Review of the Hytera PD-365 by David Norris, G7VDI

Thursday, 25 February 2016

Since my last review of the AOR AR-DV1 scanning receiver, I have spent a lot of time listening on the amateur bands, and have been surprised to discover how much activity there is on the DMR repeaters. I want to get on air more often than in recent years, and having both analogue and digital capability will certainly be beneficial.

It is interesting to note that one can get a DMR handheld for less than the price of a handheld scanner (starting at less than £100). There are VHF and UHF versions available; however as the vast majority of amateur DMR activity is on the 70cm band between 430 and 440 MHz, UHF was the way to go. At time of writing, there are only two operational DMR repeaters on the 2 metre band in the UK, although a handful may yet appear on other bands, subject to equipment availability.

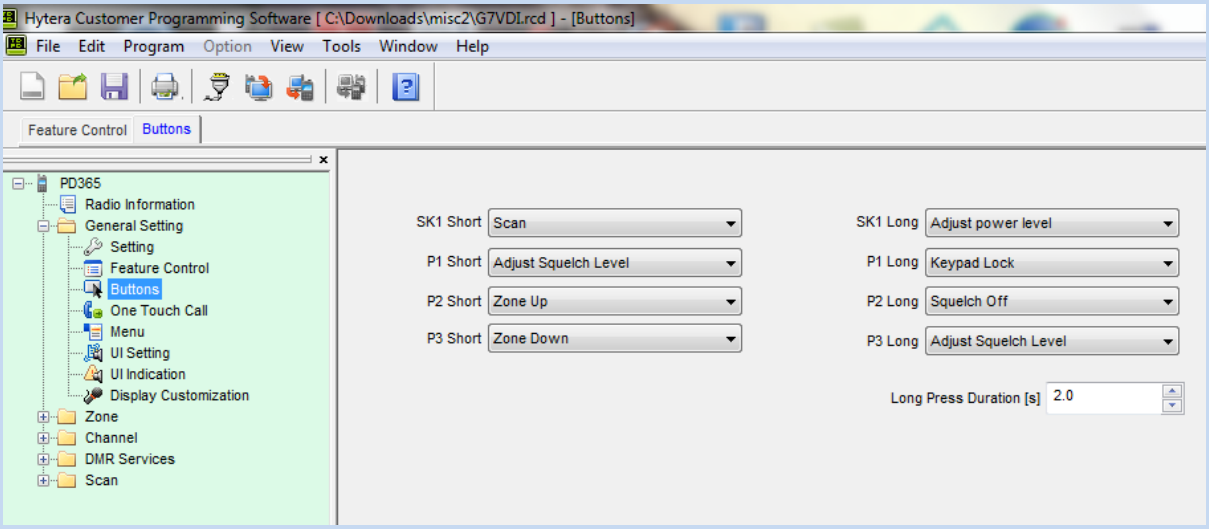
DMR radios have analogue FM capability also (to provide backward compatibility for commercial users with existing equipment), so you can use these as a standard 70cm FM transceiver as well as a DMR transceiver. DMR is certainly no substitute for HF, but it is brilliant for hooking up with people quickly and easily during one's limited spare times. I had my lunch breaks in mind in particular.

What I wanted was a compact DMR transceiver which would also provide some extra monitoring capability. After some research, I settled for the Hytera PD-365 which is available in 400-440, 430-470 MHz and also a PMR446 version. The 430-470MHz version is of most interest in the UK for amateur use. It looks rather basic at first glance (see the image below), but there is a lot of hidden functionality as we will see shortly. The PTT is on the left side, and the earphone and USB mini slot are on the right. The USB slot is for programming and charging alike – you can charge it from powered USB ports. This takes 4-5 hours for a complete charging cycle. It is worth pointing out that the programming lead supplied will not charge it, nor will a standard USB mini lead program it. This is because the programming cable has circuitry contained within which does not pass power through; whereas the circuitry is needed to carry out programming.

Battery life is quoted as 10 hours for analogue usage and 12 hours for digital, based on 5% transmit, 5% receive, and 90% standby. The battery is a 2AH lithium ion pack with no memory effects as used to plague the old Nickel-Cadmium cells. The ability to charge it using the supplied charger (a continental two pin plug, requiring an adapter in the UK, which is rather irritating), or alternatively you can charge it using your computer's USB port at work, or a compatible car charger which charges other USB devices.

The built in aerial performs quite well for its stature, but please note that no provision is made for an external aerial to be connected. This is an important point to take note of. After all this radio is marketed mainly with business usage in mind.

The buttons on the front can be programmed – the user can configure the function of each under the “General setting > Buttons” submenu, allowing the user to use them as a shortcut to their preferred frequently used operations. This simplifies operation, and is a welcome feature of many handheld radios nowadays since different users may have different usage patterns.



