Installation of the BHI DSP board in an Icom 735

Before digital signal processing (DSP) came along, the typical ham had few tools with which to deal with noise. Noise blankers were helpful for periodic noise such as that created by automobile ignition systems. Noise limiters were somewhat helpful for damping but not eliminating atmospheric noise such a static crashes. Otherwise, goosing the RF and AF gain controls was about all that could be done to keep the noise level at bay.

Then following a long line of innovations that have sprung from the combination of digitizing information, inexpensive computing power, and inexpensive miniature hardware, along came DSP. In a nutshell, a signal containing intelligence, e.g., voice information, and noise is passed through a DSP circuit. This circuit discards the portions of the signal that fit the criterion for noise, or, in other words that do not fit the criterion for intelligent information. So, at the output the original signal appears without the noise. Sounds too good to be true, huh?

The key is in the software or firmware which contains the statistical definitions for intelligence. The statistics you had in college, e.g., normal curves and Fourier series, play a big role here. See, your professor was right. It's not useless.

Any transceiver manufactured in the last few years will have DSP built in. But what about older gear? One option is to add an outboard DSP unit between the audio output and the speaker or headphones. Many of these units are available. A second option is to add DSP internally. In the latter case the audio signal is intercepted upstream from the volume control, before the audio amplifier. The signal is then routed through a DSP circuit. The processed signal is then returned to the normal path through the audio amplifier and on to the speaker or headphones.

Fortunately, BHI, Ltd. sells a DSP board that is perfect for the latter approach. This board offers 8 levels of noise cancellation and is available from W4RT Electronics in Huntsville, AL (BHI NEDSP1061-KBD DSP noise cancelling board. About $140 plus shipping (www.W4RT.com). Sometimes you can even get free shipping). The board comes with an external push-button switch and some mounting hardware.

I installed this board in a Kenwood 440 following instructions available on the web (http://www.f1lvt.com/files/516-ts440english.95.pdf). The results were terrific. I then wanted to install a board in an Icom 735. However, I was unable to find any documentation. So, below is the procedure I followed to install the board. This board, a couple of cable ties, a push-button switch, standard tools and soldering tools, and a little patience is all you need. It will probably take about 2 hrs to install the board. So, put on some coffee and let's dig in.

The idea is to install the DSP module in the audio path prior to the audio amplifier and prior to the volume control. In practice this usually means replacing a coupling capacitor between a pre-amp stage and the amplifier stage. In the case of the 735, it is capacitor C279 located on the bottom main board. With the help of figures 1, 2, 3 and 4 you should be able to find it. Then, do this:

1. Remove the bottom cover
2. Remove the screws which attach the board to the case

3. Disconnect the two grey coax leads and the two grey, 3-pin connectors near the coax output connector (See Figure 5). With these wires disconnected, the board can be flipped over such that the capacitor can be unsoldered.
4. Locate the capacitor on the underside of the board and unsolder and remove it Figures 6 and 7)
5. Connect the DSP board red and blue signal leads, ground, and power lead (Figure 8). The power lead is connected by unplugging the plug from J10, inserting the power lead in the hole for the red, power lead on J10 and reinserting the plug. The board is then secured by tie wrapping it to the wiring bundle next to the front panel. There is plenty of room to do this while keeping the board clear of nearby circuitry.
6. Then, an external push button is wired in parallel with the keyboard push button (Figure 9). This switch will be used to enable noise cancellation and select the level.
7. Figure 10 shows the board secured with a tie wrap, the keyboard covered with a piece of large shrink wrap, and the push-button switch.
8. Figure 11 shows the final product. When the transceiver is turned on, the board will announce its current setting with a series of beeps, i.e., one beep=level 1, two beeps=level 2…eight beeps=level 8. However, noise cancellation will be off. To turn it on, simple press the push button briefly and the announced noise cancellation level will take effect. Press it again to turn off noise cancellation. To change the level, hold the button down and the level will move up one and announce itself with the appropriate number of beeps. Doing this at level 8 will return to level 1.
9. Figure 12 is an attempt at a visual representation of the effects. The scope is connected to the speaker output and the transceiver tuned to a spot on the band with just noise.

Well, that's it. Pretty simple and it makes the old Icom 735 workhorse a pretty serviceable transceiver for today's noisy bands. In practice, I have found that I never use levels 5 and above. With these levels, too much of the voice information is taken out with the noise. Younger ears might not find this to be a problem.

This issue is one of the trade offs. As more and more noise is taken out, the DSP routines also take out some voice. Think of it like two partially overlapping normal distributions. One is noise and one is voice (or noise plus voice if you prefer). At level 1, the routine can tell the difference because it is dealing with the parts of the distributions that do not overlap. As the level is increased noise cancellation is applied to the portions of the distributions that overlap. This, of course, means that some voice will also be cancelled since the routine is not as good at distinguishing it from noise in the areas where the distributions overlap. This problem is not limited to DSP and has been around for a long time in the form of signal detection theory, i.e, detecting a signal in noise. See, that professor was right about that too.

