

# K2 2nd Xfil SSB Mod

**Eliminate the Frequency Roll-Off On One End of the K2 SSB Filter**  
ver. 5    11 January 2003    (Includes KI6WX's additions to the original mod)

**Applicability:** This mod is **ONLY** applicable to K2s with serial numbers **LOWER** than **3000** which include the SSB Option board. If your K2's s/n is **3000** or higher, **DO NOT** consider this mod as it has already been incorporated into your PC board design.

## Background:

K2 owners have commented upon the level of frequency roll-off attributed to the K2 SSB Option filter at one end or the other of the audio spectrum (depending upon which band and mode you are using at the time). The stock K2 SSB Option filter is fairly 'flat' across its full bandwidth. However, the 2<sup>nd</sup> Xtal filter (2<sup>nd</sup> Xfil) in the IF tends to cause a moderate amount of signal roll-off on one end of the SSB filter chain when it is in use. This translates to high-pitched receive audio when using USB on the bands 160M thru 17M, and when using LSB on 15M and above.

There are two ways to 'flatten out' the apparent response of the SSB Option filter:

1. Adjust L34 until the passband of the filter appears to be more uniform. Unfortunately, while this is the easier method, it will result in the slug of L34 being turned far enough into the L34 can that the overall signal-to-noise (S/N) ratio of the K2 receiver will be compromised.
2. Add a 'padding' circuit to the 2<sup>nd</sup> Xfil, so that L34 can be left at its point of best S/N ratio, but to 'broaden' the 2<sup>nd</sup> Xfil passband during SSB reception only. This is the method we have chosen to adopt because it appears to not compromise receiver performance in either the CW or SSB modes.

(Note: Once the mod is in place, L34 will be adjusted to a setting that is far closer to optimal for all three modes.)

## Technical Details:

Refer to the accompanying schematic for component references.

The only 'electrical' modifications required to the K2 2<sup>nd</sup> Xfil are to REMOVE C180 (10pF, 22pF in the FT units) from the RF Board, to add one resistor across the input to U11 (NE602) and to ADD a 100pF 'padder' capacitor in parallel with C182 on the RF Board. However, since this padder capacitor is to be used **ONLY** during SSB operation of the SSB Option Filter (OPT1), it must be capable of being switched in/out of the circuit. This will be accomplished by picking up a voltage (at pin 3 of J10, XFIL Out) which is only present when the SSB Option filter is selected. The voltage turns on an NPN transistor which in turn grounds one end of the added padder capacitor, thus putting it in parallel with C182.

