John Barraclough, G0SJB ◆ e-mail: G0SJBJohn@gmail.com

# GB7TD - A digital repeater

## West Yorkshire engages MotoTRBO technology

Michael, G1XCC and Mick, M0LEV with the new repeater. The cabinet also contains 23cm, 2m and 6m boxes.

**A GOOD THING?** Let's be honest. Repeaters are a bit like that well-known brand of yeast extract – you either love them or you avoid them. Repeaters get used, abused, forgotten, taken for granted but, above all, misunderstood. Sad but true. Because it's undoubtedly also true that many established amateurs were tempted into taking the licence through monitoring repeater nets in their SWL days, myself included.

Designed primarily for mobile users, repeaters also provide vital social connections for many of those who have an impairment or limited mobility, allowing them to contribute more to the hobby. Repeaters also have the capability to connect amateurs all over the world using quite basic equipment.

So, can we agree that, on balance, repeaters are 'a good thing'?

**LOOKING TO THE FUTURE.** You could be forgiven then, for believing that with FM the accepted primary mode and a growing digital D-Star network, we've taken repeaters about as far as they need to go. But that wasn't the view of a group in West Yorkshire. The Five Towns Repeater Group already had three active FM repeaters covering 23cm, 2m and 6m, co-sited in the shadow of Arqiva's Emley Moor transmitter tower. But when an opportunity presented itself to return 70cm to the portfolio – and to take them in a brand new direction – they grabbed it with open arms.

At 11.20am on Monday 24 June 2013, GB7TD, the UK's first DMR (Digital Mobile Radio) repeater, was switched on and with coverage and quality reports already exceeding all expectations, the number of regular users is set to grow rapidly. It uses Motorola's MotoTRBO technology and is connected to the DMR-MARC system, a network that already has close to two hundred internet linked DMR repeaters around the world and one that gets bigger by the week.

**HOW DMR WORKS.** The DMR system and its network differ from D-Star in a number of ways. DMR is based on an open standard, which means that encode/decode software is available licence-free and this has resulted in equipment being produced across a number of manufacturers.

First used for commercial applications in 2005, the system was designed from the outset to comply with tight emissions specifications set by the European Telecommunication Standards Institute (ETSI) and Federal Communications Commission (FCC). Consequently, equipment is of commercial quality, but competition and sheer numbers make new and used gear available relatively inexpensively.

DMR employs Time Division Multiple Access (TDMA) that enables two discrete 'Time Slots' – effectively two separate voice channels within one 12.5kHz frequency allocation – so two QSOs are possible simultaneously. Additionally, these slots are software routed to various 'Talk Groups' that allows the user to make an area or group specific call. Talk groups are also stored within the preset memories so no re-programming is required in order to set up a QSO. Just select the appropriate preset, make the call and all repeaters on the same talk group will key up, worldwide.

In order to access the system, users first need to register online with DMR-MARC, who will provide a seven figure ID that should be programmed into the transceiver. The ID includes a country specific identifier, which is used by the system to route a contact to the desired talk-group, produce a 'Last Heard' log of on-air users and to compile system data.

**THE GB7TD INSTALLATION.** Pretty much standard equipment for all DMR repeater installations is the Motorola DR3000 – standardisation aimed at maintaining optimum network compatibility. GB7TD has Tx/Rx on 439.1625MHz and 430.1625MHz respectively, feeding a custom manufactured end-fed dipole 10 metres above ground level. With the site at approximately 220 metres above sea-level, the combination gives excellent coverage throughout West Yorkshire. Add a mobile antenna – even a basic quarter wave – and, as you would anticipate, range increases dramatically with reports received as far away as Hull and North Yorkshire.

GB7TD's network connectivity is achieved via a 3G router. A fixed broadband connection was considered, but the first few weeks using 3G have proved how frugal the system is in terms of data. Projections are that even with a significantly higher number of users, only around 1GB will be required per month.

The energy behind both the repeater group and the GB7TD project is repeater keeper Michael Lockwood, G1XCC. Michael has been licensed for some twenty five years and is a true higher frequency and repeater enthusiast. He was quickly convinced that, in addition to its other advantages, the DMR system addressed some of the limitations that D-Star can present, especially for mobile operation.

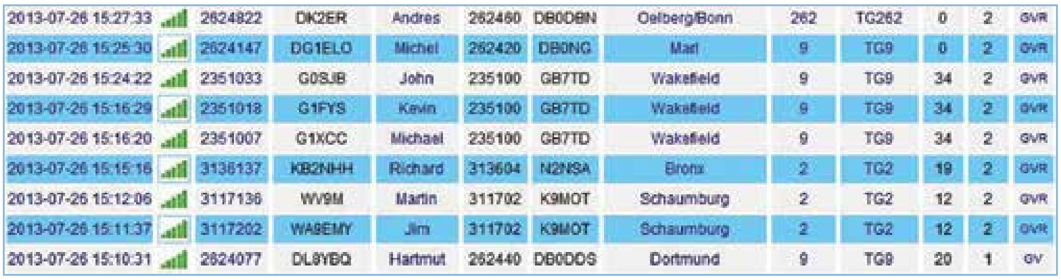
"We'd already looked at D-Star, which is great and connects thousands of amateurs around the world every day", he said, "but we decided that with a pre-requisite for digital technology and a focus on safe mobile use, a superior system was available, hence our decision to go with DMR.

"Setting up anything more than a local QSO from scratch on D-Star in a mobile situation is not easy. In contrast, the permanently linked network and preset nature of DMR equipment makes mobile use very simple and, more importantly, as safe as possible.

"The configuration is also more user friendly for those who may be less technically minded and is especially suited,

GB7TD Motorola DR3000 repeater.

