Fire Department Two-Tone Tone Out

Learn How To Receive These Special Signals

Text by John Bolduc

There are different ways a two-way radio or pager can be signaled or alerted. Many of us are familiar with sub-audible CTCSS tones that are used to open the squelch a receiving radio to allow it to receive a desired signal. This article however is concerned with Analog tone Paging that will "trip" pagers, beepers, and more importantly the current generation of two-tone decoding capable Uniden scanners. These Uniden models include the BR330T, BCD996T, and BCD396T. Currently Radio Shack scanners do not have this capability.

Although most Radio Shack scanners are made by GRE, some are built by Uniden. These Uniden built Radio Shack scanners have a slightly altered appearance and bear the Radio Shack name. Might we be seeing some Uniden built Radio Shack scanners in the near future with two-tone alerting capability?

Analog Tone Paging

There are various forms of analog tone paging including DTMF Paging & ANI, 5/6 Tone Paging & ANI, Hexadecimal Sequential Code (HSC) Paging, and 2 Tone Sequential Paging. It is the 2 tone sequential paging that we will specifically explore. Two tone sequential paging is a very common format used to alert fire departments, rescue squads, ambulances and similar agencies. You may hear this referred to by the brand name of Motorola QuickCall 1 & 2, General Electric Type 99, Reach Two Tone, or generically as Plectron.

The Minitor II was a very common pager since the 1980's carried by fire department members and is a Motorola product. The current version is the Minitor V. With this format the first two tones are used are referred to as A and B and is used for "regular" tone outs. Tones C and D are typically used as an additional call type to the pager or for group calls.

Without first knowing what the tones are, how do you determine which type of two tone sequential system you are monitoring? You can tell by the length of the tones and the gap, if any, between the tones.

In the Motorola Quick Call 1 the individual call tones are transmitted for one second with gap of 200 milliseconds between the tones. For group calls a single tone of eight seconds is transmitted.

In the Motorola Quick Call 2 the individual call tones are transmitted for one second of tone A, no gap, and 3 seconds of tone B. For group calls a single tone of eight seconds is transmitted. In the General Electric Type 99 for an individual call, tone A is transmitted for one second, no gap, and tone B transmitted for 1.5 seconds.

In the Plectron Fast Duotone tone A is transmitted for 0.75 seconds, no gap, and tone B transmitted for 0.25 seconds. In the Plectron Slow Duotone tone A is transmitted for 3 seconds, no gap, and tone B transmitted for 0.25 seconds. In the Reach Two Tone Fast, tone A is transmitted for 150 milliseconds, 259 milliseconds gap, and tone B transmitted for 150 milliseconds.

In the Reach Two Tone Slow, tone A is transmitted for 2 seconds, 0.25 seconds gap, and tone B transmitted for 0.70 seconds. The tables below outline the possible frequency of the tones used in the various formats. This table is sorted in ascending order by tone to make frequency look up much easier for the scannerist. There are several charts on the Internet that list the tones in a logical but non ascending format. These tables also get into what combinations of tones are possible.

Not every combination of two tones listed in our table is actually used. Our simplified table is concerned with a quick look up tone frequencies to program our scanners. If you considerably more technically inclined you can view some of those tables at:

http://www.usalertllc.com/CODING.doc
http://www.midians.com/pdf/tone_signaling.pdf
http://www.genave.com/two-tone_paging.htm

Motorola Quick Call II.

Motorola Tones sorted in ascending value				
288.5	296.5	304.7	313.0	321.7
330.5	339.6	349.0	358.6	368.5
378.6	389.0	399.8	410.8	422.1
433.7	445.7	457.9	470.5	483.5
496.8	510.5	524.6	539.0	553.9
569.1*	584.8	600.9	617.4	634.5
651.9	669.9	688.3	707.3	726.8
746.8	767.4	788.5	810.2	832.5
855.5	879.0	903.2	928.1	953.7
979.9*	1006.9	1034.7	1063.2	1092.4
1122.5	1153.4	1185.2	1217.8	1251.4
1285.8	1321.2	1357.6	1395.0	1433.4
1472.9	1513.5	1555.2	1598.0	1642.0
1687.2	1733.7	1781.5	1830.5	1881.0
1930.2	1989.0	2043.8	2094.5	2155.6
2212.2	2271.7	2334.6	2401.0	2468.2

*Optional Two-tone group (diagonal) alert tones:

Motorola Quick Call I

Motorola (older) Quick Call 1				
346.7	358.9	371.5	384.6	398.1
412.1	426.6	441.6	457.1	473.2
489.8	507.0	524.8	543.3	562.3
582.1	602.6	623.7	645.7	668.3
691.8	716.1	741.3	767.4	794.3
822.2	851.1	881.0	912.0	944.1
977.2	1011.6	1084.0	1122.1	1161.4
10471.				