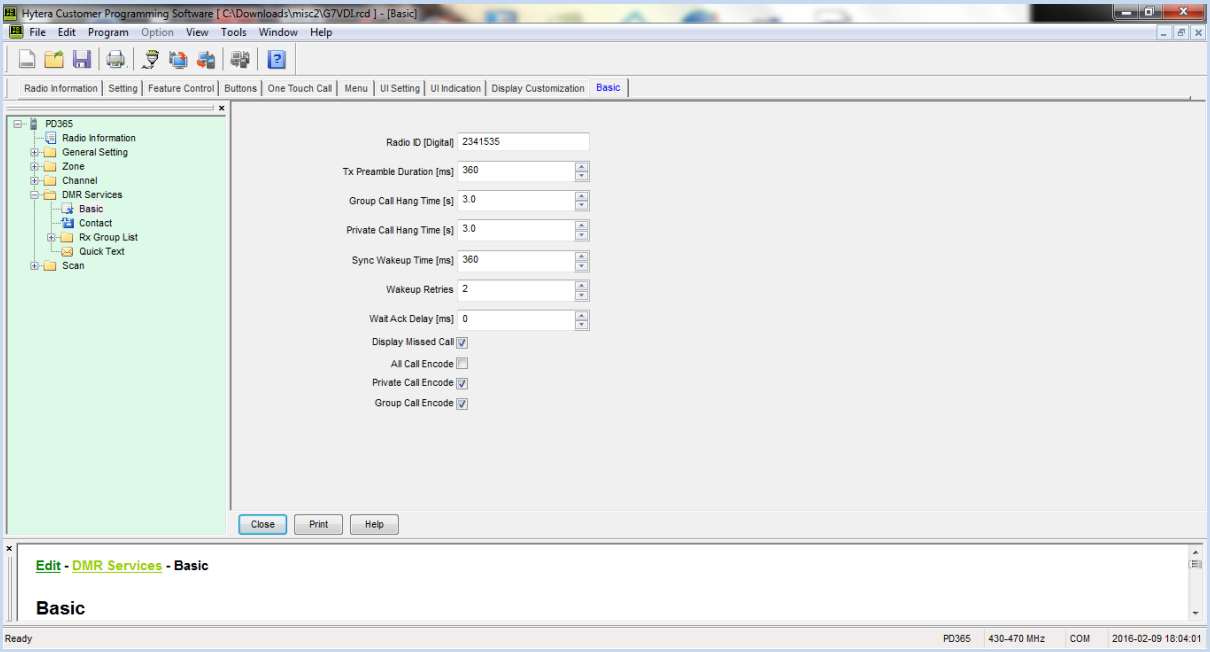
Programming

The first hurdle is to get hold of the software to program the radio. So, if you have yet to buy your radio be sure to get a programming cable; it looks like a standard USB mini but the wiring inside is not standard, (deliberately of course!). You will need firstly to obtain the software 'CPS, or customer programming software as Hytera call it), and then you will need a codeplug which is in essence the configuration file. You can of course write your own, but there are ready made codeplugs for various areas of the UK ready loaded with the amateur repeaters you need. Programming a codeplug from scratch is probably best left to those with previous experience.

