



DMR Radio Mode Switch
Application Notes



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Documentation Information

This section describes the conventions and revision history of this document.

Documentation Conventions

Icons

Icon	Description
 Tip	Indicates information that can help you make better use of your product.
 Note	Indicates references that can further describe the related topics.
 Caution	Indicates situations that could cause data loss or equipment damage.
 Warning	Indicates situations that could cause minor personal injury.
 Danger	Indicates situations that could cause major personal injury or even death.

Notations

Item	Description
“ ”	The quotation marks enclose the name of a software interface element. For example, click “OK”.
Bold	The text in boldface denotes the name of a hardware button. For example, press the PTT key.
->	The symbol directs you to access a multi-level menu. For example, to select “New” from the “File” menu, we will describe it as follows: File -> New.

Revision History

Version	Date	Description
R2.0	09-2018	<ul style="list-style-type: none"> ● Modified document name as <i>DMR Radio_Mode Switch_Application Notes</i>. ● Added descriptions on manual switch in section 1.1 Introduction, 1.3 Principle, 3.2 Radio Configuration and 4 Application Example. ● Added descriptions on channel signaling detection during mode switching. ● Deleted descriptions on radio restart during mode switching.
R1.0	12-2015	Initial release.

1. Overview

1.1 Introduction

DMR radio can operate in conventional/XPT mode, DMR trunking mode or MPT trunking mode. With Mode Switch feature, users can flexibly select the mode to meet communication requirements in different scenarios.

The Mode Switch includes Automatic Switch and Manual Switch.

1.1.1 Automatic Switch

With Mode Automatic Switch enabled, the radio can automatically switch from DMR trunking mode to conventional mode or MPT trunking mode when the signal of DMR Trunking System cannot be received or is weak, to ensure uninterrupted communication with other radios. But only when the MPT Trunking System meets the Mode Automatic Switch requirements, including the signal strength is higher or equal to Trunking Mode Automatic Switch Threshold and channel signalling is correct, can the radio switch to MPT Trunking mode.

When the radio detects signal of the DMR trunking system is higher or equal to Trunking Mode Automatic Switch Threshold and channel signalling is correct:

- The radio in conventional mode switches the mode according to roaming settings.
 - If conventional system does not support roaming, the radio switches back to DMR trunking mode automatically and unconditionally.
 - If conventional system supports roaming, and signal strength satisfies the communication requirements, the radio will not switch back to DMR trunking mode. Only when signal strength cannot satisfy the communication requirements, the radio can switch back to DMR trunking mode automatically.
- The radio in MPT trunking mode switches the mode according to Priority Operation Mode.
 - If Priority Operation Mode is set to DMR trunking system, the radio switches back to DMR trunking mode automatically.
 - If Priority Operation Mode is set to None, and signal strength satisfies the communication requirements, the radio will not switch back to DMR trunking mode automatically. Only when signal strength cannot satisfy the communication requirements, the radio can switch back to DMR trunking mode automatically.

1.1.2 Manual Switch

Users can switch the operation mode through radio menu, Group/Channel Knob, programmable key or One Touch Call/Menu.

1.2 Application Scenario

In the actual application, the scenario of mixing Conventional System and DMR Trunking System or mixing MPT

Trunking System and DMR Trunking System often appears.

In areas beyond the coverage of DMR trunking system or when the signal is weak, the radio working in DMR Trunking mode can automatically switch to Conventional mode or MPT Trunking mode with Mode Automatic Switch feature, to ensure a continuous communication.



Note:

Mode Automatic Switch feature is only available for the radio that supports multiple working modes.

1.3 Principle

1.3.1 Automatic Switch

The principle of Automatic Switch varies with the working mode combination of the radio.

DMR Trunking + MPT Trunking

The radio switches between MPT trunking mode and DMR trunking mode.

When Priority Operation Mode is set to None:

1. If the radio in DMR trunking mode (or MPT Trunking mode) cannot receive the signal from the base station or the signal is weak, the radio starts to hunt channels which can be used to register, and calculate the Trunking Mode Switch Detect Time.
2. If the radio in DMR Trunking mode (or MPT Trunking mode) still cannot register successfully after a whole hunting, and the Trunking Mode Switch Detect Time is expired, it starts to hunt MPT trunking (or DMR trunking) channels.
3. If the MPT trunking (or DMR trunking) channel satisfies Mode Automatic Switch and the channel signalling is correct, the radio switches to MPT trunking mode (or DMR trunking mode) automatically, and continues to hunt channels which can be used to register.

When Priority Operation Mode is set to DMR Trunking mode, if the radio switches from DMR trunking mode to MPT trunking mode, the process is the same as above. If the radio switches from MPT trunking mode to DMR trunking mode, the process is slightly different.