## Components Required:

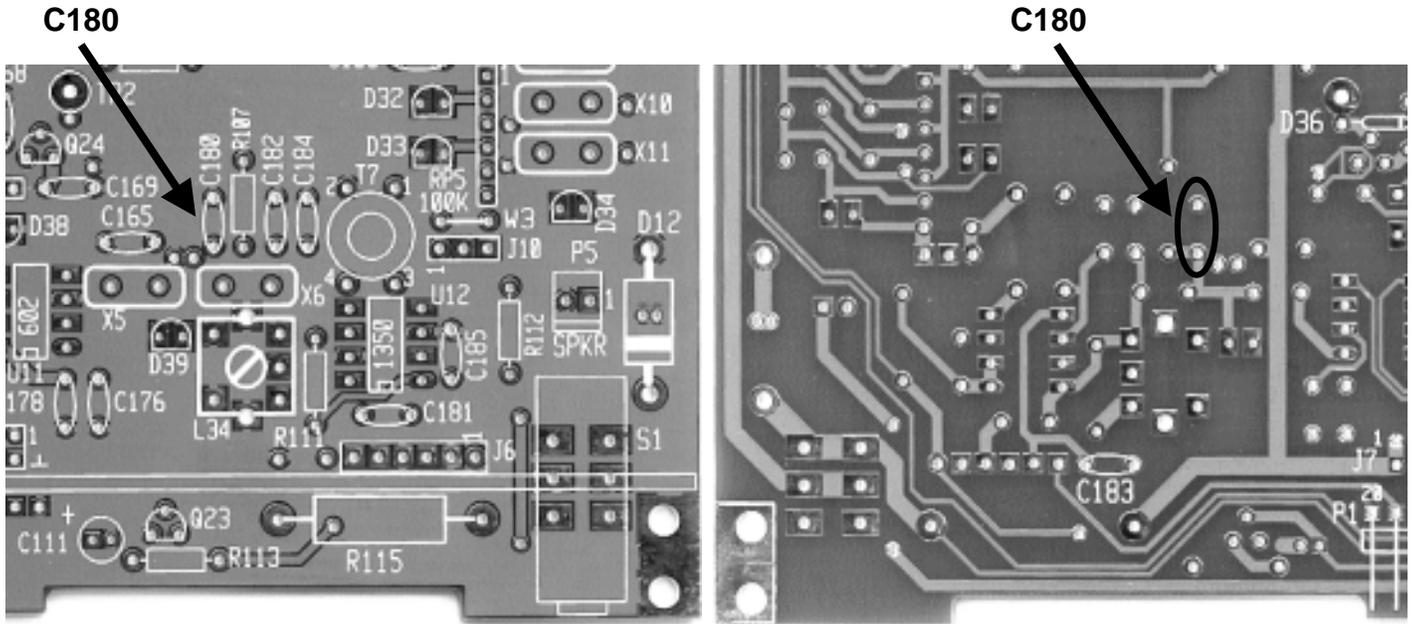
- (1) NPN small signal transistor (2N4124, 2N3904, 2N2222, PN2222, or equiv.)
- (1) 3.3k to 3.9k Ohms 1/4W resistor
- (1) .01uF capacitor (Low-Voltage OK)
- (1) 100pF capacitor (Low-Voltage OK)
- (1) 5.6k 1/4W resistor

## Changes Required:

Refer to the accompanying pictorial diagram of the RF board and the accompanying pictures of the completed installation for assistance in locating PC board pads and component positioning.

1. Remove the top & (front) bottom covers of the K2 and set them aside.

2. Remove the SSB Option board and set it aside. The SSB Option board will not be touched during this mod, however you may have to locate components which are hidden beneath it in order to confirm that you are soldering to the proper pads on the bottom of the RF Board.
3. With the K2 upright and facing you, locate C180 (about 1.5" in from the front edge of the RF board, and about 2" in from the right edge, just behind X5 & X6). This capacitor will probably be 22pF in Field Test K2s and 10pF in the production units.



**K2 RF Board (Viewed from TOP)**

**K2 RF Board (Viewed from BOTTOM)**

4. CAREFULLY remove C180. Heat the solder joint and remove each lead individually. Then, once the capacitor has been removed, if you wish (although not required), you may remove any remaining solder in the now empty holes.
5. Position the K2 upside down with the front panel facing you.
6. Using the diagrams provided, locate the three (3) PC board pads to which you will connect this mod.
  - a) J10 has two SQUARE and one ROUND pad. J10-3 is the SQUARE pad closest to the left edge of the RF Board.
  - b) Ground – The ground pad used to connect lead 2 of T7 to ground. You may have to refer to the top side of the RF Board in order to properly locate and identify the bottom-side pad related to T7 lead 2.
  - c) The Ungrounded side of C182 (180pF). This pad is also connected to pin 8 of U12 (U12-8).
7. Note: The following instructions assumes you will use a plastic cased (TO-92) NPN transistor in this mod.
  - a) Place the flat side of the NPN transistor flat against the RF Board, just to the right of J10.
  - b) Cut the two outside leads (emitter and collector) of the transistor to a length of 1/4" (6.5mm).
  - c) Bend the emitter lead (see attached pictorial for transistor basing) outward slightly, so that it touches the ground pad used to ground lead 2 of T7. Solder this lead in place.
  - d) Bend the center (Base) lead of the transistor straight UP (away from the RF Board), and cut it so that it extends 1/16" (1.5mm) above the transistor.
  - e) Cut the leads of the 100pF capacitor to a length of 1/8" (3.0 mm).

