

Amateur Radio Notes V

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Discovering DMR – 3

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3) Putting it all together

Okay, time to kick things into high gear and get on the air with DMR!

3a) First things first: Register for CCS7 ID

To operate on the DMR system, you need to register with an authentication and routing system called CCS7 (Callsign Communication System, 7-digit).

The DMR system uses the CCS7 ID number instead of your callsign, though its authentication service maps your CCS7 ID number to your callsign.

Registrations for everywhere—including North America, South America, Asia, and Oceania, Europe, and Africa—are now all handled by [RadioID.net](#) [↗](#).

The registration systems are administered by volunteers so be patient, it can take a few days to receive your CCS7 ID.

Note 1: If you already have a CCS7 ID—for example, I got one to use with D-STAR on DCS reflectors—it will work for the DMR system, as well. No need to get another.

Note 2: Since DMR operates using the CCS7 ID, your callsign may not be transmitted to the radio the way it is with D-STAR, so you need to announce your callsign just like you do on analog.

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3b) Customer Programming Software (CPS)

Many ham radios can be programmed from the keypad on the radio, but the process is cumbersome. In many cases, the manufacturer or a third party offer radio programming software to make it easier to program a radio, especially when you want to add a lot of memory channels.

DMR radios are different because typically they allow programming the radio only from an application called Customer Programming Software (CPS). In fact, because of this, commercial DMR radios often don't have keypads; although some DMR radios made for amateur radio now do allow some limited amount of programming to be done via a radio's keypad.

Using the CPS, you add your basic settings and defaults, like your CCS7 ID and, in some cases, how you want certain buttons to behave (for example, do one thing when you short press them and another when you long press them). You also add contacts, zones, and scan lists, and then weave them all together as channels.

A note about codeplugs

Once you're finished entering all your information into the CPS, you should save it. What you then have is called a "codeplug"; in other words, it's a collection of data in the form of code that you can plug into your radio.

Sometimes you can get an existing codeplug that was created for your model of radio, which has most of the information you need already in it. Then all you have to do is open that codeplug in your CPS and customize it for your own use. At the very minimum, you must enter your own CCS7 ID.

To learn how everything fits together, it can be really helpful to look at an existing codeplug for your model of radio, even if the data it contains isn't completely relevant to your own needs. In my case, a ham who lives in a different area shared a codeplug with me that he had created for the same model of radio as I have. I loaded it into my CPS and spent some time studying it to better understand how the pieces fit together. Once I had a better understanding, I built a fresh codeplug for my own radio. A shoutout to Dirk, N2PDQ, for his help with this!

Another thing I did was to create a spreadsheet with lists of my contacts, zones, scan lists, and digital and analog channels.