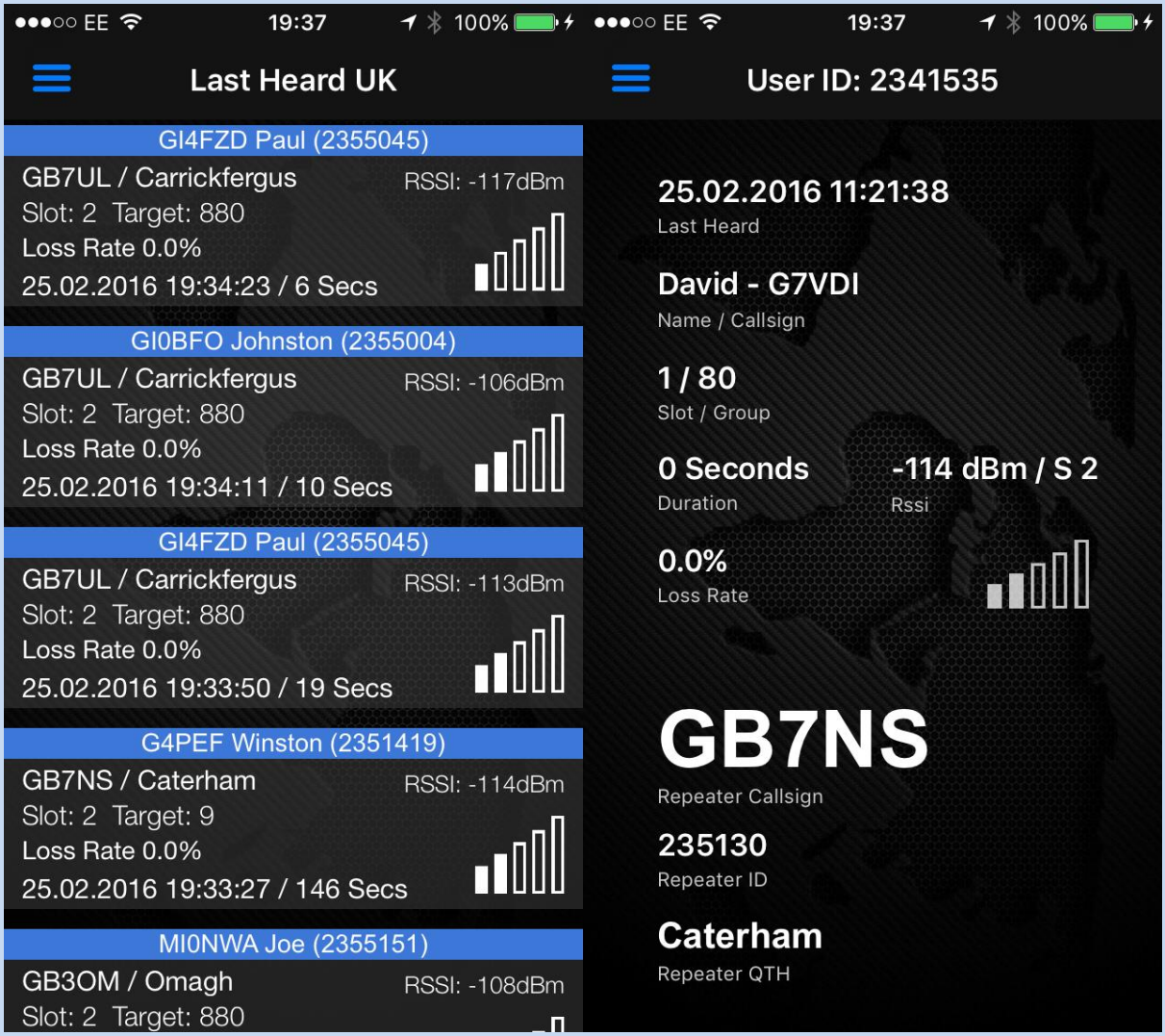
The software is available from Hytera at http://www.hytera.com/productResources.htm?columnId=416&proId=2493 – although you will have to register before you can download (Urgh). However, there are also one or two other sites hosting it if you spend time searching.

Then you will need your codeplug. As I live in London I used a codeplug from G7HID's site: http://www.codeplugcentral.co.uk/index.php?option=com_osdownloads&view=item&id=19&Itemid=241 which has all the London area repeaters programmed complete with the relevant talkgroups and timeslots. This gets you started listening, but before you transmit (assuming you are a licenced radio amateur of course!), there is still something else you will need first…

Each DMR radio needs a unique radio identification number to access the DMR-MARC network. You can't just use the radio out of the box as with good old analogue, or make up your own number! In order to get your own identification number, visit http://register.ham-digital.net/ where you register. You will need to prove that you are licenced by uploading a copy of your validation document; once this is done you will usually be issued with your identification number in 1-2 days. This will need to be programmed via the CPS software, and then you're good to go. The Identity number can be found under "DMR Services > Basic". Edit out the default number and replace it with your own number allocated to you.



It is the radio identity number which makes system abuse much harder, as well as making excellent diagnostic tools possible, such as the excellent DMR tool app designed by Matthew Millar (matt@dstarcomms.com, callsign M0DQW), as shown below. It even tells you what signal strength the repeater is hearing you at:



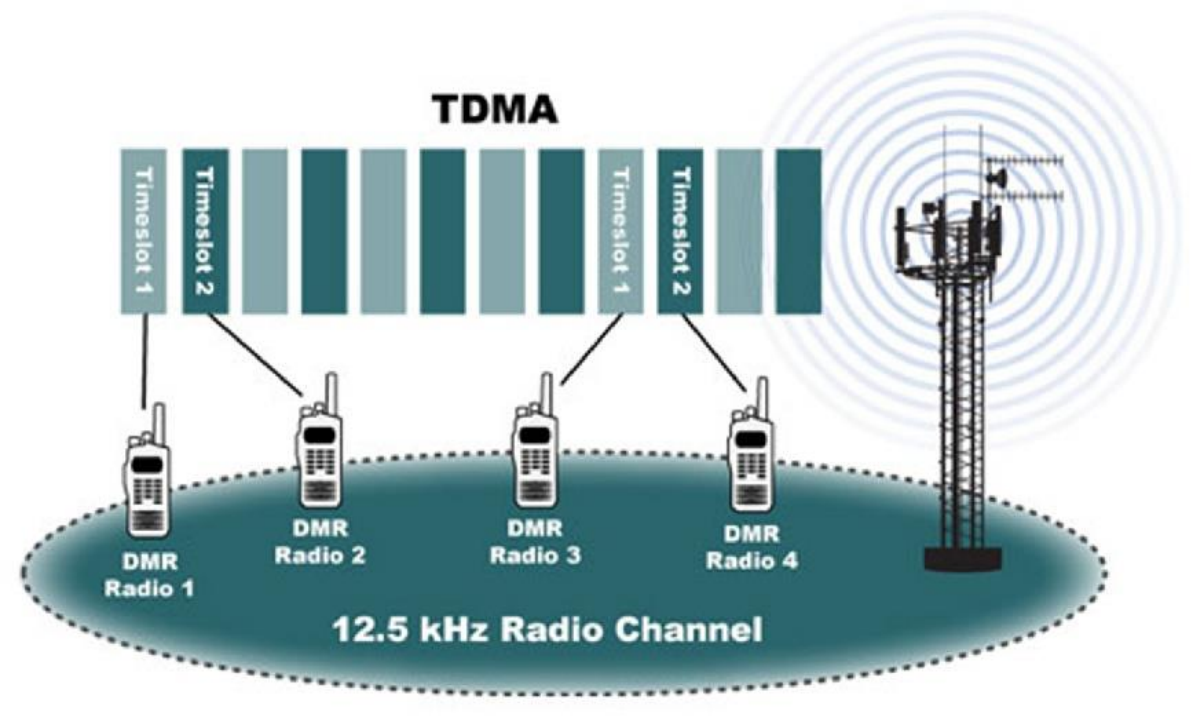
Whilst I awaited my own radio ID number, I gave the PD-365 a try on analogue and got good audio reports.

A quick introduction to talk groups, colour codes, timeslots and TX options (Digital mode only)

I am assuming that you are an old hand at amateur radio but new to DMR. If not, skip this part if you wish. At time of writing, the official list follows below. It's worth mentioning that DMR uses time division multiplexing to allow two voice (or data) communications on the frequency simultaneously. Timeslots change over every 30 milliseconds, giving the user impression of a continuous communication. As a rule, wide area talkgroups use timeslot one, and regional and local talk groups use slot two.

Colour codes are DMR's equivalent to CTCSS or DCS, and allow co-channel user groups to be separated. Values are 0-15, with amateur radio mainly using values 1-3.

If the repeater you want to use is already in use, then assuming that only one timeslot is in use you will be able to make use of any talk group which is configured to use the vacant timeslot. For example, if a wide area talk group is active on slot one, then local contacts via talk groups using slot two are still available as illustrated below in this diagram from the Digital Mobile Radio Association.

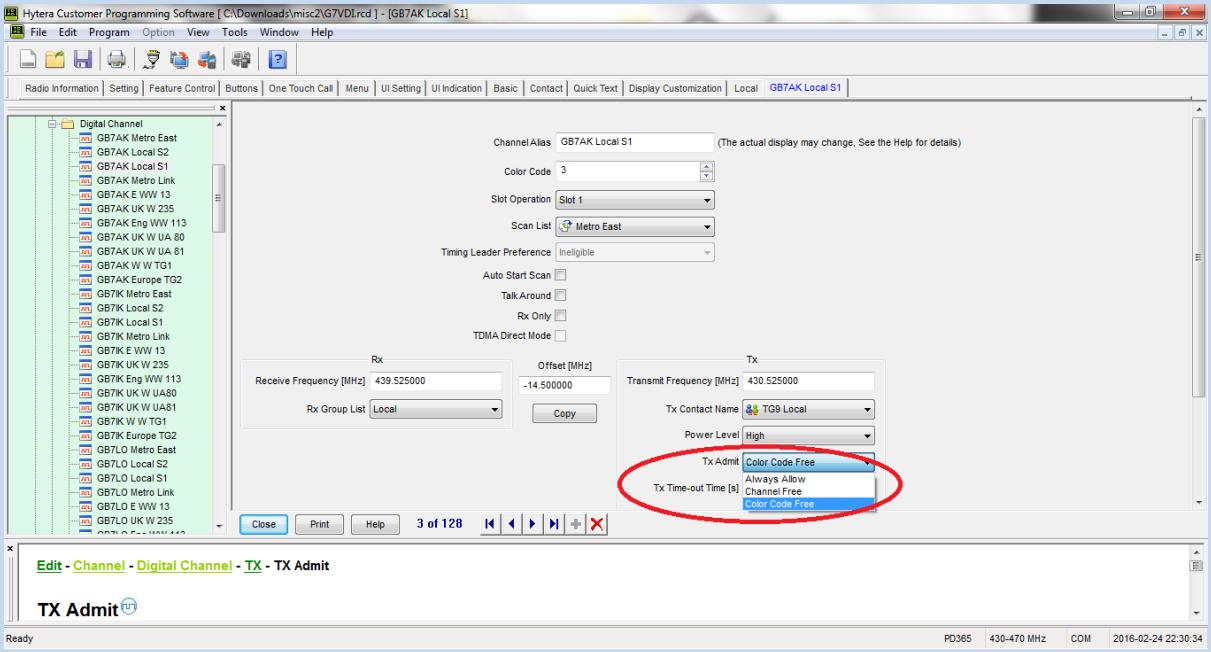


DMR allows three options to handle co-channel interference. All DMR radios will detect a signal on the transmit frequency; if a signal is present (DMR or otherwise) the radio will respond according to its programming.