- f) Solder one lead of the 100pF capacitor to the Ungrounded side of C182.
  - g) Solder the other end of the 100pF capacitor to the collector lead of the transistor. Take care to ensure that this junction does not touch any other PC board pads or component leads.
8. Cut both leads of the 3.3k resistor to 3/8" (9.5mm) and solder one end of the resistor to pin 3 of J10 (J10-3).
  9. Carefully bend the resistor up and over the three pins of J10, so that its free end touches the (vertical) base lead of the transistor.
  10. Cut the leads of the .01uF capacitor to 1/8" (3.0mm) and solder one lead of this capacitor to the ground pad you soldered to in step 7c (above).
  11. Bend the other capacitor lead so that it, touches the (vertical) base lead of the transistor, and nothing else.
  12. Trim to length and solder together all three leads at the base of the transistor
  13. Bent one lead of the 5.6k resistor back against the resistor body and then trim both leads to 1/8" (3.0mm). Bent the tips of the leads down at a 45-degree angle in preparation for soldering them to the PC board.
  14. Install the 5.6k resistor between pins 1 & 2 of U11 (NE602).

This completes the installation of the K2 2<sup>nd</sup> Xfil SSB mod.

#### Test & Alignment:

**NOTE:** If you have installed the KAF2 AF Filter. **BE SURE** to switch it **OUT** of the line (using the slide switch on the KAF2 PC board) before you begin alignment with Spectrogram. Then, remember to switch it back **IN** once you have completed alignment.

1. With an ohmmeter, confirm that neither J10-3 nor U12-8 are grounded.
2. Reinstall the SSB option board, taking care to properly align all pins of the option board with their mating jacks on the RF Board.
3. I.F. Amplifier Alignment (from the K2 Manual):

L34 is a slug-tuned inductor, located near the right front corner of the RF board, very close to the Control board. The label for L34 may be difficult to see with the Control board plugged in.

Using the wide end of the plastic tuning tool supplied with your kit, adjust the slug in L34 until it is near the top of the can. **Stop turning the slug when it appears to be at the top or when you feel resistance.**

Turn L34's slug one full turn clockwise (down into the can).

Set the band to 40 meters using **BAND+** or **BAND-**. Select CW Normal and a bandwidth between 400Hz and 800Hz.

Make sure the RF GAIN control is fully clockwise (max. gain). Disconnect any antenna, if one was connected.

Tap **PRE/ATTN** until the **PRE** annunciator turns on.

Connect a pair of headphones (stereo or mono) to the front panel jack, and turn the AF GAIN control to about midway.

Slowly tune the VFO to locate the weak internally-generated signal near 7000 kHz. (If you can't hear the signal at all, you may have a receiver problem. Try the 40-meter Band Pass Filter Alignment as outlined in the K2 manual, then refer to Troubleshooting if necessary.)

While listening to the weak signal at 7000 kHz, adjust L34 for the best signal strength and lowest noise. The best overall setting typically occurs at 1-2 turns below the top of the can.

**NOTE:** In the steps to follow, you may be required to adjust the BFO settings of your K2 for best **received** signal in one or both SSB modes. This mod **does not** impact your **transmitted** SSB signal because the 2<sup>nd</sup> Xfil is switched *out of the circuit* in TX mode and is used **only** on receive. Therefore, to ensure that SSB transmit performance will not be compromised, your FL1/OP1 settings should be adjusted **“by the book”** (the SSB Option manual). Further adjustment of FL1/OP1 should **only** be undertaken if you have a means for monitoring your transmitted signal quality and carrier rejection.

