

DMR OPERATING BASICS & BEST PRACTICES

KØNGA MIKE

ROCKY MOUNTAIN HAM RADIO



MIKE'S DMR DOCTRINE

DMR was created for commercial use.

It was never designed nor intended for Amateur Radio use.

Some things about DMR are not going to make sense.

Accept this. It will make your life easier.



WHAT IS DMR/TRBO?

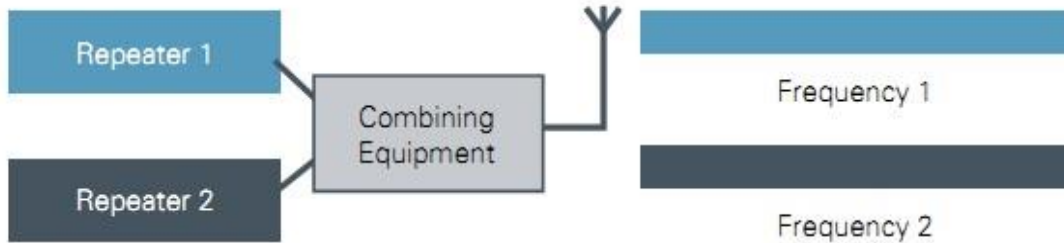
- DMR (Digital Mobile Radio) is an international commercial digital radio standard that originated in Europe
- TRBO refers to MotoTRBO which is Motorola's implementation of the DMR standard
- Many Amateur Radio repeater networks use MotoTRBO equipment, which is why they are commonly referred to as "TRBO" networks
- You do not need to use a Motorola MotoTRBO radio to use these networks



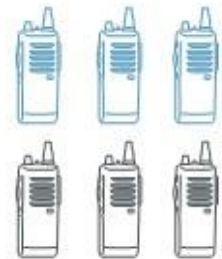
TWO REPEATERS IN ONE!

TDMA saves licensing and equipment costs by enabling the equivalent of two 6.25 kHz channels within a single licensed 12.5 kHz channel

Two-channel Analog or Digital FDMA System

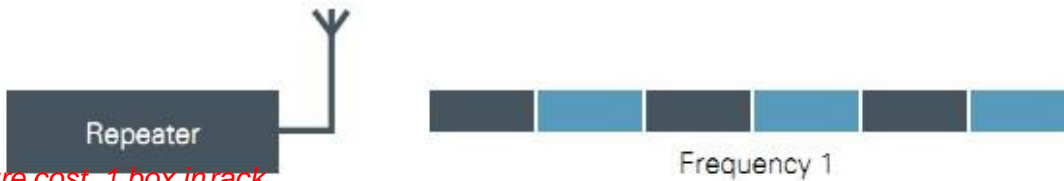


One call per repeater and channel



Radio Groups

Two-channel Digital TDMA System



Two calls per repeater and channel



Radio Groups

*Lower infrastructure cost, 1 box in rack
TWO voice channels from one repeater*



NEW CONCEPTS

- Frequency Pair – not new
- Color Code – Functions similar to a CTCSS or DCS access tone
- Repeater Slot – Each DMR Repeater has two, you must specify which one to use
- Talk Group – Each repeater slot can be logically segmented further into talk groups
- Receive Group – List of talk groups to monitor on the channel's assigned repeater slot



GET A RADIO

- You must have a Tier 2 DMR Radio (very common)
- You get what you pay for
 - Low cost radios on the market are not created equal
 - Ask around about user experience
 - Check the radio list at rmham.org
- Feature sets can vary widely among manufacturers
- Choice of radio is mainly a matter of what is important to you. I'm a contact list junkie.
- Recommendation: Get a radio that has sample codeplugs available, or is supported by the N0GSG utility.



GET A RADIO ID

- <https://www.radioid.net/> -> Register ID -> User Registration (at the bottom of the page)
- Everything works best when each radio has a unique ID
- Put your Radio ID in the codeplug and upload to the radio
- Radio ID is NOT a replacement for ID'ing. You must still ID vocally every 10 minutes per FCC regulations.