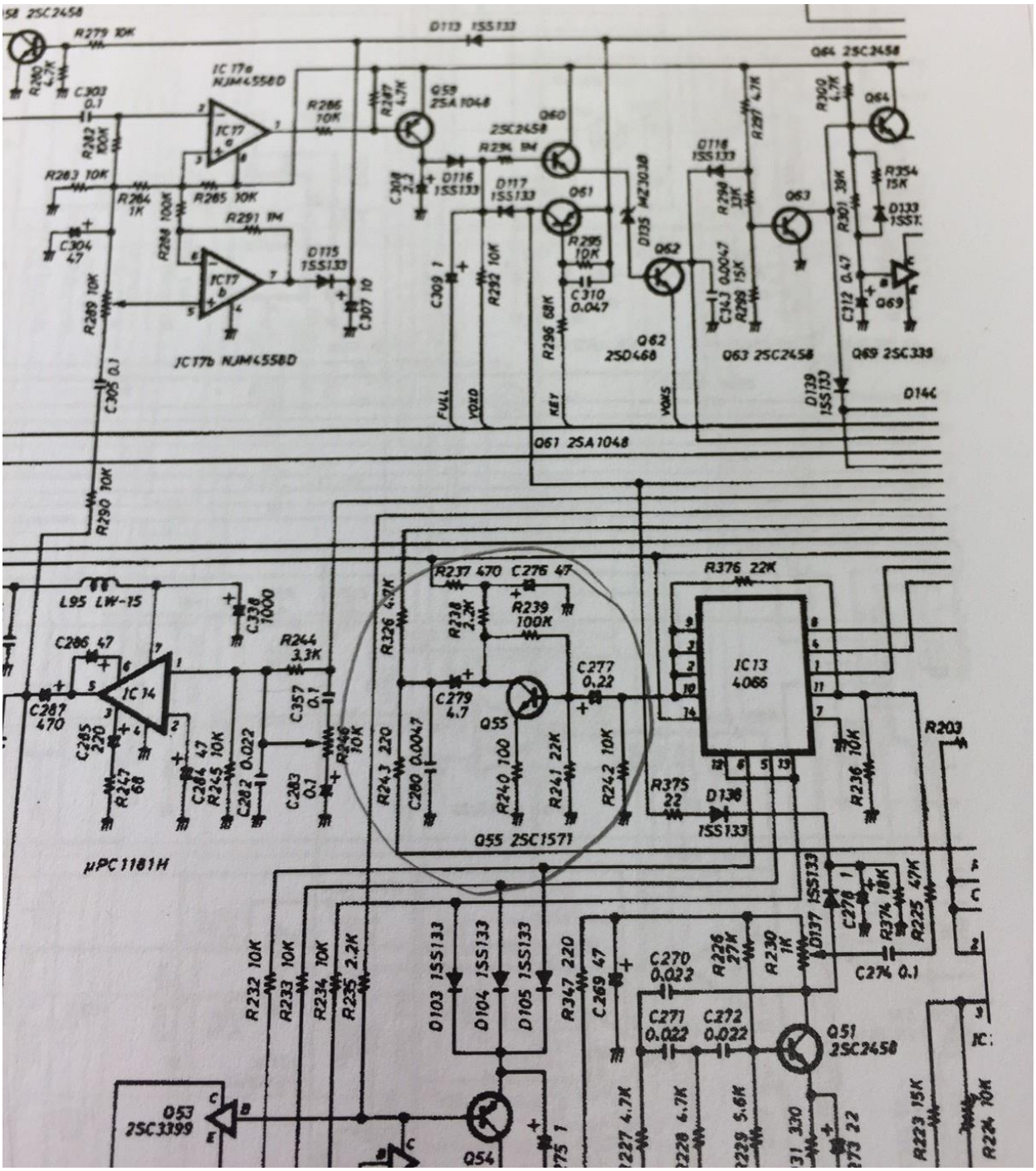

Figure 1. Coupling capacitor C279 which will be replaced with the DSP module

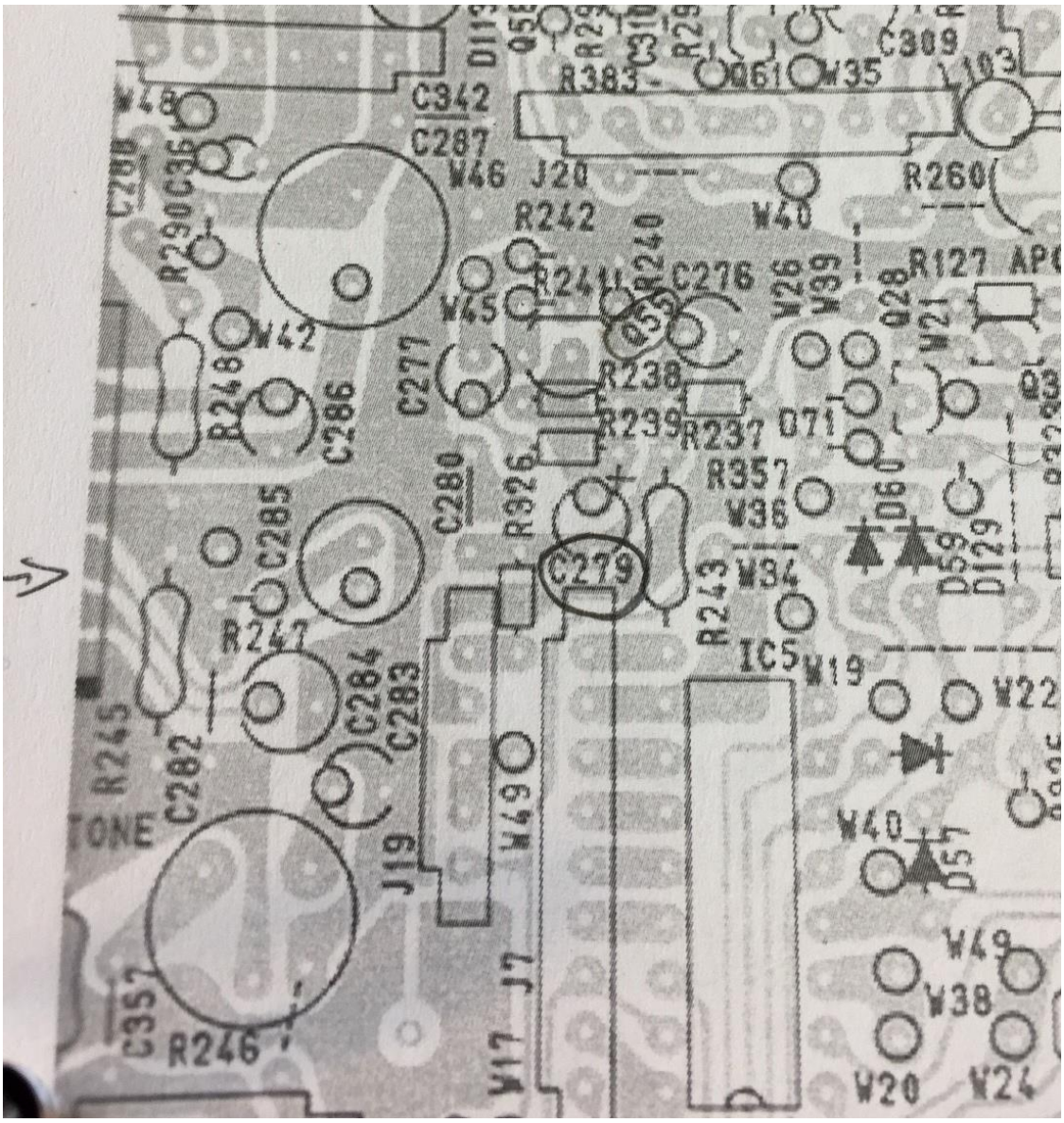

Figure 2. Location of C279

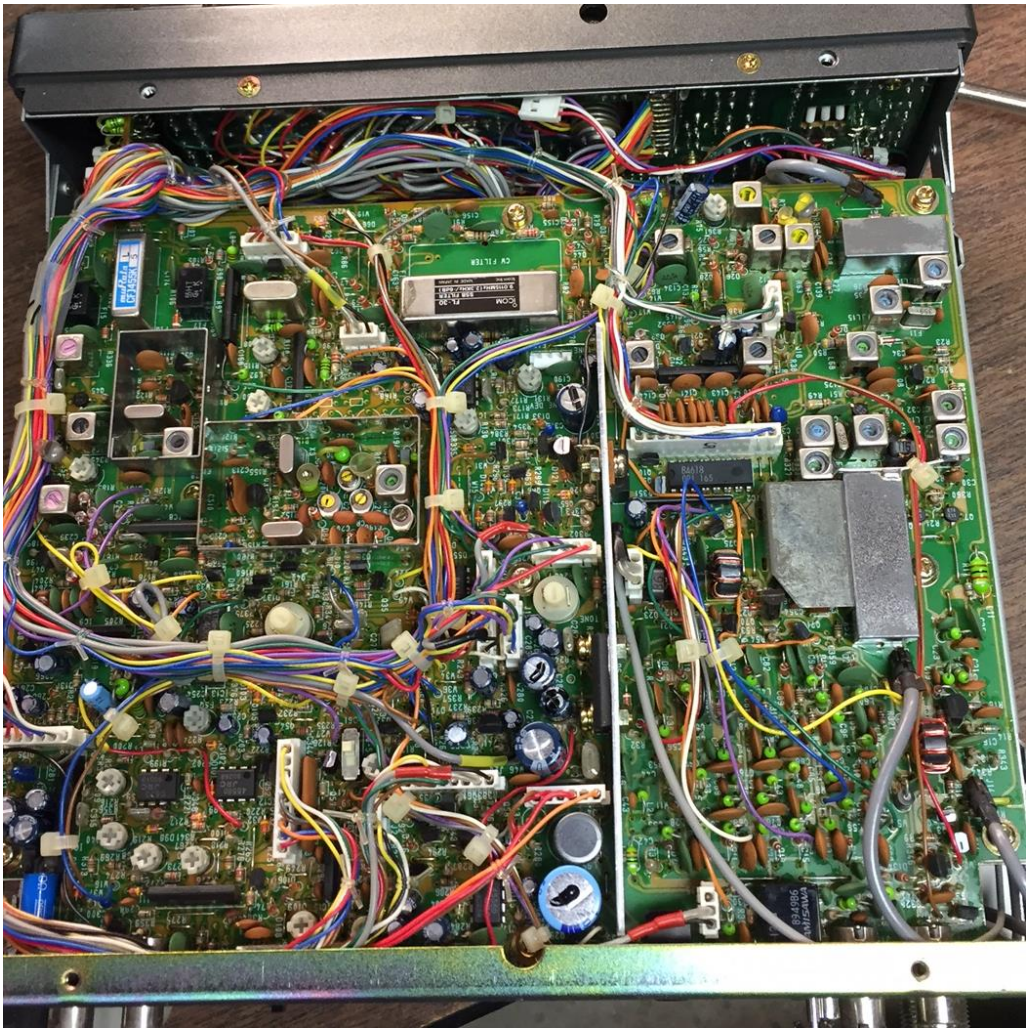

Figure 3. Capacitor C279. Locate the tone control in the center of the picture to the left of the long metal shield. C279 is the small electrolytic capacitor at about 7:00 from the tone control and at the end of connector J7.