4. Attach an antenna to the K2. Switch to the USB and LSB modes, in turn, with **FL2/OP1** selected (**not FL1/Op1**), and verify that USB and LSB now sound more closely matched in noise pitch.
5. If you feel the need for further adjustment of the **receive filter settings**, You can use CAL FIL to change the BFO setting for BF2/3/4. (It might be useful to start with the BFO settings for OP1 for LSB and USB from the SSB adapter manual.)

If you have access to a computer-based audio spectrum analyzer program (such as *Spectrogram* for the PC<sup>1</sup>), connect the K2's audio output (from the headphones jack) to your PC sound card and use the software to re-check your BF2 (through BF4) filter settings for the USB and LSB modes. Instructions for performing these adjustments are available at the Elecraft web site, on the Builder's Resource page.

6. If you are still not happy with the sound (slope of the filter passband), you can tweak L34 while going back and forth between the LSB and USB modes.

Remember that significant adjustment of L34 (e.g. much more than 2 turns inward from the top of the IF can), may compromise the signal-to-noise ratio of the K2 receiver.

Representative *Spectrograms* of the before- and after-mod SSB filter bandpass responses are included at the end of this document. Please note that displays of your particular filters may appear different due to slightly different manufacturing characteristics of the crystals used in your particular radio.

#### Notes:

- <sup>1</sup> *Spectrogram* (for PC compatibles only) is available from:

Spectrogram Software: (currently v 7.0 \$45, shareware 10-minute time-limit AND date-limited as well)

<http://www.visualizationsoftware.com/gram.html>

Spectrogram v 6.x (10-minute time limit only, but NOT a significant problem. Just restart Spectrogram and continue, Spectrogram SAVES your previous settings, so you should not have to re-configure it each time you have to restart. Once you become familiar with Spectrogram, you can complete the entire filter alignment in one pass, and well within the 10-minute time limit.)

<http://www.visualizationsoftware.com/gram/programs/gram6.zip>

Spectrogram v 5.1.7 - Last FREEWARE version

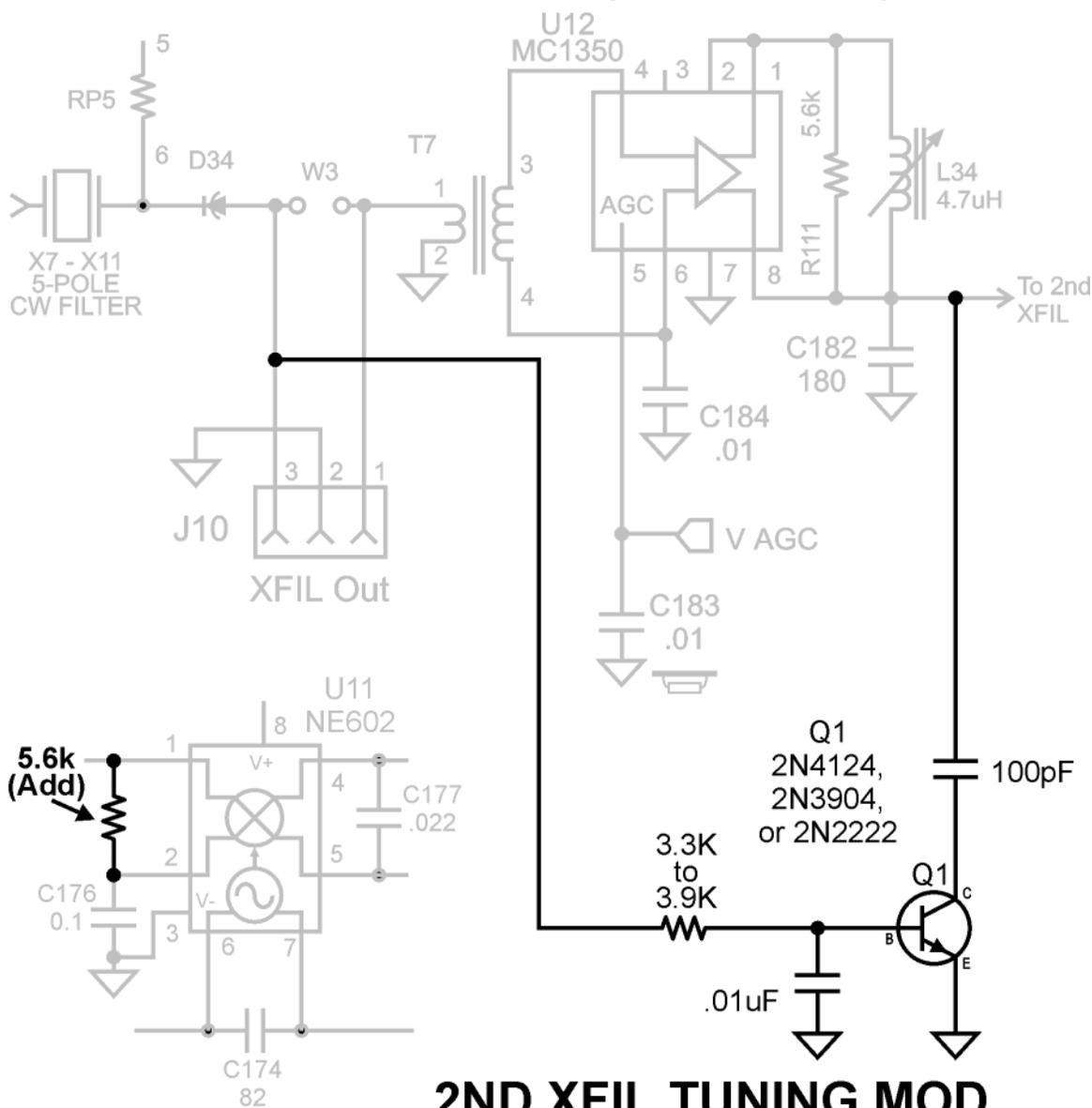
<http://home.t-online.de/home/on6et/software/gram517.zip>