fx DMR															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Z#	Zone	Digi Anal	Rptr oSPOT Anal	Ch#	Channel DISPLAY ONSCREEN	RX Freq	Offst MHz	TX Freq	Tone	Pwr	Call ID: Talkgroup Callsign	CC	TS	TX Contact DISPLAY ONSCREEN
2	1	oSPOT BM1	Digi	oS	1	usCO STWD 3100	436.0000	Smplx	436.0000		Low	3100	1	2	usCO STWD 3100
3	1	oSPOT BM1	Digi	oS	2	PRA LCL 310044	436.0000	Smplx	436.0000		Low	310044	1	2	PRA LCL 310044
4	1	oSPOT BM1	Digi	oS	3	XRF00A 2049001	436.0000	Smplx	436.0000		Low	2049001	1	2	XRF00A 2049001
5	1	oSPOT BM1	Digi	oS	4	XRF00B 2049002	436.0000	Smplx	436.0000		Low	2049002	1	2	XRF00B 2049002
6	1	oSPOT BM1	Digi	oS	5	usTX STWD 3140	436.0000	Smplx	436.0000		Low	3140	1	2	usTX STWD 3140
7	1	oSPOT BM1	Digi	oS	6	N AM 93	436.0000	Smplx	436.0000		Low	93	1	2	N AM 93
8	1	oSPOT BM1	Digi	oS	7	WW 91	436.0000	Smplx	436.0000		Low	91	1	2	WW 91
9	1	oSPOT BM1	Digi	oS	8	WW EN DYN 913	436.0000	Smplx	436.0000		Low	913	1	2	WW EN DYN 913
10	1	oSPOT BM1	Digi	oS	9	US WD 3100	436.0000	Smplx	436.0000		Low	3100	1	2	US WD 3100
11	1	oSPOT BM1	Digi	oS	10	TAC 310	436.0000	Smplx	436.0000		Low	310	1	2	TAC 310
12	1	oSPOT BM1	Digi	oS	11	TAC 311	436.0000	Smplx	436.0000		Low	311	1	2	TAC 311
13	1	oSPOT BM1	Digi	oS	12	TAC 312	436.0000	Smplx	436.0000		Low	312	1	2	TAC 312
14	1	oSPOT BM1	Digi	oS	13	E OK 31402	436.0000	Smplx	436.0000		Low	31402	1	2	E OK 31402
15	1	oSPOT BM1	Digi	oS	14	zAPRS 310999	436.0000	Smplx	436.0000		Low	310999	1	2	zAPRS 310999
16	1	oSPOT BM1	Digi	oS	15	zPARROT 310997	436.0000	Smplx	436.0000		Low	310997	1	2	zPARROT 310997
17	1	oSPOT BM1	Digi	oS	16	US WD SCAN TAC	436.0000	Smplx	436.0000		Low	3100	1	2	US WD 3100
18	2	Analog1	Anal	Anal	1	aUHF Calling	446.0000	Smplx	446.0000		High				
19	2	Analog1	Anal	Anal	2	aLARC	448.0000	-5.000	443.0000	80.5	High				
20	2	Analog1	Anal	Anal	3	aEVARC	449.0000	-5.000	444.0000	123.0	High				
21	2	Analog1	Anal	Anal	4	aEVPINE	443.3250	Smplx	443.3250	123.0	High				
22	2	Analog1	Anal	Anal	5	aNCARC	447.2750	-5.000	442.2750	100.0	High				

That way, I could make sure I had all the necessary information—like frequencies, color codes, time slots, and talkgroup IDs—before I began working in the CPS. I also thought about how I wanted to organize things, for example, my zones, so that my most frequently used channels would be most easily accessible.

Above all, be prepared to be patient

It takes time to weave together a decent codeplug. My suggestion is that you start with one digital and one analog zone, and add just a few channels to each. Then play around with the radio for a while to get hands-on experience with how it all works. After that, you'll be in a better position to plan how to organize and build your full codeplug.

I've tried four different CPS apps now. All of them have different approaches, while sharing one trait: they all seem a bit half-baked. But what to do, at this time there's no choice except to use the CPS that's available for your radio, even if it's a bit clunky.

My approach to codeplug design

I use a zone-centric organization. I try to keep the number of channels in each zone reasonably small. My first DMR radios were limited to 16 channels per zone. Even though my current radio, the

AnyTone AT-D878UV, doesn't have that limitation, I still keep the number of channels relatively short simply because if there are too many, I find it a pain to scroll through them.

Hint: My primary zone (#1) is where I put the talkgroups I use most frequently; consequently, this zone can change over time. My secondary zone is actually the last one in the list, because it takes just one click of the UP key to go backwards from the first to last zone.

I have a zone for all the U.S. regions and several zones for the U.S. states because ... well ... why not. I like having the option to drop in on any state's talkgroup whenever I want, and I'd never remember the talkgroup numbers if they weren't in my radio.

I also have a couple zones for nearby repeaters, one for analog frequencies that are used by our local ARES group, one for other analog frequencies, and one for use with my duplex hotspots (I don't use those very much—I prefer the simplicity of the simplex hotspots—but I do play around with them once in awhile).

I put the talkgroup number in all my channel names as a way to help me learn them, for example, for Colorado Statewide, my channel name is US CO STWD 3108 and for Colorado Severe Weather, CO SVR WX 31083. Because I see those talkgroup numbers every time I dial in a channel, I can then memorize the numbers over time for those that I use on a regular basis.