General Electric Type 99.

GE Type 99 tones sorted in ascending value				
517.5	532.5	547.5	562.5	577.5
592.5	607.5	622.5	637.5	652.5
667.5	682.5	697.5	712.5	727.5
757.5	772.5	787.5	802.5	817.5
832.5	847.5	862.5	877.5	892.5
907.5	922.5	937.5	952.5	967.5

Plectron Paging

Much like facial tissue is referred to by the brand name Kleenex, signaling tones have often been referred as Plectron tones, whether they were Plectron originated or not. Plectron was one of the first systems used to use tone pager alerting for volunteer departments. The systems has three formats, single tone, double tone slow, or double tone fast

Plectron Tones sorted in ascending value				
282.2	294.7	307.8	321.4	335.6
350.5	366.0	382.3	399.2	416.9
435.3	454.6	474.8	495.8	517.8
540.7	564.7	589.7	615.8	672.0
701.0	732.0	765.0	799.0	834.0
871.0	910.0	950.0	992.0	992.0
1036.0	1082.0	1130.0	1180.0	1232.0
1287.0	1344.0	1403.0	1530.0	1598.0
1669.0	1743.0	1820.0	1901.0	1957.0
1985.0	2073.0	2164.0	2260.0	2361.0
2465.0	2575.0	2688.0	2807.0	2932.0
3062.0				

Single Tone - 3.0 seconds of tone A
Slow Dual Tone - 3.0 seconds of tone A, .25 seconds of tone B
Fast Dual Tone - .75 seconds of tone A, .25 seconds of tone B

Reach Tone Paging

REACH format paging system similar to the Two Tone Sequential systems by Motorola and General Electric. REACH format uses an A tone of 2.0 seconds, and a B tone of 0.8 seconds. Group Call is 5 seconds. REACH tones are outlined in the table below.

495.0	512.0	530.0	549.0	588.0
609.0	631.0	653.0	676.0	700.0
725.0	750.0	776.0	804.0	832.0
862.0	892.0	923.0	956.0	990.0
1025.0	1061.0	1098.0	1137.0	1177.0
1219.0	1261.0	1306.0	1352.0	1400.0
1449.0	1500.0	1553.0	1608.0	1664.0
1723.0	1784.0	1847.0	1912.0	1980.0
2049.0	2121.0	2196.0	2274.0	2354.0
2437.0	2523.0	2612.0	2704.0	2799.0
2898.0	3000.0	3106.0	3215.0	3329.0
3446.0	3568.0	3694.0	3824.0	3960.0

Zetron Tone Paging

588.0	609.0	631.0	653.0	676.0
700.0	725.0	750.0	776.0	804.0
832.0	862.0	892.0	923.0	956.0
990.0	1025.0	1061.0	1098.0	1137.0
1177.0	1219.0	1261.0	1306.0	1352.0
1400.0	1400.0	1449.0	1449.0	1500.0
1500.0	1553.0	1553.0	1608.0	1608.0
1664.0	1723.0	1784.0	1847.0	1912.0
1980.0	2049.0	2121.0	2196.0	2274.0
2354.0	2437.0	2523.0	2612.0	2704.0

Zetron uses a series of tones for its Fire Dispatch & Alerting system.The tones are outlined in the table below.

SECODE/Digital Dial Alerting

This system is used in some the EMS community to alert hospitals to incoming patients from ambulance companies. The 2 standard tones used are 2805 & 1500. This system was also used by the older IMTS mobile telephones, prior to cellular phones. The system sends a steady tone, and pulses this tone very similar to pulse telephone dialing.

Brief introduction to pager Cap Codes

The table used in this example is an extreme simplification of a more complex set of table used to determine valid combinations of alert tones.

A Cap Code is a number unique to a pager and allows a dispatcher to page directly with it and not other pagers. With the design of most formats comes a set of tables that relate to a cap code. Cap codes are typical three digits longs. In our sample of a typical setup, the first digit in the cap code tells you which tone table to refer. The Cap Code determines which two tones within the table, Tone A and Tone B, the dispatch encoder will send to activate a particular pager. Tone A is indicated by the second digit in the cap code and tone B is indicated by the third digit in the cap code.