<http://z-k.narod.ru/decode/gram517.zip>

<http://dx-antwerp.org/hamsoft/gram517.zip>

<http://home.wanadoo.nl/nl9222/programs/gram517.zip>

## ORIGINAL CIRCUIT (RF BOARD)



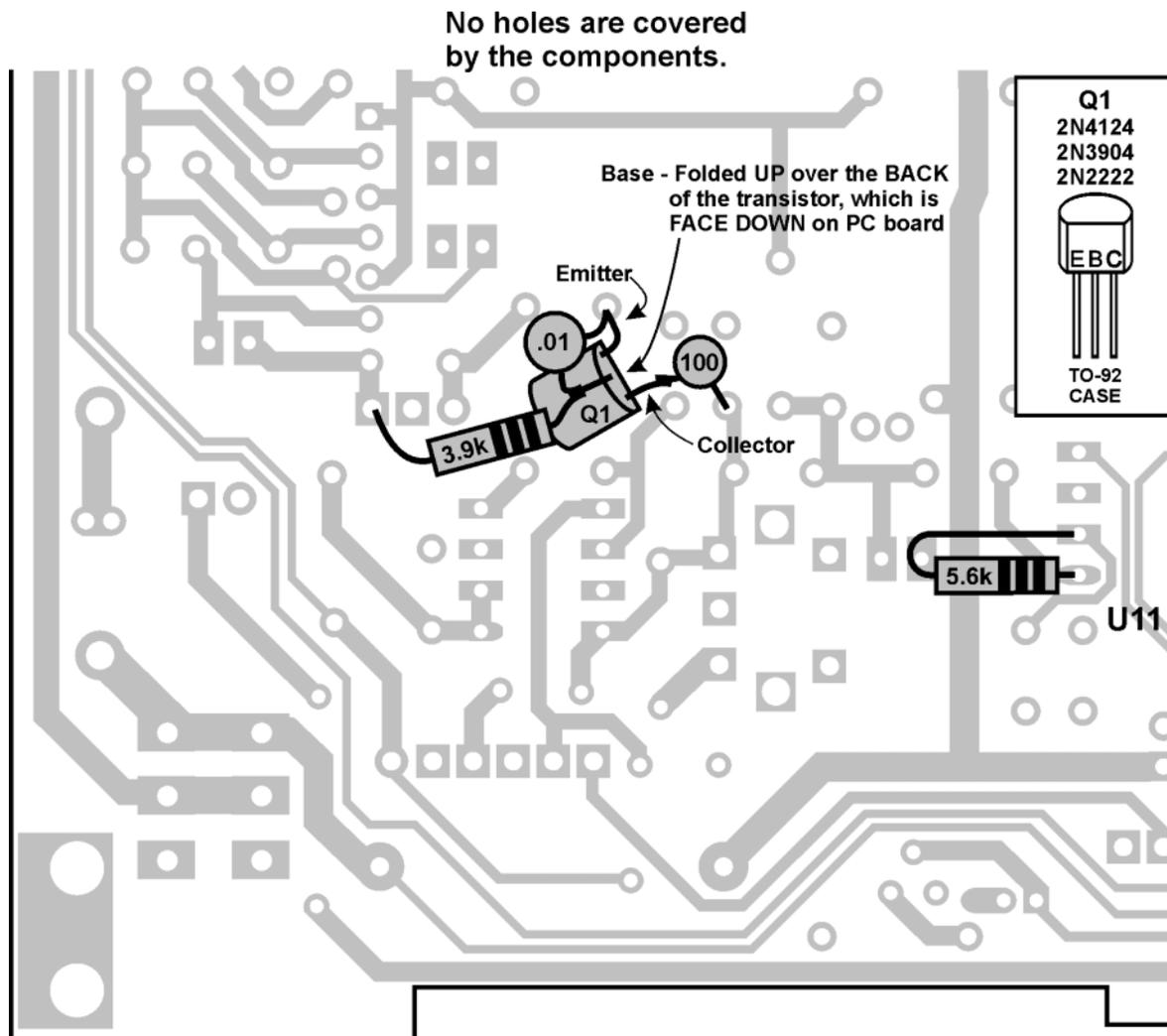
### 2ND XFIL TUNING MOD

Install all components on the bottom of the RF board, using short leads.

NJSS 10/30/2002

# K2 2nd XFiI SSB Tuning Mod

by: Wayne Burdick (N6KR) and John Grebenkemper (KI6WX)



Left front corner of K2 RF board, with K2 Inverted (bottom side)