- In 'polite' mode, your DMR radio will not transmit if a signal is detected on the TX frequency;
- In the 'polite to own colour code' mode the radio will not transmit if a DMR signal with the same colour code is present, however it will transmit if the colour code does not match, or an analogue signal is present;
- In 'impolite' mode, it will transmit regardless of the presence of a signal on the TX frequency (I often refer to this as CB mode due to the conduct I often used to encounter on 27MHz in days gone by!).

The first option will prevent doubling with any other user – try this first. If co-channel users not relayed through your repeater often prevent transmission (which should not happen often in practice, except maybe under tropospheric lift conditions), try the second option which will still avoid doubling with other DMR users of the repeater you are communicating through. This is highly recommended as the third option will allow doubling, which often happens in error during nets - by my own observation.

The options are set per digital channel, and are referred to as channel free, colour code free, and always allow, respectively. I use the second option by default, although you can set these specifically for each channel; it is not a global setting.



In general, the guiding rule regarding talk group usage is to use the most local talk group possible for your contact. For example, move off the UK wide talkgroups for local contacts, and move off UK wide talkgroup 235 to user activated talkgroups 80 or 81 for long contacts across the UK. QSO's shouldn't really take place on the 'worldwide' groups. Remember that others may wish to call, so be sure to leave gaps between overs, and avoid 'tailgating' as this can deny others access. This isn't HF! It is inevitable however that mistakes may happen from time to time.

This is the current list of talk groups generally available on UK repeaters.

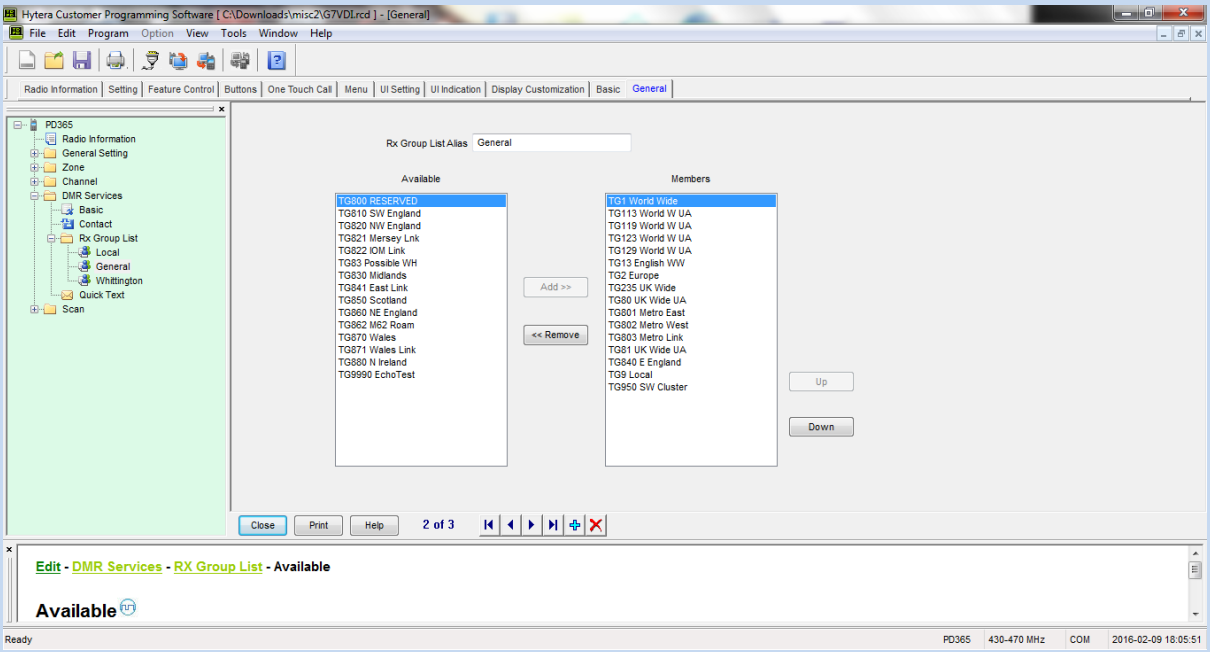
Timeslot 1	***Timeslot 2***
TG1 User Activated Worldwide	TG9 Local Primary
TG2 User Activated Europe	
TG13 User Activated Worldwide English	TG801 Metro East (AK, CK, CL, EK, EX, IK, LO & SE)
TG235 User Activated UK Wide	TG802 Metro West (EP, GF, HR, ID, MP, NS & SC)
TG113 User Activated Worldwide English 1	TG810 South-West England (AV, BK, CT, 3WE & WL)
TG123 User Activated Worldwide English 2	TG820 North-West England (BR, CA, HM, LP, MB, MR & PN)
TG119 User Activated Worldwide Any Language 1	TG830 Midlands (FW & GB)
TG129 User Activated Worldwide Any Language2	TG840 East of England (CL, CT, DS, FU, LN, MK & PE)
TG80 User Activated UK-wide 1	TG841 User activated link MK and DS
TG81 User Activated UK-wide 2	TG850 Scotland (DD & EE)
TG822 User Activated Special link between CA, BR and PN	TG860 North East England (EL, HS, HX, LE, SR, TD, TP & XX)

