

Sinewave Sidetone Mod.

Feb 26, 2000, WJ4P

Editor's note: The K2's sidetone generator was designed to support a wide range of user selected frequencies. It is generated as a square wave by the microprocessor and then filtered by an op-amp based roll off filter. The roll off characteristics of this filter were chosen to accommodate the wide range of possible sidetone frequencies and as a result the lower sidetone frequencies will tend to have a little more third harmonic content than the higher ones which are nearer the filter's cutoff frequency.

Randy's sidetone mod. optimizes the filter following the sidetone generator for a narrower range of frequencies, which allows it to filter the result to more closely approximate a pure sine wave. Have fun!

Tonight I finally cracked the sidetone "nut"! I now have a pure sinewave from the sidetone circuit working in serial numbers 183 and 661. It's VERY easy. Here's the modification to the control board...

1) Add a 47 K ohm resistor to the position of C24, a .0027uF capacitor. Pull up one side of C24. It doesn't matter which side. I had to completely remove it first then extend one lead out from the body of the capacitor so that it would have one lead in a hole and one lead up in the air for a "flying connection". Add the 47K ohm resistor to the other hole, also standing on end. Tack solder the top of the 47K ohm resistor to the "top" lead of C24, making a "flying" connection. Note: If the only modification you make is to add the 47K resistor, the tone will smooth out enough that you WILL notice a difference (for the better) but the tone will not be a clean sine wave. The next step will give the sine wave.

2) Make sure C33 is a 2.2uF electrolytic capacitor. (If you made the previous modifications to the sidetone I suggested some time ago, you might want to use these new values.)

3) Solder a 47mH inductor across pins 7 and 10 of RP5. Do not remove RP5, and there is no need to cut any traces. Just tack solder the 47mH inductor across pins 7 and 10 of RP5.

Note: For those of you who prefer to run low frequency sidetones, the sidetone begins to become slightly distorted below 530Hz and loses the nice sinewave shape below that. To compensate, use a 4.7uF cap at C33 or tack a 2.2uF cap across it on the back of the board. The higher frequency side-tones will be nice but at a slightly lower amplitude which isn't really a problem since you can reset the level at will.

Your done! Put your K2 back together and start enjoying the sweet sound of a sine wave sidetone!

BTW, miniature 47mH chokes are available from Mouser Electronics - part number: 434-03-473J, at 800 346 6873. Approximate cost \$1.36 each.

Additional Design Notes from Randy:

The side tone/ spot tone begins life as a square wave that is integrated and then smoothed by an op amp and associated filtering circuit. If you were to look at the sidetone coming from your K2 with a scope you would see a fairly sine-ish wave but there are irregularities that cause the tone to have that "edgy" kind of buzz sound. This makes it a little bit harder to match the received signals to the spot tone for one thing, Some folks find the tone just slightly objectionable with the buzz being such a noticeable component of the audio.

I think the "buzz" is a high frequency component getting through the filtering process. Viewing the sidetone square wave on the scope I noticed a very large but "fast" negative pulse that was reduced by the addition of the resistor at C24.

The added inductor is the part that is usually not readily available but there is a wide range that will work. Seems to me the values ran from about 10mH to 47mH and by using the appropriate capacitor at C33 produced the proper resonant circuit. Tom, NOSS put out a table of parts for C33 and the added inductor.

The added inductor helped a lot to smooth the sidetone, but I wasn't satisfied with the earlier results. The tone is very smooth now with the added resistor at C24. I was able to listen to an unmodified K2 and mine side by side and the difference is very obvious.

One thing I saw was that it was "better" to have the circuit resonance on the low side (about 500Hz) to clean up the low end just in case I or someone else might want to operate it that way. The higher tones were fine doing that. Also, I *think* the combination that uses the smaller caps (about 4.7uF) and larger inductor values seemed to sound better overall. I don't have any scientific info on that thought, just an impression coming away from the long night of testing. And the mod is easier going with the stock cap at C33 and just tacking in the appropriate inductor across RP5 7 to 10.

I did see the post about the fellow who "removed" the resistors. Interesting, and it won't hurt IMO. The impedance of the choke is way lower than 1K, it's about 30 ohms. So it seems to me that cutting the lands is a bit "aggressive" and not required.

Notes from Tom, NOSS:

In case you wish to dabble in the WJ4P mod to clean up the K2 sidetone a bit, and you can't locate chokes in the value/size you want, consider this:

Mouser Electronics 1-800-346-6873 <http://www.mouser.com>

11mm High Reliability Pluggable Coils (0.56" L x 0.38" dia.)

Mouser #	Inductance mH	Max. DC Res OHMS	Max DC Current	Price ea.
434-03-103J	10.0	23	110	\$1.36
434-03-123J	12.0	24	100	\$1.36
434-03-153J	15.0	28	90	\$1.36
434-03-183J	18.0	34	85	\$1.36
434-03-223J	22.0	39	80	\$1.36
434-03-273J	27.0	48	70	\$1.36
434-03-333J	33.0	56	65	\$1.36
434-03-393J	39.0	62	60	\$1.36
434-03-473J	47.0	73	55	\$1.36

Caps to match the above inductors at (about) 500Hz:

XICON Radial-Lead 25V Aluminum Electrolytic Capacitors

Mouser #	Cap. Value in uF	Dia. x Len in inches	Price Ea	Matching Inductor in mH	Resonant Freq (Hz) of Ind. and Cap.
140-XRL25V2.2	2.2	0.2 x 0.43	\$0.05	47 mH	500 Hz
				39	540
				33	620
				27	680
				22	720
				18	800
140-XRL25V4.7	4.7	0.2 x 0.43	\$0.05	39 mH	370 Hz
				33	430
				27	460
				22	500
				18	530
				15	600
				12	680
				10	750
140-XRL25V10	10	0.2 x 0.43	\$0.05	27 mH	300 Hz
				22	340
				18	370
				15	420
				12	460
				10	500

***NOTE:** "Resonant Frequencies" are, at best, approximations, but, the good part is... it probably doesn't matter a lot at that frequency... anything remotely in that range will probably work quite well.*

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NO, I have NO interest in Mouser, other than the fact that they have what they sell, and they are, by far, the best electronics parts company I've ever dealt with.

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