1. The radio in MPT trunking mode regularly detects the DMR trunking signal.
2. If the radio detects DMR trunking signal satisfies the Mode Automatic Switch, it switches to DMR trunking mode no matter whether MPT trunking system can satisfy the communication requirements or not.

Conventional + DMR Trunking

The radio switches between conventional mode and DMR trunking mode.

- Switching from conventional mode to DMR trunking mode: The requirements depends on roaming settings in the conventional system.
 - Roaming is supported (e.g. in IP Multi-site Connect system): If the radio cannot receive the signal from the main site, detects DMR trunking channel signaling is correct and DMR trunking channel satisfies Mode Automatic Switch, the radio switches to DMR trunking mode automatically.
 - Roaming is not supported: The radio works in DMR trunking mode in priority. If it detects DMR channel signaling is correct and DMR trunking channel satisfies Mode Automatic Switch during hunting, the radio switches to DMR trunking mode automatically.
- Switching from DMR trunking mode to conventional mode: If the radio cannot register to the DMR trunking system after hunting, and Trunking Mode Switch Detect Time is expired, the radio switches to conventional mode automatically.

1.3.2 Manual Switch

Users can manually switch the mode by the following methods.

Radio Menu

- Manual Switch and Auto Switch menus
 - Manual Switch: Select the available modes.
 - Auto Switch: Enable Mode Automatic Switch. The radio switches the mode according to [1.3.1 Automatic Switch](#).

- Zone/Subgroup menu

When Zone/Subgroup Switch Mode is enabled, the Zone menu (conventional/XPT mode) and the Subgroup menu (DMR trunking mode) display as Zone/Subgroup menu. The Zone/Subgroup menu includes all information of the two menus.

- In DMR trunking mode, select any conventional/XPT channel in Zone/Subgroup menu to switch to conventional/XPT mode.
- In conventional/XPT mode, select any DMR trunking subgroup member in Zone/Subgroup menu to switch to DMR trunking mode.

Programmable Key

- Mode Auto Switch: Enable Mode Automatic Switch. The radio switches the mode according to [1.3.1 Automatic Switch](#).
- Operation Mode Switch: The radio switches the mode in the order of “conventional/XPT mode – DMR trunking mode – MPT trunking mode”.
- Operation Mode Shortcut: The radio accesses Manual Switch menu.

- Channel Up/Down (conventional/XPT mode) and Group/Private Up/Down (DMR trunking mode): Press this key in DMR trunking subgroup that includes conventional/XPT channels to switch between conventional/XPT mode and DMR trunking mode. See [Step 4](#) in section [3.2.2 Manual Switch](#) for configurations
- Zone Up/Down (conventional/XPT mode) and Subgroup Up/Down (DMR trunking mode): When Zone/Subgroup Switch Mode is enabled, the Zone menu (conventional/XPT mode) and the Subgroup menu (DMR trunking mode) display as Zone/Subgroup menu. The Zone/Subgroup menu includes all information of the two menus.
 - In DMR trunking mode, press Subgroup Up or Subgroup Down key to select any zone to switch to conventional/XPT mode.
 - In conventional/XPT mode, press Zone Up or Zone Down key to select any subgroup to switch to DMR trunking mode.

One Touch Call/Menu

Enable Operation Mode Switch. The radio switches the mode in the order of “conventional/XPT mode – DMR trunking mode – MPT trunking mode”.

Channel/Group Knob

Rotate the Channel/Group Knob to switch between conventional/XPT mode and DMR trunking mode. Before switching mode, you need to add conventional/XPT channels to DMR trunking subgroup. See [Step 4](#) in section [3.2.2 Manual Switch](#) for configurations.

GPIO Pins

The DMR trunking mobile radio can switch the mode through GPIO Pin 3, 12, 16, 20, 22 or 23. When the radio detects an active level at the GPIO pin, it enables Operation Mode Switch and switches the mode in the order of “conventional/XPT mode – DMR trunking mode – MPT trunking mode”. See [Step 5](#) in section [3.2.2 Manual Switch](#) for configurations.

1.4 Version

- R9.0: Zone/Subgroup Switch Mode feature is added. The radio will not restart during mode switching.
- R7.6: Mode Automatic Switch feature between Conventional/Digital Trunking mode is added.
- R6.5: Mode Switch Result Backup feature is added.
- R6.0: Initial release of Mode Automatic Switch feature between MPT Trunking mode and Digital Trunking mode.

The list above is only the main modifications about the Mode Automatic Switch feature in each version. For more details, please refer to corresponding Release Notes.

