Decoding the Secrets of CTCSS

While most rigs can *send* these low-frequency audio tones, *decoding* them is a handy trick, too!

By Ken Collier, KO6UX

If you're an FM operator, you'll encounter *CTCSS*—*C*ontinuous *T*one-*C*oded *S*quelch *S*ystem—early in your ham career. You may discover it while you're puzzling over the fact that a particular repeater seems deaf to your signals.

Like most hams, you'll probably check your *Repeater Directory* and determine that CTCSS is in use. No problem. Just program your FM transceiver to send (*encode*) the proper audio tone and the repeater opens its doors to you. In most cases you won't hear the tone because its frequency is quite low, near the bottom end of the range of human hearing. That's why you'll often hear CTCSS tones referred to as *subaudible*—literally "below audibility."

This subaudible tone-control system was originally developed by Motorola and marketed under the name *Private Line*, or just *PL* for short. To this day the tone frequencies established by *Private Line* remain the CTCSS standards (see **Table 1**). As a result, many hams refer to CTCSS as "PL"—often without knowing what the letters stand for! You'll even hear PL used as a verb, as in, "They PLed the repeater last month." (Translation: They installed CTCSS on the repeater last month.)

While many hams are familiar with the idea of sending a CTCSS tone to use a repeater, not everyone understands CTCSS *decoding*. Virtually all modern FM rigs can send CTCSS tones, but only a few offer the ability to receive and process (*decode*) such tones as standard equipment. CTCSS decoders are usually available as options.

If you're about to purchase an FM transceiver, should you shop for a rig that includes CTCSS decoding? If the radio you already own offers a CTCSS decoder as an option, should you install it?

Table 1—CTCSS Frequencies (Hz)

69.3
71.9
74.4
77.0
79.7
82.5
85.4
88.5
91.5
94.8
97.4
100.0
103.5
107.2
110.9
114.8
118.8
123.0
127.3
131.8
136.5
141.3
146.2
151.4
156.7
162.2
167.9
173.8
179.9
186.2
192.8
203.5
210.7

218.1
225.7
229.1
233.6
241.8
250.3
254.1

An Electronic Gate-Keeper

A CTCSS decoder allows you to choose which signals are heard in your transceiver's speaker. When you activate the decoder, your radio will fall silent. Only the signals that carry the CTCSS tone you've selected are passed through to your receiver's audio amplifiers and, ultimately, to the speaker. All other signals are ignored. They're still there, but you won't hear them.

By activating the CTCSS decoder you're making your transceiver behave like a tone-protected repeater. But why would anyone want to limit what they hear? There are three good reasons:

Limiting Access

In the beginning, amateur repeaters used CTCSS to restrict access to certain groups or individuals. (Only those who knew the correct CTCSS tone frequency could use the repeater.) Although some repeaters still use CTCSS in this fashion, they are the exception. After all, it's relatively easy these days to determine which CTCSS frequency is in use on a particular repeater. Some modern radios will even display the frequencies of received CTCSS tones. All you have to do is monitor the repeater input frequency and, when a user is within range so you can copy him direct, decode the tone from his transmission.

However, CTCSS is still a good way to limit access to other devices such as simplex autopatches, remote bases and so on. If you are going to use your mobile rig as a temporary cross-band repeater (another feature found in many radios today), it's a good idea to use a CTCSS decoder on the input. This will limit access to only you and those you've chosen to operate the system.

When used in conjunction with DTMF (*touchtone*) tones, CTCSS can be a more effective tool to limit access. In fact, many "closed" repeaters require users to send specific DTMF tones, in addition to a constant CTCSS tone.

Frequency Sharing

To some extent, CTCSS can make it easier for different groups to use the same frequencies without bothering each other. This application is seen most often in repeater networks.

In heavily populated areas it is not uncommon to find repeaters sharing the same frequency pairs. Coordination groups try to arrange it so that these systems are separated by a considerable distance, but coverage areas often overlap. This means that some stations are able to access two or more repeaters at the same time (see **Figure 1**). By installing CTCSS on both repeaters, stations are limited to accessing only one repeater at a time. They must send the correct subaudible tone to use the repeater they desire. (Modern FM transceivers make this easy by allowing you to specify particular CTCSS tones when you program repeater frequencies into memory.)

CTCSS can also be a big help on simplex. For example, one of the FM simplex nets that I frequent here in southern California shares the frequency with another group about 75 miles away. Many of us can hear them, and this can be more than a little annoying!

The solution? Everyone on our net uses CTCSS decoders set to 100 Hz and everyone sends 100-Hz tones whenever they transmit. As a result, we hear only each other! The only drawback is that it's difficult for newcomers to join the net unless they know our system. If they attempt to break in without sending a 100-Hz tone, we probably won't hear them.

