Getting Started with DMR

Breaking down the complexities of programming your digital mobile radio for repeater use.

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Setting up a digital mobile radio (DMR) has a very steep learning curve. My first experience programming my AnyTone AT-D878UVII Plus to work on my local DMR repeater was very frustrating. I ended up asking a friend for help, and the only way I got it to work was by mirroring his radio settings with mine while we were talking on the phone; the only difference was the *DMR ID*, a unique numeric identifier for each operator.

While I was able to program my radio this way, I didn't understand what each setting did and how they interacted with each other — or the repeater. Knowing what each setting does and why you need to program it a certain way in the control programming software (CPS) will clear up some of the confusion.

Understanding the basics of programming a radio to work with an analog repeater is often one of the first things a new licensee needs in order to get on a local 2-meter repeater. DMR programming is similar, but has more options.

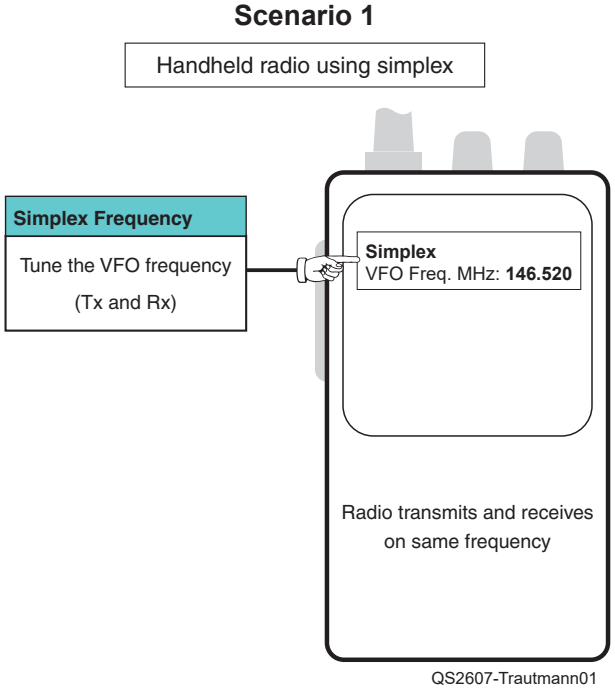

Figure 1 — A radio programmed to operate in simplex mode.

I'll start by describing and showing the relationships of the radio you're programming, the operating frequency for transmission and reception, and the *attributes* (settings that can be entered into the radio that can be associated with either the frequency or the radio and potentially stored in a memory location) in four scenarios. We'll discuss a radio programmed for analog simplex, one programmed for an open analog repeater, a radio programmed to work with a repeater requiring a CTCSS tone, and programming for a DMR repeater.

Scenario One: Analog Simplex

This is the simplest of the four examples, and it's the foundation we'll build on. Programming a frequency into the variable frequency oscillator (VFO) of an analog radio will allow you to transmit FM on that radio. Because it's simplex, this also allows you to listen for others transmitting on that same frequency. The key here is that this is the same frequency for transmission and reception. In the US, 146.520 MHz is the 2-meter national simplex frequency.

Remember, simplex is radio-to-radio transmission, which is limited in distance by the power of the radio and your physical location.

Figure 1 represents a radio with the frequency 146.520 MHz programmed into a VFO. This is easily done from the face of the radio by accessing the VFO and turning the knob until the frequency is displayed.

Scenario Two: Analog Radio Programmed for an Open Repeater

This example depicts a radio programmed for use with an *open* repeater — one that does not require a CTCSS or Digitally Coded Squelch tone to be used (we'll talk more about tones in scenario three).

Repeaters are normally located on a tall tower or mountaintop to extend the range beyond what's capable with the simplex example in scenario one. To work with a repeater, a radio needs to transmit on the repeater's input frequency and receive on the repeater's output frequency. The receive and transmit frequencies are usually offset by ± 600 kHz or 1 MHz on the 2-meter band, and 5 MHz on the 70-centimeter band, as these are the standards for these bands. The