RADIO ID

The screenshot displays the 'Customer Programming Software - HAM2000 [Untitled.rdb] - [Setting]' window. The interface includes a menu bar (File, Edit, Program, Option, View, Tools, Window, Help) and a toolbar with icons for file operations. A left-hand navigation pane shows a tree structure for 'CS750' settings, including 'Radio Information', 'General Settings', 'Setting', 'Menu', 'Microphone/VOX', 'Buttons', 'One Touch Call', 'User Defined Tone', 'UI Indication', and 'Conventional'. The main area is divided into several sections: 'Basic', 'Scan', 'Channel Display Mode', 'Battery Save', 'TalkAround', and 'Power-On Screen'. The 'Radio ID' field in the 'Basic' section is highlighted with a red circle and contains the value '3108111'. Other settings include 'Radio Alias [P.O.M Line 1]' set to '-> KONGA Mike <-', 'Power On Message Line 2' set to 'HELLO HAMCON!', 'Unique Radio ID' set to '00', 'Squelch Normal Level' set to '3', 'Squelch Tight Level' set to '9', 'Radio Language' set to 'English', 'Monitor Type' set to 'Open Squelch', 'Tx Preamble Duration [ms]' set to '960', and 'Digital RX Voice Gain Level' set to '6'. The 'Scan' section has 'Analog Hang Time [ms]' and 'Digital Hang Time [ms]' both set to '500'. 'Channel Display Mode' has 'Auto Lock Keypad' unchecked and 'Auto Lock Delay Time [s]' set to '5'. 'Battery Save' has 'Save Preamble' and 'Save Mode Receive' both checked. 'TalkAround' has 'Group Call Hang Time [ms]' set to '3000' and 'Private Call Hang Time [ms]' set to '4000'. 'Power-On Screen' has 'Channel Display Mode' set to 'Alias', 'Power Up Designated Zone' set to 'Zone 1', and 'Designated Home Zone' set to 'Zone 1'. At the bottom, there are 'Close', 'Print', and 'Help' buttons. The status bar at the very bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and '2016-04-04 08:45:06'. A red circular logo is visible in the bottom right corner.

LEVERAGE THE SAMPLE CODEPLUGS

- Available on the RMHAM Website
 - www.rmham.org
 - MotoTRBO/DMR -> Sample Codeplugs
- All RMHAM TRBO repeaters programmed in
- Quickest way to get on the air
- Use as a foundation for your own codeplug
- Use as a starting point for the NOGSG utility



TALK GROUPS AND REPEATER SLOTS

- Each repeater has 2 repeater slots (time slots)
- Each slot can handle 1 conversation at a time. Thus, each repeater can handle 2 simultaneous separate conversations
- Some networks allow multiple talk groups on the same repeater slot
- Only one talk group can be transmitting at a time on a single repeater slot
- It may be necessary to monitor the other talk groups on a repeater slot to determine if the slot is free to operate on



ID YOUR TALK GROUP

- When calling, identify which talk group you are transmitting on.
- “This is K-0-N-G-A on Rocky Mountain”
- Many Hams scan various channels and may want or need to turn scan off and tune to your channel to respond.
- If you don’t ID the talk group, the responding ham may not know which channel to tune to.



REPEATER NETWORKS

One of these things is not like the other...



WHAT IS A REPEATER NETWORK

- A repeater network is comprised of two or more repeaters connected together in such a way that when one repeater receives a transmission, it is broadcast by the other connected repeaters.