1.5 Restriction

- The radio which has been stunned or killed cannot use Mode Automatic Switch feature.
- If the radio supports switching to Conventional mode, please configure the power-on channel for the radio.
- Mode Automatic Switch feature is not supported by XPT mode. If the power-on channel of the Conventional mode is set to XPT channel, the radio cannot switch back after switching from Trunking mode to Conventional mode. Thus, if you want to enable the Mode Automatic Switch feature, please do not set the XPT channel as the power-on channel of the Conventional mode.

2. Device Requirements

DMR series radio such as PD98X, PD78X, MD78X.

Refer to the DMR Series Radio List provided by Hytera for details, and consult your dealer for specific models.

3. Configuration

3.1 Configuration Tools

Customer Programming Software (CPS): V9.00.07.015 or later.

3.2 Radio Configuration

CPS interface is slightly different when the radio supports different modes. This section takes the trunking radio that supports DMR Trunking mode, Conventional mode and MPT Trunking mode as the example.

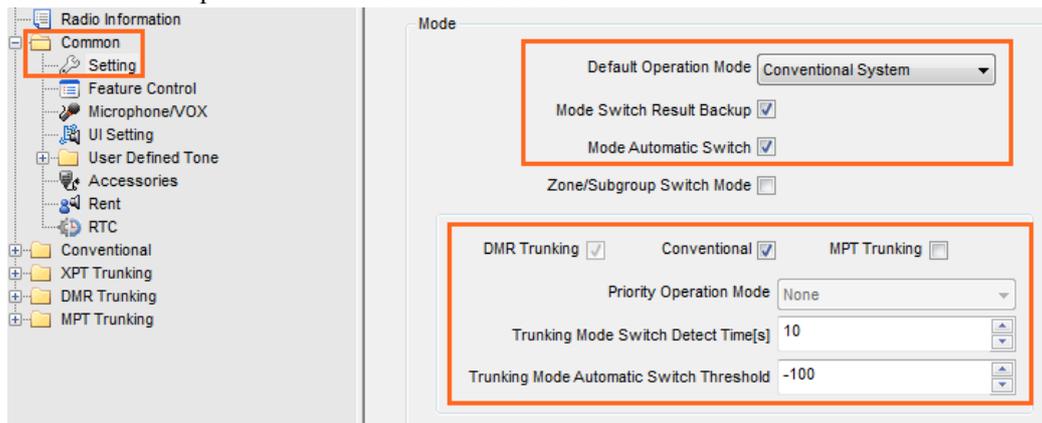
3.2.1 Automatic Switch

Step 1 Configure the communication parameters such as RX frequency and TX frequency.

Step 2 Enable Mode Automatic Switch feature, and configure related parameters.

CPS Path: Common -> Setting -> Mode.

Parameters: See parameters in the red box below.



- **Default Operation Mode:** Sets the default operation mode in which the radio will work when powered on.
If the radio supports two or more operation modes, make sure that one of them is set to be the default operation mode.
- **Mode Switch Result Backup:** Sets whether the radio will back up the changed operation mode.
The radio works in default mode upon power-on. When this feature is enabled, the radio works in the saved mode upon next power-on, otherwise it keeps working in default mode.
- **Mode Automatic Switch:** With this feature enabled, the radio switches the mode automatically when signal strength of the current mode is weak or there is no signal, and another mode satisfies the switching requirements.
- **Conventional:** Sets whether the radio can switch to Conventional mode.

If this parameter is checked, the radio switches between DMR Trunking mode and Conventional mode. Conventional and MPT Trunking cannot be checked or unchecked at the same time.

This parameter is valid only when the radio supports Conventional mode.

- MPT Trunking: Sets whether the radio can switch to MPT Trunking mode.

If this parameter is checked, the radio switches between DMR Trunking mode and MPT Trunking mode.

This parameter is valid only when the radio supports MPT Trunking mode.

- Priority Operation Mode: Sets the priority of trunking mode in which the radio works.

This parameter works only when the radio switches between DMR Trunking mode and MPT Trunking mode. Currently only DMR Trunking mode can be set as the priority operation mode.

Suppose the radio supports mode A and mode B, and mode B is the priority mode. When the radio works in mode A, if it detects signal of mode B satisfies mode automatic switching requirements, the radio switches to mode B automatically.

- Trunking Mode Switch Detect Time: Sets the channel hunting time period when the Trunking Mode Automatic Switch feature is enabled.

When the radio works in MPT Trunking System, DMR Trunking System or Conventional Roaming System, if the hunting time exceeds this time period and another operation mode satisfies the Mode Automatic Switch requirements, the radio will switch to this operation mode automatically.