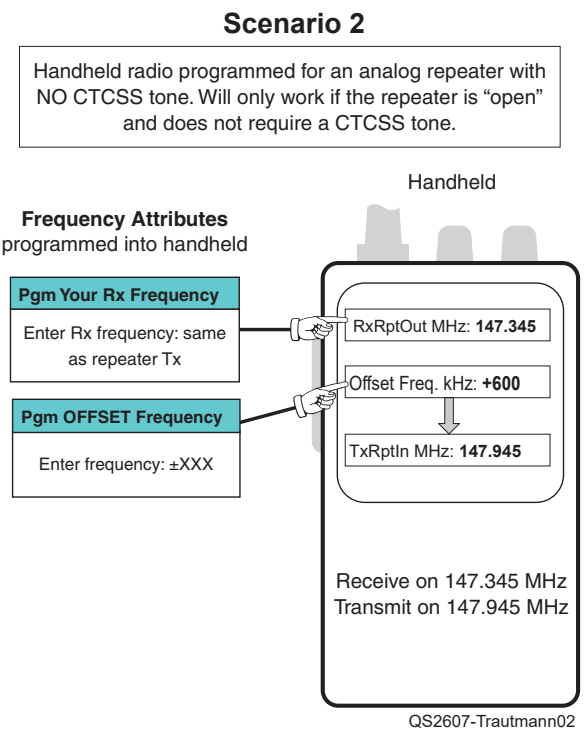

Figure 2 — A handheld radio programmed to operate with an open repeater.

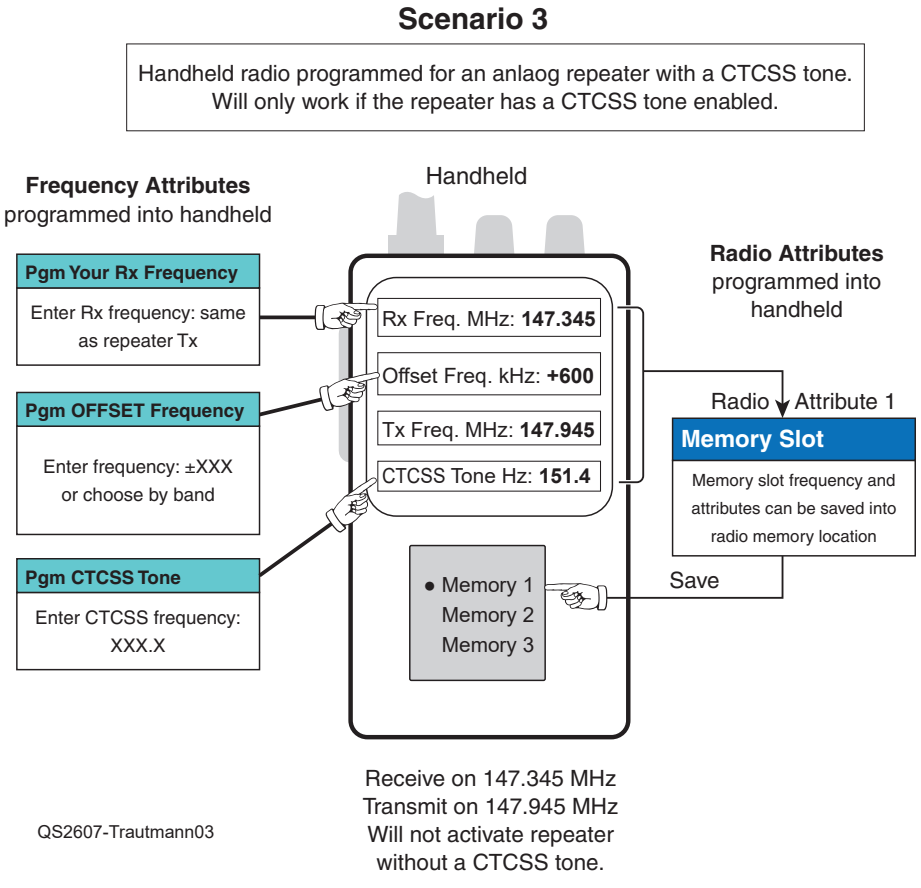

Figure 3 — A handheld radio programmed to operate on a closed repeater.

frequency is offset by either adding or subtracting this value to or from the output frequency of the repeater, as established by standards.

In Figure 2, the radio has a frequency of 147.345 MHz programmed as the receive frequency, and a frequency attribute of a +600 kHz offset. These work together so the radio transmits on the repeater's input frequency of 147.945 MHz when the push-to-talk (PTT) button is pressed. The radio does this automatically when set up as in this example.

Scenario Three: Analog Repeater with a PL Tone, Plus a Memory

Some repeaters require a *sub-audible tone* (one you cannot hear) to unlock the repeater and allow it to retransmit your signal. The tone the repeater uses is determined by the repeater operator. You can find the specific tone for a repeater in *The ARRL Repeater Directory*® or on the website of the club that maintains the repeater.

