How to program a DMR Radio for Phoenix from Scratch

It is always best to program your own DMR Code Plug if you can. That way you understand what is going on as opposed to just turning the knob. The settings on any particular radio will change over time so knowing how to alter stuff allows you to keep up. There is no correct way to design a code plug. Another good reason for doing your own!

The actual steps are not that complicated. It is a given that you have the programming lead and have installed the Code Plug editor (sometimes called a CPS) and the USB Driver. Most CPS editors do not allow you to insert changes; forcing you to append alterations. Make sure you leave sufficient gaps in lists to allow for later insertions (if you care about such things!)

Before you start it is good practice to connect the radio to the computer and download the current settings. Then save these to a file. You may need them later! There may already be some settings, particularly if it is second-hand. Looking at these may help the understanding. If you are going to program from scratch remember to start with a clean file.

There are a number of steps you need to make, and in the order given below:

General Settings.

Before you can use the radio, you must get yourself a DMR ID. These are obtained from: https://www.radioid.net/register#!

Somewhere in the CPS there will a General Settings>ID option in which to set this for your radio. Also name the radio with your call sign. In theory the actual ID does not matter as you still have to give your call sign as per your licence; so you can use someone else's radio. It is not good practice to request a second ID for the same call sign, although people do.

Create Digital Contacts.

The DMR network uses Talk Groups. These define the destinations of calls. There are two kinds of calls. Public Talk Groups are all Group Call. Private Calls use people's 7-digit DMR ID. These then allow one-to-one calls; not all networks support private calling so I will ignore this topic.

This is where the first confusion appears. These Digital Contacts are called different things on different radios, and even on the same radio in different contexts! Digital Contact = Contact Name (in a channel configuration) or a Talk Group (as a Group Call on the repeater) Once they have been defined it is easier to think of them as Talk Groups.

Group Call Talk Groups are like routings to a particular area. This could be World-wide, EU-wide, East Anglia or just the local repeater. Each Talk Group has its own Digital Contact. Hence the need to define them first. For instance, on Phoenix Talk Group 1 is World-wide. Using this Talk Group will open EVERY repeater on the network in the world. Talk Group 235 is UK-wide, opening every repeater in the UK. Talk Group 9 is Local to the repeater. It only opens that repeater. There is a list of the current Talk Groups further down this document.

So, for every Talk Group you wish to use you need to create a Group Call Digital Contact. Use the Talk Group number as the ID. Define a suitable unique Contact Name to describe it. i.e. 1 WW.

Later you could add individuals DMR IDs as Private Calls so you can do person-to-person calls.

Create Simplex Channels.

You can create both Analogue and Digital channels. It is good practice to create Simplex Channels first and add Duplex channels after. Just keeps it tidy. You are more likely to add new repeaters than ordinary frequencies!

The Analogue channels should be self-explanatory if you have programmed Analogue radios before. Name, Frequency, or Frequencies if a repeater. CTCSS codes where required.

Digital Simplex channels are a little bit trickier. Being Digital they need a Contact Name (which is the Digital Contact described above) For Simplex channels this is always Talk Group 9. There is also a setting called a Colour Code. This is synonymous to a CTCSS code. For Simplex Digital channels this is always set to CC1.

UHF Digital Channel Frequencies: D1 438.5875, D2 438.6250, D3 438.6125 (calling), D4 438.6250, D5 438.6375 and D6 438.6500.

Create DMR Repeater Channels.

Once you get to repeaters the situation gets a little bit more complicated, and long winded. The simplest way is to create a set of channels covering all the Talk Groups available on the repeater. Then you create them all again for a second repeater, and so on. With currently 27 Talk Groups on each Phoenix repeater this becomes a long list of channels.

Some CPS editors allow you to export the channels to a spreadsheet, add more (by duplicating them, changing things and the importing them back again. This MAY make the process easier. The Alinco DJ-MD5 export has a bug and does not re-import APRS settings. Other than that, it seems OK.