GB7TD custom end fed dipole.



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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013-07-26 15:27:33 | 📶 | 2624822 | DK2ER | Andres | 262460 | DB0DBN | Oelberg/Bonn | 262 | TG262 | 0 | 2 | GVR |
| 2013-07-26 15:25:30 | 📶 | 2624147 | DG1ELO | Michel | 262420 | DB0NG | Marl | 9 | TG9 | 0 | 2 | GVR |
| 2013-07-26 15:24:22 | 📶 | 2351033 | G0SJB | John | 235100 | GB7TD | Wakefield | 9 | TG9 | 34 | 2 | GVR |
| 2013-07-26 15:16:29 | 📶 | 2351018 | G1FYS | Kevin | 235100 | GB7TD | Wakefield | 9 | TG9 | 34 | 2 | GVR |
| 2013-07-26 15:16:20 | 📶 | 2351007 | G1XCC | Michael | 235100 | GB7TD | Wakefield | 9 | TG9 | 34 | 2 | GVR |
| 2013-07-26 15:15:16 | 📶 | 3136137 | KB2NHH | Richard | 313604 | N2NSA | Bronx | 2 | TG2 | 19 | 2 | GVR |
| 2013-07-26 15:12:06 | 📶 | 3117136 | WV9M | Martin | 311702 | K9MOT | Schaumburg | 2 | TG2 | 12 | 2 | GVR |
| 2013-07-26 15:11:37 | 📶 | 3117202 | WA9EMY | Jim | 311702 | K9MOT | Schaumburg | 2 | TG2 | 12 | 2 | GVR |
| 2013-07-26 15:10:31 | 📶 | 2624077 | DL8YBQ | Hartmut | 262440 | DB0DDS | Dortmund | 9 | TG9 | 20 | 1 | GV |

DMR-MARC ‘Last Heard’ typical screen.

Motorola DM3600 mobile installation.

Typical handhelds; the DP4600, DP4400 and DP3600.

for example, to the visually impaired. Together with the commercial quality of the gear, the fantastic audio clarity and extended battery life on the HTs, we think we’ve found the perfect digital solution.”

Of course, professional opinion counts for a lot and the choice of digital system was made easier thanks to invaluable input from another of the group’s regulars. In common with many of those who set up and use the DMR network, Karl, G1YPQ, works with Motorola Solutions products and was able to share his knowledge and experience with the group. “I use all amateur modes, including D-Star and I work every day with Motorola equipment” he said, “given the brief for GB7TD, the MotoTRBO/DMR system was simply the best match – no question”.

### MotoTRBO/DMR features:

- Two virtual channels/ two simultaneous QSOs on one 12.5kHz repeater allocation
- Talk-groups/selective regional and area calls – local/UK/Europe/worldwide etc
- Extended range compared with FM and D-Star, including simplex
- Class leading audio
- Commercial quality equipment
- Simplicity of operation
- Reduced power consumption/extended battery life

Additional funding was provided by Mick, M0LEV who says his investment is already paying dividends. “I frequently spend time with my family forty odd miles away in East Yorkshire and I can access the system from there with just four watts on a handheld. I’m amazed by the coverage and the quality we’re getting. On top of that, battery life is brilliant – I recently went four days on one battery!”

Mike Swiatkowski, AA9VI, is an RF engineer based at Motorola HQ in Schaumburg, Illinois. He works on the design of MotoTRBO equipment and as a major contributor to the development of the DMR-MARC network, Mike provided invaluable input to GB7TD.

“The best thing about our network is that it was designed by specialists from within the industry who have a personal stake in its professionalism and decorum. There is literally a treasure-chest of expertise on the network daily whose success is self-evident to all network users. Many of the early DMR-MARC trustees had no idea that it would grow to what it is today. When compared to other technologies that require a minimum 10kHz guard band between voice channels, DMR is far more spectrum efficient. Its main benefits over earlier amateur radio modes are immunity to inter-modulation products and multipath loss of sync between the mobile and repeater, with excellent adjacent channel selectivity.”

“We’re excited that after growing the network for a few years, the UK has joined the USA, Canada, Australia, New Zealand and South Africa on our English language talk group.

## DMR EQUIPMENT.

In terms of transceiver choice, Motorola’s MotoTRBO range is currently the most popular, mainly down to its availability both new and pre-used. A basic handheld such as the DP3400 can cost as little as £120 or so, with accessories such as chargers, batteries, etc available affordably from specialist online traders and auction sites.

Most models can be programmed to include both digital and FM simplex and repeater channels, with similar equipment also made by Hytera, Tait and Vertex Standard for example. Additionally, Chinese manufacturer Kirisun currently has handheld and mobile models on beta test. It’s important to note however that because of the commercial origin of the equipment, transceivers have to be pre-programmed using, in Motorola’s case, their Customer Programming Software. Michael recommends sticking to a standard preset configuration for each radio model and standard files can be supplied for that purpose. As well as making programming easier and quicker, this minimises the potential for system incompatibility issues.

## DEVELOPING THE NETWORK IN THE UK.

The Five Towns group is hoping that West Yorkshire’s enthusiasm for DMR will spread and will demonstrate DMR at future rallies and events. If you see them at one, why not introduce yourself and give it a try? You might decide you like Marmite after all…

**THANKS.** The DMR community is always very willing to assist new projects, but G1XCC would particularly like to thank Mike Swiatkowski, AA9VI and Ralf Klingler, DR6RK who went out of their way to provide encouragement and technical advice throughout the GB7TD project.

WEBSEARCH

www.gb3yw.co.uk

www.dmr-marc.net

http://dmrassociation.org/the-dmr-standard/