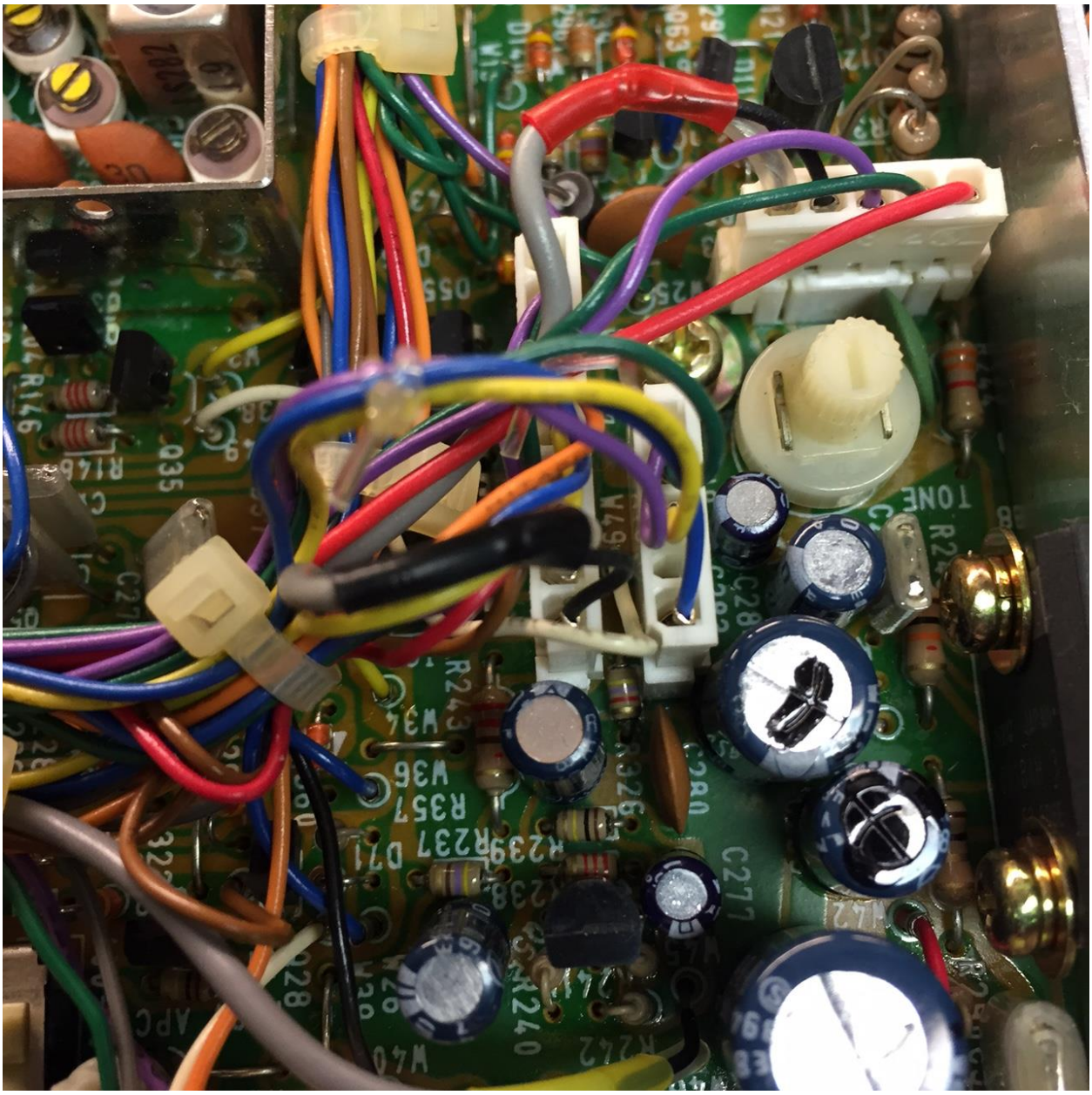

Figure 4. Close up of capacitor C279. It is the small electrolytic a little below the center of the picture and between the end of the longer, vertical