

Falcon Direct

TechNote

Subject - Narrow Band Two Stepping

As most VHF and UHF 2-way radio users know, the Federal Communications Commission (FCC) has mandated a reduction in the bandwidth authorized for Two-Way radios sold and used in the USA to narrow band by December 31, 2012, or earlier if specified by the requirements of the users FCC license.

The question is, just exactly what is meant by "narrow banding"? For VHF users, it means channel spacing between existing channels will be reduced from 15 kHz to 7.5 kHz which will allow the creation to two "new" frequencies in between the two channels on either side of an existing channel.

For example, let's say that you are currently licensed to operate on 155.760 MHz. The adjacent channel below is 155.745 MHz (15 kHz down from your frequency). The upper adjacent channel is 15 kHz higher (155.775 MHz). Now, if we split that 15 kHz separation in half (7.5 kHz), we have two "new" frequencies (155.7525 on the lower side and 155.7675 on the upper side).

All radios sold in the USA after January 1, 2000 were required to be narrow band compatible (i.e. capable of operating with 15 or 7.5 kHz channel spacing). So far, so good. That means that a ten year old Kenwood or Motorola radio should be capable of being converted to narrow band. As far as it goes, this statement would be true, BUT.....

There is another condition, not so well publicized, that is causing a problem for many users who have paid to have their radios narrow banded only to find out that they sound terrible. The most common complaint is noisy, or "fuzzy". The range isn't what it was and the radios sound terrible. We all know that the simple act of narrow banding typically reduces range 10% or more than what it was when operated at 15 kHz channel spacing. But the condition being reported is worse - MUCH worse! We call the problem *two stepping*, and it's not a dance!

Without getting too technical, let us just say that there is a circuit used in the manufacture of current vintage 2-way radio called a synthesizer. The function of this gadget is to produce the desired operating frequency. The concept is kind of like building blocks. By adding building blocks, you can create a word, structure, or both. In the case of the synthesizer, the frequency is developed in steps (think blocks if you prefer). These blocks (or steps) normally come in four sizes - 15, 7.5, 5.0, or 2.5 kHz.

Technically, all current VHF frequency channel spacing can be created by a synthesizer operating with 5 kHz steps. However, the new narrow band frequencies created by the FCC required a synthesizer step capable of being equally divided into the frequency in 2.5 kHz steps. Now we've got a problem!

If you are simply converting an existing frequency to narrow band (7.5 kHz channel spacing), a 5 kHz step is OK since the "old" frequency channel spacing, based on 15 kHz can be equally be divided by 5. However, if you plan to add additional channels, like the national Homeland Security "Call" and "TAC" channels, there is a problem. For example, the first national emergency channel is 155.7525. As you will note, this frequency has FOUR digits, ending in a "5" after the decimal. That tells us that this is a narrow band frequency with 7.5 kHz channel spacing.

Now we can see the problem. 15 can be divided by 5 with the answer being 3. 7.5 can NOT be divided by a whole number of 5 (actually 5.0). The divisor has to be a lesser number than 7.5. The largest number that can equally divide 7.5 is 2.5 (the smallest would be .5).

So, what we are saying is that your radio must be capable of being programmed in 2.5 kHz steps. If the radio is only capable of 5.0 kHz steps, it cannot be properly programmed for any of the NEW narrow band frequencies. It CAN be used to narrow band original or primary channels (frequencies ending in three digits after the decimal)

If your mobile or portable radios are not capable of programming in 2.5 kHz steps, the net result is DISASTER! When trying to program a frequency based on 2.5 kHz steps (156.1725 for example), the synthesizer cannot produce the required equal division and will round off the frequency to 156.170. This means the mobile or portable is "off frequency" which creates the VERY poor performance.

The solution is to replace the 5 kHz step radio with one capable or producing 2.5 kHz steps. If you are looking at new radios, be sure and pick one capable of programming in 2.5 kHz steps. There are two exceptions:

1) If you only intend to program an existing primary channel to narrow band, you can save yourself a lot of money by purchasing radios at closeout prices that are not capable of 2.5 kHz programming.

2) The aforementioned information applies only to VHF radios. It does NOT apply to UHF radios which have 12.5 kHz channel spacing which has been available in all radios since 2010 (for some models, even earlier).

There are some other factors that you may want to consider. For example, UHF repeaters use paired frequencies with 5 MHz separation between transmit and receive. This makes UHF far less susceptible to interference from distant stations.

One last tip - when selecting a new radio, always be sure that you choose one with the highest number value when evaluation the Adjacent Channel Selectivity (i.e. 90 dB is MUCH better than 80 db in terms of performance, for narrow band radios). See www.adcommeng.com/Narrowbanding_for_Technicians.pdf for more information Go more questions! Need some help? Give us a call at 800.489.2611.