particular frequency an operator may unintentionally step on other stations because he/she cannot hear that the frequency is in use. (Some radios can prevent this with a "busy channel lockout" function to prevent transmitting if the frequency is in use).
- It is a bad idea to use any coded squelch system to hide interference issues in systems with life-safety or public-safety uses such as police, fire, search and rescue or ambulance company dispatching. Adding tone or digital squelch to a radio system doesn't solve interference issues, it just masks them. The presence of interfering signals should be corrected rather than masked.

Summary

Tones can be confusing, not only because of the difference among radio brands in terminology and operational controls but also because the way they work is counter-intuitive. It is very easy to fall into the misconception that a tone on your transmitted signal will prevent other stations from hearing your signal. But the reality is much the opposite: if you do *not* encode a tone on your transmitted signal, then other stations (such as a repeater), that have enabled tone-decoded squelch will not hear you. Conversely, if you have enabled tone-decoded squelch on a frequency, you will hear *only* stations that have encoded the same tone on that frequency.

Remember: *a key doesn't prevent you from entering unlocked gates but a locked gate prevents entry without the correct key.* The tone you transmit (encode) is a key; the tone squelch activated in a receiver (decode) is a locked gate.