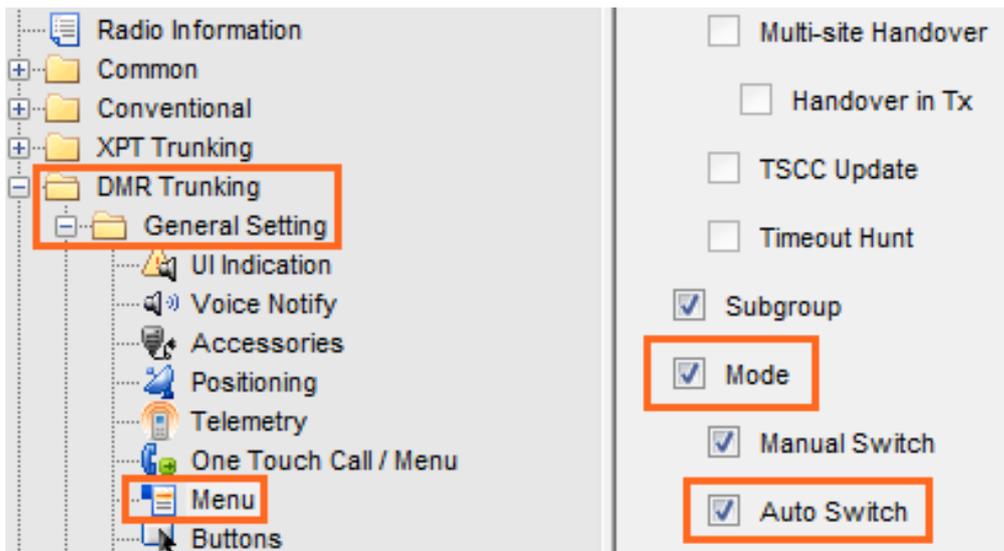
- Trunking Mode Automatic Switch Threshold: Sets the threshold for automatic mode switch in trunking mode.

When the signal strength of another mode is higher than or equal to this threshold, the radio will switch to another mode automatically. For example, when the signal strength of DMR Trunking is greater than this threshold, the radio will switch to DMR Trunking mode.

Step 3 Configure Auto Switch menu if you want to enable or disable Mode Automatic Switch via radio menu.

CPS Path: DMR Trunking -> General Setting -> Menu -> Mode.

Parameters: Mode and Auto Switch.



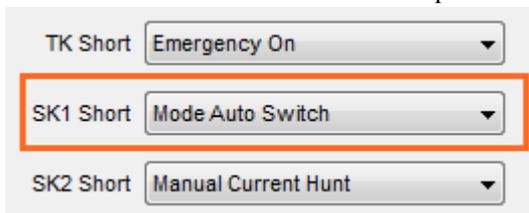
Note

CPS path for conventional and MPT trunking modes is General Setting -> Menu -> Mode. The Auto Switch menu in conventional and MPT trunking modes cannot be checked at the same time.

Step 4 (Optional) Configure Mode Auto Switch programmable key if you want to enable or disable Mode Automatic Switch through this key.

CPS Path: DMR Trunking -> General Setting -> Buttons.

Parameters: Mode Auto Switch. Take SK1 Short as an example.



Note

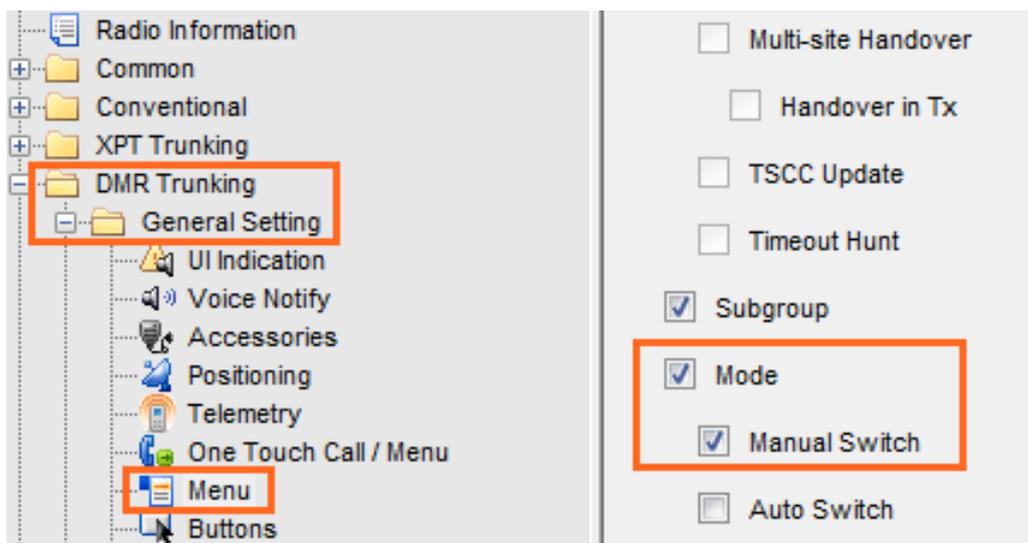
CPS path for conventional and MPT trunking modes is General Setting -> Buttons.