NØSS 10/30/2002

## K2 - 2<sup>nd</sup> XFIL Tuning Mod

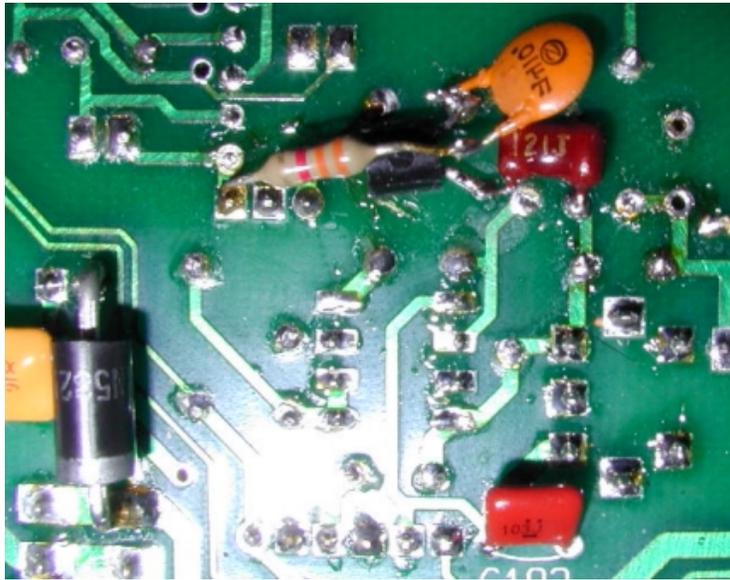


Photo #1 - Mod as viewed from the FRONT edge of RF Board

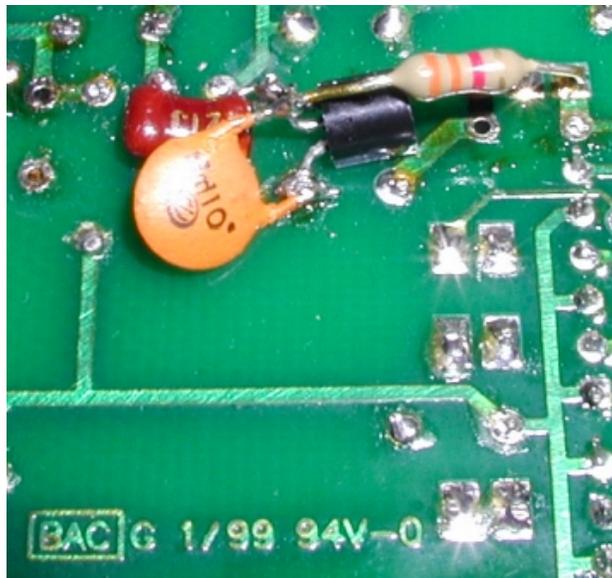


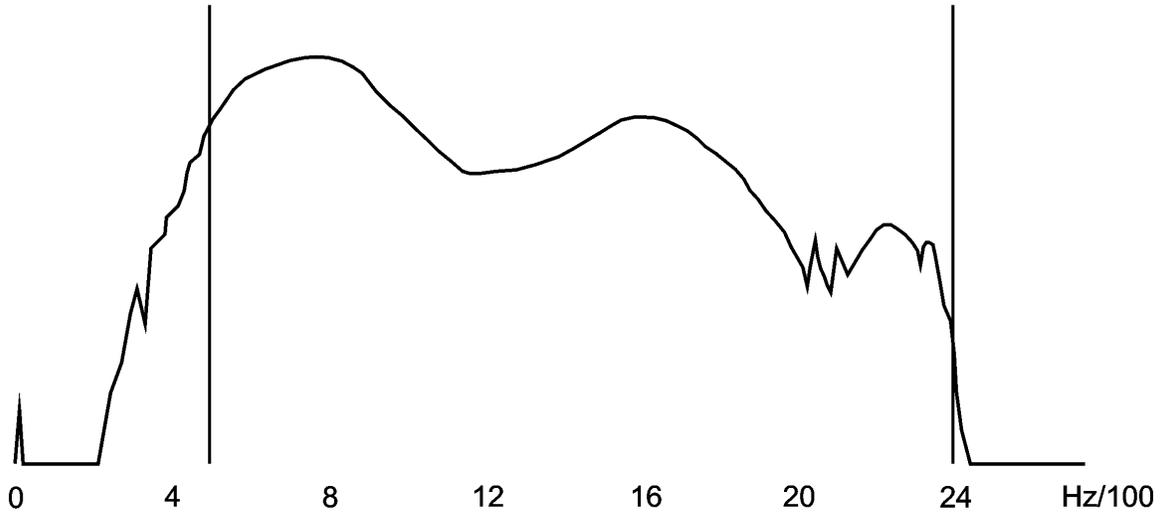
Photo #2 - Mod as viewed from the BACK edge of RF Board