connector and the 100K resistor.

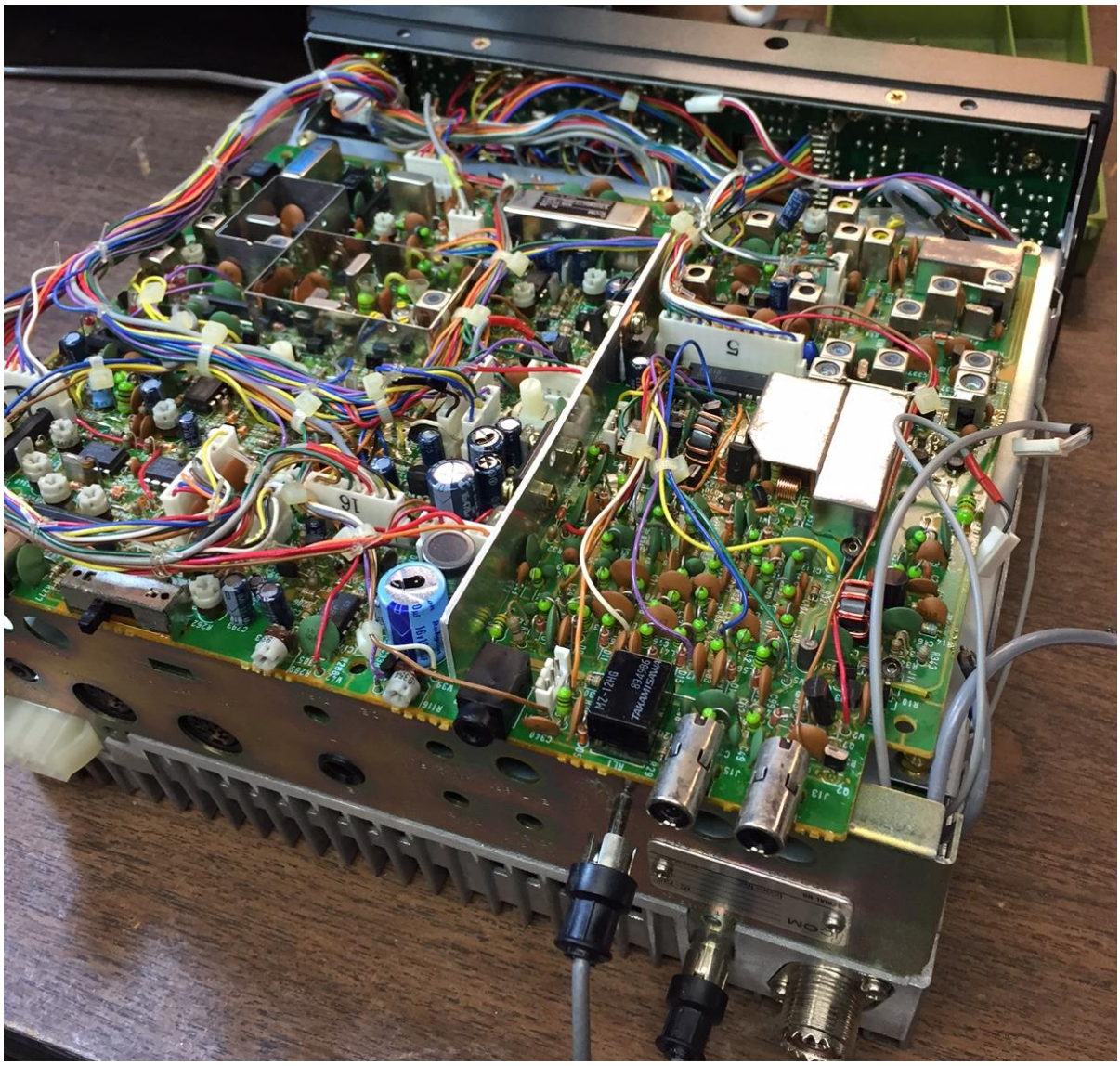

Figure 5. Bottom main board removed and two grey coax connectors and two grey 3-pin connectors disconnected.