3.2.2 Manual Switch

Step 1 Configure Manual Switch menu if you want to switch the mode via radio menu.

CPS Path: DMR Trunking -> General Setting -> Menu -> Mode.

Parameters: Mode and Manual Switch.

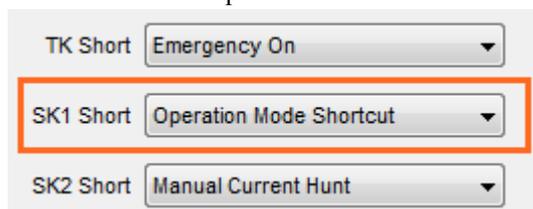


Note
CPS path for conventional/XPT and MPT trunking modes is General Setting -> Menu -> Mode.

Step 2 Configure Operation Mode Switch or Operation Mode Shortcut programmable key if you want to switch the mode through this key.

CPS Path: DMR Trunking -> General Setting -> Buttons.

Parameters: Operation Mode Switch or Operation Mode Shortcut. Take SK1 Short as an example.



Note
CPS path for conventional/XPT and MPT trunking modes is General Setting -> Buttons.

Step 3 Configure Operation Mode Switch in Menu/Feature List if you want to switch the mode through One Touch Call/Menu.

CPS Path: DMR Trunking -> General Setting -> One Touch Call/Menu.

Parameters: Operation Mode Switch. Take Numeric Key 1 as an example.



- The Menu/ Feature List is configurable only when Type is set as Menu/Feature.
- CPS path for conventional/XPT mode is General Setting -> One Touch Call/Menu.

- CPS path for MPT trunking mode is General Setting -> One Touch Call/Feature.

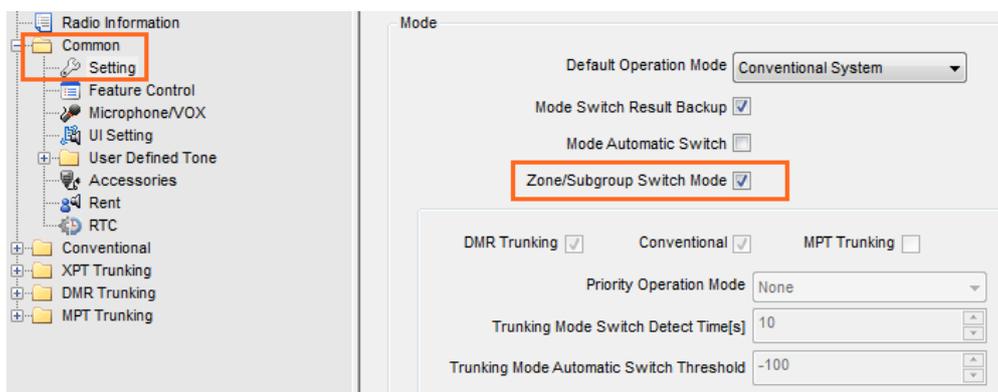
Step 4 Configure the following parameters if you want to switch the mode through Channel/Group Knob.

1. Enable Zone/Subgroup Switch Mode.

When this feature is enabled, the Zone menu (conventional/XPT mode) and the Subgroup menu (DMR trunking mode) display as Zone/Subgroup menu. The Zone/Subgroup menu includes all information of the two menus.

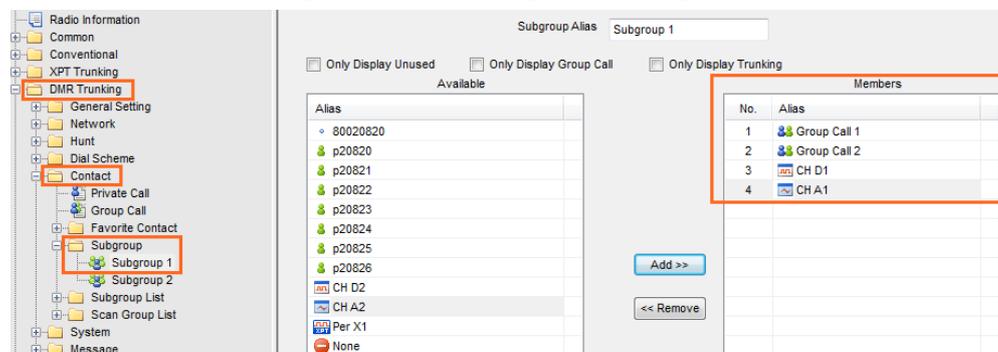
CPS Path: Common -> Setting -> Mode.

