Ham Tips

from KH6CQ

Sub-Audible Tone
and What You Need to Know About It

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In the late 1960s and early 1970s when VHF amateur radio FM repeaters were still a novelty, some repeater owners put sub-audible tone decoders on their receivers to restrict access to their dues-paying members. The tone frequency was a highly guarded secret and you couldn't get it unless you were a member in good standing of the group. These systems were called closed repeaters or private repeaters and were the subject of much criticism from proponents of open repeater systems, i.e., repeaters that simply used carrier squelch.

Today, most open repeaters now use sub-audible tone decoders to mitigate co-channel interference and extend their coverage areas; however, there are a very few that remain closed to the general amateur radio community for one reason or another.

The Name Game

Before we get into the merits and pitfalls of using sub-audible tone encoding and decoding, you should understand that the generic name for encoding and decoding by means of a continuous sub-audible tone is Continuous Tone Carrier Squelch System (CTCSS). In the 1960s Motorola introduced this technology into their land mobile radios and called it Private Line (PL). Other manufacturers followed suit but with their own trade names. Table 1 lists the more prominent ones.

Some two-way radio technicians use the nickname buzz when referring to sub-audible tone because on radio receivers not designed with PL in mind, the low-end audio response didn't roll off fast enough to eliminate the sub-audible tone and a buzzing sound was heard whenever the transmission being received contained a sub-audible tone. Most Hams refer to

sub-audible tone as PL, probably because it rolls off the tongue better than CTCSS.

Table 1
Trade Names for CTCSS

TRADE NAME	LMR COMPANY
Private Line — PL	Motorola
Channel Guard — CG	General Electric
Quiet Channel — QC	Radio Corporation of America
Call Guard — CG	E. F. Johnson
Private Channel — PC	Standard Radio Corporation
Quiet Talk — QT	Kenwood

What PL Does and Does Not Do

Contrary to popular belief, PL does not provide you with a private channel for your communications. Since most commercial users never correctly understood this feature it's not unusual that some Hams don't get it right either.

Using PL means that you will not hear the transmissions of other stations unless they are transmitting the same sub-audible tone your receiver is set to receive. It does not mean that other users cannot hear you. Quite the contrary; all users with carrier squelch will hear your transmissions.

Not all Radios Support all PL Tones

Although sub-audible tone encode and decode is a common feature in modern radios, you should be aware that every radio does not support all of the standard PL tone frequencies listed in Table 2. Some radios do not provide a few of the standard tones, while other radios provide different or additional tones.

Table 2
Tone Codes and Standard Sub-Audible Frequencies in Hertz

CODE	FREQ	CODE	FREQ	CODE	FREQ
XZ	67.0	1B	107.2	6A	173.8
WZ	69.3	2Z	110.9	6B	179.9
XA	71.9	2A	114.8	7Z	186.2
WA	74.4	2B	118.8	7A	192.8
XB	77.0	3Z	123.0	M1	203.5
WB	79.7	3A	127.3	8Z	206.5
YZ	82.5	3B	131.8	M2	210.7
YA	85.4	4Z	136.5	M3	218.1
YB	88.5	4A	141.3	M4	225.7
ZZ	91.5	4B	146.2	9Z	229.1
ZA	94.8	5Z	151.4	M5	233.6
ZB	97.4	5A	156.7	M6	241.8
1Z	100.0	5B	162.2	M7	250.3
1A	103.5	6Z	167.9	0Z	254.1

One reason this is important is if you're buying a new radio. Before you purchase it, you'll want to make sure it has the capability of encoding and decoding all of the PL frequencies used in your area.

Something to keep in mind if you're buying an add-on board for an older radio is that some of them do not support all of the standard frequencies. For example, the popular ComSpec model TE-32 Tone Encoder supports all standard tones from 67.0 to 203.5 Hz except 69.3 Hz.

Applications and Benefits of Sub-Audible Tone

While the use of a sub-audible tone is still mostly associated with gaining access to conventional repeaters, there are many other applications in which PL encode and decode features can be used to great advantage. Here are some examples.

- Enabling PL decode on a repeater's receiver can prevent undesired signals, including random noise, from keying the repeater.

- Enabling PL encode on a repeater transmitter can benefit users in a couple of ways. Users who hear more than one repeater on the same RF frequency can use their PL decoder to screen out the undesired repeaters. In addition, users who scan multiple RF frequencies or mobile users who travel through high noise areas can improve the reliably of their scanning because their radios will not be tricked into stopping by false signals.

- In a linked repeater system, using full PL (encode and decode) on the link receivers and transmitters prevents false keying due to interference on the link receiver's input. In addition, turning the PL encode off while the link transmitter identifies minimizes the number of IDs that will be heard by users.

- Remote base systems can use multiple receivers to cover a large area. Each receiver is activated by a different PL tone. This prevents more than one receiver from being simultaneously activated by a station within range of more than one of the receivers.

- To use PL effectively you may want to program multiple memory channels with the same RF frequency but different PL tones.

- Enabling full PL on the UHF simplex frequency used for a cross band repeater is an excellent idea. It reduces the likelihood that undesired signals will key the repeater.

- Using full PL on handheld radios keeps distractions to a minimum by minimizing chatter. For example, if two ARES teams are working in close proximity they can share the same RF channel but use different PL tones so that they only hear the transmissions pertaining to their team. If you do this, you must check to make sure the frequency is clear before you transmit. You can do this by pressing the Monitor button on your radio. This temporarily disables the PL decoder so you can hear if someone else is already using the frequency.

Summary

PL encode and decode, once considered an elite and expensive option, is now a standard feature in most modern radios.

There are two main reasons that we use PL. One is to limit the amount of radio traffic heard to those stations in a particular group of users. Another is to allow users who use the scanning feature of their radios to mitigate incidental interference thus achieving a better scanning experience.

Using PL does not give you a private communications channel. It simply means that you won't hear anyone who is not using your PL tone. Everyone without PL as well as only those with your PL tone will hear all of your transmissions.

Once you understand what PL can and cannot do, you'll come to appreciate how handy it is to have this feature in your FM handheld and mobile radios.

73 from KH6CQ

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