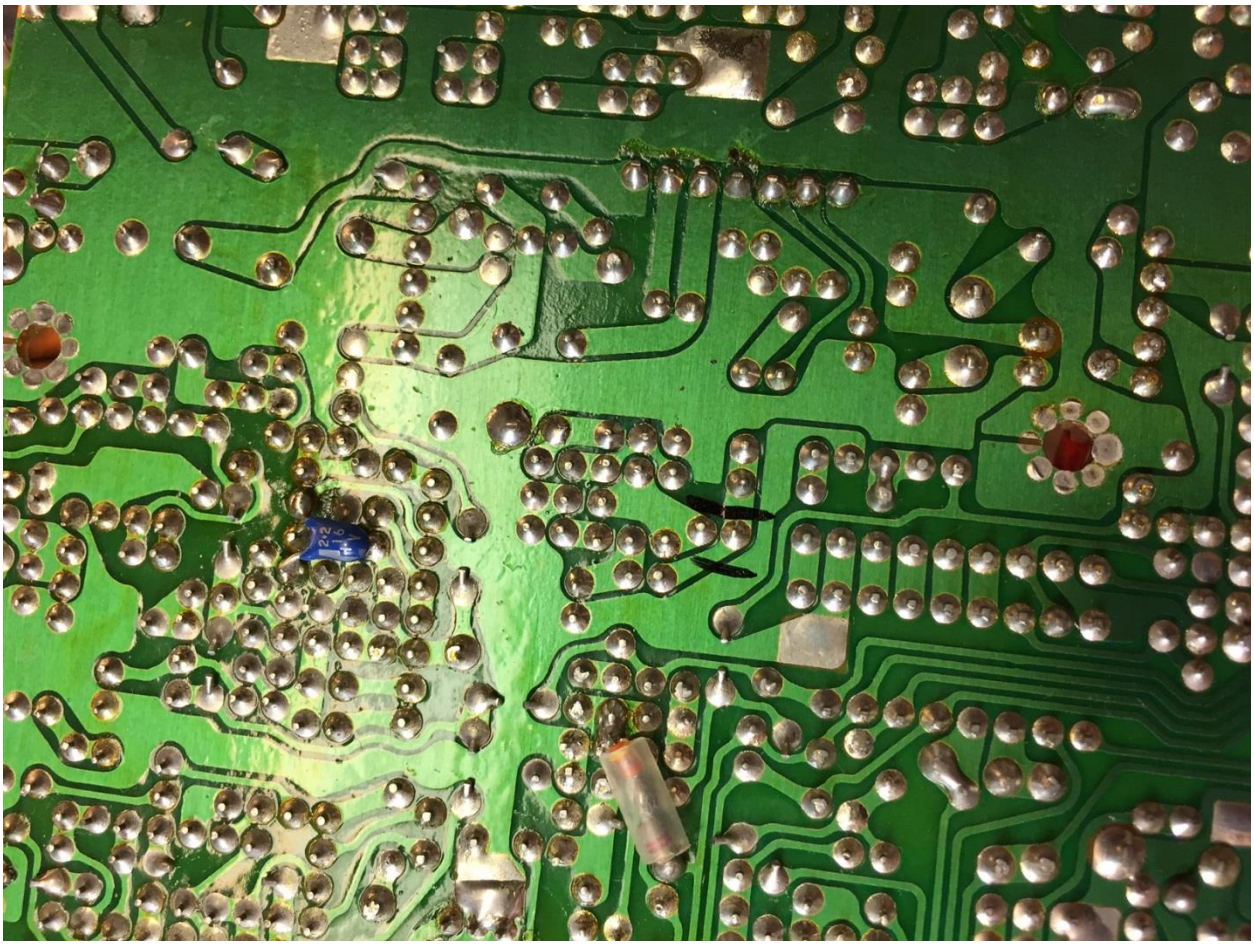

Figure 6. The two black lines mark the location of C279 on underside of the board