Anyway, the basics. You need to know the Name of the repeater (Ipswich is GB7MK) Its frequencies (RX 439.600 TX 430.600) and its particular Colour Code (13) Also the available Talk Groups. The Phoenix repeaters have a standard set but some repeaters are mixed Phoenix and Brandmeister (locally Beccles, Mendlesham) and this makes things trickier. I shall ignore these for this document.

So, for each repeater you wish to use, you need to create a Channel for each Talk Group. With the appropriate repeater RF settings (RX, TX and CC). Note that some Talk Groups are on Time Slot 1 and some on Time Slot 2 (and TG 9 is on both so needs 2 channels, one for each Time Slot)

The Channel Name is important as it has to be clear in a few characters and unique. I.e. "1WW MK", "801 South E MK". Then for each new repeater you define you can just change the last 2 characters, "1 WW AL" for the Tunstall repeater for instance. You may prefer a different naming scheme.

Remember to perhaps leave gaps for future Talk Groups.

Following is a list of the Talk Groups available on a Phoenix repeater. Also, an explanation of their behaviour. It is good practice to program all of them as you never know which ones you may end up using:

DMR Code Plug Programming Guide (Phoenix)

Always On Talk Groups (East Anglia)

Slot 1	Slot 2	Name
TG 1**		World Wide Calling
TG 2**		Europe Calling
TG 9		Local Secondary
	TG 9	Local Primary
TG 13**		World Wide English
TG 235**		UK Wide Calling
	TG 840**	East Anglia
	TG 841**	East Suffolk
	TG 9990	Echo Server

User Activated Talk Groups

Slot 1	Slot 2	Name
TG 5		Australia Calling
TG 80**		UK Wide 1
TG 81**		UK Wide 2
TG 82**		UK Wide 3
TG 83**		UK Wide 4
TG 84**		UK Wide 5
TG 113**		World Wide English 1
TG 119		World Wide 1
TG 123**		Word Wide English 2
TG 129		World Wide 2
	TG 801**	South East
	TG 810**	South West
	TG 820**	North West
	TG 830**	Midlands
	TG 850**	Scotland
	TG 860**	North East
	TG 870**	Wales
	TG 880**	Northern Ireland

Always On Talk Groups are active when there are no User Activated Talk Groups being used on that Time Slot.

The appropriate regional 8XX Talk Groups are Always On, the rest being User Activated.

There is a 5 (maybe an 8) second hold-off timer that prevents another Talk Group taking over an active QSO on an Always On Talk Group.

Talk Groups marked with the ** are also available directly as Talk Groups from Hotspots via the DMR+ IPSC2 Phoenix F server.

User Activated Talk Groups remain inactive until a user 'keys up' on the Talk Group when the repeater is idle on that Time Slot.

Once activated a Talk Group remains so for 15 minutes after the last TRANSMISSION from the user. This means a user in a NET has to ensure someone on the repeater talks or keys-up before the time out occurs.

If they don't, the Talk Group will time out and no further transmissions will be heard over the repeater.

While a User Activated Talk Group is active on a Time Slot, the 'Always On' and other User Activated Talk Groups are switched off. This implies that they will not become active again until 15 minutes after the last outgoing transmission on that Time Slot.

For clarity I have left out all the Special Links These can be found at http://www.dmr-uk.net/index.php/layout/

Create Zones.

Once you have your Channels defined you can then create Zones. Think of these as collections of Channels. You can put the same Channel into as many Zones as you like. I have the same 3 Channels from three local repeaters in the same Zone. That way I can quickly 'roam' as I drive around the area. Most radios do not make it easy to change Zones!

Simplex Analogue and Digital Channels can be placed in their own Zones. Say perhaps "Analogue Simplex", "Analogue Repeaters", "Digital Simplex". They can also be put in mainly digital Zones.