	TG862 M62 MOTORWAY (HS, HX, LE, MR & TD)
TG9 Local Secondary	TG870 Wales and Marches (HM & PN)
	TG880 Northern Ireland (Reserved)
	TG9990 Echo Back for Audio Test

It follows that if talk groups are used incorrectly, a good deal of annoyance can be caused. Avoid long overs particularly on wide area groups.

It is also worth mentioning that although many of the talk groups are standardised, it is a decision for the repeater keeper as to which talk groups are provided.

Talk groups are in fact listed in the menu “DMR Services > RX Group list” section. You will need to program the list of talk groups which you want to receive – only talk groups in this list will open the squelch. The amateur talk groups are included in the codeplug for your area, but if you want to add others – for example for out of band monitoring – you will need to add them yourself. I will cover this later.

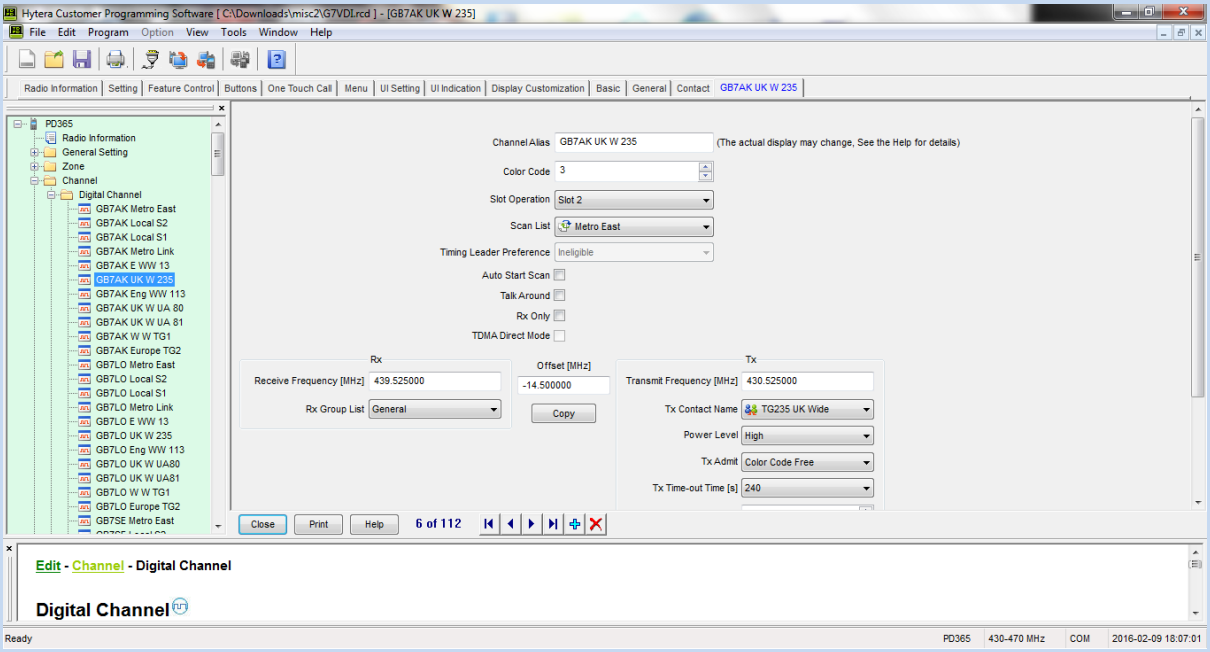


A hint - It is best not to have receive groups programmed for channels you use to transmit since this causes confusion (if you want to ‘scan’ all talk groups in a zone – and normally this means all talk groups available on each repeater, then program in a single dedicated channel for the zone with your receive group list, and select RX only for this channel, since this avoids accidentally replying to someone on a different talk group to one you are working on.) When in QSO you really only want to hear those on the same talk group as yourself!