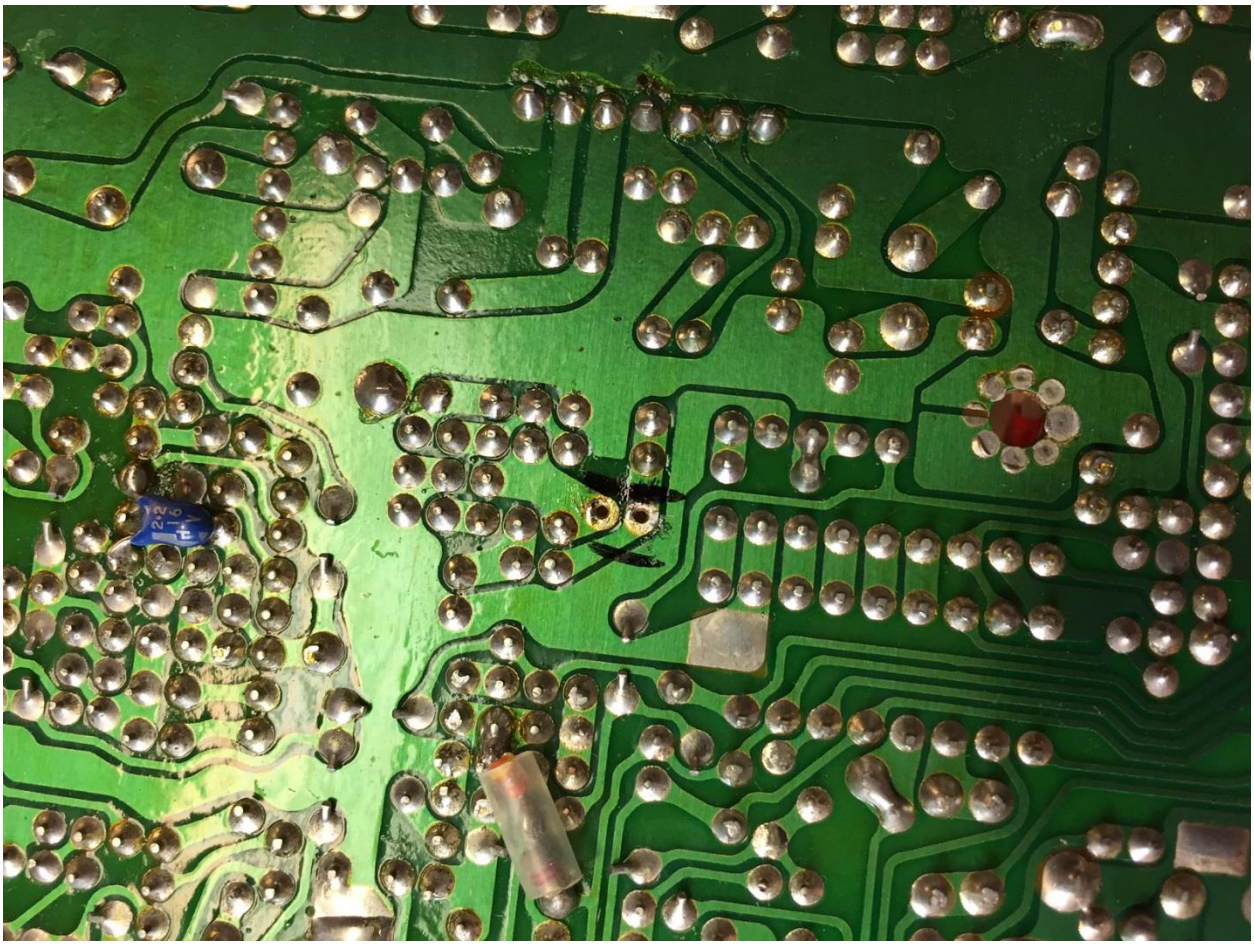

Figure 7. C279 has been removed.