KNOW YOUR NETWORK

- Network: A collection of repeaters linked together to achieve a larger area of coverage
- Three most well-known networks in Colorado:
 - Rocky Mountain Ham Radio (RMHAM)
 - DMR-MARC
 - Brandmeister
- Each network works a little differently in how the repeaters interact with each other
- Read up on each network's website
- Know the difference between static and dynamic (user-activated) talk groups



RMHAM DMR NETWORK

- Five Original Talk Groups: Rocky Mountain (wide), North, South, Denver, and Lookout Local
- Newer Talk Groups: Devilshead Local, Eastern (mostly VHF today)
- When contacting another ham, use the smallest coverage talk group possible
- If necessary, use Rocky Mountain to make contact, then move to a smaller coverage talk group if possible



TALK GROUP COURTESY

- Use the smallest area coverage talk group necessary for contact
- For example: In Denver, the smallest talk group coverage is “Lookout Local” or “Devilshead Local” (one repeater each)
- Use Rocky Mountain to initiate contact, then move to a “smaller” talk group if possible
 - This leaves Rocky Mountain open for other Hams to make contact

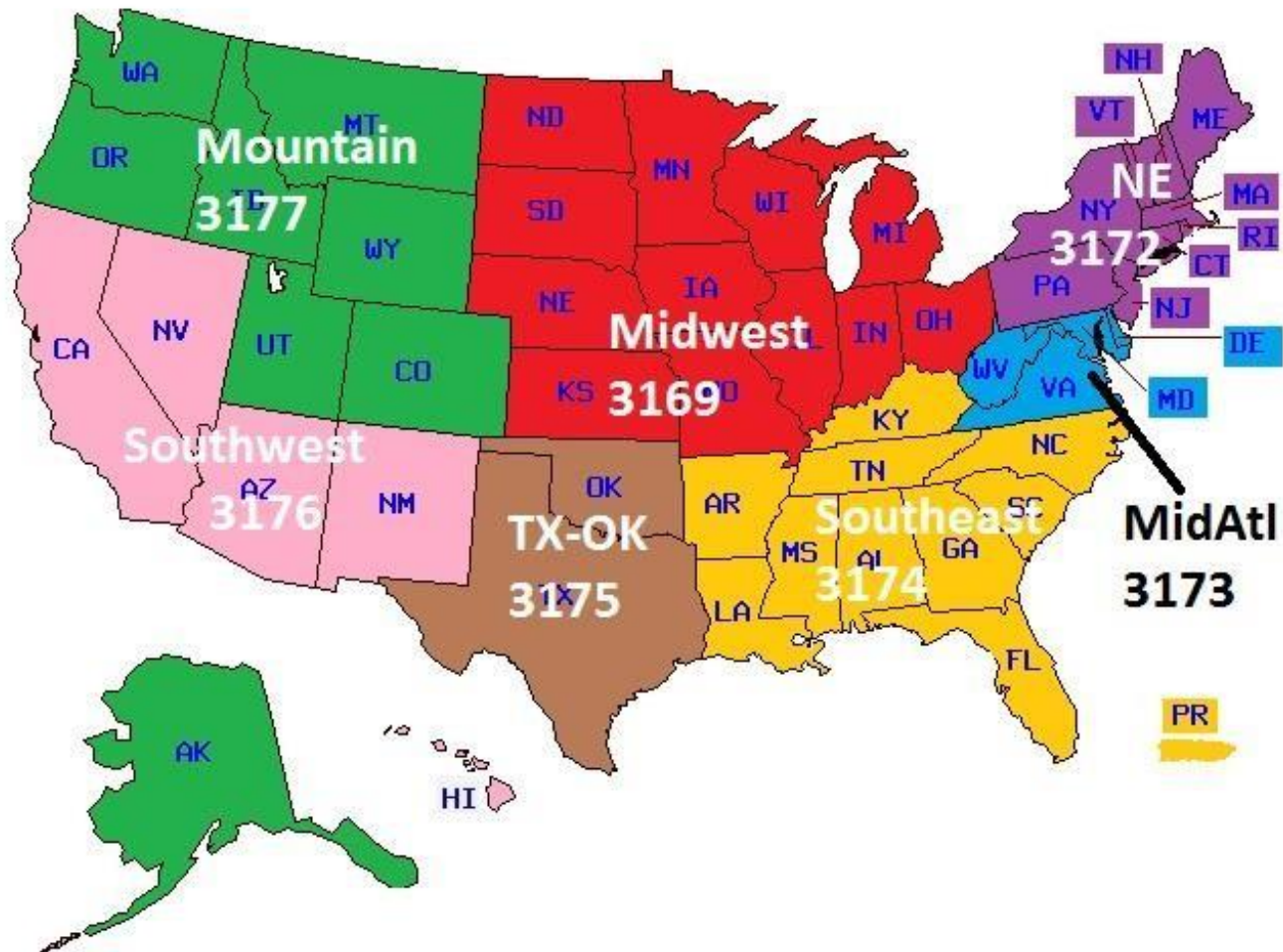


DMR-MARC

- World Wide, MANY talk groups
- Most Talk Groups are static
- World Wide, World Wide English, North America, Local, *US Regionals*
- Colorado is in the Mountain regional talk group
- Also has User Activated Talk Groups, sometimes called Tactical Talk Groups (e.g., TAC310), which are only active when you transmit on them.



DMR-MARC US REGIONAL TALK GROUPS



BRANDMEISTER

- World Wide, MANY talk groups
- All Talk Groups are dynamic; A Talk Group can be made static on a repeater by the repeater operator
- All Talk Groups (unless made static on a repeater) are user activated
- Remote users cannot activate a Talk Group on a remote repeater
- Desired Talk Group must be programmed into the radio channel (with
 - some advanced exceptions)



BRANDMEISTER

- Two ways to access the Brandmeister network:
 - Traditional Repeater
 - Brandmeister site has a map of all repeaters