A CTCSS tone, commonly referred to as a *Private Line* (PL) tone, is another attribute that can be associated with the frequency (just like the offset) and programmed into the radio.

In Figure 3, the frequency attributes shown at the left in turquoise instruct the radio to transmit a CTCSS tone and to shift, using the offset, to the correct transmit frequency when the PTT button is pressed.

In this scenario, we've introduced the first radio attribute, shown in blue on the right side of Figure 3. Radios can save a frequency with its associated frequency attributes into a memory location. These are generally referred to as *radio memory locations*. The memory stores the frequency attribute details so they can be called up quickly for this repeater. Saving these details in a memory channel saves you from having to remember the offset or CTCSS tone each time you want to use this repeater. Recall memory location one, and everything

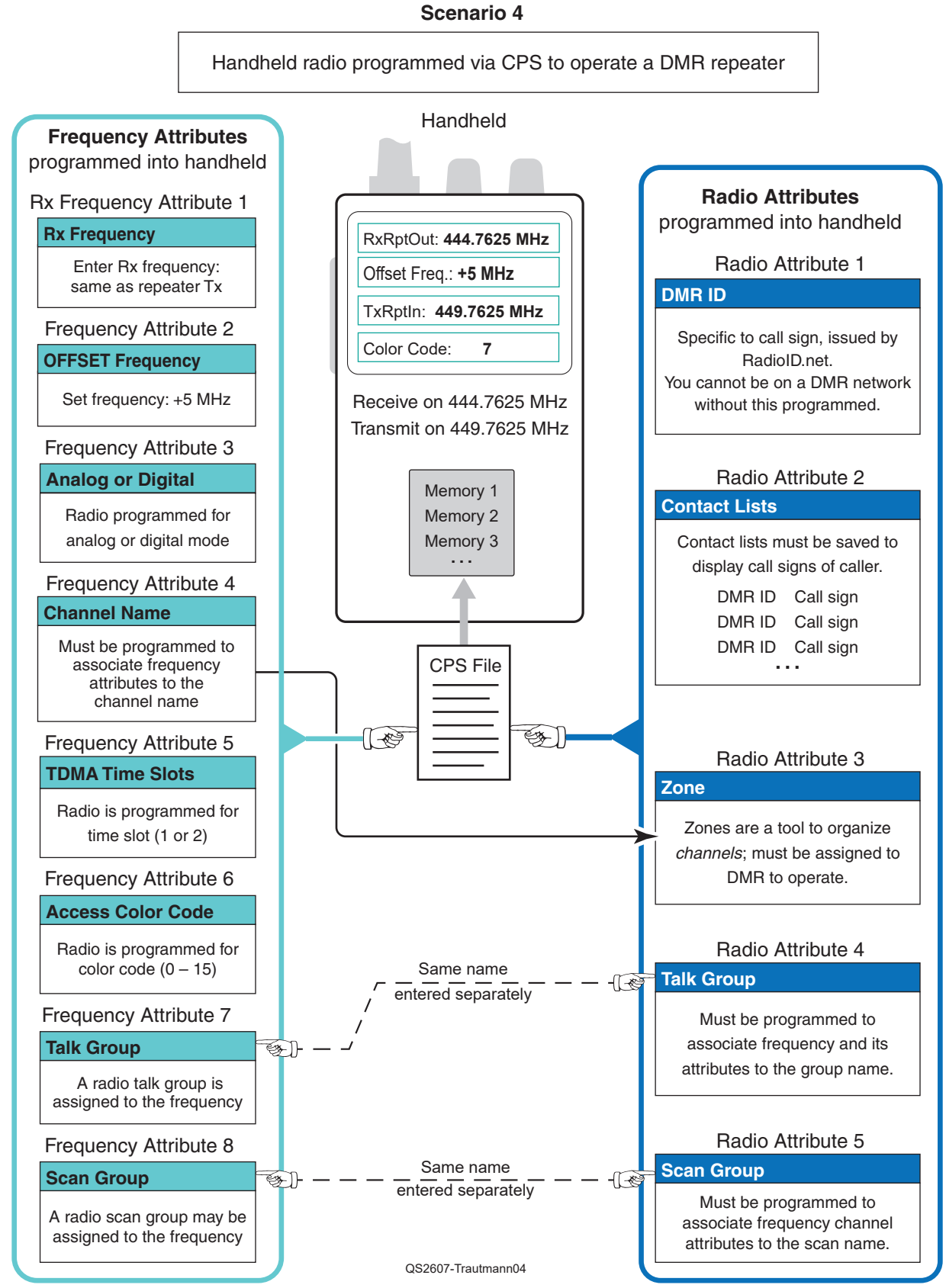

Figure 4 — A DMR with radio and frequency attributes. Visit **https://youtu.be/T3zwa69hg0Y** to watch Karin Thompson, KD4DXX, of RT Systems walk through the process of setting up a DMR radio.