As there are so many Talk Groups on Digital repeaters, I prefer to split them into two Zones (necessary if you are restricted to 16 channels in a zone) as they are easier to select. I put the International and National Talk Groups in one Zone and the Regional ones in another. On the end of all Digital Zones, I add TG9 TS1 and TS2 and 9990 Parrot. This allows quick selection of the LOCAL Talk Groups and the Parrot Talk Group is great for checking you have access (Parrot echoes back your transmission – hence the name)

So, for instance I have the following Zones defined:
Digital Simplex, Analogue Simplex, Analogue Duplex.

Then for each of the local DMR repeaters I have these two zones:
GB7MK -Ipswich (TGs 1-84, 840, 9TS1 and TS2 and 9990 ECHO)
GB7MK 8XX (TGs 801-880) Also D1-D5 (not room for D6 in 16 channels!)

These are repeated for AL – Tunstall, CL – Clacton, ND – North Ellingham, YL - Lowestoft

Useful Frequencies.

A table of the local frequencies is given as an appendix – as they change!

Finally, some more advanced things to consider:

(Digital) RX Group lists

Once Digital Contacts are entered, RX Group lists can be created. Relevant information from the example table: Label and Time Slot. RX Group lists are limited to a maximum of 32 talk groups per list. The intent is to monitor all talk group activity on a time slot. Only contacts set to "Group Call" can be added.

There are generally two ways of creating RX Groups. The first uses a one-to-one relationship where each Talk Group has its own RX Group List. The second includes all available Talk Groups on a repeater's time slot into a single list. The latter creates lists unique to a repeater that cannot be reused on another repeater, unless the configuration is exactly the same. If the repeater has less than 32 talk groups on a time slot, put them all in one RX Group list. If there are more than 32, then create one RX list per talk group.

To keep repeater specific group lists unique, name the list: repeater location followed by "TS1/2" for the time slot designation. Example: "Some City TS1," "Some City TS2."

RX Group lists and the RX list selected for a channel are the first places to look when there is a suspected radio programming issue or nothing is being heard.

RX Groups are created in the same order as the repeater listing. In the CPS software, create RX Group lists and include the listed Digital Contact(s)

There is an issue with RX Groups that you need to consider. There is no simple way of telling the radio to NOT switch to a different channel if a signal is received on a grouped Talk Group. You may be in a QSO on one Talk Group and during a handover a signal comes in on a different one. If RX Groups are useful it may be a good idea to duplicate the Zone and Channels with one set with and one without the RX Group settings.

Miscellaneous Channels Settings

Some other settings definitions that may or may not be available on your CPS:

- Admit Criteria: determines when the radio is allowed to transmit.
  - Always: allows the radio to transmit any time the PTT is pressed. This is the most disruptive option and may interrupt another QSO in progress.
  - Channel Free: the radio will only transmit when there is no transmission in progress on the time slot.
  - Colour Code (Free): the radio will only transmit when the time slot is free on the repeater matching the colour code. This mode pings the repeater at the beginning of each transmission to find a matching colour code. This pinging is also an indicator if you're making the repeater or if it is in use.
  - "Colour Code" is recommended for a repeater, "Channel Free" for hotspot & simplex use.

- In Call Criteria: action taken while receiving a call and the PTT button is pressed. This can be thought of as the 'interrupt a call' setting.
  - Follow Admit Criteria: follow the setting defined in "Admit Criteria."
  - Always: always transmit, even while receiving a call.
  - "Follow Admit Criteria" is recommended for a repeater, "Always" for hotspot & simplex use.

- Auto Scan: when the channel is selected, the radio begins scanning channels defined in the selected "Scan List." For this option to function: create channels, add the channels to a Scan List, then create another new channel with the newly created Scan List selected and "Auto Scan" checked.

- Lone Worker: the user receives an alert from the radio after a specified amount of time and must acknowledge by pressing any button on the radio. If the user does not respond to the alert, it is assumed the user is injured or incapacitated. The radio switches to an emergency mode so the user can be located and assisted. I have not seen this used in ham radio.