Parameters: Zone/Subgroup Switch Mode.



2. Add the conventional/XPT channels to the DMR trunking subgroup.

CPS Path: DMR Trunking -> Contact -> Subgroup -> Subgroup N.

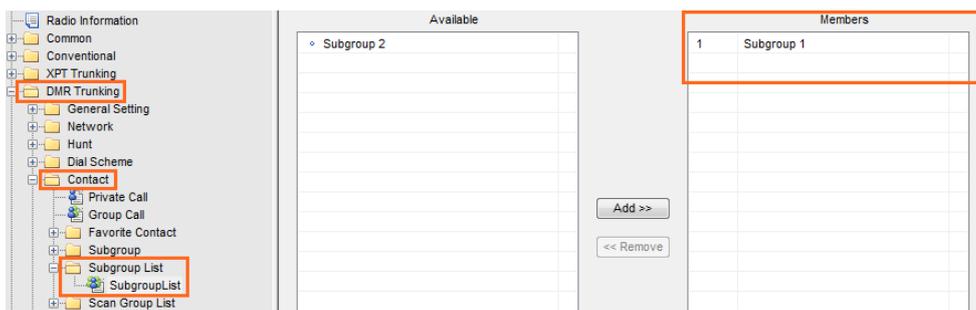


Note

- The conventional/XPT channels are not be available if Only Display Group Call or Only Display Trunking is checked.
- The conventional/XPT channels and subgroup members are used to switch mode only. Users call them via PTT.

3. Add the DMR trunking subgroup that includes conventional/XPT channels to Subgroup List.

CPS Path: DMR Trunking -> Contact -> Subgroup List.



- (Optional) Configure Channel Up/Down (Conventional/XPT Mode) and Group/Private Up/Down (DMR Trunking Mode), and Zone Up/Down (Conventional/XPT Mode) and Subgroup Up/Down (DMR Trunking Mode) if you want to switch the mode through this key.

CPS Path: DMR Trunking -> General Setting -> Buttons.

Parameters: Channel Up/Down and Group/Private Up/Down, or Zone Up/Down and Subgroup Up/Down. Take Group/Private Up and Group/Private Down in DMR trunking mode as an example.



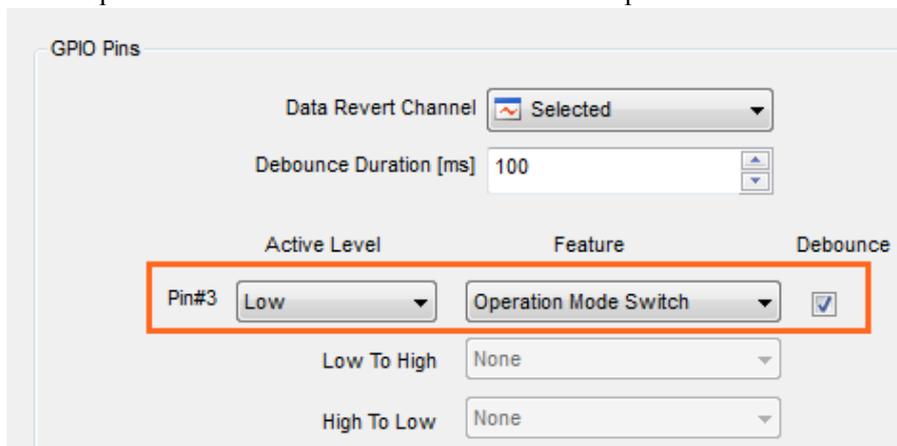
Note

- > CPS path for conventional/XPT mode is General Setting -> Buttons.
- > It is suggested to configure the same programmable keys in different modes.

- Step 5** Configure Operation Mode Switch to GPIO Pins feature if you want to switch the mode through GPIO pin of DMR trunking mobile radio.

CPS Path: DMR Trunking -> General Setting -> Accessories -> GPIO Pins.

Parameters: Operation Mode Switch. Take Pin#3 as an example.



Note

- > CPS path for conventional/XPT and MPT trunking modes is General Setting -> Accessories ->

GPIO Pin.

- It is suggested to configure the same GPIO Pin in different modes.