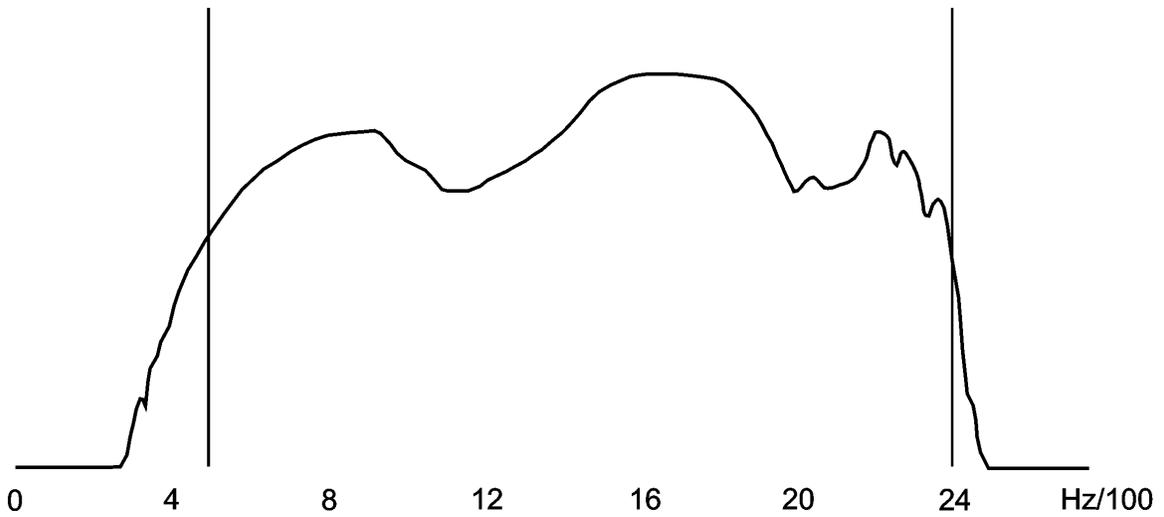
Photo #3 - Mod showing transistor BASE lead bent AWAY from RF board

# K2 - 2nd XFil SSB MOD

LSB OPT1 - FILTER RESPONSE BEFORE MOD

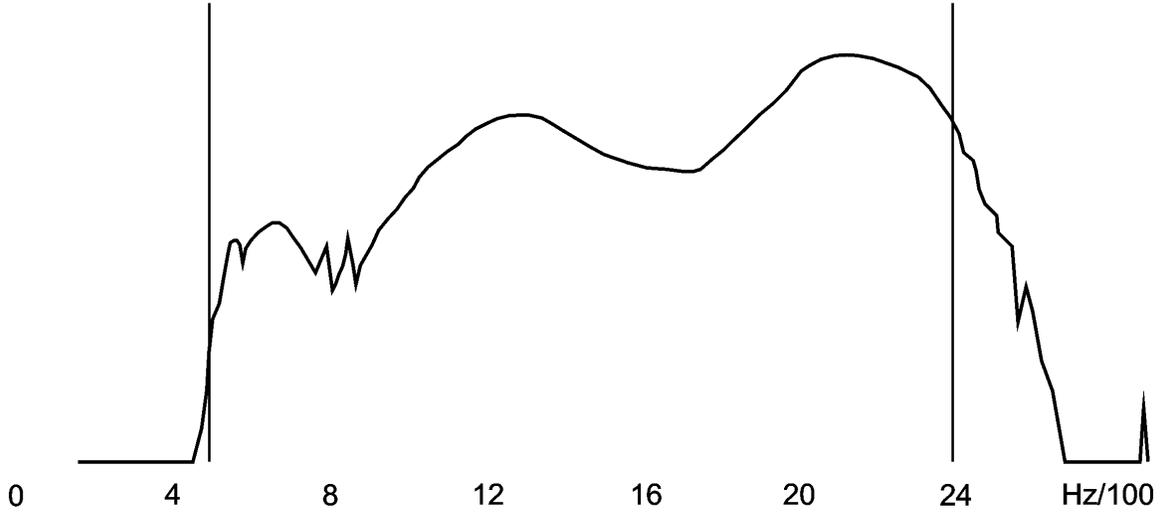


LSB OPT1 - FILTER RESPONSE AFTER MOD



# K2 - 2nd XFil SSB MOD

USB OPT1 - FILTER RESPONSE BEFORE MOD



USB OPT1 - FILTER RESPONSE AFTER MOD