 - Work mostly like any other DMR repeater
 - Hotspot
 - Different types available
 - Short-range, only practical for personal use
 - OpenSpot currently to most widely used



CHANNEL BASICS

“To experience true DMR freedom, you must learn to program your radio yourself.” -Me, constantly



BASIC PROGRAMMING CONCEPTS

- In order to program a DMR radio for repeaters, you must know:
 - Repeater frequencies
 - Repeater Color Code
 - Desired Talk Group/Receive Group
 - The Repeater Slot that Talk Group is on



CHANNEL EXAMPLE

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The main window shows the configuration for a Digital Channel (DCH 1). The left sidebar contains a tree view with categories like 'Radio Information', 'General Settings', 'Conventional', 'Zone', 'Channel', 'Analog Channel', 'Digital Channel', 'Scan', 'DMR Services', 'Emergency', 'Personality', 'DTMF Services', 'MDC Services', '2Tone Services', '5Tone Services', and 'Smart Call'. The 'Digital Channel' category is expanded, showing 'DCH 1' selected.

The main configuration area includes the following fields and settings:

- Channel Alias: DCH 1
- Digital ID: 1
- Color Code: 1 (highlighted with a red circle)
- Repeater/Time Slot: Slot 1 (highlighted with a red circle)
- Scan List: None
- Auto Scan Start:
- Rx Only:
- Talk Around:
- Lone Worker:
- VOX:
- Offset [MHz]: 0.000000
- Apply:
- Receive Frequency [MHz]: 400.000000 (highlighted with a red circle)
- Transmit Frequency [MHz]: 400.000000 (highlighted with a red circle)
- Ref Frequency [MHz]: Middle
- Rx Group List: None (highlighted with a red circle)
- Emergency Alarm Indication:
- Emergency Alarm Ack:
- Emergency Call Indication:
- Ref Frequency [MHz]: Middle
- Tx Contact: Contact1 (highlighted with a red circle)
- Emergency System: None
- Power Level: High

At the bottom of the window, there are buttons for 'Close', 'Print', and 'Help', along with a status bar showing '1 of 1' and navigation icons. The system tray at the very bottom indicates 'Ready', 'CS750', '400-470 MHz', 'USB', and the date/time '2016-04-04 09:41:07'.