For the most part, the order of the talkgroups that I enter doesn't matter, except for the top ten or so, especially the first. That's because of the 878's shortcut, which I really like: the talkgroup list can be accessed quickly by pressing the List key (a.k.a., Exit key), which is the red **--** key on the right just above the P2 key. And then you can scroll down through the talkgroups in the order they are entered. For that reason, I have talkgroup 4000 (group call) as the first talkgroup so that I can easily trigger it by clicking the List key and then, since 4000 is the first in the list, by clicking PTT. This makes it easier to escape from a busy talkgroup if people aren't leaving pauses between transmissions.

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3c) "Read" your radio to start a new codeplug


I'm a fairly cautious person, so the way I started out was to open the CPS and "read" my new radio, save that as a codeplug backup file, and then make a copy of it to work in. That way I'll have the radio's

original codeplug to go back to in case, for example, I mess things up badly enough that I want to start over, or if I want to reset the radio to give it to someone else.

Most DMR radios I've seen require a special cable that enables them to be connected to the PC's USB port. Once it's plugged in, open the CPS, turn on the radio, and then click the CPS Read button. It takes just a few moments to read the radio's data.

Similarly, whenever you want to update your codeplug, make a copy of it, and then make your changes to the copy. That way, if you need to you can revert to the previous working codeplug.

Driver signature enforcement

I use a 64-bit Windows 10 laptop for my amateur radio programming. In early 2018, Microsoft released an update that is much stricter in its handling of third-party driver signature verification. Since then, I sometimes have to use an Advanced Boot Option (option 2 in this [How-To Geek article](#) ) to temporarily disable driver signature enforcement in order to read and write from my radios using their supplied USB drivers. I've run into this with the Kenwood TH-D74A, Hytera AR-685, and AnyTone AT-D868UV and AT-D878UV USB drivers.

1. Open the Windows (10 or 8) advanced boot option menu by holding down the Shift key and clicking Windows > Restart.
2. In the Choose an option window, click Troubleshoot.
3. In the Troubleshoot window, click Advanced options.
4. In the Advanced options menu, click Startup Settings (may need to go to the second Advanced options screen to find it), and then click Restart.
5. Windows will restart and display the Startup Settings options. Press the F7 key to select Disable driver signature enforcement. I've found that when I've done this once, I'm able to use the radio's USB driver from then on.

See also: [AnyTone firmware updates](#) .

3d) General settings

There are a variety of general settings. The most important one is to enter your CCS7/DMR ID as the device or radio ID.

Other settings control things like how buttons behave, how menus are displayed, and whether and how one-touch calls are set up.

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3e) Create contacts/talkgroups

There are a couple kinds of contacts: talkgroups and individuals. For the AnyTone AT-D878UV and D868UV, you important the contact list and set up the talkgroups you want to use.

- **Name/alias** – A description of the talkgroup (for example, Colorado statewide) or individual (callsign and first name).
- **Call type** – Group call, Private call, or All call. For amateur radio, Group calls are most common. A Private call is rarer for ham radio; an example of when it is used is a parrot call (echo test) or for linking to unlinking from a reflector. An All call is primarily a commercial feature used by a user in a supervisory capacity, for example, a call from an individual radio to all radios in a system.
- **Call ID** – A talkgroup ID number or an individual's CCS7 ID.
- There may be other options, for example, whether or not a receive tone sounds prior to unmuting the radio when a Group, Private, or All call is being received.

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3f) Create digital channels

This is where it all comes together!

i) Primary channel settings

The following essential items that must be set up for each channel:

- **Channel name**
- **Color code** – Hotspots typically use color code 1.
- **Time slot** – Simplex hotspots typically use time slot 2.

- **RX frequency** – When setting up a hotspot, you choose a frequency to use with it, which should be one that is mostly unused in your area. Then you use that frequency for every channel that uses the hotspot.
- **TX frequency** – In some CPS applications, this can be auto-generated from the offset. Many hotspots are simplex, so the RX and TX frequencies are the same; however, there are some dual or duplex hotspots available now, which require offsets.

Important! Avoid frequencies used for other purposes, for example, 435.0 - 438.0 and 145.8 - 146.0, used internationally for satellite communication, which can be disrupted by even low power hotspot transmissions.