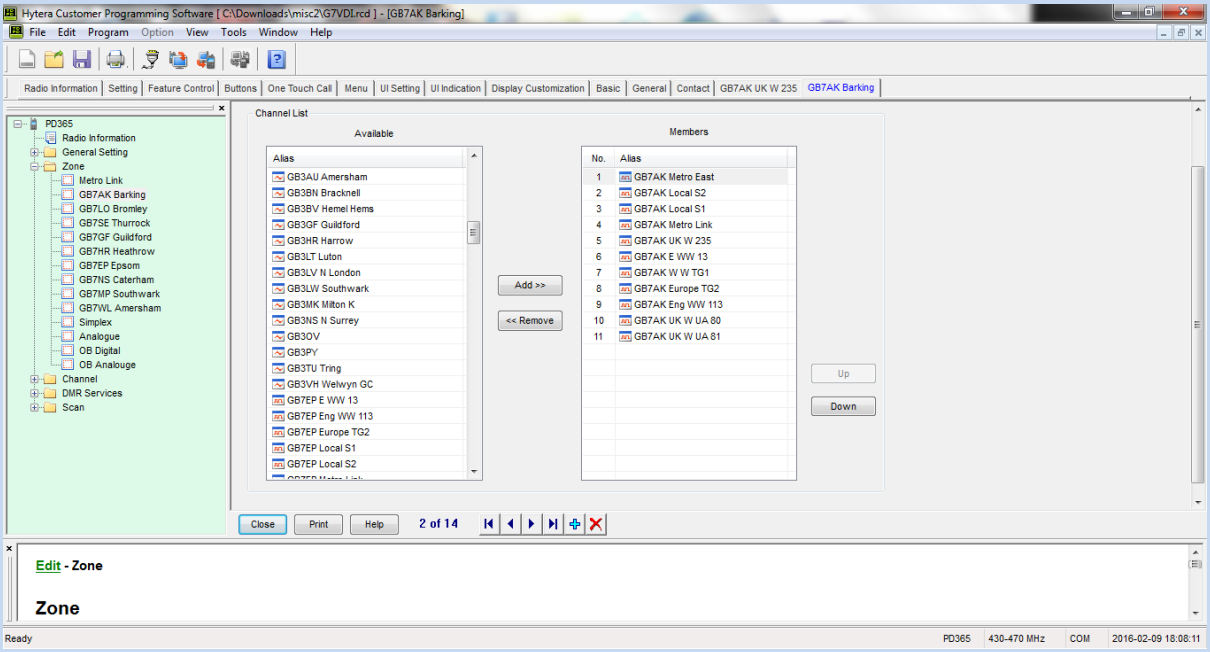
Channels are defined in the “Channels” section; these are divided into analogue and digital subgroups. A total of 128 analogue and 128 digital channels can be defined.

The transmit and receive frequencies for each channel are defined here for repeater inputs and outputs respectively. For analogue, CTCSS and DCS tones are defined; for digital channels, the colour code, transmit talk group and timeslot must be stipulated.

A scan list allows you to optionally add channels to scan in the background when this channel is selected; whereas the receive group list defines which talk groups you will hear when monitoring this channel. These are options you may wish to change with experience.



A ‘Zone’ is basically a group of channels. I would recommend using a zone for each repeater you wish to transmit through. The channels for each zone include the talk groups available on each repeater. So, on each channel, the zone name tells you which repeater you are operating on, and the channel number confirms the talk group in use. Of course, you can also make receive only zones for out of band monitoring if you wish, (be sure to enable the ‘receive only’ option on out of band channels to prevent accidentally transmitting out of band!). I have used the GB7AK repeater as an example of a zone. So each digital channel each contains the transmit and receive frequency, as well as a timeslot (1-2), a colour code (0-15) and a talk group number from 0 to 16777216.



For out of band monitoring

For amateur systems, the timeslot, colour code and talk group information are widely available, but if you wish to monitor any out of band systems, then you need to find this information out. I will only give this a brief mention here, but there are third party decoders available for DMR and a number of other digital modes. Remember that DMR radios lack a feature to override the timeslot/talk group/colour code in use to receive any DMR user in range.

For systems where the timeslot, colour code and talk group information are not publicly available, you will need to use a tool such as DMR decode (a Java program available on Github) to find out the numbers. It is available from https://github.com/IanWraith/DMRDecode/downloads . Since this is a Java program, it is not platform specific and can run on Windows, Linux and Macintosh, although I have only tried it out on Windows 7.

Also worth a mention is Digital Speech Decoder from http://www.dsdplus.com/ which decodes DMR as well as a number of other digital radio modes including APCO25 and digital PMR446.

As time of writing, the AOR AR-DV1 does display the timeslot and colour code number if the firmware is up to date, but not so far the timeslot (According to AOR, a future firmware update will add this capability, although bug fixes are their highest priority). So I wait in anticipation!

Please note that DMR Decode requires a receiver with a discriminator output to decode correctly; my AR-DV1 has a discriminator output but this is generally only found in high end receivers. However, it can be added to some others if you are confident enough tom perform the modification yourself. A good site to check out is http://discriminator.nl/index-en.html over in the Netherlands, which provides details for adding a discriminator output to a number of models.