If you see a cap code of 123 you will look at the first digit, which is a one. This means to refer to tone table one. Referring to Table 1 the digit 1, in this example, means that Tone A is selected from Table 2 Group 3 and Tone B is selected from Table 2 Group 4. Consulting Table we read down the column for tone group 3 (from the first digit of our cap code table 1) to the digit 2 (the second number of our cap code) and come up with Tone A as 296.5. For Tone B we would consult group 4 to digit 3 (from the third number of our cap code) and come up with 378.6.

TABLE 1

1st Digit of Cap Code	Group for Tone A	Group for Tone B
1	3	4
2	2	1
3	1	2
4	4	3

TABLE 2

	Group 1	Group 2	Group 3	Group 4
Number	Freq	Freq	Freq	Freq
1	349.0	600.9	288.5	339.6
2	368.5	634.5	296.5	358.6
3	389.0	669.9	304.7	378.6
4	410.8	707.3	313.0	399.8

Okay, we've talked about tones until we are blue in the face. But how do we as a hobbyist determine what the tones are to program into our fire tone out detecting scanners.

Asking may work, but many fire fighters don't know what the tones are in their pagers. You normally would have to pop a pager open to determine what the tones are. A dispatcher, fire department radio technician, or higher ranked officer might know the tone. Some might tell you, and some might eye you with suspicion. Worse you, I've experienced being told totally incorrect information. Let's not resort to that mode.

The Internet and various "groups" are not yet a very good source for tones, although there are pockets of abundant data for limited areas.

Let's figure out the tones on our own. Maybe not the exact tones, but tones that are accurate enough to make those scanners trigger on a fire tone out as reliable if not more than a Minitor pager.

What do you need to determine the tones? A fairly up to date personal computer running Windows, any scanner with a headphone or audio out jack, and a frequency reading/counting software program.

Right of the bat I am going to recommend the program WTune. You can download Wtune at http://www.cipoo.net/wtune_e.html. Word of caution, I found Windows Me gave me some problems running the program.

The great advantage to this program is you can produce a text file listing the dominant frequency at multiple small points in time. A fire tone our would produce a steady listing of one, two, or four dominant tones over many, many intervals in the text file. The dispatch audio portion would show the dominant frequency jumping all over the place at each interval.

An alternative program to use for determining tone frequencies is tuner12. You can download it at: http://www.techmind.org/audio/tuner12.exe This program does not provide text logging.

So how do I do this?

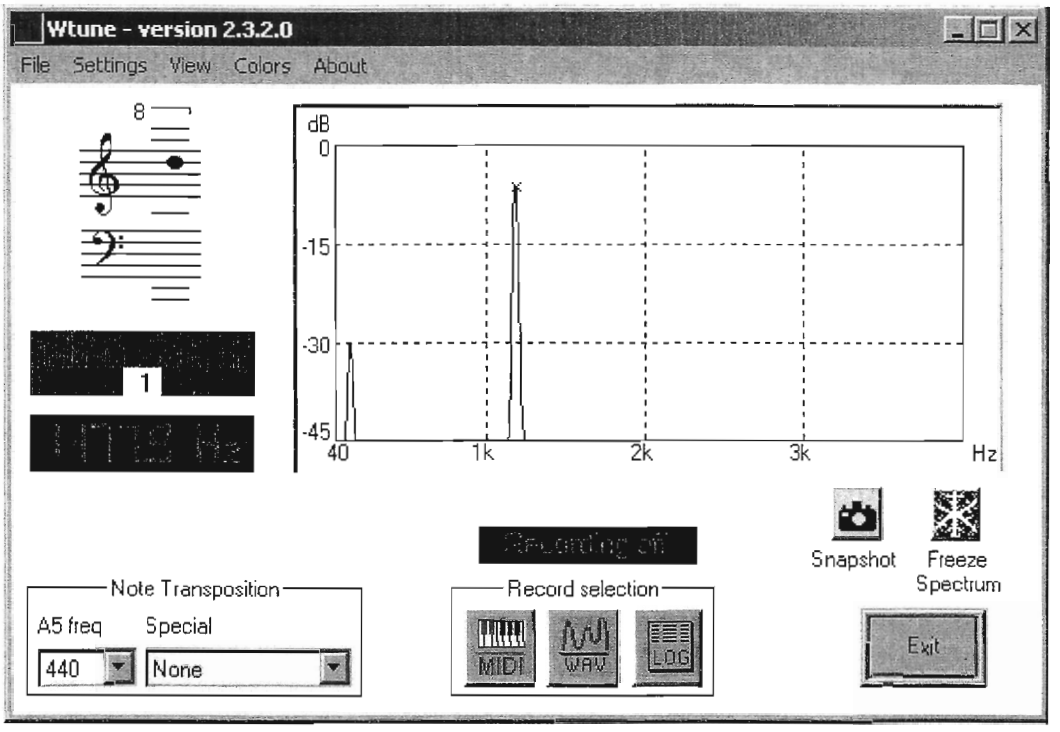
Connect on end of an audio patch cord to your scanner, the other end to the audio input (or microphone input jack if you don't have an audio input jack). When you turn your scanner on, you will be monitoring the scanner audio through the computer speaker. Turn your scanner on. Start the Wtune program.