COLOR CODE

- DMR repeaters use a Color Code as the first access point after the receive frequency
- Color Codes are designed to allow two repeaters with the same frequency to operate effectively if they are relatively close to each other
- You must know the Color Code of the repeater in order to successfully use the repeater



CONTACT LIST

- DMR radios use a Contact List for:
 - Private Call (used for Radio IDs)
 - Talk Groups (required for most repeaters)
 - All Call (often used for simplex)
- Radios with displays will show the Radio ID of person who is transmitting
- If you have the Radio ID in your radio's Contact List, the contact name or tag will display instead of the Radio ID
- Typical contact names include call sign and name



TALK GROUPS

- Access Control (analogous to tones on analog radios) is accomplished with Talk Groups
- If a repeater uses Talk Groups, you must know which Talk Groups the repeater uses in order to use the repeater with your radio
- Talk Groups are assigned to a Repeater Slot in a repeater
- More than one Talk Group can be assigned to a single Repeater Slot, but only one Talk Group can use the slot at any given time



CONTACT LIST EXAMPLE

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The window title is 'Customer Programming Software - HAM2000 [C:\Users\michael\CloudStation\RMHAM\Connect Systems\RMHAM_CS750_SampleCodeplug_2016-03-31_Ne...'. The menu bar includes 'File', 'Edit', 'Program', 'Option', 'View', 'Tools', 'Window', and 'Help'. The toolbar contains icons for file operations and help. The main window is titled 'Contact' and features a tree view on the left and a table on the right.

The tree view on the left shows the following structure:

- CS750
 - Radio Information
 - General Settings
 - Conventional
 - Zone
 - Channel
 - Scan
 - DMR Services
 - Text Message
 - Contact
 - Rx Group List
 - Encrypt
 - Emergency
 - Personality
 - DTMF Services
 - MDC Services
 - 2Tone Services
 - 5Tone Services
 - Smart Call

The table on the right displays the contact list with the following columns: No., Contact Name, Call Type, Call Id, and Receive Tone.

No.	Contact Name	Call Type	Call Id	Receive Tone
1	DMR MARC WW	Group Call	1	No
2	DMR MARC LCL	Group Call	2	No
3	DMR MARC NA	Group Call	3	No
4	DMR MARC WW Eng	Group Call	13	No
5	DMR MARC Simplex	Group Call	99	No
6	Rocky Mountain	Group Call	700	No
7	Lookout Local	Group Call	710	No
8	South	Group Call	719	No
9	Denver	Group Call	720	No
10	North	Group Call	721	No
11	NoCo Net	Group Call	3171	No
12	DMR MARC MTN	Group Call	3177	No
13	NR2Y Marinus	Private Call	3108001	No
14	WA2YZT Paul	Private Call	3108002	No
15	K0JSC Jeff	Private Call	3108003	No
16	N2PDQ Dirk	Private Call	3108004	No
17	KF0KR Thomas	Private Call	3108005	No
18	N0GQX Gerald	Private Call	3108006	No
19	N0VBY Mike	Private Call	3108007	No

At the bottom of the table area, there are buttons for 'Add', 'Insert', 'Delete', 'Sort By Name', and 'Sort By Id'. Below the table, there are 'Close', 'Print', and 'Help' buttons.

The status bar at the bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and '2016-04-04 09:49:01'.