4. Application Example

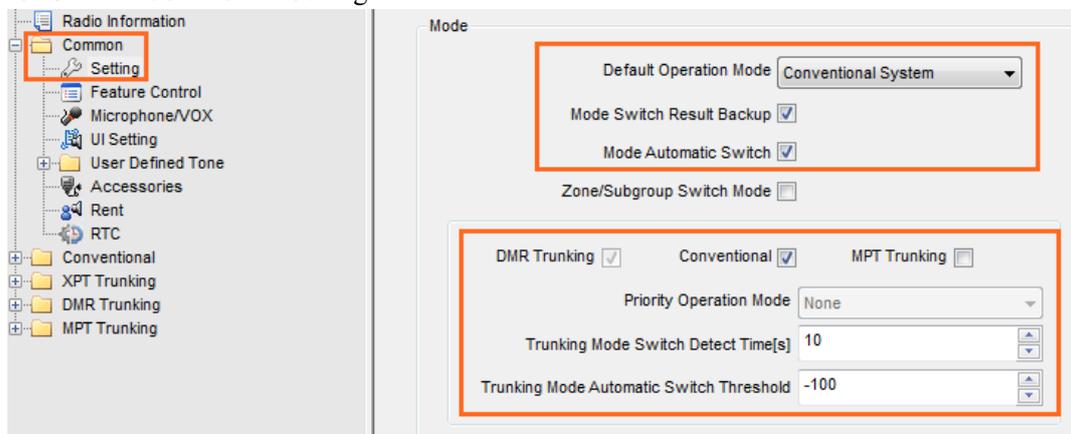
We take setting DMR Trunking System to be the default operation mode as an example, the configurations are as follows.

4.1.1 Automatic Switch

Step 1 Configure the communication parameters such as RX frequency and TX frequency.

Step 2 Configure Mode Automatic Switch feature.

CPS Path: Common -> Setting



Configuration results are as follows:

- Default Operation Mode: DMR Trunking System
- Mode Switch Result Backup: Checked
- Mode Automatic Switch: Checked
- Conventional: Checked
- Priority Operation Mode: None
- Trunking Mode Switch Detect Time: Keep the default value
- Trunking Mode Automatic Switch Threshold: Keep the default value

Step 3 Move the radio into the coverage of the DMR Trunking System, the Trunking Mode will be used then.

Step 4 Move the radio out of the coverage of the DMR trunking system and enters into the coverage of conventional system.

When the radio successfully switches to conventional mode automatically, DM appears on the screen. Shielding the signal can achieve the same effect as moving the radio.

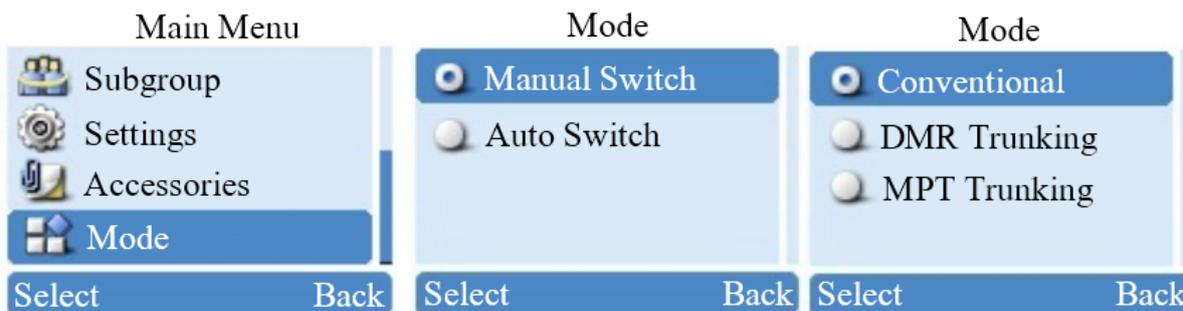
Step 5 Move the radio into the coverage of the DMR Trunking System.

The radio switches to DMR Trunking mode automatically if the DMR trunking channel signaling and signal strength satisfy the requirements. The switch is successful when TM appears on the screen.

4.1.2 Manual Switch

Radio Menu

Configure Manual Switch menu (Step 1 in section 3.2.2 Manual Switch) to switch the mode via radio menu. The menu path is Menu -> Mode -> Manual Switch.



Programmable Key

Associate Operation Mode Switch or Operation Mode Shortcut with SK1 Short (Step 2 in section 3.2.2 Manual Switch).

- Operation Mode Switch: Short press SK1 to switch the mode in the order of “conventional/XPT mode – DMR trunking mode – MPT trunking mode”.
- Operation Mode Shortcut: Short press SK1 to access Manual Switch menu.