You can either start logging to the text file immediately or if you are going to be right at the computer you can start logging the instant you hear a tone coming across. I would suggest you be at your computer throughout the logging process. The disadvantage of logging immediately is that you get a large file or text to sort through. However, if you wait to you hear the alert tones, you will have to start the logging the very instance you hear the fire alert tone. In either case, I strongly suggest you stop the logging once you

get a tone out.

Every time you start, stop, and start logging again, you generate a brand new log file. So you could be generating a second log from your scanner while reviewing the text of the first log file. The log files are saved to your Windows Desktop, for better or worse. If you're not tidy your Windows desktop will be overflowing with Wtune log files.

You could walk away from your computer and read the log file later. I strongly suggest if you do this, you monitor a single channel on your scanner. This way any "hits" you get will belong to that frequency. If you do log in the unattended mode and you scan multiple frequencies you will not be able to tell which channel generated which fire tone out tones. I would suggest that if you are logging your scanner unattended, that you concentrate one frequency at a time.



EXAMPLE OF Wtune screen

The left is a digital readout of the dominant frequency. On the graft is shown the dominant fire tone out tone, and to the far left of that you can see the CTCSS tone displayed.

EXAMPLE OF WTune Log File

Wtune version 2.3.2.0 session file

time	dominant frequency	closest note	cents mismatch	dB
00:00:00:00	INFO> start of logfile			
00:00:05:07	1199.8 Hz	D7	+05	0
00:00:05:40	1199.7 Hz	D7	+21	0
00:00:05:65	1199.8 Hz	D7	+28	0
00:00:05:82	1199.9 Hz	D7	+31	0
00:00:06:07	1266.7 Hz	D7#	+32	0
00:00:06:24	1266.8 Hz	D7#	+31	0
00:00:06:49	1266.9 Hz	D7#	+31	0
00:00:06:57	1266.8 Hz	D7#	+31	0
00:00:06:82	1266.9 Hz	D7#	+31	0
00:00:07:57	1266.7 Hz	D7#	+31	0
00:00:07:99	1266.9 Hz	D7#	+31	0
00:00:08:07	1266.8 Hz	D7#	+31	0
00:00:08:24	1266.9 Hz	D7#	+31	0
00:00:08:32	1266.7 Hz	D7#	+31	0
00:00:08:49	1266.8 Hz	D7#	+31	0
00:00:09:02	INFO> no input signal or out of range			

You can ignore the last three column of the file. We are mainly concerned with the second column, the dominant frequency. It appears that there is one second of the first tone from time interval 05:07 to 06:07 reading 1199.7 plus or minus a few tenths of a Hertz. The second tone follows immediately in this case lasting not quite three seconds 06:07 to 09:02 reading 1266.8 plus or minus a few tenths of a Hertz.

You now have two tones to program into you fire tone capable scanner. Note, how to program your particular scanner is not the intent of this article.

Your curiosity is now getting the better of you and you say to yourself, get I wonder what these tone match any of the tone on two tone sequential tone charts. Well "bad news" is often the tones you don't match the charts. They kind of fall in between a couple of official tones. Or perhaps tone A matches near exactly the tone on one chart and tone B matches near exactly the tone on a different chart. At this point I do not have an explanation for this.

The good news is that the tones I've acquired, even the ones that fall into limbo off the charts, have worked 100% percent of the time when programmed into a Uniden scanner. I don't know how much tolerance the Uniden scanner have on programming the fire tone out tone, but I'm guessing they are a little bit liberal and may have a slight chance of falsely alert the scanner on an adjacent tone.