Band plan: See your country's band plan and your local frequency use plan. For example, for the U.S., see: [U.S. Band Plan](#). For the U.S. State of Colorado, see: [Colorado Frequency Use Plans](#) (especially, [CCARC Guidelines on Hotspots](#)). To find links for other U.S. states, refer to the [Amateur Radio: Frequency Coordinators](#) list by Tom, W2XQ. See also the info posted by Ron, VE1AIC: [Digital Voice frequencies](#).

- **TX contact** – Choose the contact that you previously set up that you want to use with the current channel.
- **Power level (default)** – Varies from radio to radio, ranging from low to high. I choose low for all the hotspot channels I set up, and typically choose high for the DMR repeater and analog channels.
- **Admit criteria/TX Permit** – This controls when your radio is allowed to transmit on a DMR repeater. The most common recommendation I heard was to use color code free (AnyTone calls this Different Color Code), which means that you're allowed to transmit on the repeater when no one else is transmitting on the same color code. That way, you avoid doubling. This is one advantage of the DMR standard: your radio is constantly receiving from the repeater in between your micro transmissions, so it knows the status of the repeater at all times.

ii) Other channel settings

In addition, there are a few other items that can be set up for each channel, including:

- **Talkaround (on/off)** – This typically means using the RX frequency (a repeater's output channel) for direct simplex communication, radio to radio, rather than through the repeater. For example, talkaround can be useful if someone with a more powerful radio that can hit the repeater wants to talk to someone nearby with a less powerful radio that can't hit the repeater.
- **TX Timeout Timer (TOT)** – A limit on how long you can transmit (in other words, the length of time that you can hold down PTT). This is done to protect the radio. A reasonable timeout is 120 - 180 seconds (in any case, it should be set to an amount of time less than the repeater's timeout).

There's also a TOT pre-alert tone that you can set to warn you a few seconds before the timeout, so you can transmit "Pause," and then reset.

- **Scan list** – This is a "Which comes first, the chicken or the egg?" step. For some radios, you have to create channels first in order to create scan lists (see the next step), but then after you create the scan lists, you have to come back and add them to the channels you want to have them available for.

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3g) Create scan lists

I don't use this feature much and have set up only a few scan lists, for example, one that includes all the BrandMeister regional talkgroups, and another that includes all the talkgroups on nearby DMR repeaters. I created a channel in each of the associated zones that has an appropriate scan list selected for it, so I can dial in that channel and then begin scanning.

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3h) Create analog channels

Setting up an analog channel for a DMR radio is similar to what you do for an analog radio. There is one difference in the CPS I have used: I needed to set the CTCSS tone for both the RX and TX frequencies, even when they are the same.

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3i) Create zones

When I created my zones, I thought about the groups of channels I think I'll want to use in proximity.

Since most of my activity will be via the hotspot, and since the hotspot I was using had separate connectors for the BrandMeister and DMR-MARC networks, I set up my zones this way:

1. The BrandMeister talkgroups I'll monitor most frequently via hotspot.
2. The UHF analog frequencies I use.
3. The DMR-MARC talkgroups I'll monitor most frequently via hotspot.
4. Talkgroups on the nearby DMR repeaters I'll monitor when driving.
5. All the BrandMeister regional talkgroups via hotspot.

6. All the BrandMeister U.S. statewide talkgroups via hotspot (obviously, this requires multiple 16-channel zones).

Then I added the appropriate channels to each zone, and organized the channels in the order I figured I'd want to flip through them.

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3j) Save codeplug and write to radio

As you're working in the CPS, you should save regularly, and save it one more time when you're finished.

The final step is to connect your radio to your PC with the programming cable, turn on the radio, and then click the CPS Write button to transfer the codeplug to the radio. It takes just a few seconds. My radio restarts when the write is complete. At that point, all the new contacts, zones, channels, basic settings, etc. are in the radio and ready to use.

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3k) QSO!

And it worked! I fired up my hotspot, turned on my radio, selected a channel with a BrandMeister talkgroup I was interested in, keyed up once to link to the talkgroup and, once I heard that the talkgroup was free, a second time to announce myself (DMR etiquette is to give your callsign and announce the talkgroup you're monitoring, for example, "KE0FHS monitoring 3108"). Another person on the talkgroup acknowledged me, and I had my first DMR chat. Nice !

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