A reminder to **play safe and always use the 'Receive only' option** on any out of band systems you might program in is in order, as otherwise it is all too easily to accidentally press the PTT and therefore transmit out of band.

Summary

For a radio amateur wanting a compact UHF handheld to use on their lunch break or whilst out and about, this radio represents excellent value for money. It's not well suited for vehicle use since it does not have any provision for connecting an external aerial. But it performs well on both digital DMR and analogue modes, and it's light and discreet to carry besides giving good battery life, making it well suited for my intended pattern of use, i.e. pedestrian mobile.

I have had good audio reports whether digital or analogue modes were in use, although you may wish to try adjusting the mic gain if you receive reports that you sound much louder or quieter than the majority of other stations (experience the annoyance of listening in a group using widely differing audio levels to find out why! I have had to turn up the volume to hear the quietest station in a group, only to find the loudest one wakes up everyone in the house). It is worth remembering that audio level settings are intended to be adjusted allowing it to be equally usable in a quiet library area or a building site where demolition is taking place. Therefore careful audio level settings need to be found.

For out of band monitoring you will need to use DMR Decode or the suchlike to find out the vital timeslot, colour code and talk group in use (my AOR AR-DV1 displays the timeslot and colour code but not the talk group number; AOR say this feature will later be added via a firmware update). You may already know this if you read my previous review!

Like all DMR gear, all parameters must be programmed in prior to use as no search facilities are available, but then this is a business radio not a scanning receiver. It is unfortunate that with added functionality comes extra complexity, especially when you are just starting out.

It's robust but lightweight and is well designed from an ergonomic point of view. Given that it also performs well on air, I expect it to become widely used by the amateur fraternity.

Specifications as per the manual:

Specifications

General		
Frequency Range		UHF: 400-440MHz, 430-470MHZ*, 446MHZ*
Channel Capacity		256
Channel Spacing		25/12.5KHz
Operating Voltage		3.7V
Battery		2000mAh (Li-Ion)
Battery Life (5/5/90)		Digital: approximately 12 hours Analogue: approximately 10 hours
Weight		160g
Dimensions		123 x 55 x 23mm (PD35X) 106 x 54 x 23mm (PD36X)
Frequency Stability		±0.5ppm
Antenna Impedance		50Ω
Receiver		
Sensitivity (Digital)		0.22μV/BER 5%
Sensitivity (Analogue)		0.22μV (Typical) (12dB SIN AD) 0.4μV (20dB SIN AD) 0.22μV (12dB SIN AD)
Adjacent Selectivity	TIA-603	60dB @ 12.5KHz/70dB @ 25KHz
	ETSI	60dB @ 12.5KHz/70dB @ 25KHz
Spurious Response Rejection	TIA-603	70dB @ 12.5/25KHz
	ETSI	70dB @ 12.5/25KHz
Inter-modulation	TIA-603	70dB @ 12.5/25KHz
	ETSI	65dB @ 12.5/25KHz
Hum & Noise		40dB @ 12.5KHz 45dB @ 25KHz
Rated Audio Power Output		0.4W
Rated Audio Distortion		<5%
Audio Response		+1 ~ -3dB
Conducted Spurious Emission		<-57dBm

PD35X/PD36X, X=2, 5,6 or 8, model number varies geographically. For details, please contact our regional sales representatives.

Transmitter	
RF Power Output	UHF High power: 3W UHF Low power: 1.5W
FM Modulation	11K0F3E @ 12.5KHz 16K0F3E @ 25KHz
4FSK Digital Modulation	12.5KHz Data Only: 7K60FXD 12.5KHz Data & Voice: 7K60FXW
Conducted/Radiated Emission	-36dBm <1GHz, -30dBm >1GHz
Modulation Limiting	±2.5KHz @ 12.5KHz ±5.0KHz @ 25KHz
FM Hum & Noise	40dB @ 12.5KHz 45dB @ 25KHz
Adjacent Channel Power	60dB @ 12.5KHz, 70dB @ 25KHz
Audio Response	+1 ~ -3dB
Audio Distortion	≤3%
Digital Vocoder Type	AMBE++ or SELP
Digital Protocol	ETSI-TS102 361-1,-2,-3
Environmental	
Operating Temperature	-30°C~ +60°C
Storage Temperature	-40°C~ +85°C
ESD	IEC 61000-4-2 (Level 4) ±8kV (Contact) ±15kV (Air)
Dustproof & Waterproof	IP54 Standard
Humidity	Per MIL-STD-810 C/D/E/F/G Standard
Shock & Vibration	Per MIL-STD-810 C/D/E/F/G Standard

* 430-470MHz, 446MHz, coming soon. 446MHz only CE certificated.

All specifications are subject to change without notice due to continuous development.