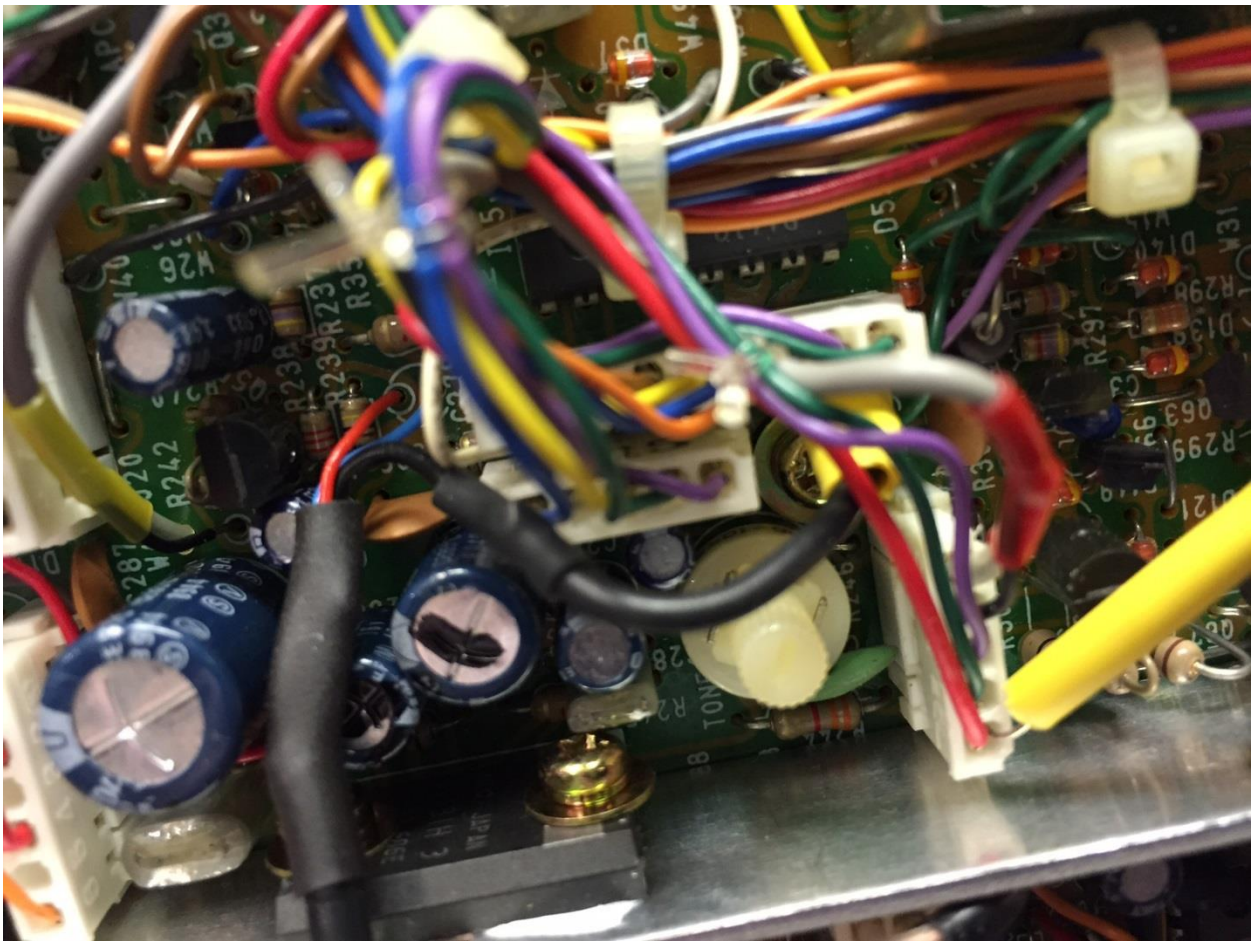

Figure 8. The DSP red and blue signal leads, black ground, and red power lead (covered with yellow insulation) connected to IC735 board.

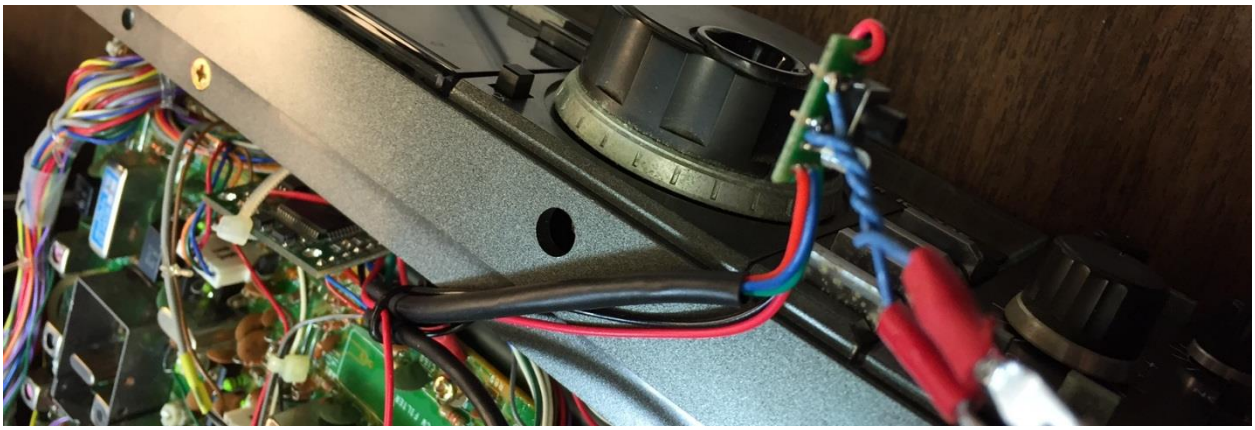

Figure 9. Push-button switch connections to the DSP keyboard

Figure 10. DSP board and push-button switch installed. The board is secured to the wiring bundle with a cable tie and a large piece of shrink wrap covers the DSP keyboard.

Figure 11. The red push button is used to enable DSP and select the level of noise cancellation.

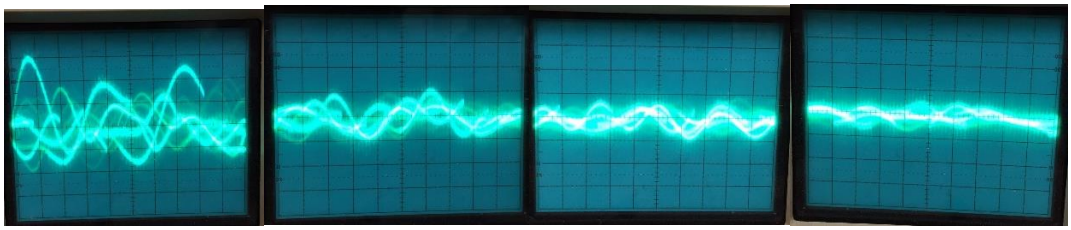

Figure 12. Level zero (none), one, two and four of noise cancellation.