The Good, The Bad, And The Ugly

The "good" is that you don't have to solely rely on your scanner as the source of "scanner" audio for Wtune to work

with. You could use Wtune in conjunction with on-line scanners on the Internet. The "bad" part is audio is heavily processes and produces a wavering reading to the log file. You get a much greater range of frequencies when reading the fire tone out tones. You basically can gather a low, middle, and high set of tones to program into your scanner in three sets. The combination that trips your scanner during an actual tone out is the correct one.

You could also use recorded audio files of past incidents. The "ugly" part comes in here. Unless you recorded and play back the audio on the exact same computer, you don't know if the playback speed is a couple of tenth of a percent fast or slow. My experience show this is enough to throw your reading off by 30-60 Hertz, depending on if your reading a low tone or a high tone. This is enough to make your readings real ugly. Pretty much useless.

The only way to make these recording useful is if you can read an analog CTCSS tone from the recording and match that to what you know is the precise CTCSS tone of the transmission in question. For instance I had some recordings that were suspect as to playback vs. record speed. I knew the CTCSS tone for the audio I was listening to was supposed to be 114.8Hz. I was reading the CTCSS tone on the recording at 119.5. Roughly a five percent error. You can do the algebra and convert you fire tone out tone readings off the recording to get a prettier looking final number.

Sample Tones for Florida

Station / User	A	B
	C	D
Tallahassee FD All Call	378.6 - 8 Seconds	
Tallahassee FD -1	321.7	378.6
Tallahassee FD -2	339.6	378.6
Tallahassee FD -3	358.6	378.6
Tallahassee FD -4	399.8	378.6
Tallahassee FD Div1	330.5	349.0
Lake Jackson Vol	339.6	569.1
Miccosukee Vol	358.6	569.1

Sample Tones for New York

Monroe Cnty Group Tone	1180	
Wayne County	1180	672
	1159	768

Sample Tones for New Hampshire

Amherst EMS	732.0	1232.0
Bedford EMS	584.8	617.4
Bedford Fire	617.4	584.8
Concord Fire	1050	1100
Epsom Fire	2100	834.0
Goffstown FD Stn 18	2361.0	2932.0
Goffstown FD Stn 19	2361.0	1232.0
Goffstown EMS A1	2361.0	1530.0
Goffstown EMS A 2	2361.0	1985.0
Londonderry Fire	539.0	457.9
Merrimack All Call	1185.2	1251.4
Merrimack EMS	1153.4	1185.2
Merrimack Fire	1185.2	1153.4
Merrimack EMS Rsq	1200	1267
Motorola Alert-1 Universal Straight Tn	1000.0	
Motorola Alert-2 Universal Hi-Lo Tone	1500	900
Motorola Alert-3 Universal Pulse Tone	1000.0	
Rollinsford Fire	564.7	1149.0

Sample Tones for Pennsylvania

Allegheny County	1050	
Allegheny County	800	1500
Carnegie EMS	651.9	810.2
Carnegie VFD	371.5	412.1
Carnegie VFD	313.8	496.8
Etna VFD	746.8	832.5
Lower Valley EMS	399.8	928.1
Medical Rescue Team South	881	794.3
Monroeville	707.3	
Monroeville	1063.2	746.8
Monroeville - Monroeville #1 VFD	349.0	707.3
Monroeville - Monroeville #3 VFD	389.0	707.3
Monroeville - Monroeville #4 VFD	1063.2	707.3
Monroeville - Monroeville #5 VFD	433.7	707.3
Monroeville - Monroeville #6 VFD	457.9	707.3
Oakdale VFD	794.3	977.2
Whitehall VFD	794.3	645.7
Whitehall VFD	645.7	794.3

A few of more points to point out!

Some pagers have a battery save mode in which they "wake up" every few seconds" If they hear a special long tone, they will then be in the mode to receive a regular two-tone sequential tone alert. The preamble could be confused for Tone A if you don't recognize that the preamble tone is about four times as long as a Tone A should be.

If you enter the 15000 for tone A and 800 for tone B for fire departments that use the Motorola "Warble Alert" tone, it will activate the Uniden's fire tone alert. It could prove useful if can't get individual tones.

The RELM RPV599A-PLUS VHF Handheld Transceiver is capable of two tone decoding.

Web Sites to consider for more information:

http://www.wpascanner.com/wiki/index.php/Tones
http://www.two-way-radio-tech.com/two-way-radio-glossary.html
http://www.falcon4u.com/PagingTechnicalInfo.html
http://www.braddye.com/pager.html
http://www.gahenryradio.com/tonetut.htm