One Touch Call/Menu

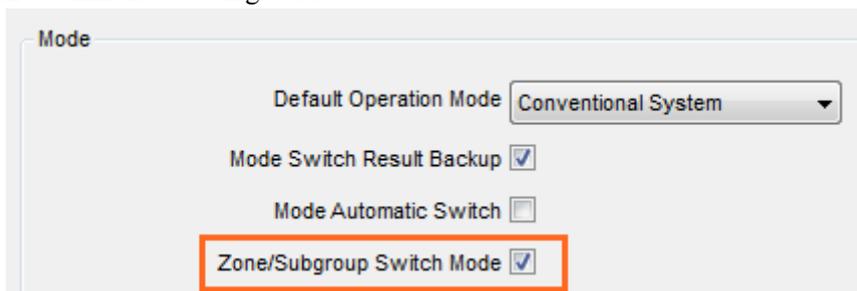
Associate Operation Mode Switch with Numeric Key 1 (Step 3 in section 3.2.2 Manual Switch).

Press Numeric Key 1 to switch the mode in the order of “conventional/XPT mode – DMR trunking mode – MPT trunking mode”.

Channel/Group Knob

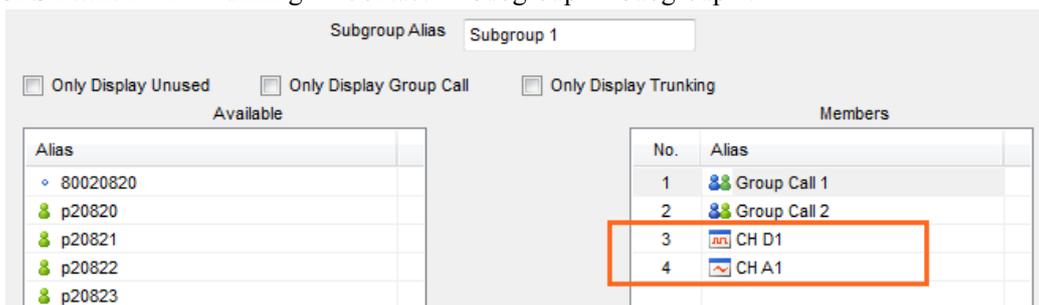
Step 1 Enable Zone/Subgroup Switch Mode.

CPS Path: Common -> Setting -> Mode.



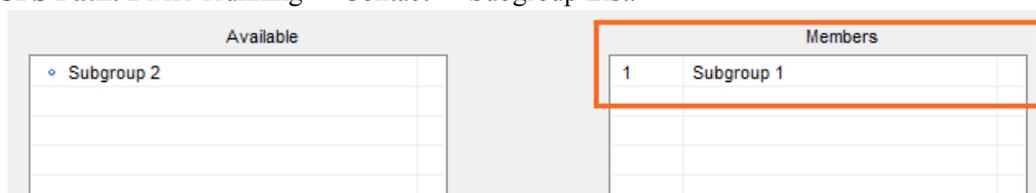
Step 2 Add CH D1 and CH A1 to the DMR trunking subgroup 1.

CPS Path: DMR Trunking -> Contact -> Subgroup -> Subgroup 1.



Step 3 Add subgroup 1 to the Subgroup List.

CPS Path: DMR Trunking -> Contact -> Subgroup List.

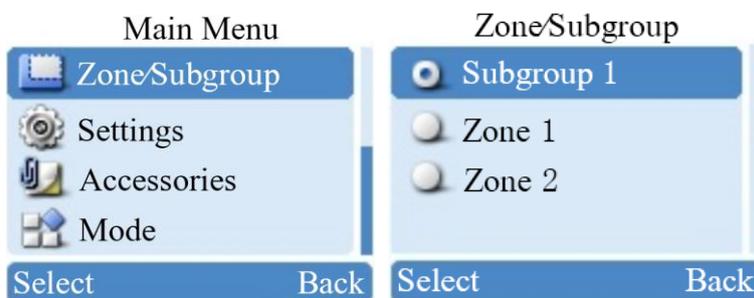


Step 4 Write the configuration to the radio.

Step 5 Move the radio into the coverage of DMR trunking System.

The radio displays TM and operates in DMR trunking system.

Step 6 Select Main Menu -> Zone/Subgroup in radio menu, and then choose Subgroup 1.



Step 7 Select CH D1 or CH A1 in Subgroup 1 through radio menu or Channel/Group Knob.

The radio successfully switches to conventional mode when DM displays on the screen.

Step 8 Select Group Call 1 in Subgroup 1 through radio menu or Channel/Group Knob.

The radio successfully switches to DMR trunking mode when TM displays on the screen.

Abbreviations

Abbreviation	Full Name
CPS	Customer Programming Software
DMR	Digital Mobile Radio
IP	Internet Protocol
XPT	Extended Pseudo Trunk



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Address: HYT Tower, Hi-Tech Industrial Park North, Beihuan
RD., Nanshan District, Shenzhen, China

Postcode: 518057
<http://www.hytera.com>