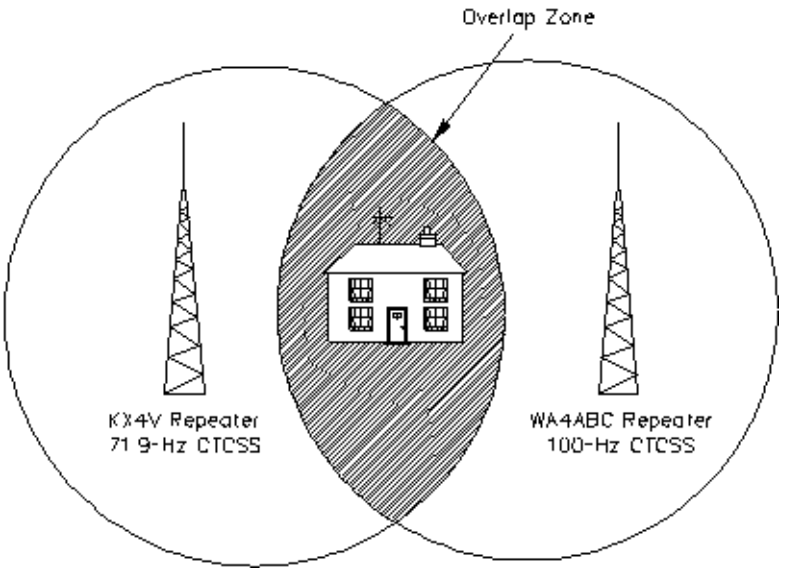

Figure 1—CTCSS offers an effective solution for repeater systems with overlapping coverage. In this example, the ham who lives in the overlapping zone can send a 71.9-Hz tone to use the KX4V repeater, or a 100-Hz tone to use the WA4ABC machine.

Selective Calling

Sometimes you want to be a little “selective” about the signals you receive. You want to be available when friends call, but you don’t want to hear all the other noise and chatter on the frequency. CTCSS provides the solution!

If your rig is equipped with a CTCSS decoder, you can switch it on and hear nothing until someone transmits using the correct tone. This is handy when you’re driving with your family (not everyone appreciates the sounds of Amateur Radio!), or when you’re busy at home.

This technique often works better on simplex than through repeaters. Many repeater systems will not pass CTCSS tones. So, if you transmit using a CTCSS tone on the repeater input, it may not be present on the output. The easiest way to find out is to set up a test with a friend.

Be careful when using CTCSS for selective calling. Most amateur transceivers don’t offer an easy way to disable the CTCSS decoder. Some H-Ts include a “monitor” button that opens the squelch even when the decoder is on, but most mobiles do not. Just because your radio is silent, that doesn’t mean that the frequency isn’t in use. Disable your decoder and check the frequency before you transmit.

CTCSS can also be used for a type of selective *paging*. For example, some hams live in areas where it is possible to hear more than two repeaters on the same frequency (although they can usually access only the local machine). To eliminate this irritating problem, the repeater trustee can set up the system to transmit a continuous CTCSS tone on the output frequency (see **Figure 2**). Everyone who owns a rig equipped with a CTCSS decoder can set their decoder to accept signals carrying that tone *only*. This automatically screens out transmissions from the distant machine—only the local repeater is heard!

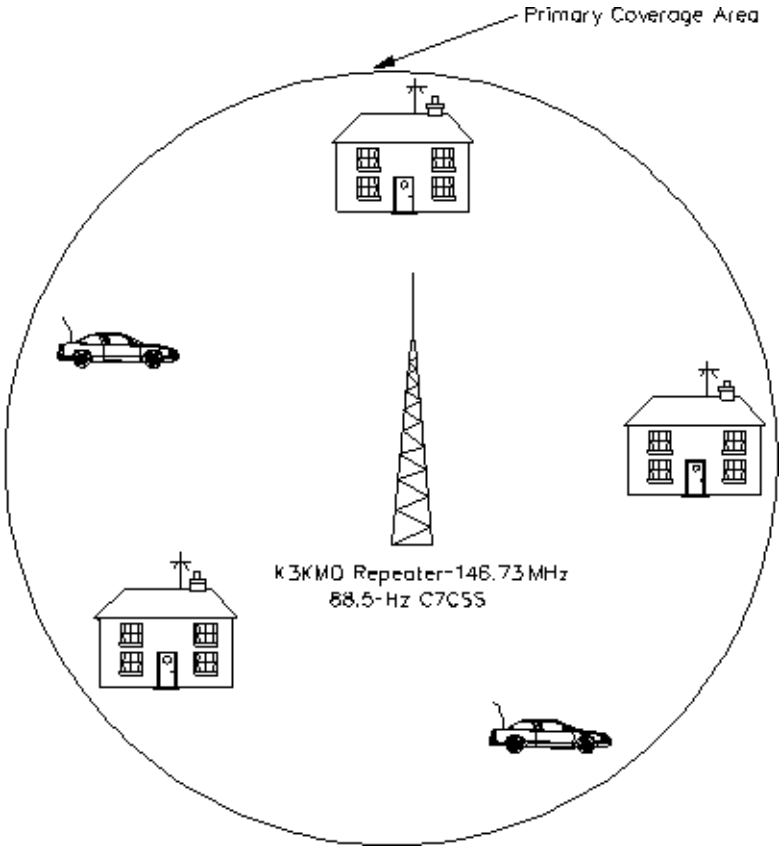

Figure 2—Hams in the coverage area of the K3KMO repeater also hear signals from distant machines. To cure the annoying problem, the trustee of K3KMO switches on a 88.5-Hz tone encoder on the output of the machine. Whenever the K3KMO repeater is up, the tone is transmitted as well. Anyone who owns a rig equipped with a CTCSS decoder can set it to respond to the 88.5-Hz tone. Now they only hear transmissions from the K3KMO repeater!

Have You Decided?

Is there a CTCSS decoder in your future? If your favorite repeater is having difficulty with another overlapping system, the repeater trustee may install a CTCSS system to help cure the problem. If your radio can't decode the tone, you won't share the benefit. As you've seen, a CTCSS decoder is also a valuable asset if you're a busy person who doesn't want to be bothered by random chitchat. A CTCSS decoder might allow you to keep the radio "noise" at a tolerable level, while still providing a way for your buddies to reach you.

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