RECEIVE GROUPS

- Receive Groups are how DMR radios use Talk Groups when receiving signals
- Talk Groups are assigned to Receive Groups. Receive Groups are assigned to the receive frequency on the channel in your radio.
- More than one Talk Group can be assigned to a Receive Group
 - Recommended config by DMR-MARC
 - Can cause confusion when scanning
- Remember Mike's DMR Doctrine



REPEATER SLOTS

- DMR repeaters have 2 “time slots” that share a frequency, allowing for two separate, simultaneous conversations
- This means one repeater can do the work of two while using less bandwidth than a single analog repeater
- You must know which Repeater Slot you wish to use in order to set up your radio (more on this later)



EXAMPLE CHANNELS

Channel	Color Code	Time Slot	Receive Frequency	Transmit Frequency	Talk Group
Squaw Rky Mtn	7	Slot 1	446.9375	441.9375	Rocky Mountain
Squaw Central	7	Slot 2	446.9375	441.9375	Central DMR MARC
Lee Hill WW	1	Slot 1	445.05	440.05	WW DMR MARC
Lee Hill WW Eng	1	Slot 1	445.05	440.05	WW Eng DMR MARC
Lee Hill NA	1	Slot 1	445.05	440.05	NA DMR MARC
Lee Hill LCL	1	Slot 2	445.05	440.05	LCL DMR MARC
Lee Hill MTN	1	Slot 2	445.05	440.05	MTN



EXAMPLE CHANNEL - RMHAM

The screenshot displays the 'Customer Programming Software - HAM2000' interface. The window title is 'Customer Programming Software - HAM2000 [C:\Users\michael\CloudStation\RMHAM\Connect Systems\RMHAM_CS750_SampleCodeplug_2016-03-31_Ne...'. The menu bar includes File, Edit, Program, Option, View, Tools, Window, and Help. The toolbar contains icons for file operations and help. The main window is titled 'Contact | DMR MARC WW | Thorodin Rk Mtn'. On the left, a list of contacts is shown, with 'Thorodin Rk Mtn' selected. The right pane shows configuration settings for this contact:

- Digital ID: 12345
- Color Code: 7
- Repeater/Time Slot: Slot 1
- Scan List: TRBO Denver
- Auto Scan Start:
- Rx Only:
- Talk Around:
- Lone Worker:
- VOX:

Receive and Transmit sections:

- Receive Frequency [MHz]: 446.800000
- Offset [MHz]: 0.000000
- Transmit Frequency [MHz]: 441.800000
- Ref Frequency [MHz]: Middle
- Rx Group List: Rocky Mountain
- Emergency Alarm Indication:
- Emergency Alarm Ack:
- Emergency Call Indication:
- Encrypt:
- Transmit Ref Frequency [MHz]: Middle
- Tx Contact: Rocky Mountain
- Emergency System: None
- Power Level: High
- Tx Admit: Color Code Free
- Tx Time-Out Time [s]: Infinite

At the bottom, there are buttons for Close, Print, and Help, along with a status bar showing '29 of 69' and navigation icons. The system tray at the very bottom shows 'Ready', 'CS750', '400-470 MHz', 'USB', and the date/time '2016-04-04 09:53:56'.



ZONES

- Channels are assigned to Zones
- Only one (1) Zone can be in use at a time
- On HTs, corresponds with channel selection dial
- Radios can have numerous zones
- Channels can be a member of more than one Zone



QUESTIONS?



STUFF AND THINGS

- RMHAM Website – <http://www.rmham.org>
- Interactive DMR repeater map: <http://bit.ly/rmham-trbo-map>
- Radio ID – <https://www.radioid.net/>
- DMR-MARC Website – <http://www.dmr-marc.net>
- Brandmeister
- Dashboard: <https://brandmeister.network/>
- Audio Feeds: <http://hose.brandmeister.network/>
- Wiki: <https://wiki.brandmeister.network>
- Contact Me: KONGA@arrl.net



DMR NETS

- **RMHAM TRBO Tech Net**
 - First Saturday of the Month, 7:00 PM, Rocky Mountain talk group
- **World Wide DMR-MARC Net**
 - World Wide talk group, Saturdays, 16:00 UTC Summer, 17:00 UTC Winter
- **DMR-MARC Tech Net**
 - North America talk group, Thursdays, 01:00 UTC Summer, 02:00 UTC Winter (This translates to Wednesday Night in the States)