- Allow Talkaround: this allows the radio to operate simplex mode when a repeater is not available or out-of-range. TX and RX frequencies must be different for this option

to function. Talkaround is enabled/disabled manually via the radio's "Utilities" menu, select "Radio Settings," select "Talkaround," then select "Turn On/Off."

- Emergency System: settings for an emergency alarm. I have not seen this used in ham radio.

- Privacy: DMR includes the ability to "scramble" transmissions. This is a form of encryption and not normally allowed in the UK.
  - There may be different levels of encryption available, set by different length keys.
  - All the radios must share the same key.
  - The encryption is brand / radio specific.
  - Encryption may, under specific circumstances, be used by RAYNET for emergency communications.

- RX/TX Ref Frequency: These two drop-down selections are provided to change the radio's basic oscillator frequency in the receive or transmit side. Because the radio covers such a wide frequency range, on some specific receive or transmit frequencies there can be a birdie generated internally which interferes with reception or transmission. If this occurs, by simply trying a different setting from the current setting, it should be possible to get clear reception and a clean transmission. Leave "TX/RX Ref Frequency" at the default unless you experience problems transmitting or receiving and track the problem down to the radio itself.

These settings will generally be applied to every digital channel and are a good template for actual programming:

- Channel Mode: Digital
- Band Width: 12.5kHz
- TOT[s]: 180s (3 min) max for repeater & hotspot, 600s (10 min) max for simplex channels.
- Power: "High" for repeaters & simplex – unless really close, "Low" for hotspots.
- Admit Criteria: "Colour Code" for repeater, "Channel Free" for hotspot & simplex.
- Allow Talkaround: Yes
- Emergency System: None
- Privacy: None
- In Call Criteria: "Follow Admit Criteria" for repeater, "Always" for hotspot & simplex.

Appendix A – Ipswich Area Frequency Tables

Analogue Simplex

Frequency	Usage
145.4000	**FDARS Net**
145.450	Chat 2m
145.500	RSGB News

Also, you can add VHF S8 to S23 as discrete channels as they are easier to select then to switch the radio to VFO. Frequencies are from 145.200 to 145.575 at 25KHz spacing.

Analogue Duplex

RX Frequency	TX Frequency	CTCSS	Repeater	
145.0650	**145.050**	**110.9**	**GB3PO**	**Ipswich**
145.6875	145.9875	110.9	GB3EA	Wickhambrook
145.625	145.025	94.8	GB3NB	Norwich
145.725	145.125	110.9	GB3DA	Danbury
145.6125	145.0125	67.0	GB3CL	Clacton
430.850	438.450	110.9	GB3BZ	Braintree
433.350	434.950	67.0	GB3CW	Colchester
433.225	434.825	67.0	GBsCL	Clacton
433.175	434.775	110.9	GB3DE	Mendlesham
430.975	438.575	110.9	GB3EZ	Wickhambrook
433.100	**434.700**	**110.9**	**GB3PO**	**Ipswich**
433.350	434.950	94.8	GB3YL	Lowestoft

Digital Simplex

On VHF these run from DV16 to DV46. Frequencies are from 145.200 to 145.575 with 12.5KHz spacing. These are the same frequencies as the analogue channels.

On UHF these run from D1 438.5875 to D6 438.650 on a 12.5KHz spacing. D3 is the calling channel.

Digital Duplex

RX Frequency	TX Frequency	Colour	Repeater	
145.7875	145.1875	1	GB7YL	Lowestoft
439.600	**430.600**	**13**	**GB7MK**	**Ipswich**
439.400	**430.400**	**2**	**GB7AL**	**Tunstall**
439.6375	430.6375	3	GB7CL	Clacton
439.4125	430.4125	1	GB7ND	Great Ellingham
439.575	430.575	2	GB7EB	Beccles*
439.4375	430.4375	1	GB7PP	Mendlesham**

* Beccles is mixed Phoenix and Brandmeister so does not support all the Talk Groups
** Mendlesham is multi-mode