you programmed (frequency, CTCSS tone, and offset) is instantly restored and ready for use. Frequency attributes are specific instructions for the radio to take when that frequency is selected. Radio attributes are specific things the radio can store for future use, like a memory channel for a repeater.

Scenario Four: DMR Repeater

Programming a DMR can be daunting. In Figure 4, you can see that there are many more frequency attributes (in turquoise, in the left-hand column) than those for an analog repeater. There are also more radio attributes (in blue, in the right-hand column). Many of these options or attributes are determined by the repeater operator.

You may need to program the following frequency attributes (see the sidebar "DMR Terms" for definitions of these terms): offset, analog or digital, channel name, time slot, color code, talk group, and scan group.

DMR operations require additional specific radio attributes to work properly. They include a DMR ID, a contact list, a zone, talk groups, and a scan group.

The *contact list* is just what it sounds like, a list of people or groups that you pre-program into your radio. A *contact* is an individual who is registered with a DMR ID from this list; the radio will display their call sign and other information about the person transmitting the signal you're hearing. As of this writing, the database contains more than 297,000 DMR IDs. More advanced DMRs can store enormous numbers of contacts, allowing you to see the call signs of anyone you talk to via DMR.

Talk groups (TGs) are virtual locations for conversations on the DMR network. You join a talk group when you connect to the DMR network. For example, TG 91 is the worldwide talk group, and TG 3 is the North American talk group. Not all repeaters are allowed to access all talk groups. Check information about the repeater you're attempting to use for which talk groups you can access through the repeater.

The *channel name* helps you identify the channel in use on the face of the radio.

Zones are absolutely required when setting up a DMR. Without being in a zone, the radio doesn't know the memory channel exists. Zones allow you to group channels for easier access.

Scan lists contain lists of channels to scan when you enable the scan function. This feature is a little tricky, because you must assign each channel to a scan list, then assign that scan list to the channel. Two programming entries are necessary for this to work. A named scan list must be created, and then a channel can be added to it. Step two is to then go to the channel program and select the scan list you just created and add it there as well.

DMR Terms

Offset — The difference between transmit and receive frequencies on a repeater (e.g., +5 MHz on UHF).

Analog/digital — Indicates whether the channel uses analog FM or digital DMR modulation.

Time slot — One of two time slots (TS1 or TS2) on a DMR channel; each slot carries separate traffic, and they must match the repeater settings.

Talk group — A virtual location for conversations on the DMR network (e.g., TG 91 Worldwide). Talk group lists can be found and downloaded from websites such as DMR-MARC (**https://dmr-marc.net**), TGIF Network (**https://tgif.network**), and BrandMeister (**https://brandmeister.network/?page=talkgroups**).

Color code — A digital access code (0 – 15) similar to a CTCSS tone in analog. It must match the repeater settings.

Scan group — A list of channels your radio scans for activity. Scanning cannot begin on a channel that does not have a scan group assigned (this is set up as a radio attribute but must be attached to a memory as a frequency attribute for it to work).

DMR ID — A unique numeric identifier for each operator, registered at **https://radioID.net**.

Contact list — A list of radio operators registered with a DMR ID. These will be displayed on your radio when someone is heard. This is not required for operations, but it is a great conversation starter when you hear someone calling and know a little about them.

Zone — A required grouping of channels in your radio for easy organization (e.g., local repeaters).

Channel name — The label you assign to a programmed channel (e.g., Repeater A TG3100).

Summary

The learning curve to understand how a DMR is set up for successful operation can be steep, but once you grasp the concepts and enter all these parameters correctly, you'll quickly see just how powerful and versatile a DMR can be.

For specific, step-by-step instructions on how to program a DMR, ARRL's *Using the Baofeng® Radio* by John Leonardelli has a chapter on programming a Baofeng DR-1801UV DMR.

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